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VEGETABLE GROWING

Future material for the sweet pepper breeding, created at VRDS - Bacău

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Keywords: genetic recombination, repeated individual selection, hybrid populations, character variability

ABSTRACT

The breeding works carried out at the V.R.D.S. - Bacău had in view enrichment of sweet pepper germplasm stock by habitations between the Romanian and foreign cultivar, and selections, performed within an advanced homozygous hybrid population. During 2008-2010 they studied the most valuable lines, as compared to Export cultivar, registered and cropped all-over Romania. The Commission for the Cultivar Testing and Registration has homologated the line L-75. Among the material obtained the lines L-75; L-53 and L-51 gave the highest yields.

INTRODUCTION

Spread on all continents today's pepper culture enjoy unanimous appreciation for the high productions and rich content of vitamin C (100 200 mg/100 g of fresh substance), sugars (5.4%), vitamin A and minerals (8.5 mg calcium, phosphorus 24 mg, iron 0.4 mg/100 g of fresh substance), who raise the food and diet value (Ambăruş Silvica, 1999).

Open field surfaces planted with green pepper or protected spaces expanded in the last period and required a greater diversification of the range of varieties.
Variety, important factor of production, must always meet the growing and often changing requirements of production, driven by consumer needs. Consumers have high demands in terms of color, shape, size and taste fruit and the producer must meet these requirements, making in addition productivity, precocity and resistance to pathogens.

In this purpose, in VRDS Bacau were conducted researches that focused on obtaining new varieties of sweet pepper, more productive, high quality fruit, early, with tolerance to diseases. In a same time our new obtained varieties are competitive on internal and external market. Through this research we aimed to enrich the fund of germplasm material, improving the outlook for the bell peppers.

MATERIALS AND METHODS

In order to obtain new varieties of sweet pepper were used as starting material for breeding global and domestic range varieties, as genitors for different genetic recombination.

The research method used was repeated individual selection in hybrid population's homozygous advanced (Pot1og A., Velican V., 1971).

RESULTS AND DISCUSSION

The main characteristics of the fruit from these perspective lines are highlighted in (Table 1) are:
• technological maturity fruit color: yellow, green and light green;
• fruit shape varies from the conical prism and truncated pyramid;
• the number of lodges;
• pericarp thickness ranging from 0.69 to 10 mm;
• fruit length varies from 9.5 cm (L 51) to 13.8 cm (L 53).

Average yield guidance appreciated in comparative culture during 2008- 2010 range from 40.86 t/ha and 53.87 t/ha (Table 2).

The best results in terms of a record production were registered at lines L 53 (53.87 t/ha), L 75 (50.41 t/ha) and L 51 (49.32 t/ha).

Early production appreciated on 10.08 (Table 2) ranges from 13.95 t/ha to 10.11 t/ha, the earliest being L 51 (13.95 t/ha), L 53 (13.79 t/ha), L 75 (12.60 t/ha).
In terms of resistance to virus (VMT, VMC), studied lines shows tolerance in natural infection field conditions.

CONCLUSIONS

Following breeding works was obtained a valuable material that meets the proposed objectives.

- The highest productions were obtained byL-51(53,87 t/ha) and L-75 (52,51 t/ha)
- The highest early productions was obtained by L-53 (13,95 t/ha).

AKNOWLEDGEMENT

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TABLES AND FIGURES

Table 1

General characterization of the pepper perspective lines

Specification	Fruit colour at maturity	Shape fruit	weight (g)	lodge number	Fruit size (cm)		Shape index	Pulp thickness (cm)
					length	diameter		
L-51	yellow-red	Prism shape	135	3-4	9,5	8,5	1,11	1,1
L-53	green-red	Conical shape,	130	2-3	13,8	8,9	1,55	0,97
L-75	green-red	pyramidal truncated	135	3	10,2	7,5	1,36	0,98
L-76	yellow-red	Prism shape	125	3	9,6	7	1,37	0,96
L-6	green-red light	Prism shape	110	3	10,2	7,5	1,36	0,79
L-l	green-red	Prism shape	128	3-4	11.1	8,1	1,3	0,7
L-2	yellow-red	Prism shape	110	3	11,2	7,9	1,41	0,8
L-5	green-red	pyramidal truncated	120	3	10,3	7,2	1,43	0,8
L-32	yellow-red	Prism shape	100	3	10,1	7,4	1,36	0,77
L-I9	yellow-red	Prism shape	105	3	9,8	7,3	1,34	0,76
L-12	yellow-red	Prism shape	128	3	9,6	7,9	1,21	0,69
Export (wt)	yellow-red	Prism shape	100	3-4	9,6	7,9	1,21	0,69

Table 2

Early productions realized by pepper lines

Line	2008		2009		2010		Average		Difference signification
	t/ha	% from total production	t/ha	% from total production	t/ha	% from total production	t/ha	% from total production	
L-51	16,87	29	11,7	27	13,42	29	13,95	28,3	
L-53	15,52	26	12,3	24	13,63	27	13,79	25,6	***
L-75	14,60	26	10,5	23	12,74	26	12,60	25	***
L-76	12,74	27	10,2	25	12,67	28	12,09	26,6	***
L-6	10,24	22	8,32	21	10,25	23	10,25	22	**
L-l	10,77	24	8,98	22	10,70	25	10,11	23,6	00
L-2	13,19	29	10,7	27	12,88	30	12,23	28,6	
L-5	11,51	26	9,74	24	11,70	28	10,98	26	**
L-32	12,30	28	10,0	26	12,45	29	11,56	27,6	
L-I9	12,77	29	10,5	27	12,41	29	11,87	28,3	-
L-12	12,60	30	10,8	28	12,92	31	12,09	29,6	*
Export (wt)	11,28	26	9,64	24	11,73	28	10,87	26	**

DL 5% = 0,72 t/ha
DL 1% = 1,07 t/ha
DL 0,1% = 1,44 t/ha

Table 3

Production results obtained in orientation comparative culture by the perspective pepper line

Line	Production (t/ha)				Relative production (%)	Difference by witness (t/ha)	Difference signification
	2008	2009	2010	Average			
L-51	58,2	43,45	46,3	49,32	117,91	7,49	***
L-53	59,7	51,42	50,5	53,87	128,78	12,04	***
L-75	56,18	46,05	49	50,41	120,51	8,58	***
L-76	47,22	43,95	45,25	45,47	108,7	3,64	**
L-6	46,59	39,62	44,6	43,6	104,23	1,77	-
L-l	44,9	40,82	42,8	42,84	102,41	1,01	-
L-2	45,5	39,9	42,95	42,78	101,91	0,8	-
L-5	44,3	40,62	41,8	42,24	100,98	0,41	-
L-32	43,96	38,8	42,95	41,9	100,17	0,07	-
L-I9	44,05	39	42,8	41,95	100,29	0,12	-
L-12	42	38,9	41,7	40,86	97,68	-0,97	
Export (wt)	43,4	40,2	41,9	41,83	100	0	-

DL 5% = 2,66 t/ha
DL 1% = 3,42 t/ha
DL 0,1% = 4,51 t/ha

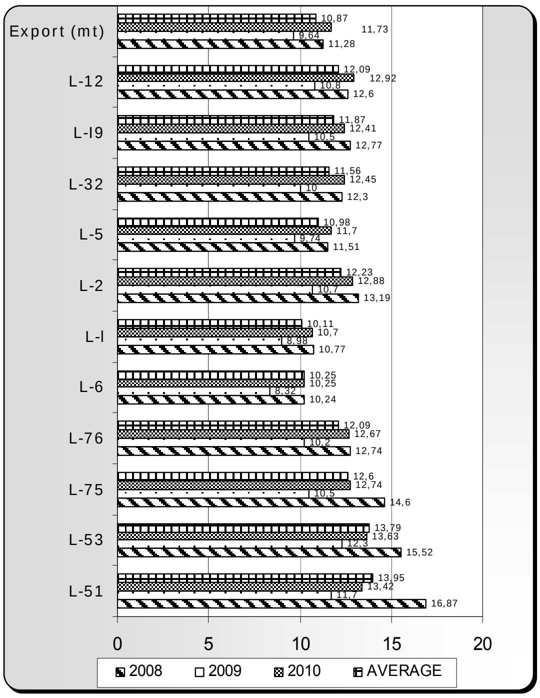

Fig. 1 Early productions realized by pepper lines

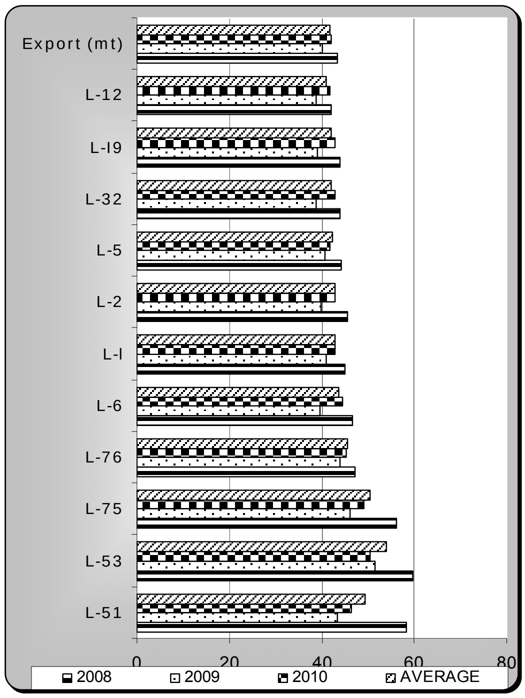

Fig. 2 Production results obtained in orientation comparative culture by the perspective pepper line

Determination of the production performance of new carrot cultivars in Constanta area

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Keywords: assortment of carrots, comparative culture, production

ABSTRACT

This paper presents the study of a new assortment of new hybrids in terms of culture in Constanța County. To achieve experience were studied 10 variants presented in Table 1. Of the 10 variants, nine are new hybrid cultivars, as a witness was elected a traditional variety Nantes improved recently. Sampling was performed at different dates depending on the earliness of each variant group. The work began when the thickened roots of carrots have reached typical size of each cultivar. At harvest time the plots were recorded productions repetitive experimental variants. Production reported in tonnes/ha was interpreted statistically by variance analysis method.

New carrot cultivars studied experience can be grown in production results in the Municipality of Constanța; Biometric determinations reveal that the entire experimental range shows values very close to those presented in catalogs of company; Napoli F1 is remarkable that the early production, harvested at 90 days after the mass emergence was 27. 70t/ha; The group is distinguished Bangor F1 mid early cultivars with a production of 71.43 t/ha and late cultivars Kamaran F1 group with 78.24 t/ha; Washers are suitable for freezing as nearly the entire range except Chantanay type cultivars or Flakke useful for freezing of carrot cubes.

INTRODUCTION

Carrot is an important vegetable species for food consumers of all ages. In our country, culture, technology updates have appeared such as newly created hybrids, productive and high quality, high performance technology for precision seeding, appropriate pesticide, harvesting, sorting and packing any mechanized. Besides fresh for immediate consumption and the consumption industry in recent years has appeared there any other recovery, as for example freezing (Bernard L., 1995, Chira A., 2001, Popescu Victor, 2000, ***1985).

This paper presents the study of a new assortment of new hybrids in terms of culture in Constanța County.

MATERIAL AND METHODS

To achieve experience were studied 10 variants presented in Table 1. Of the 10 variants, nine are new hybrid cultivars, as a witness was elected a traditional variety Nantes improved recently.

The biological material used to create the experience consisted of the following cultivars:

- 5-S-Nantes, traditional cultivar early, cylindrical with rounded root is suitable for crops in their field or successively, good storage capacity;
- Napoli F1 - cultivar, very early, early harvesting for fresh consumption to 60-65 days from the East, the characteristic size of 90-95 days intensely pigmented roots Nantes type, recommended for early worship in their own field;
- Nandrin F1 - early cultivar with roots Nantes type with smooth, deep orange colour, have high ecological plasticity due to vigorous rosettes with erect leaves can be harvested mechanically;
- Bangor F1-type cultivar Nantes-Berlicum semi early, with cylindrical roots and sharp tip is suitable for mechanized culture, full-industrialization destination (in the form of frozen diced), fresh or immediate consumption;

- F1-Cupar semitardiv cultivar, with roots tapered Chantennay type, with rounded, mechanically harvestable recommended for keeping fresh and freezing;
- Narbone F1-type cultivar Nantes significantly rooted culture resistant to cracking recommended for fully mechanized storage for consumption or freezing (diced);
- Canada F1 - semitardiv cultivar, type Chantenay with tapered roots with large rounded, colorful, suitable for fresh consumption, storage or freezing (diced);
- F1-Florida - late-type cultivar Flakke with sharp tip and tapered roots resistant to cracking, we encourage fresh consumption, freezing, dehydration.

Experimental cultures were sown on a plot prepared by standard technology, on 22 March 2009. Culture has sprung up in about 18-20 days, depending on the quality of seeds used. The date of rising was noted for each variant.

Works were applied care: combat full of weeds, irrigation, plant health treatments for the maintenance of culture, fazial fertilization. The number of works was influenced by the vegetation period.

Sampling was performed at different dates depending on the earliness of each variant group. The work began when the thickened roots of carrots have reached typical size of each cultivar.

Alternative set of batches were performed for all variants studied morphological measurements whose results are presented in Table 2.

At harvest time the plots were recorded productions repetitive experimental variants. Production reported in tonnes/ha was interpreted statistically by variance analysis method (Table 3).

RESULTS AND DISCUSSION

Vegetation periods range achieved in the early harvest for which we worked were: 5S-Nantes 120 days, Naples F1-91 days, 96 days Nandrin, Nevis F1 115 days, 120 days Bangor F1, F1 Cupar 130 days, 130 days Narbone F1, F1 Canada 130 days, 144 days Camaran F1, F1 Florida 150 days.

It is recommended that in most cultivars dimensions-length, diameter and weight are very close to those mentioned in the descriptions in the catalogs.

Chantenay type cultivars are distinguished by reduced length of the edible part, and the Nantes type with a constant diameter throughout the length of the root. Average weight varies depending of earliness root cultivars. The lowest values of these characteristics were measured at 83.30 g F1 Naples, and the biggest in F1 Kamaran 272.15 g.

The entire length of roots grown variety is not excessive and does not create difficulties technological dislocation.

Production results (Table 3) highlights the very best values ranging from 27.70 t/ha in Naples F1 and 78.24 t/ha Kamaran F1.

Negative difference between the control and hybrid F1 Naples production is distinct significant. All other cultivars witness to exceed production in total differences is very significant.

CONCLUSIONS

1. New carrot cultivars studied experience can be grown in production results in the Municipality of Constanta;
2. Biometric determinations reveal that the entire experimental range shows values very close to those presented in catalogs of company;
3. Napoli F1 is remarkable that the early production, harvested at 90 days after the mass emergence was 27. 70t/ha;
4. The group is distinguished Bangor F1 mid early cultivars with a production of 71.43 t/ha

and late cultivars Kamaran F1 group with 78.24 t/ha;
5. Using the experimental range of crops can harvest carrots in their field from late June until late September and early October;
6. Washers are suitable for freezing as nearly the entire range except Chantanay type cultivars or Flakke useful for freezing of carrot cubes.

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TABLES

Table 1

Experimental variants - Carrot cultivars – Poiana, 2009

Variant	Cultivar	Earliness group	The consumer
1(M1)	Nantes 5 S	Semi early	Fresh consumption, storage, freezing (rings)
2	Napoli F1	Early*	Fresh consumption, storage, freezing (rings)
3	Nandrin F1	Semi early	Storage, frozen (diced)
4	Nevis F1	Semi early **	Fresh consumption, storage, freezing (rings)
5	Bangor F1	Semi early	Fresh consumption, storage, freezing (rings)
6	Cupar F1	Semitardiv ***	Fresh consumption, storage, freezing (rings)
7	Narbone F1	Semitardiv	Fresh consumption, storage, freezing (rings)
8	Canada F1	Semitardiv	Fresh consumption, frozen (rings), dehydrated
9	Kamaran F1	Tardiv ****	Storage, frozen (diced)
10	Florida F1	Tardiv	Fresh consumption, storage, freezing (rings)

*Early – 90-95 days, **Semi early – 115-120 days, ***Semitardiv – 125-135 days, ****Tardiv – 140-150 days

Table 2

Biometric measurements of consume parts at carrot assortment experimented, Poiana, 2009

Variant	Cultivar	Root lengths, cm	Diameter of roots cm	Medium weight of roots g
1(M1)	Nantes 5 S	16.30	2.84	116.34
2	Napoli F1	13.35	1.96	83.30
3	Nandrin F1	18.15	2.81	161.40
4	Nevis F1	16.85	2.60	121.65
5	Bangor F1	19.60	3.45	224.50
6	Cupar F1	14.40	4.60	197.25
7	Narbone F1	21.60	3.55	246.40
8	Canada F1	15.60	4.15	145.76
9	Kamaran F1	23.40	3.88	272.15
10	Florida F1	18.30	3.80	180.45

Table 3

The synthesis of experimental results of total yield, Poiana, 2009

Variant	Cultivar	Total yield, t/ha	Dif. of yield t/ha	Yield %	Dif. of yield %	Significant
1(M1)	Nantes 5 S	39.64	-	100.00	-	-
2	Napoli F1	27.70	-11.94	69.87	-30.13	oo
3	Nandrin F1	68.15	+28.51	171.92	+71.92	***
4	Nevis F1	59.36	+19.72	149.74	+49.74	***
5	Bangor F1	71.43	+31.79	180.20	+80.20	***
6	Cupar F1	72.16	+32.52	182.04	+82.04	***
7	Narbone F1	76.82	+37.18	193.79	+93.79	***
8	Canada F1	62.57	+22.93	157.84	+57.84	***
9	Kamaran F1	78.24	+38.60	197.37	+97.37	***
10	Florida F1	65.16	+25.52	164.38	+64.38	***

DL 5% = 6.05t/ha, DL 1%= 8.84 t/ha, DL 0.1%= 12.48 t/ha

The effect of silicate minerals on the head weight of white cabbage and on the colonization and damage of onion thrips

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Keywords: white cabbage, *Thrips tabaci*, onion thrips, antixenosis, kaolin, silicate minerals

ABSTRACT

In the last few decades onion thrips has become a major pest of white cabbage in the summer production period. Although the most effective control measure is the use of resistant varieties, little is known about the resistance mechanism(s) involved. In 2008, a study was carried out with 6 cultivars to confirm that antixenosis is at least partly responsible for the resistance of white cabbage against onion thrips. The number of adult thrips was counted on the outer ten head leaves twice during head formation. Onion thrips damage was also assessed at full maturity of cabbage. Cabbage head weight was recorded at each assessment. Two different silicate mineral products Surround® WP and Kolloidizált Mikromeliorit® was applied as foliar spray treatments several times during head formation. Antixenosis was found to be responsible for the resistance of 'Balashi', 'Bloktor' and 'Riana' cultivars, since the number of colonizing onion thrips adults found on head leaves was significantly lower than that of 'Green gem', 'Hurricane' and 'Quisor'. The resistant cultivars ('Balashi', 'Bloktor' and 'Riana') similarly suffered significantly lower damage than the susceptible ones ('Green gem', 'Hurricane' and 'Quisor'). The foliar spray treated cabbage heads were usually significantly bigger, than the untreated ones. The increased growth of cabbage was most likely caused by the positive effects of the silicate minerals on the development of cabbage. The foliar spray treatments in general had no effect on thrips colonisation and in consequence on thrips damage but it seemed to increase the number of colonizing thrips adults and in consequence the damage of thrips in 3 cases (out of 12).

INTRODUCTION

White cabbage is one of the oldest cultivated vegetable plants. In the Middle East Europe its field cultivation has been known for more than 500 years. It has a major role in the world, especially in the Far East. It represents 10 percent of the world's vegetable production and 20 percent of the total cultivation area (Zatykó, 2004). In the last two decades the onion thrips has become a major pest of white cabbage in the summer production period (Fail, 2002).

The onion thrips – ***Thrips tabaci*** **LINDEMAN, 1889** – belongs to Order Thysanoptera, Suborder Terebrantia, Family Thripidae (Jenser 1988), syn.: *Thrips allii* GILETTE, *Thrips communis* UZEL, *Thrips solanaceorum* WIDGALM, *Thrips bicolour* KARNY, *Thrips debilis* BAGNALL, *Thrips hololeucus* BAGNALL (Jenser, 1982). Thrips damage on white cabbage was reported for the first time in the United States of America in the late 19th century (Lintner, 1892). In the 1950's in the south east part of Iowa State's cultivation area Wolfenbarger and Hibbs (1958) found bronze discolouration on the surface of white cabbage head forming leaves, and the symptoms were attributed to the damage of onion thrips. In 1983 Kretschmer (1984) confirmed with his experiment that similar symptoms like the ones described above were caused by thrips damage.

Silicate minerals and their utilization

The utilization of kaolin for fruit and vegetable cultivation is mostly studied in the United States of America. Surround® WP (NovaSource, Tessenderlo Kerley Inc., Phoenix, AZ, USA) - 95% kaolin clay - proved to be efficient against several insect pests, especially against those that damage fruit crops including pear, apple, grape, berries and some vegetables. It is excellent against sunburn and heat stress damages (Anonymous 2004). The particles reflect infrared and ultraviolet rays, cooling the surface of the fruit. Additionally decreases the foliage temperature of the treated trees. According to USDA studies photosynthesis is increased with 30 percent (Heacox, 2001). A recent study confirmed the effectiveness of kaolin against flower thrips (*Frankliniella* spp.) damaging rabbiteye blueberry (*Vaccinium ashei* READE). Although the treatment decreased the flower thrips population with 50%, it did not influence the yield (Spiers et al. 2003). In South Africa thrips cause severe damage in mango plantations. In field trials kaolin based Surround® WP (a registered product in South Africa) was used in two ways: by itself and combined with sulphur. It was applied once or twice at the beginning of the season. It proved to be effective against thrips, while combined with sulphur it was efficient against other pests (Joubert et al. 2004). The kaolin based Surround® WP is used against heat stress and sunburn in pineapple plantations. Several trials have proven that the early use of kaolin before any major temperature changes reduces the occurrence of inner or outer sunburn. Under hot and dry climatic conditions it prevents leaf damage, resulting in a significant yield increase (Bell et al. 2006). In the southern United States of America the biggest yield loss in tomato is caused by TSWV. The virus is exclusively spread by thrips. In a two years field trial the effectiveness of essential oils (geraniol, lemongrass oil and tea tree oil), kaolin clay and traditional insecticides against thrips were compared. The treatments did not clearly affect the insect populations, but kaolin combined with essential oils decreased the occurrence of TSWV. Kaolin treatments increased the yield by over 26% (Reitz et al. 2008). Larentzaki et al. (2008) observed a negative effect of kaolin on the biology of onion thrips. In untreated onion plots significantly more adults and larvae were captured then in kaolin treated plots.

The Kolloidizált Mikromeliorit® (Geoproduct Healing Minerals Ltd., Mád, HU) is a mineral crop protectant and foliar fertilizer, most frequently used in ecological farming. Its main ingredients are silicate minerals - clinoptilolite 40-50%, clay minerals (montmorillonite, illite, etc.) 20% -, and volcanic glass 30-40%. It is recommended against paprika and tomato blossom rot and damping off, apple sunburn, and against downy- and powdery mildew in several crops.

The aim of this study is to test the effect of two different foliar spray silicate minerals on the yield of white cabbage. There is an important question to be answered as well: do silicate minerals affect the colonization and damage of onion thrips on white cabbage?

MATERIALS AND METHODS

The experiment was carried out at the Tordas Station of the Central Agriculture Office, Tordas, Hungary. Greenhouse grown seedlings of 6 cultivars, ('Balashi', 'Bloktor', 'Green Gem', 'Hurricane', 'Quisor' and 'Riana') were transplanted outdoors on the 15th of May 2008. Plots were composed of 7 rows of 13 plants, spaced 0.6 by 0.6 m apart. These plots were replicated six times in a randomized block design with an alleyway of 3 m separating replicates. Standard herbicide, fertilization and irrigation practices were employed. Plants were treated with pesticides against pest and disease. Two plots received no further treatments and served as control, two were treated with Surround® WP and two with Kolloidizált Mikromeliorit®.

The time and methods of foliar spray treatments

Treatments were first applied as soon as cupping began. During head formation plants were sprayed altogether 10 times, from 24th of June until 29th of August. The frequency of applications was influenced by natural rainfalls. Surround® WP was always applied in a dose of 20kg/ha. Kolloidizált Mikromeliorit® was applied in the same dose at the time of the first two treatments but from its third application onwards the dose was doubled to 40kg/ha, because of inappropriate coverage on the cabbage foliage in the lower dose. A surfactant (Silwet L-77, in a dose of 15ml/l) was added to both silicate minerals at every application.

The measurement of cabbage yield

The weight of sampled cabbage heads was measured with a digital scale. This was carried out before any further assessment.

Antixenotic evaluation

In order to assess the antixenotic resistance of cabbage cultivars the number of colonizing thrips adults was counted on cabbage head leaves two times, at the beginning and in the second half of head formation. For every treatment 24 randomly selected cabbage heads were removed and placed in plastic bags from each plot (dates are given in Table 1 under the 'Antixenotic evaluation' column). The samples were immediately transported to the laboratory and kept in plastic bags at room temperature until the antixenotic evaluation was completed. The first ten outer head leaves were removed one after the other and the number of adult thrips on both sides was counted under a stereomicroscope. The combined number of adult thrips on all ten leaves was used in statistical analysis describing the number of colonizing adults in a given cabbage head.

Damage assessment

Onion thrips damage assessment was carried out at harvest maturity of the varieties (exact dates are given in Table 1 under the 'Damage assessment' column). 24 randomly selected cabbage heads were taken from each plot. For the assessment of thrips damage (the result of spontaneous thrips infestation) an evaluation method was developed (Fail, 2006). Cabbage head leaves were evaluated and peeled off the head one after the other until four consecutive leaves showed no damage. For every examined head-forming leaf the extent of damage was noted (only on the underside of the leaves) in the form of the proportion of damaged surface to the entire surface of the leaf: from 0 to 1 with an accuracy of 0.1. Resistance is represented by the sum of these values describing the rate of damage observed in the whole head. A given figure expresses the size of the total damaged leaf surface in the entire cabbage head in proportion to the size of the underside of the first head-forming leaf.

Data Analyses

Data were analyzed with PASW Statistics 18, release 18.0.0 (July 30, 2009). When the original data met the assumptions of normality (tested by Kolmogorov-Smirnov test), treatments and cultivars were compared by Tukey's test or Games-Howell test depending on the homogeneity of variances (tested by Levene test). When the original data of colonizing thrips adults and thrips damage did not meet the assumption of normality, Tukey's test or Games-Howell test was performed on the normalized square root and log transformed data. When normality was not achieved after data transformation, the nonparametric Kruskal-Wallis test was used, followed by Mann-Whitney U tests for comparisons of treatments and cultivars. All data are reported as original means and 95 % confidence interval of means on figures 1-5. Means with different letters are significantly different from each other according to the applied statistical test ($P \leq 0.05$). On figures 2-5, the letters right next to the confidence intervals show the differences between the applied treatments within a cultivar. Those letters situated in a coloured box above figure 1-5 show the differences between cultivars within treatments.

RESULTS AND DISCUSSION

Cabbage yield

At the time of the first evaluation cabbage head weight was between 34 and 117 gram. By the time of the second measurement the cabbage heads almost reached harvest maturity; head weight was between 1800 and 2600 gram. At the time of the final evaluation head weight varied between 2300 and 3500 gram.

Evaluating cabbage yield in the control treatment in the second half of head formation it was found that 'Quisor', 'Riana' and 'Balashi' cultivars had the biggest head weight (Fig. 4.). In contrast to this, the cultivars 'Bloktor', 'Green Gem' and 'Hurricane' produced considerably smaller heads. The head weight of 'Bloktor', 'Green Gem' and 'Quisor' cultivars in the Surround® WP treatment was equal to that of in the control treatment (Fig. 4.). But in case of 'Balashi', 'Hurricane' and 'Riana' cultivars the mean weight of sampled cabbage heads was significantly bigger in the Surround® WP treatment than in the control treatment. The mean head weight of 'Bloktor' cultivar in the Kolloidizált Mikromeliorit® treatment was equal to that of in the control treatment (Fig. 4.). But the mean weight of the collected cabbage heads in case of 'Green Gem' and 'Quisor' was slightly bigger, in case of 'Balashi', 'Hurricane' and 'Riana' cultivars was significantly bigger in the Kolloidizált Mikromeliorit® treatment than in the control treatment.

At harvest maturity a similar result was found than in the second half of head formation regarding cabbage yield. The cultivars 'Quisor', 'Green Gem' and 'Balashi' had the biggest head weight (Fig. 5.). In contrast to this, the cultivars 'Bloktor', 'Riana' and 'Hurricane' produced smaller heads. The mean head weight of 'Bloktor' and 'Quisor' cultivars in the Surround® WP treatment was equal to that of in the control treatment (Fig. 5.). But in case of 'Green Gem' slightly bigger, in case of 'Balashi', 'Hurricane' and 'Riana' cultivars significantly bigger cabbage heads were harvested in the Surround® WP treatment than in the control treatment. The head weight of 'Green Gem' cultivar in the Kolloidizált Mikromeliorit® treatment was equal to that of in the control treatment (Fig. 5.). In case of 'Bloktor' slightly bigger, in case of 'Balashi', 'Hurricane' and 'Riana' cultivars significantly bigger cabbage heads were harvested in the Kolloidizált Mikromeliorit® treatment than in the control treatment. However, 'Quisor' produced slightly smaller heads in the Kolloidizált Mikromeliorit® treatment than in the control treatment (Fig. 5.). We assume that this phenomenon was due to biased sampling since the contrary was observed for 'Quisor' when head weight was measured in the second half of head formation (Fig. 4.).

When considering all six cultivars in both yield assessments, the Surround® WP treated cabbage heads were 7 times bigger and 5 times equal in weight, than the untreated ones. Similarly, the Kolloidizált Mikromeliorit® treated cabbage heads were 9 times bigger, twice equal and once smaller in weight, than the untreated ones. The observed higher yield of cabbage was most likely caused by the positive effects of the silicate minerals on plant growth, which has been reported in other crops (Heacox, 2001, Anonymous, 2004, Bell et al. 2006, Reitz et al. 2008).

There seemed to be a difference between the cultivars in their yield response to the silicate mineral foliar spray treatments. The mean head weight of 'Balashi', 'Hurricane' and 'Riana' cultivars was always bigger in both silicate mineral foliar spray treatments than in the control. At the same time, the yield of 'Bloktor', 'Green Gem' and 'Quisor' increased in the silicate mineral foliar spray treatments once, twice and once, respectively.

Antixenotic evaluation

Significant differences were found between the 6 cultivars in the number of adult thrips counted in cabbage heads. At the time of the first antixenotic evaluation the most thrips were found on the cultivar 'Green Gem' (Fig. 1.). Equally less number of thrips colonised the cultivars 'Quisor' and 'Hurricane'. Concerning those cultivars ('Bloktor', 'Riana' and 'Balashi') that were categorised as resistant in previous studies (Fail, 2005, 2006, Fail at al. 2002, 2008) even less thrips colonised the small cabbage heads (Fig. 1.). At the time of the second assessment a drastic increase in the number of colonising thrips was observed on the susceptible cultivars. The most adult thrips were again counted on 'Green Gem' in the control treatment (Fig. 2.). Significant difference was observed between 'Quisor' and 'Hurricane', the latter one supporting a thrips population three times the size then 'Quisor'. The resistant cultivars were again colonised by the least number of thrips, although there were no significant differences in between them (Fig. 2.).

The silicate mineral foliar spray treatments did not seem to affect the thrips colonisation of cabbage in 9 cases out of 12 (Fig. 2.). The mean number of thrips found in heads was slightly more only on ‘Hurricane’ and ‘Riana’ cultivars in the Surround® WP treatment compared to the control treatment. Similarly, slightly more thrips were found on ‘Riana’ only in the Kolloidizált Mikromeliorit® treatment than in the control treatment (Fig. 2.).

This study further confirms that antixenosis does play a role in the resistance of cabbage to onion thrips. The silicate mineral foliar spray treatments had very little or no effect on thrips colonising cabbage.

Damage assessment

The most intensive damage was noticed on ‘Hurricane’ cultivar in the control treatment (Fig. 3.). ‘Green Gem’ and ‘Quisor’ was damaged to a considerably less extent. Concerning the resistant cultivars, they only suffered insignificant damage but amongst them the highest mean value of the damage rating scale was calculated on ‘Bloktor’. The damage on ‘Balashi’ and ‘Riana’ was absolutely negligible (Fig. 3.).

The silicate mineral foliar spray treatments in comparison with the control did not seem to affect the extent of damage in cabbage in 9 cases out of 12 (Fig. 3.). ‘Riana’ was damaged slightly more in both silicate mineral foliar spray treatments than in the control treatment (Fig. 3.). This is most likely the direct consequence of the increased number of colonising thrips observed previously in both treatments (Fig. 2.). Although the same number of thrips colonised the cultivar ‘Bloktor’ in all three treatments, slightly more damage was observed on this cultivar in the Surround® WP than on the other two treatments (Fig. 3.). On the contrary, more thrips colonised the cultivar ‘Hurricane’ in the Surround® WP treatment than in the control, this did not lead to greater damage in the Surround® WP treatment at final harvest (Fig. 3.).

There was a positive correlation between the number of colonising adult thrips and the thrips damage assessed at harvest maturity. The value of the calculated Spearman rank correlation coefficient between the two variables was 0.541 ($P \leq 0.000001$) in case of the first antixenotic assessment. At the time of the second antixenotic evaluation an even stronger correlation ($\varrho = 0.702$, $P \leq 0.000001$) was observed between the two variables.

CONCLUSIONS

Based on this trial it was concluded that the use of Surround® WP and Kolloidizált Mikromeliorit® in a foliar spray treatment series more often than not increased the yield of cabbage. The cultivars ‘Balashi’, ‘Hurricane’ and ‘Riana’ better responded to the treatments than the other three studied cabbage cultivars. The silicate mineral foliar spray treatments had very little or no effect on thrips colonising cabbage and in consequence on the thrips damage assessed at harvest maturity.

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TABLE AND FIGURES

Table 1

Timetable of evaluations

Variety	1st Antixenotic evaluation		2nd Antixenotic evaluation		Damage assessment	
	date	d.a.t.	date	d.a.t.	date	d.a.t.
Balashi	25th of June	41	24th of July	70	11th of August	88
Bloktor	25th of June	41	04th of August	81	10th of October	148
Green Gem	19th of June	35	21th of July	67	12th of August	89
Hurricane	24th of June	40	31th of July	77	17th of September	125
Quisor	19th of June	35	29th of July	75	19th of August	96
Riana	24th of June	40	28th of July	74	21th of August	98

*: d.a.t. = days after transplantation

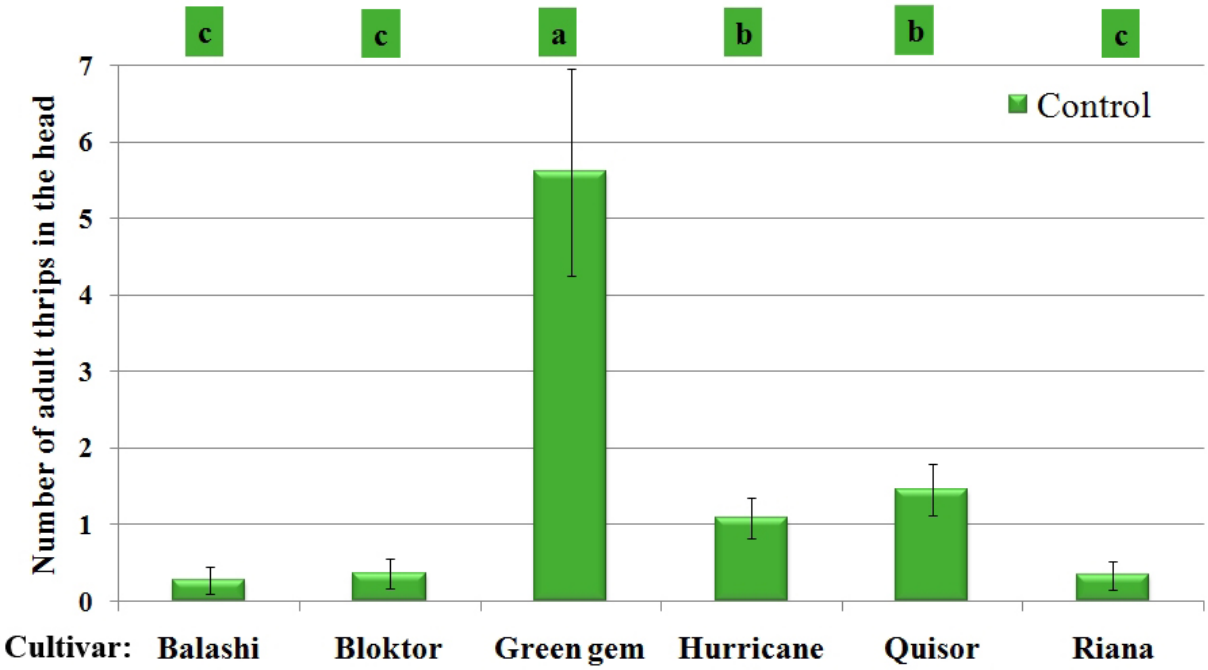

Fig. 1. Number of colonizing adult thrips at the beginning of cabbage head formation (P≤0,05)

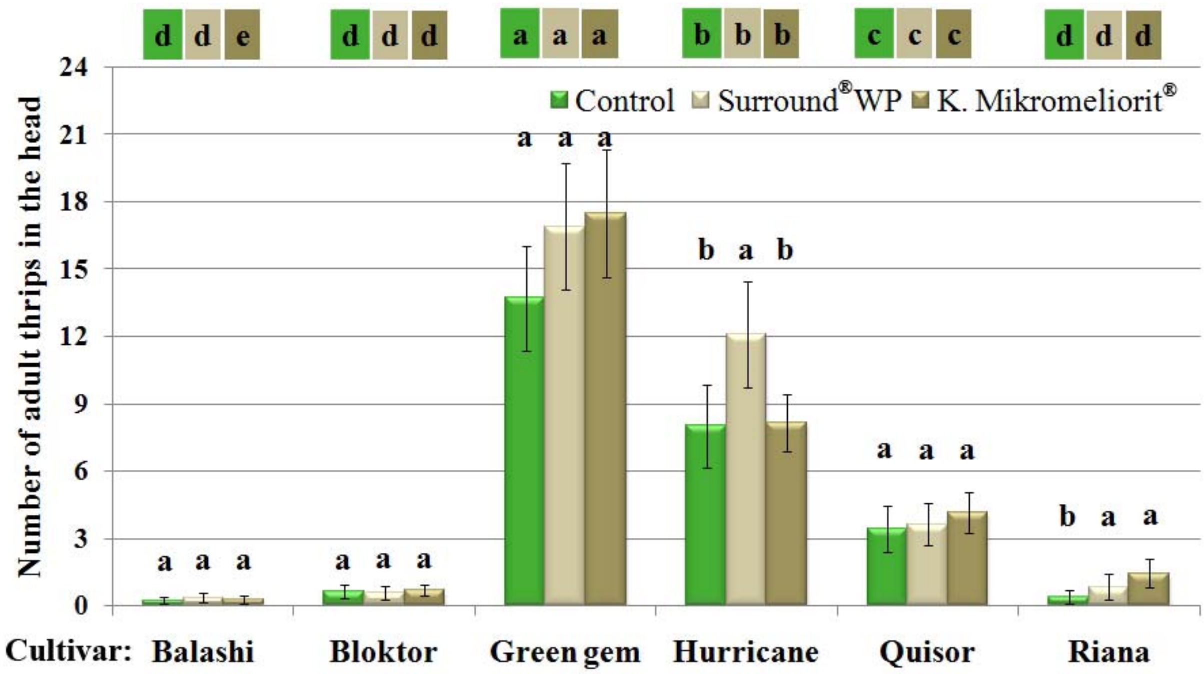

Fig. 2. Number of colonizing adult thrips in the second half of cabbage head formation (P≤0,05)

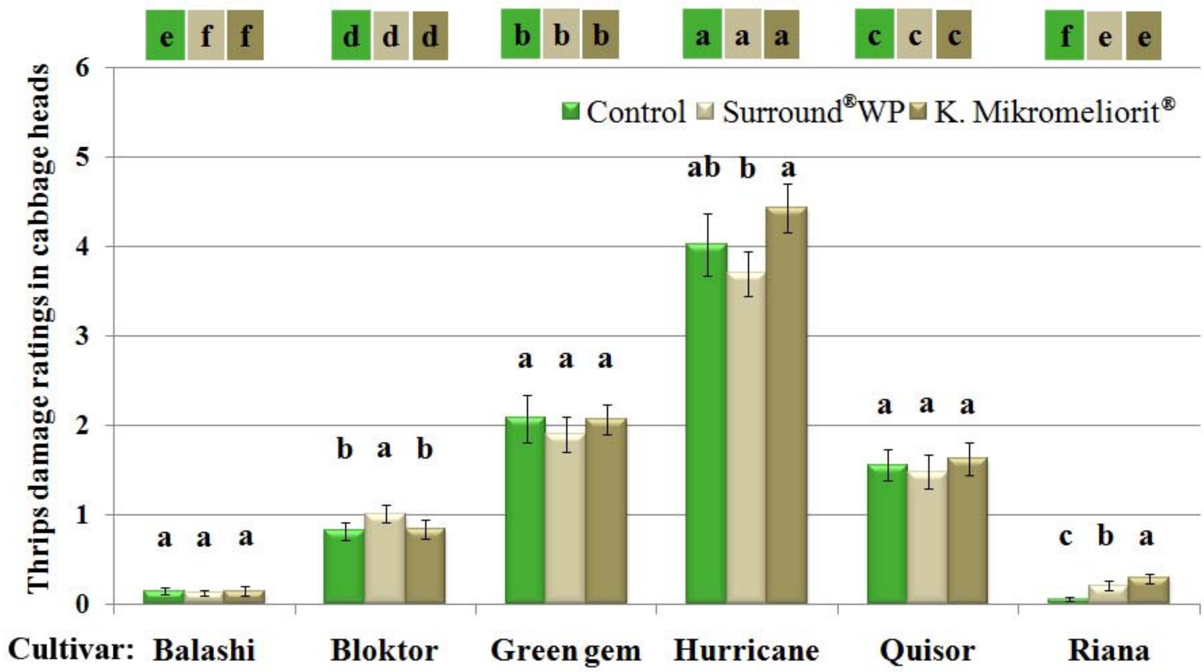

Fig. 3. Thrips damage ratings at harvest maturity of cabbage heads (P≤0,05)

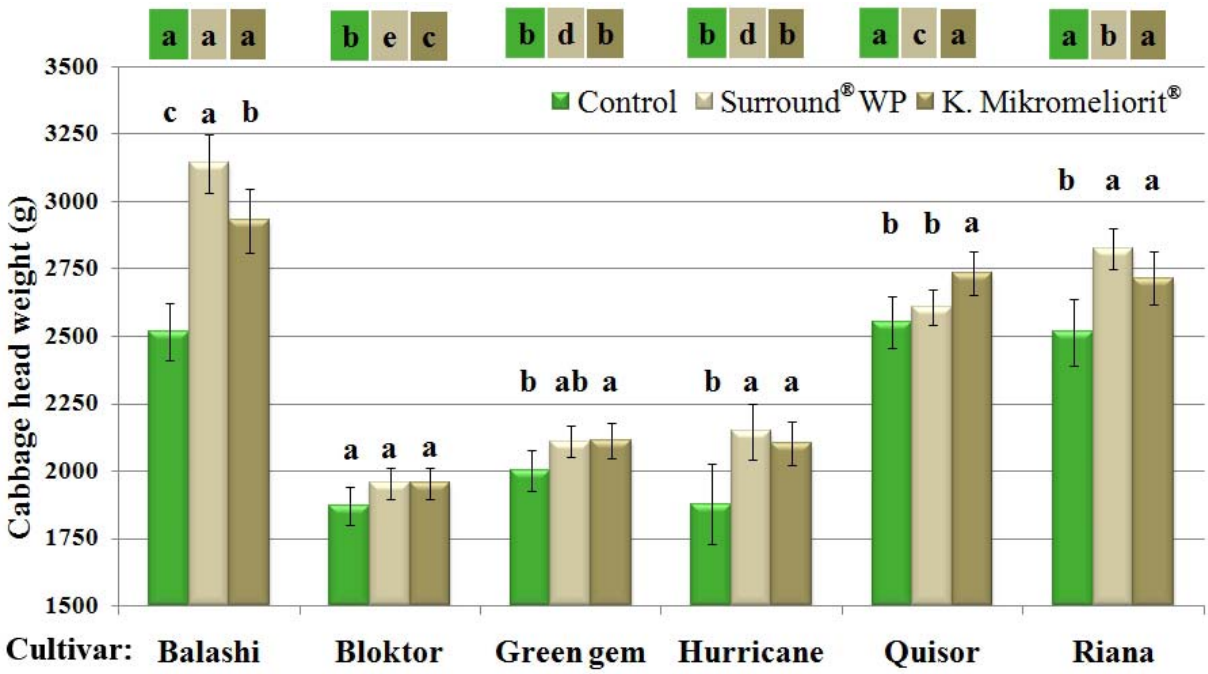

Fig. 4. White cabbage head weight in the second half of head formation (P≤0,05)

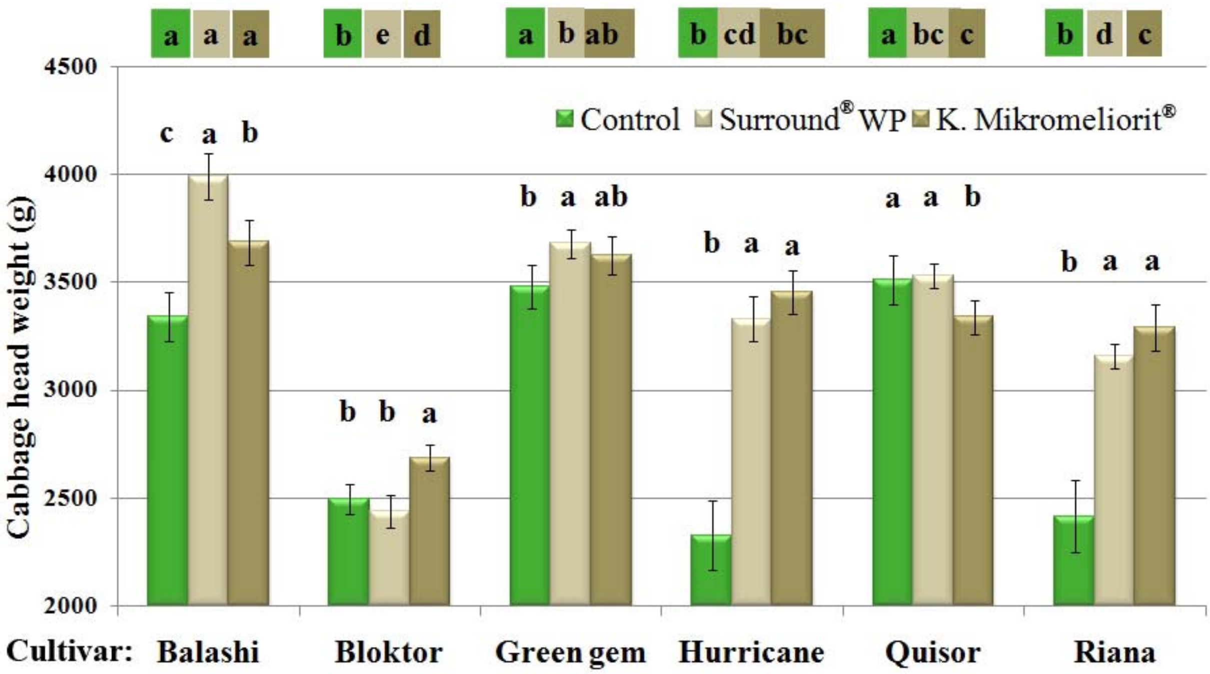

Fig. 5. White cabbage head weight at harvest maturity (P≤0,05)

Comparative study on total polyphenolics and flavonoids content at artichoke and cardon

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Key words: *total polyphenolics, flavonoids, cardon, artichoke*

ABSTRACT

This paper presents a comparative study of total polyphenols and flavonoids content in the artichoke and cardon. Evolution/dynamic of the content of the total polyphenols and flavonoids was performed on some of these plants vegetative prgans: leaves, the inflorescences flesh (edible part) at the consumption stage and after overcoming this phase, during flowering. The total polyphenol content was analyzed by Folin-Ciocalteu method and the flavonoid content by spectrophotometry using the method specified in the Romanian Pharmacopoeia X. The results have shown that comparing with leaves, the edible part contains a 2-3 times larger amount of total polyphenols and a 1.17 times of flavonoids, first in terms of content ranged the red artichokes. After passing the optimal timing of consumption, during blooming, the amount of total polyphenols and flavonoids in the inflorescence's flesh falls very strongly. Cardon leaves contain 1.3 to 1.5 more total polyphenols and 1.1 more flavonoids comparing with artichoke.

INTRODUCTION

Total polyphenols and flavonoids are water soluble antioxidants naturally present in vegetables, fruits, green tea, wine, etc. that can make a major change in human metabolism. Classified as antioxidants whose main action is to prevent the formation of free radicals, in the body inflowed polyphenols are quickly and easily converted into polyphenolic metabolites. Flavonoids are one of the strongest groups of antioxidant nutrients from all the plant polyphenols and they can be key components of our natural antioxidant defence system (Velioglu et al., 1998, Kähkönen et al., 1999, Valentão et al., 2002).

Present research (Gebhardt, 2001, Bundy et al., 2008, Wilder et al., 2009) indicate flavonoids as protective elements capable of reducing the incidence of cancer, certain cardiovascular diseases and other age-related degenerative diseases, being potent antioxidants and "sweepers" of free radicals.Polyphenols have several advantages that allow them to be used in pharmaceutical and cosmetic industry.

Artichoke (*Cynara scolimus L.*) was introduced in therapy since the 16th century, but only in 1931 the choleretic action of this plant was established, and later research studies confirmed that these properties are due to cynarin and polyphenols (Gebhardt, R., 2001, Pandino, 2010). In therapy, from artichoke, are used the leaves, roots, and also the edible parts, which contain cynarin, polyphenols, flavones, inulin, potassium salts, magnesium, tannin, pectins, amino acids, carbohydrates, organic acids, enzymes, etc. (Ciofu et. al., 2003, Bundy et al., 2008, Pandino et al., 2010, Todaro et al., 2010).

The cardon (*Cynara cardunculus* L.) is also a plant with nutrient medicinal and economic value (Chaux and Foury., 1994, Kähkönen et al., 1999, Valentão et al., 2002). The flavonic heterozide and polyphenols content by this plant protect the liver and stimulates the liver and bile functions, and metabolites of these compounds promote diuresis and elimination of toxins. Along with artichokes, the cardon is one of the most important plants used in fighting cancer, being shown that flavonoids have a very strong anti-cancer activity in all stages of carcinogenesis (Miccadei et al., 2008, Yasukawa et al., 2010).

Currently in Romania the artichoke is cultivated on very small surfaces as medicinal plant and although is imported for consumption as a vegetable, it is not cultivated for this purpose, and the cardon is even less known and cultivated (Ciofu et al., 2003).

In this paper some partial results are included as part of research undertaken in order to determine the possibilities of using artichoke and cardon as plant for food, nutraceuticals and energy.

MATERIALS AND METHODS

In the period 2009-2010 in the *Research centre for the quality of horti-viticole products and useful substances from plants* of USAMV București there were determined the content in total polyphenols and flavonoids from artichoke and cardon.

The main objective of the research was to determine these substances in the leaves and fleshy part of the inflorescences (which is the edible part of these plants). The plant material was the fleshy part of the inflorescences in the consumption phase, the fleshy part of the inflorescences during and leaves of artichoke and cardon. These samples were collected from the experimental crops of USAMV Bucuresti (fig .4, 5 and 6).

For determination of total polyphenols and flavonoids from artichoke and cardon the following working methods have been used: the determination of total polyphenols by Folin-Ciocalteau method after hydroalcoholic extraction and lyophilization, and spectrophotometric determination of flavonoids by the method described in the Romanian Pharmacopoeia X (Fig.7).

REZULTS AND DISCUSSION

Results on the total polyphenol content of the artichoke and cardon fleshy part of the inflorescences at the consumption stage (Table 1), shows that red artichokes contains the highest amount (3352.8 mg/100g fresh substance), followed by cardon (2921.6 mg/100g fresh substance) and green artichokes (3352.8 mg/100g fresh substance).

Analyzing in comparison the content of total polyphenols from leaves, there is another classification of the three analyzed varieties, cardon being on the first place (1478.4 mg/100g fresh substance) and red artichoke on the second (1108.8 mg/100g fresh substance).

From the analysis of the obtained data, it can be seen that green artichoke has the lowest level of total polyphenol content in both, the edible part (2648.8 mg/100g fresh substance) and in leaves (994.4 mg/100g fresh substance) (Fig. 1 and Fig. 3).

It should be noted that although for all three cultivars the total polyphenol content was higher in the edible part than in leaves, the ratio between them is different. Thus, for the red artichokes it has been registered the highest ration in favour of the fleshy part of the inflorescences, and for cardon, the lowest.

The results from Table 2 represent the total amount of polyphenols obtained from the fleshy part of inflorescences for artichoke and cardon at the time of flowering, when they have passed the stage of consumption. It can be noticed that artichokes have a greater amount of total polyphenols 1.405 times higher than cardon.

From Tables 1 and 2 it can be appreciated that fat harvest time for consumption for both species studied, the content of polyphenols of the fleshy part of the inflorescences is quite high (in average 3001 mg/100g fresh substance to artichokes and 2922 mg/100g fresh substance at cardon). During flowering period the polyphenol content decreases very much, about 546 times for artichokes and 713 times for cardon.

The results on flavonoid content of artichoke and cardon presented in Tables 3, 4 and Fig. 3 show specific differences according to cultivars, plant organ, but also growing phase.

In the consumption phase, the amount of flavonoids in the fleshy part of the inflorescence and leaves was maximum for green artichokes, for which were determined 149.69 mg and respectively 142.21 mg/100g fresh substance. By comparison, the lowest values were recorded for red artichokes and for cardon the values were intermediate of the two artichoke cultivars (Table 3).

Analyzing the relationship between flavonoid content in the edible part and leaves, it is noted that although differences on the two organs are much smaller than in the case of total polyphenols, in the first place is still the red artichoke.

At the time of flowering, when the artichoke and cardon inflorescences passed the consumption phase, it can be observed, like in the case of the total polyphenol content, a dramatic decrease in the amount of flavonoids in the edible part (Table 4 and Fig. 1 and 2). For artichoke it has been noticed a reduction of 638 times comparing with the time of consumption, and for cardon of 736 times.

CONCLUSIONS

The largest amount of total polyphenols in the flesh part of inflorescences in the consumption phase (3353 mg/100g f.s) is found in red artichokes.

The edible part has a 2-3 times higher amount of total polyphenols and 1.17 times higher, compared to leaves.

Cardon leaves contain 1.3 to 1.5 times more total polyphenols and 1.1 times more flavonoids than artichoke.

Green artichoke has the lowest total polyphenol content in both the edible part (2648.8 mg/100g f.s.) and leaves (994.4 mg/100g f.s.).

Polyphenol content has the highest values at the stage of harvest for consumption for both artichokes and cardboard.

At consumption phase the amount of flavonoids is higher at green artichokes in both the fleshy part of the inflorescences and leaves (150 mg and respectively 142 mg/100g fresh substance).

After passing the optimal timing of consumption, respectively in the blooming stage, at both studied species the amount of total polyphenols and flavonoids strongly decreases in the fleshy part of the inflorescence, but the differences between the two species are very small.

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*** Farmacopea Română X

TABLES AND FIGURES

Table 1

The total polyphenol content for artichoke and cardon at consumption stage

Variety	Total polyphenols (mg/100g fresh substance)		
	Fleshy part of the inflorescence	**Leaves**	**Ratio**
Green Artichoke	2648.8	994.4	2.66 : 1
Red Artichoke	3352.8	1108.8	3.02 : 1
Cardon	2921.6	1478.4	1.98 : 1

Table 2

Total polyphenol content of the fleshy part of the inflorescence at the moment of flowering

Variety	Total polyphenols (mg/100g fresh substance)
Artichoke	5.500
Cardon	4.095

Table 3

Flavonoid content for artichoke and cardon in consumption phase

Variety	Flavonoids (mg/100g fresh substance)		
	Fleshy part of the inflorescence	Leaves	Ratio
Green Artichoke	149.69	142.21	1.05 : 1
Red Artichoke	143.89	122.59	1.17 : 1
Cardon	147.26	141.65	1.04 : 1

Table 4

Flavonoid content of the fleshy part of the inflorescence at the moment of flowering

Variety	Flavonoids (mg/100g fresh substance)
Artichoke	0.23
Cardon	0.20

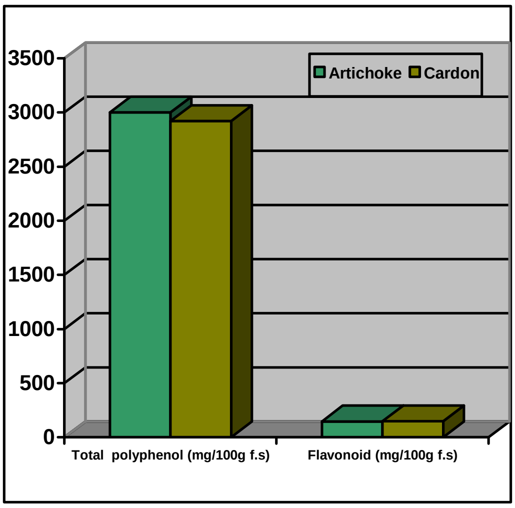

Fig. 1. Total polyphenol and flavonoid content for artichoke and cardon at consumption stage

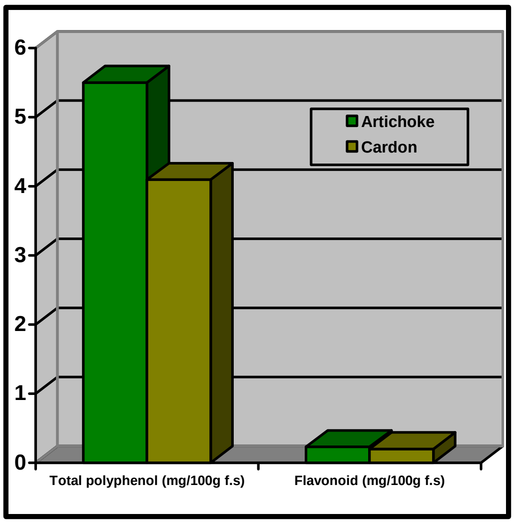

Fig. 2. Total polyphenol content and flavonoids of the fleshy part of the inflorescence at the moment of flowering for artichoke and cardon

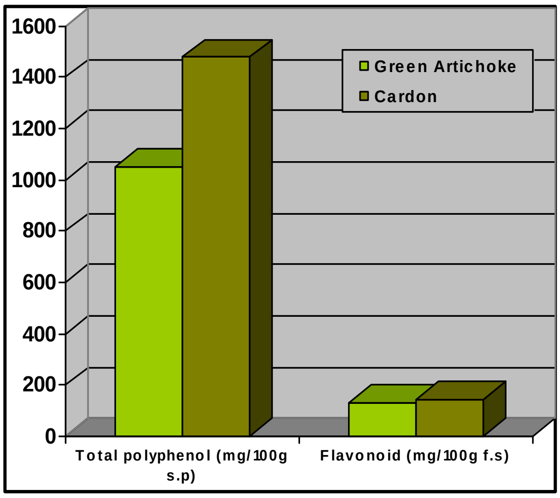

Fig. 3. Total polyphenol content and flavonoids of leaves artichoke and cardon

Fig. 4. Green artichoke plants in various stages of vegetation

Fig. 5. Red artichoke plants in various stages of vegetation

Fig. 6. Cardon plants in various stages of vegetation

Fig. 7. Equipment utilized (spectrophometer, drum freeze dryer, test-tube centrifuge)

Changes of some biochemical and agrochemical characteristics of tomatoes storage

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Keywords: tomatoes, storage, chemical and biochemical characteristics

ABSTRACT

Tomatoes are highly perishable vegetable with a very limited shelf life. Thus, because of their chemical and physical constitution, tomatoes can be kept temporarily; shelf life is a subject to the maturation phase occurring at harvest and conditions of transport and temporary storage. In 2007 were studied in greenhouses and field of the University of Agronomic Sciences and Veterinary Medicine in Bucharest 6 cultivars of tomato: Buzău 1600, Tamaris, Lustro, Abellus, Rz and Electra. After harvesting and analysis tomatoes were kept in plastic containers in a refrigerator, under conventional storage technology by freezing temperatures of 7-10^{0}C and 85-90% relative humidity to see their capacity for storage. The researches shows that tomatoes are unable to maintain the appearance and physical characteristics for more than a week, that firmness and bacterial attack; Nitrate content decreased in all cultivars investigated irrespective of the culture used (field, greenhouse) inertia due process of nitrogen metabolism in plants; Phosphorus and potassium content decreased slightly during storage; Dry matter content increased during the week following the loss of firmness of tomatoes and lower water content; Amount of carbohydrate decreased less, almost insignificant in tomatoes grown significantly in the field and greenhouse grown; Acidity decreased slowly during the first days (3-5 days) and then significantly to the seven days of storage.

INTRODUCTION

Tomatoes are highly perishable vegetable with a very limited shelf life (Addiscott, 1990, Amelkin, Amelkin, 1995). Thus, because of their chemical and physical constitution, tomatoes can be kept temporarily; shelf life is a subject to the maturation phase occurring at harvest and conditions of transport and temporary storage (Banu, 2002, 2004, Berglung, 1978). Since market demand is very high in terms of consumption of tomatoes is necessary to use methods to allow increased storage duration of their recovery (Aung, 1979, Bernard, 1995, Chira, 2001).

MATERIALS AND METHODS

In 2007 were studied in greenhouses and field of the University of Agronomic Sciences and Veterinary Medicine in Bucharest 6 cultivars of tomato: Buzău 1600, Tamaris, Lustro, Abellus, Rz and Electra.These cultivars were collected in three periods: the early ripening (11/07/2007), the maximum harvest period (23/07/2007) and end of harvest (07/30/2007). During the harvesting tomatoes were analyzed in terms of Agrochemical characteristics respectively content of nitrates, phosphorus and potassium and the biochemical characteristics: water content, dry matter, total sugars, acidity and vitamin C.

After harvesting and analysis tomatoes were kept in plastic containers in a refrigerator, under conventional storage technology by freezing temperatures of 7-10^{0}C and 85-90% relative humidity to see their capacity for storage.

We note that at storage were introduced only perfectly healthy tomatos. Agrochemical and biochemical analyses were performed at 3,5,7 days.

Agrochemical analysis methods are standardized ones respectively unmetabolized forms of nitrogen, phosphorus and potassium extraction in 2% acetic acid, extraction ratio 1:20. Nitrates were assayed by colorimetric method with AFD, phosphates by colorimetric method with Duval reagent and potassium flam-photometric method.

Methods for biochemical analysis are: for water content and gravimetric total solids, acidity titrimetric method with NaOH, vitamin C and potassium iodate method with total carbohydrate DNS.

RESULTS AND DISCUTIONS

Nitrates are dangerous to health, when they exceeded the maximum allowed values mentioned by the Ministry of Health in Romania and also by the World Health Organization for this compound in vegetables may affect the ride of blood and can lead to cancer of the stomach or duodenum. In our country, imposed limits for nitrates in tomatoes are 150 ppm for field culture and 300 ppm to culture under glass.

Nitrate analysis performed on 23/07/2007(Table 1) phase has maximum levels range between 86 and 109 ppm in the culture field, 105 and 134 ppm greenhouse culture. If the results were examined from the point of cultivars for soil culture the highest concentrations were obtained at Buzau 1600 with 107 ppm N -NO3, 109 ppm N-NO3at Lustro and 102 ppm N-NO3 at Electra. In the case of greenhouse culture significant results were obtained from Buzau 1600 125 ppmN -NO3, 118 ppm N-NO3 at Lustro and 134 ppm N-NO3 at Electra. Thus it appears that the three cultivars have a greater ability to absorb nitrate. Comparing the results with maximum permissible limit in all cases of culture and values obtained from all cultivars are under these limits means that the tomatoes are very good quality for consumption.

The phosphorus content of the test result falls within the normal range between 185 and 248.3 respectively ppm P-PO4 and potassium content is very high, varying between 1950 and 2205 ppm ensuring good quality tomatoes for both consumption and transport and storage.

Biochemical analyses (Table 2) were considered dry, acidity, vitamin C and total sugars. Dry matter content varies with both culture and cultivation. Because greenhouse culture occurred repeat the process of watering the dry matter content (SUT %) is lower. Cultivars that have accumulated large quantities of SUT are Buzau 1600, Abellus and Electra.

Acidity varies from 0.258% to 0.315% from Abellus to Electra. Acidity is generally low and varies according to cultivar and type of culture. Thus greenhouse culture pH values higher than the culture in the greenhouse field, but the difference is small, acidity is a characteristic species.

Vitamin C is a characteristic feature of vegetable species but also the cultivar. The lowest levels of vitamin C were obtained from Tamaris (17.14 mg/100g sp) and Abellus (18.12 mg/100g sp) and the highest values of this feature occurred in Rz (21, 85 mg/100g sp) and Lustro (21.35 mg/100g sp).

Last feature studied was the total amount of carbohydrates. Carbohydrate accumulation occurs due to climatic conditions appropriate to the type of crop used but the cultivar. Carbohydrate values in the low limits ranged from 3.86% at Electra by up to 4.72% in Abellus.

Analyzed over a week tomatoes were kept in the refrigerator to see their storage capacity.

Analyzes nitrate during storage (Figure 1) indicate that all cultivars there is a downward trend over time. If the field of culture, a smaller decrease occurred in Rz and higher in Electra and for the culture under glass, nitrate decrease was more evident at Electra and lower at Rz.

The evolution of dry matter (%) (Figure 2) is to increase the retention time in all cultivars regardless of the type of cultivation. Of tomatoes harvested in the field a more pronounced increase is observed in culture cultivation and greenhouse Tamaris, Abellus has grown larger.

If the total carbohydrate storage development for all cultivars (Figure 3) trend analysis is taken into sharp decline. If Rz growing field tomatoes and Electra had an increased amount of carbohydrates and lower in cultivars harvested from greenhouse cultivars Buzau and Rz amount of carbohydrate decreased to below 3.2%.

Tomatoes acidity decreased by time, by keeping them in the refrigerator. Acidity decreased more than field grown tomatoes harvested from greenhouse tomatoes. Of tomatoes harvested in the field a more pronounced decrease occurred in Electra and Rz and greenhouse tomatoes harvested from the sharp decrease observed in Lustro.

CONCLUSIONS

Research on the keeping of agrochemical and biochemical characteristics of tomato cultivars showed that:

1. Tomatoes are unable to maintain the appearance and physical characteristics for more than a week, that firmness and bacterial attack;
2. Nitrate content decreased in all cultivars investigated irrespective of the culture used (field, greenhouse) inertia due process of nitrogen metabolism in plants;
3. Phosphorus and potassium content decreased slightly during storage;
4. Dry matter content increased during the week following the loss of firmness of tomatoes and lower water content;
5. Amount of carbohydrate decreased less, almost insignificant in tomatoes grown significantly in the field and greenhouse grown;
6. Acidity decreased slowly during the first days (3-5 days) and then significantly to the seven days of storage.

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TABLES AND FIGURES

Table 1

Agrochemical analysis performed on tomato harvest

Cultivars	N-NO3-, ppm		P-PO43-		K+	
	In the field	In the greenhouse	In the field	In the greenhouse	In the field	In the greenhouse
23.07.07						
Buzău 1600	107	125	227,8	248,3	1980	2150
Tamaris	101	109	201	198	1950	2010
Lustro	109	118	212	220	1965	2150
Abellus	98	110	185	202	2040	2100
Rz	86	105	204	219	1970	2205
Electra	102	134	216	232	2010	1980

Table 2

Performed biochemical analysis of tomato harvest

Cultivars	Culture	Water %	SUT %	Titratable acidity g/100g s.p. malic acid	Vitamin C mg/100g s.p.	Total Carbohydrates %
Buzău 1600	In the field	91,15	8,85	0,268	18,24	4,13
	In the greenhouse	92,02	7,98	0,289	20,15	3,87
Tamaris	In the field	92,36	7,64	0,287	17,14	4,56
	In the greenhouse	93,01	6,99	0,312	19,45	3,96
Lustro	In the field	91,65	8,35	0,303	19,15	4,36
	In the greenhouse	92,16	7,84	0,325	21,35	4,05
Abellus	In the field	91,34	8,66	0,281	18,12	4,72
	In the greenhouse	92,25	7,75	0,315	21,20	3,87
Rz	In the field	91,25	8,75	0,265	19,12	4,68
	In the greenhouse	92,45	7,55	0,306	21,85	3,98
Electra	In the field	91,35	8,65	0,258	18,23	4,57
	In the greenhouse	91,96	8,04	0,301	20,96	3,86

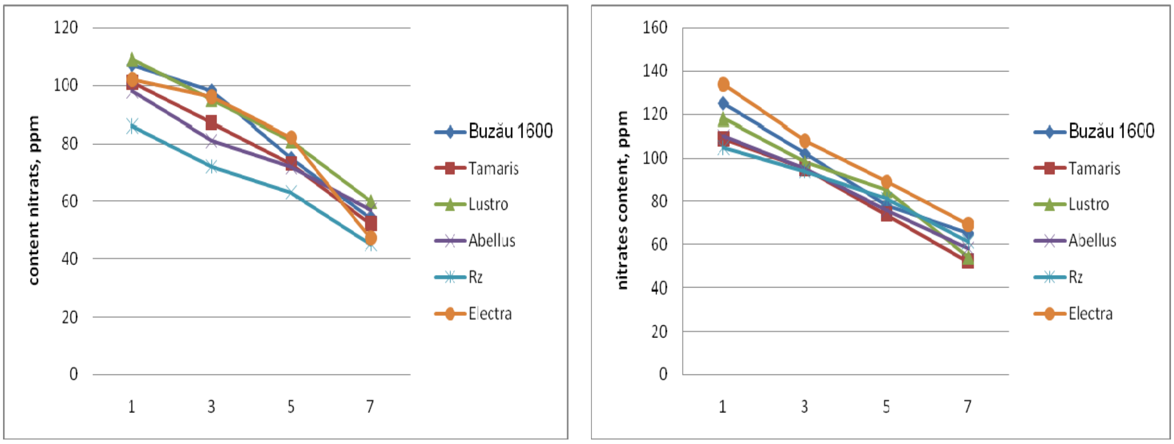

Fig. 1. Evolution nitrate content during storage and field tomatoes grown in greenhouses

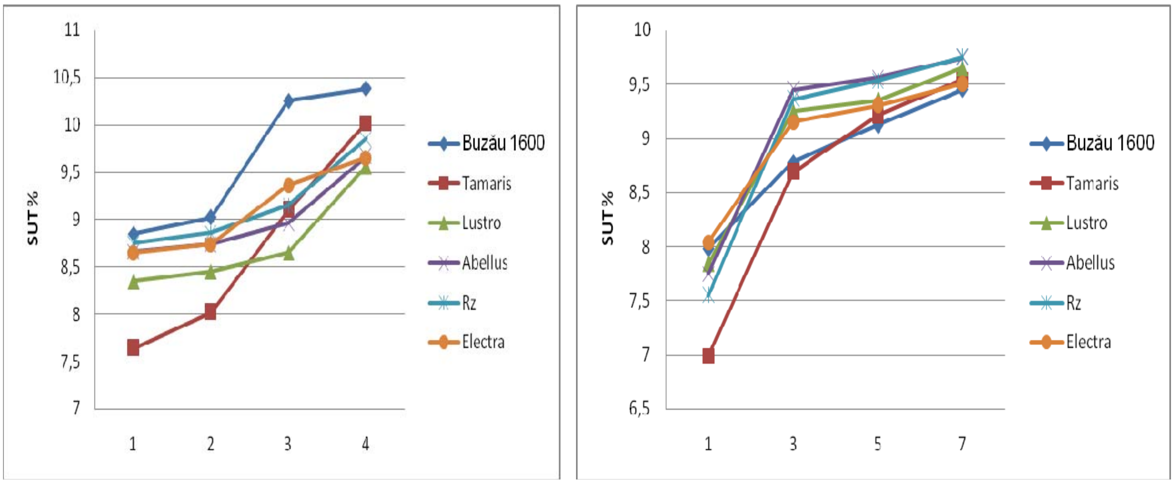

Fig. 2. Evolution of the dry matter during storage in tomatoes grown in fields and greenhouses

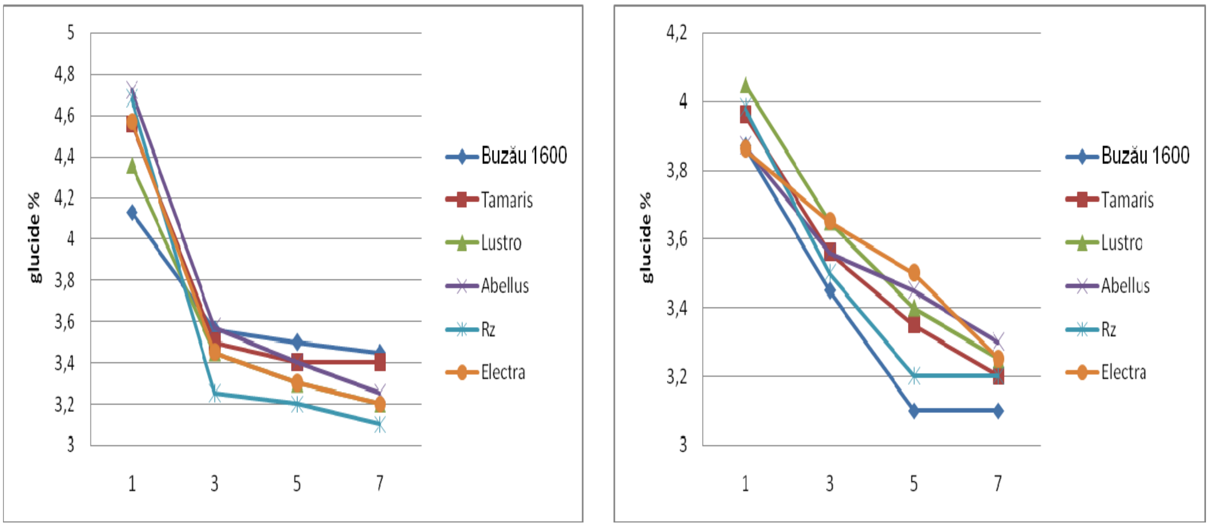

Fig. 3. Evolution during storage carbohydrate content in tomatoes grown in greenhouse and field

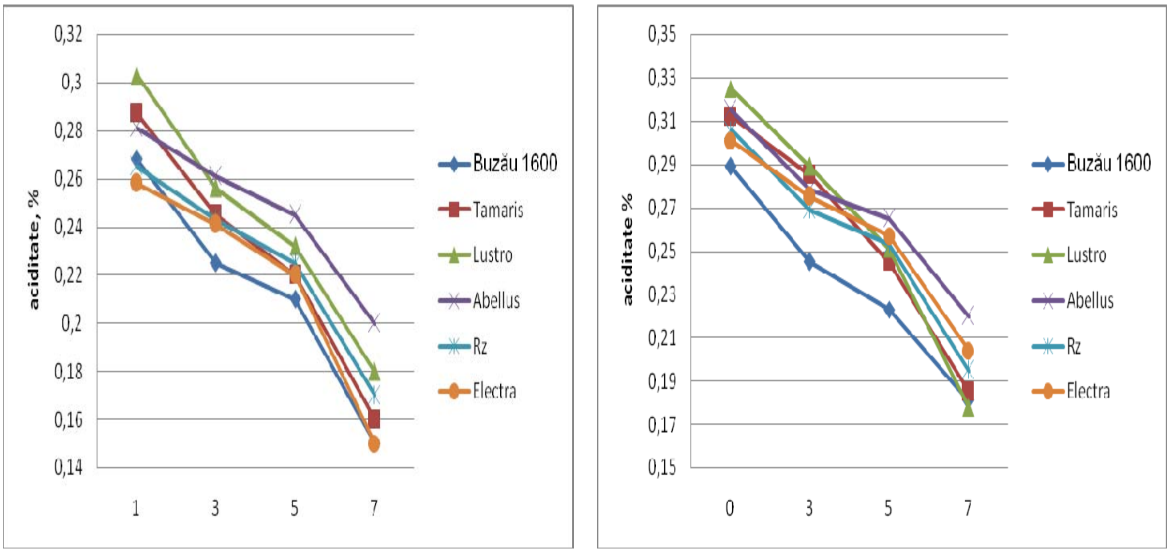

Fig. 4. Evolution of pH during storage in tomatoes grown in greenhouse and field

Iulica, a new variety of *Salvia officinalis* L. obtained at V.R.D.S. Bacău

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Vegetable Research and Development Station Bacău, Romania

Keywords: biologic, germplasm, organic, system culture, biodiversity

ABSTRACT

Initial diversity of this species was enhanced by specific factors of evolution (selection, mutation, isolation), and also by ecological conditions of the areas and agricultural technique of the areas of culture. Thus, local populations today are characterized by a evident diversity that deserves to be preserved and valued. Starting from this premise, the present study was carried out essentially aiming to draw on existing information in the literature, essential to base the study of biodiversity of this species, namely: the importance of culture, origin and systematic of species, botanical features, biological and ecological features of cultivation

INTRODUCTION

Of the approximately 500 species of the genus Salvia, in our country vegetate 3, 2 of which are exclusive culture (with *Salvia officinalis*, *Salvia splendens* - cultivated ornamental), both a spontaneous and cultivated species (*Salvia sclarea* L. Serla) and 10 more spontaneous, many of them common throughout the country (*Salvia glutionsa* L. Cinsteţ - shady places, woods, *Sage pratensis* L. Field Sage, *Salvia nemorosa* L. and *S. nutans* L., *Salvia Austrian* Jacq L. verticillata L.

Salvia officinalis L. is an aromatic semiarbust cultivated as medicinal plants, melliferous and the ornamental gardens, known since the time of the Greeks and Romans, being mentioned in Dioscorides and Galen's writings. In fact even the name of "Sage" means one who saved in Latin.

Starting from the well known fact that in the same climatic conditions and applying the same technology, can be obtained quantitatively and qualitatively different yields if the different varieties are grown. So it is concluded that the element\"biology\"variety or hybrid is a very important role in effective utilization all the technological factors.

For this reason in the context of measures regarding increasing vegetable cultures, the element "biologic” has the most mobility being able to capitalize on the highest level the conditions created by optimizing other factors.

Given the importance of variety or cultivated hybrid, we have decided to diversify our product range and introducing crop varieties that leverages the best amount of technological factors.

MATERIALS AND METHODS

The research was theoretically based on genetic determinism of character, and studies that were conducted included:

- collection of biological material for diversification and conservation of the genetic basis
- fund germplasm evaluation by observation and biometric measurements on phenotypic expression analysis (plant height, flower colour, mode of settlement of flowers, branches, etc.).
- evaluation of physiological characteristics (period of emergence and morphogenesis, earliness, production potential);
- evaluating the relationships of plants to environmental factors (to determine duration of vegetation, the length of phenophase vegetation, soil and climate conditions of the tender project, resistance to unfavourable environmental factors);
- tolerance and resistance to pathogens and pests attack.

RESULTS AND DISCUSSION

For description of the variety of *Salvia,* Iulica the document reference used, was - Nationally Guide 025/1. The characteristic regarding plant height, the position of splitting the plant, the number of stem branches, strain colour, leaf shape, colour, tip, flower, calyx and corolla were presented in table 1.

Observations and biometric measurements are presented in figures 1-4.

CONCLUSIONS

The studies were conducted to obtain a new variety of Salvia.

We realized:

- Setting up collections of plants vegetable germplasm resources with multiple uses,
- Evaluation of quantitative and qualitative characteristics,
- Diversification of current range grown by introducing new species and varieties,
- Using the genetic material collected to creation the initial material for breeding in obtaining new varieties and hybrids,
- Conservation of genetic material true maintaining the authenticity and purity,
- Enrich and improve the current range of species and varieties of vegetables with multiple uses,
- Testing and registration of new varieties to diversify the assortment of vegetable plants grown with multiple uses as bio technology.

AKNOWLEDGEMENT

The authors are grateful to Ministry of Agriculture and Rural Development who assured the founds for Sectorial Programme to made available entire research activity.

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TABLES AND FIGURES

Table 1

Description of the variety of *Salvia* Iulica

	Characteristic	Expression level	Value
1G	Plant: plant height	medium	40-50 cm
2	the position of splitting the plant:	at soil level	good
3	the number of stem branches:	big	
4	Strain: color	silvery green	8-10
5G	Stems: black purple hue	presence	
6G	Leaf: shape	broad ovate	3-5 cm
7G	Leaf: edge	crenate	
8	Leaf: tip	medium sharp	
9	Leaf: stem length	medium	2-3 cm
10	Leaf: green	light	silvery
11	Leaf: gloss	low spic terminal	
12	Flower: group		
13	Flower: position at the beginning of flowering	semierect	
14	Flower: position after blooming	semi erect	
15	Calyx: shape	elliptical	
16	Calyx: color	green	
17	Calyx: In the upper division	medium	
18	Calyx: persistence (after the fall of the corolla)	medium	5
19	Flowering stem: color	green	
20	Flower stalk: color	green	
21G	Corolla: color	dark blue	
22	Corolla: hairy	violet absence	
23	Corolla: length	medium	5
24	Corolla: the number of lobes	medium	5
25	Corolla: persistence (the blossom falls)	medium	5
26	Beginning of flowering period	early	

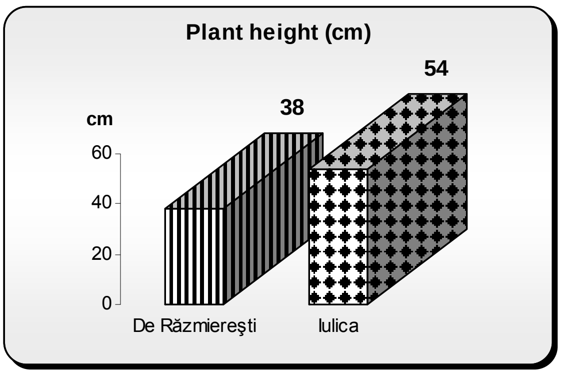

Fig. 1. Plant height

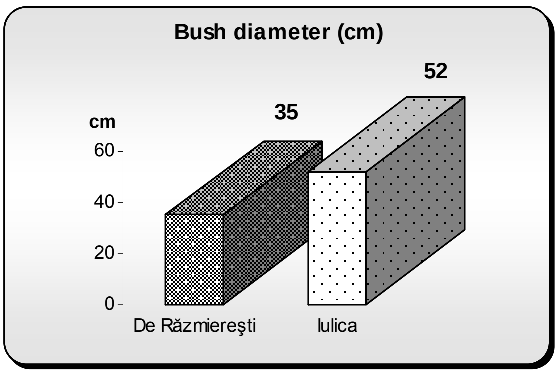

Fig. 2. Bush diameter

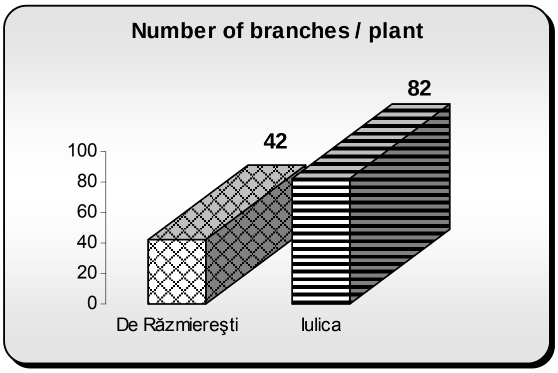

Fig. 3. Number of branches per plant

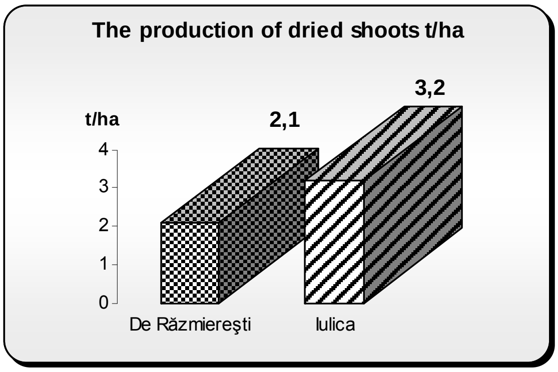

Fig. 4. The production of dried shoots

Foto 1. Sage-culture aspects

Verdana, a new *Phaseolus vulgaris* L. variety obtained at V.R.D.S Bacău

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Keywords: breeding, genealogical selection, resistance, productivity, precocity

ABSTRACT

In order to diversify and enrich the stock of germplasm with source of genes that control the useful characteristics for breeding process at beans garden (potential for high production, short growing season, quality, resistance to mildew and viruses, we used the following method

- **genealogical selection in populations,**
- **selection of the valuable lines and testing in selection field at least three years**
- **study in comparative culture of obtained lines**
- **resistance testing in artificial infection conditions**
- **study in comparative cultures in pedo-climatics condition of area and in different culture areas**
- **observations and biometrical determinations regarding the main morphological characters**
- **studies regarding variability of characters, obtained lines and created new cultivars**

INTRODUCTION

Research, breeding and crop improvement technologies, aims to enhance all the positive characteristics of the species and to obtain other new features to plant, favourable for cultivation, diminishing the role of unfavourable factors that lead to decreasing production cuts.

The plants from *Leguminosae* family, is an irreplaceable group of plants for now and future. They are an important source of food for humans and animals by high protein and carbohydrate content.

Beans have the protein content in pods ranging from 1.7 to 22.3 in dry grains (grams per 100 g of fresh weight), depending on variety and growing conditions. Because of the symbiotic relationship with nitrogen-fixing bacteria, *Leguminosae* plants have a very important place in culture and in rotation system.

Culture of plants from *Leguminosae* family is distinguished by relatively low production potential and lower stability of production. Factors that contribute to unwanted results are climate changes that can lead to poor pollination, an inefficient symbiotic process, the negative effect of rainfall during the harvest and pathogens and pests attack. All these aspects run in bean (*Phaseolus vulgaris L.)*

MATERIALS AND METHODS

Working method for obtaining genetic material was simple repeated individual selection depending on the nature of the original material has been applied. It was followed the separation of all genotypes (phenotypes) by repeated individual selection based on key quality characteristics: leaf and stem colour, flower colour, pod colour, colour, shape and grain size, presence or absence of thread, the degree of resistance to pathogens and pests attack.

Separate phenotypes which showed interests in terms of agro productivity were introduced in the selection field, where we follow uniformity of characters of each line and separation of possible segregates.

The selection was made throughout the growing season:

- At the stage of seedlings.
- The mass flowering stage.
- Linking clusters.
- Maturity of pods.

- Physiological maturity of grain.

From entire genetic material were retained in study 16 lines belonging to six populations.

  - These lines were uniform and showed no segregates.
  - Valuable lines were studied comparative cultures.

RESULTS AND DISCUSSION

Research goal was to enrich the stock of germplasm for creating new genotypes. Measurable objectives were envisaged:

a) Morphological characters:
   - length of strains (240 cm),
   - number of nodes from base to the first fertile node,
   - number of flowers in inflorescence,
   - foliage colour - dark green;
   - pod length (25 - 26 cm)
   - pod curvature,
   - pod tip - sharp truncated,
   - grain colour –white,
   - weight of 1000 seeds - dry stage 450 g,
   - dry grain size - mid;

b) Physiological features :
   - the vegetation period from rising to technical maturity mass (55 days),
   - technical maturation of grains 65 - 75 days,
   - tolerance to pathogens attack

Characterization of new genotype of garden bean variety Verdana

Verdana is an early variety

Growing period is 45 to 50 days (from rising to first pods harvest).

Plant*:*

- anthocyanic coloured absence of hypocotyls
- type of growth - climbing
- flower colour - white

The pod is straight, slightly curved, pointed green. Pod length is large, 25-26 cm length and width of 2.3-2.5 cm. Average number of pods per plant is 48-52. There is no thread and parchment-like layer.

Physiological maturity beans are white and 450 g. MMB.

Production potential is 36 -40 t pods/ha.

CONCLUSIONS

- In our researches at VRDS Bacău, we studied the species germplasm enrichment fund, prospective material for improving the garden bean, and creating new varieties with the existing competitive global range.
- After analyzing the obtained results in comparative cultures, L 53 Bacău proved to be the most valuable and was forwarded to ISTIS to be tested in comparative culture of competition across the network.
- After testing was approved the new variety Verdana.

AKNOWLEDGEMENT

The authors are grateful to Ministry of Agriculture and Rural Development who assured the founds for Sectorial Programme to made available entire research activity.

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TABLE AND FIGURES

Table 1

Studies on the positive correlations of the characters from garden bean

Character /feature	Positively correlated with:
Grain yield	The number of fertile pods per unit area, number of pods per bush, the number of grains in pod
Grain Quality	The high protein, starch, fats and vitamins content, high content of lysine, tryptophan, cystine, tyrosine and methionine, low content of cellulose.
Drought Resistant	The density of cellular juice; hairy degree of plant, short growing season, low coefficient of sweat.
Precocity	Short development stages, the stem below the insertion of clusters.

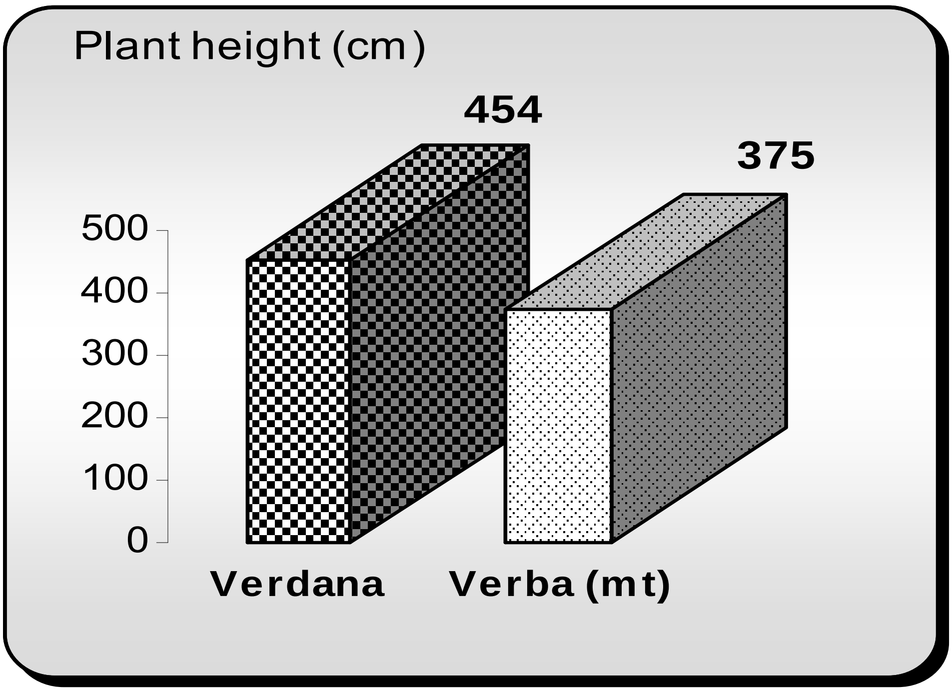

Fig. 1 Plant height

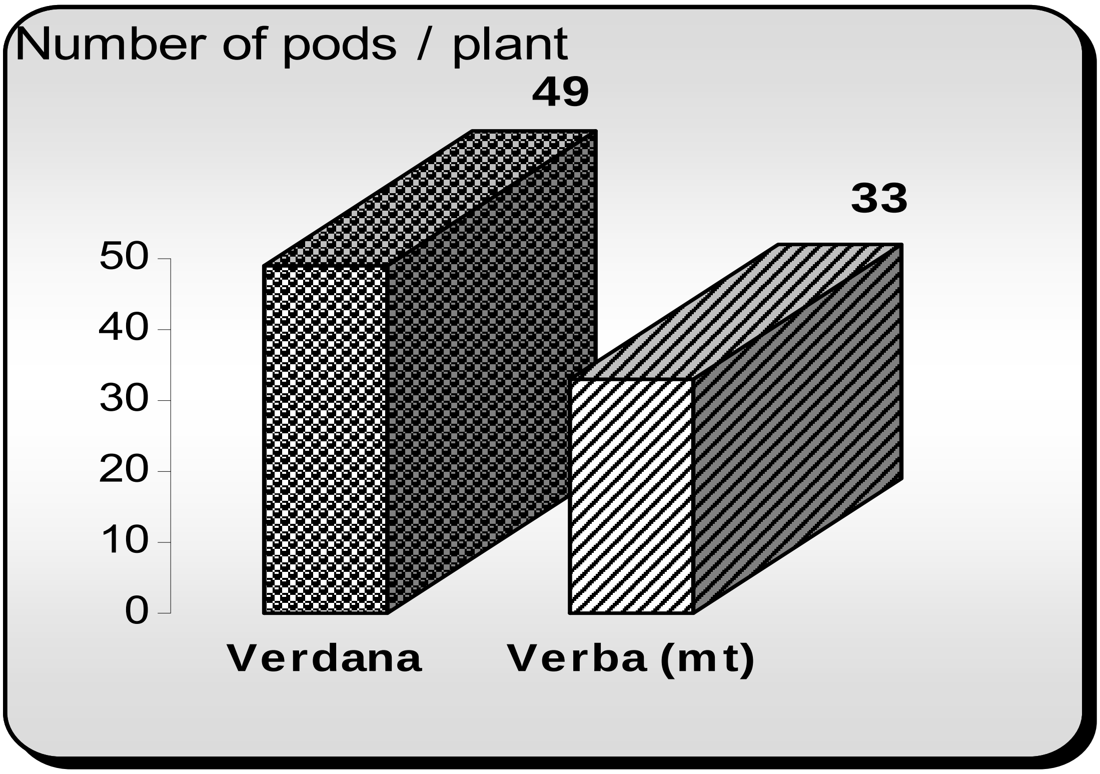

Fig. 2 Number of pods

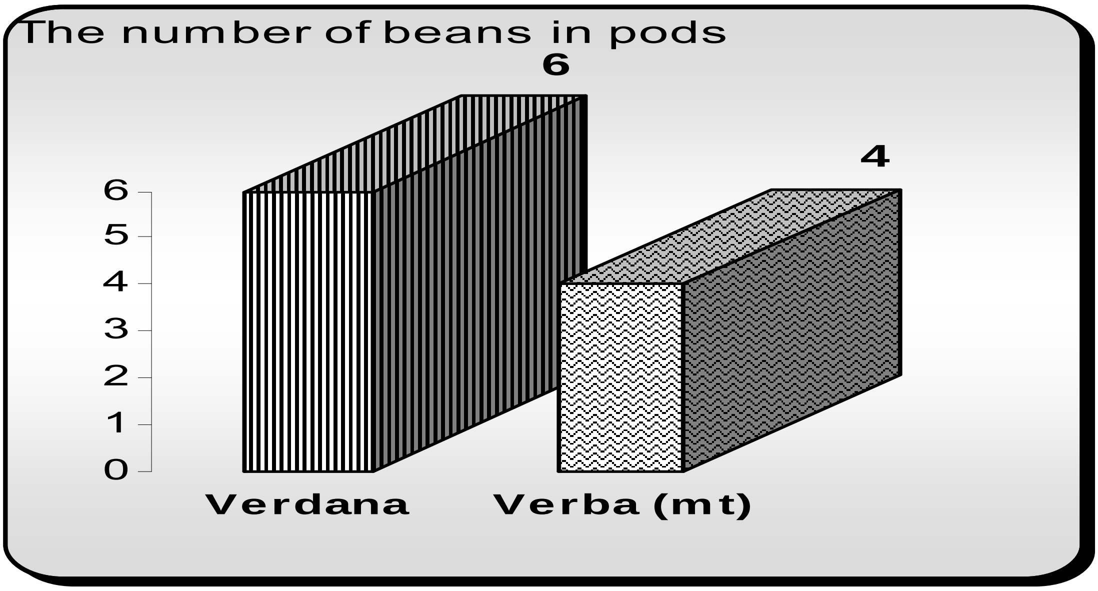

Fig. 3 The number of beans in pods

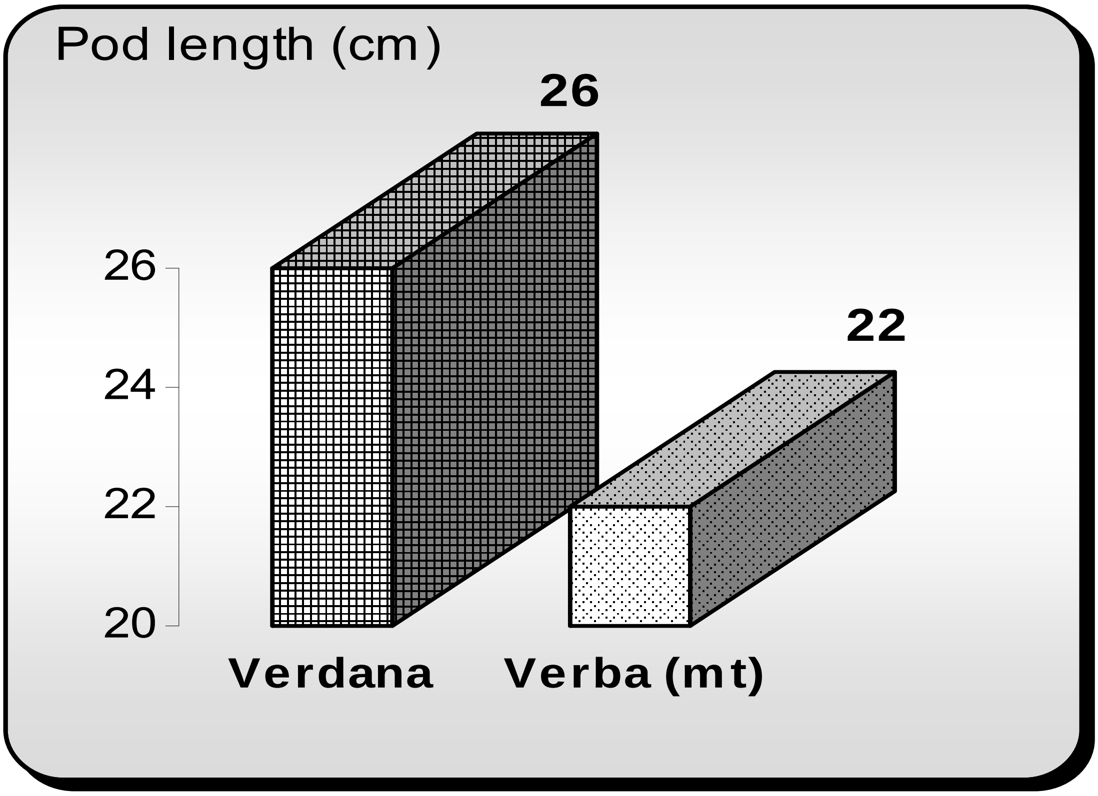

Fig. 4 Pod length

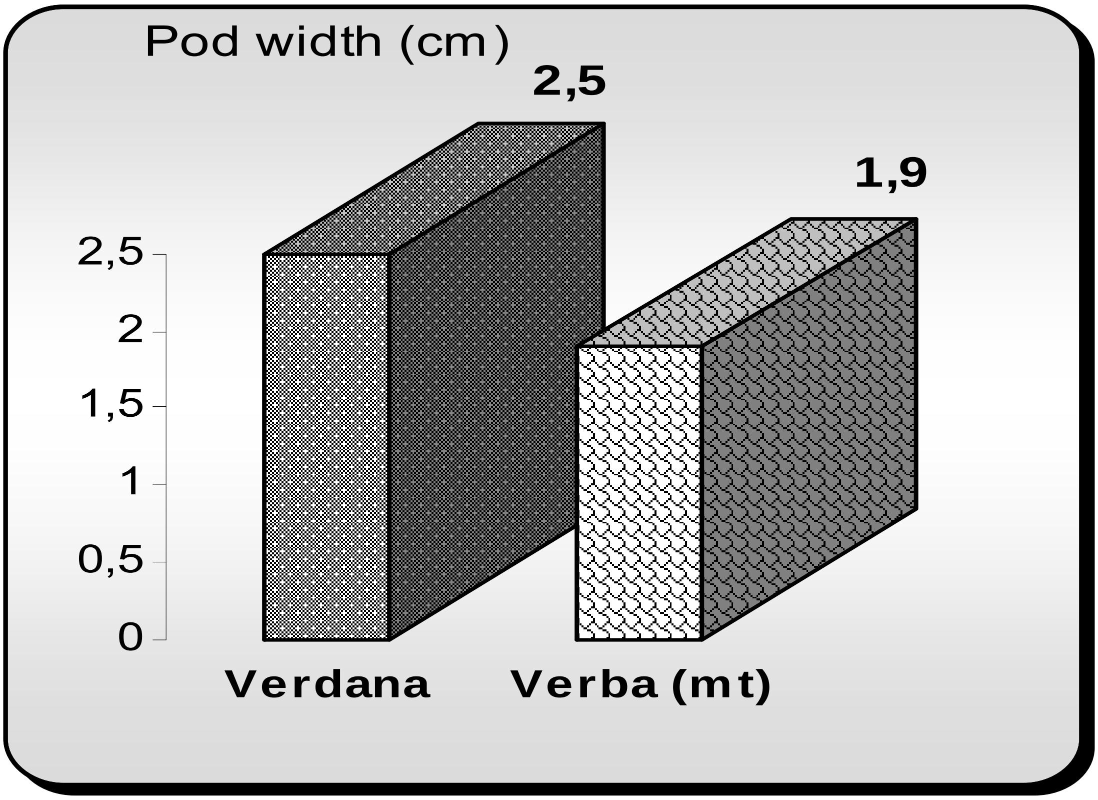

Fig. 5 Pod width

Organic vegetable growing on ecological practice

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Keywords: organic soil, soil biological activity, michorize, mushroom compost, humus, sustainable development.

ABSTRACT

The transformation of land use on soil organic conventional correction requires specific indicators. Maximum efficiency of the methods tested was the method of assessing soil biological activity where some accuracy was high. Improve the soil was done by adding compost and biomass rotation degraded and introduction of legumes.

INTRODUCTION

Practical alternative crops in the "bio" are based on the maximum exploitation of soil fertility and relatively economical. Without a good knowledge of the qualities and deficiencies in the culture, took earth, and the improvement measures to be taken, there can be no assurance of economic fertility and relatively constant. To practice organic vegetable notions should know better defining soil (Stoian, 2005; Florea, 2003).

Vermicompost is an organic product of plant waste which is used after degradation as environment for plant growth and soil as natural fertilizer (Yardim et al., 2006; Fitiu, 2000). This product is the result of an aerobic process that involves complex interactions between earthworms and microorganisms, which stabilizes the organic matter and make nutrients continue to be available for plants (Yardim et al., 2006). Methods to control pests and diseases by chemical synthesis using pesticides are very effective, but also harmful to the environment (Garcia et al., 2004).

Fields cultivated with cucumbers had a significantly development for insect populations because of the use of food waste vermicompost. Tests were conducted on soils in NPK balanced. Application rates were similar for the group treated with vermicompost and inorganic fertilizer treatment groups (Yardim et al., 2006). *Rhizoctonia* was controlled by using compost from food scraps and *Pythium ultimum* using composted manure and wheat straw or pine bark compost. *Phytophthora sp.* can be suppressed by chemical inhibitors present in the compost of hardwood bark and *Fusarium oxysporum* was controlled through the use of compost from municipal solid waste containing antagonistic microorganisms such as *Bacillus subtilis*, *Trichoderma* and *Pseudomonas* (Garcia et al., 2004).

The effects were observed in greenhouse at cucumber and tomato plants grown in soil with an amount of synthetic fertilizer replaced with 0%, 20% or 40% food waste vermicompost, standardized exposed to attacks by pests nylon mesh. The effects in greenhouse by replacement rates of 20% and 40% with synthetic fertilizer of vermicompost decreased the damage from beetles (Yardim et al., 2006).

Theses of some authors reported significant suppression of white worm, *Pseudococcu*s attacks on cucumbers and red spider *Tetranychus urticae* attacks on bean and eggplant and attacks by aphids (*Myzuz persicae*) on cabbage, according to the rate of application of vermicompost food waste (Yardim et al., 2006).

In semiarid Mediterranean areas, one of the methods to improve soil quality with a low amount of organic matter in the soil is adding organic material, either fresh (such as sewage sludge) or composting (Garcia et al., 2004).

Processing intensive the soil determined the decrease of lettuce production (*Lactuca* *sativa*) and broccoli (*Brassica oleracea*) in time. Shepherd's Purse density of weed and nettle was lower in treatments with compost (Jackson et al., 2004).

Agricultural production in greenhouse is in generally ten times higher than those produced in the field. However, conditions in greenhouse, often favoring the formation of outbreaks of arthropod and plant diseases. Tomato and sweet pepper crops grown in commercial greenhouses are usually infested with white fly (*Trialeurodes vaporariorum*) and *Botrytis cinerea* (Kapongo et al., 2008). The main intention was to introduce the pesticides to prevent and control the insects, diseases and pests in field crops. At first, the use of pesticides reduced pest attack on crop yield increase as expected. At the same time, increased use of chemical pesticides, has led to environmental contamination and also caused long-term a number of problems to society. The data were then used to estimate the potential health risk. Concentrations of pesticide residues in vegetables in different seasons indicates that winter vegetables are the most contaminated, followed by summer and rainy seasons vegetables. The concentration of different pesticides were well below established tolerances but continuous consumption of vegetables grown conventionally, with a moderate level of contamination that can accumulate in the body of consumers and may prove fatal to the human population, long-term (Bhanti and Taneja, 2007).In general, the difficulties involved in quantifying the environmental impact of pests and prevent their inclusion in economic analysis and strategies for quarantine (Cook and Proctor, 2007).

Eucalyptus oil has a broad spectrum of biological activity including anti-microbial, fungicides, insecticides, herbicides, acaroids and nematicides. The use of eucalyptus oil as a natural pesticide is very important because give to the environmental and toxicological implications of indiscriminate use of synthetic pesticides recommended by overcoming the problem of increasing amounts pest resistance (Batish et al., 2008).

It was reported that 99% of crop pests are controlled by natural enemies such as birds, spiders, parasitic wasps, viral diseases and other organisms. In fact, natural pest control not only minimizes the use of synthetic chemicals, but also protects crops also saves a significant amount of money for chemical compounds (Batish et al., 2008). Worldwide, parasites (including weeds, pathogens and insects) are the biggest competitor of crops and severely reduce crop production by 25-50%. Only weeds are responsible for a reduction of almost 34% of crop yield (Batish et al., 2008; Chirila, 2001, Chirila et al., 2001).

Lately, essential oils are potential candidates to combat weeds and pests and diseases management. This is primarily because essential oils are readily available, biodegradable and eco - friendly is easily obtained from the environment, but not least do not persist in soil and water, no toxicity against vertebrates (fish, birds and mammals) and plays an important role in protecting plants against parasites. All these properties allow the use of essential oils, even in sensitive areas such as schools, restaurants, hospitals and homes (Batish et al., 2008).

Mushrooms come in symbiosis with plants, their roots grow in and outside their phosphorus supply is done through recruitment of mucus which feed on plant roots. Micro plant can maintain activity by these secretions (Rusu et al., 2005).

MATERIALS AND METHODS

The land on which experiments were conducted was a private property of 0.40 hectares, of which 0.10 hectares were certified organic, located in southern Muntenia Teleorman. The method of assessing soil biological activity was done in September to assess the frequency frames in the soil, the model Balasca (1993). Were made using four rectangles of 50/10cm blocks scattered four variants that, in different soils (conventional and organic). Each rectangle 20 pieces were placed at 2-3 cm distance straw and waited 14 days. Then there were numbered the straws moved.

It was build a compost maker (after Badea et al., 2005) at a depth of 40 cm width 1.55 m with two compartments separated by a wall of bricks with holes. Originally there were introduced plant debris in the first compartment. When fermentation has stabilized (several weeks) was introduced frames and covered with wire mesh lid. Placed on top of dolomite flour is added, coffee waste, onion leaves. To stimulate breeding material frame was sprayed at an interval of 8-14 days with rain water and was introduced a few flowers of valerian. After several weeks everything turned into black compost humus matter. The process of composting continued and was extended for the 2nd slot following the same steps.

Humus content was improved by introducing the culture of leguminous plants (peas) by Badea et al., 2005.

Plants grown in the field are tomatoes, eggplants, peppers. Fertilizers for strengthening of vegetables: nettle (plant freshly crushed 1kg + 10 liters of water is kept in the shade to compost for four days. It is used by dilution of 1/20 to ground and 1/10 for spraying plants) and compost weeds (which is done in four weeks) (Fitiu 2003, Fitiu et al., 2003, Calin, 2005).

RESULTS AND DISCUSSION

Since the soils had an experimental batches brown gray, meaning moderate amount of humus, the necessary organic matter was improved by the introduction in the fall rotation of leguminous plants. Transformation of plant material to humus in compost was made with frames of compost maker. The use of mulching determine a limitation of soil nitrogen leaching, also was prevented emergence of different herbs and crusts, was preserved in soil moisture and photosynthesis increased efficiency due to light reflection on the undersides of leaves.

Through the method of assessing biological activity were found: in the experimental field conventional worms are few or very few, while in the experimental field worms are more and a lot. The experiments made in ecological field reflects grate number worms in soil, greater that in conventional one, hence a good soil to be cultivated with vegetables, is rich in organic matter (Fig. 1).

Through humus content improved method by introducing the culture of leguminous plants, peas respectively, reflected the economic efficiency of tomato production achieved through organic cultivation on an area of 0.1 hectares with blank culture conventional one with 24% increase (Fig. 2).

Also the same method shows the economic efficiency of eggs production achieved through organic cultivation on an area of 0.05 hectares with blank culture conventional one with 17% increase (Fig. 3).

The same method shows the economic efficiency achieved by growing production of organic pepper an area of 0.05 hectares with blank conventional culture a 14% increase (Fig. 4).

The cultivation of legumes culture before the principal culture determined an economic efficiency reflected through a production increase of 24% to tomato, eggplant 17%, 14% in pepper, compared to control groups. Legume biomass is an easily accessible source of nitrogen for *Solanaceae* family.

Nettle has a dual role, with effects of fungicide and insecticide on plants of the *Solanaceae* family, being used in fermentation of compost.

CONCLUSIONS

1. Existence of microorganisms in the soil is the primary factor of economic efficiency of organic vegetable crops;

2. Enriching the soil with nitrogen and carbon is made by adding compost, biomass and legume crop;

3. Balance between microorganisms and organic matter is maintained by that certain technological links: removing chemicals and equipment with high speed, gentle processing of the soil, introducing the culture of lawns;

4. Organic fertilization of the land is far more effective than chemical fertilization because of its bio-available for plants, *Solanaceae* family being a nitrogen hungry one.

AKNOWLEDGEMENT

Thanks to all who were with me in making this work, primarily the Department of Chemistry, Faculty of Biotechnology of UASVM, but not least Lord Professor Doctor Gheorghe Campeanu and staff Dr Nicholas Atanasiu.

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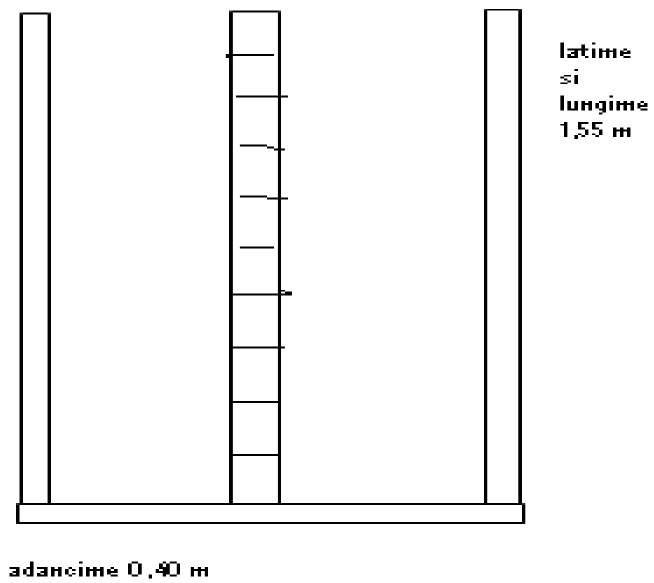
PICTURE AND FIGURES



A draw of compost maker

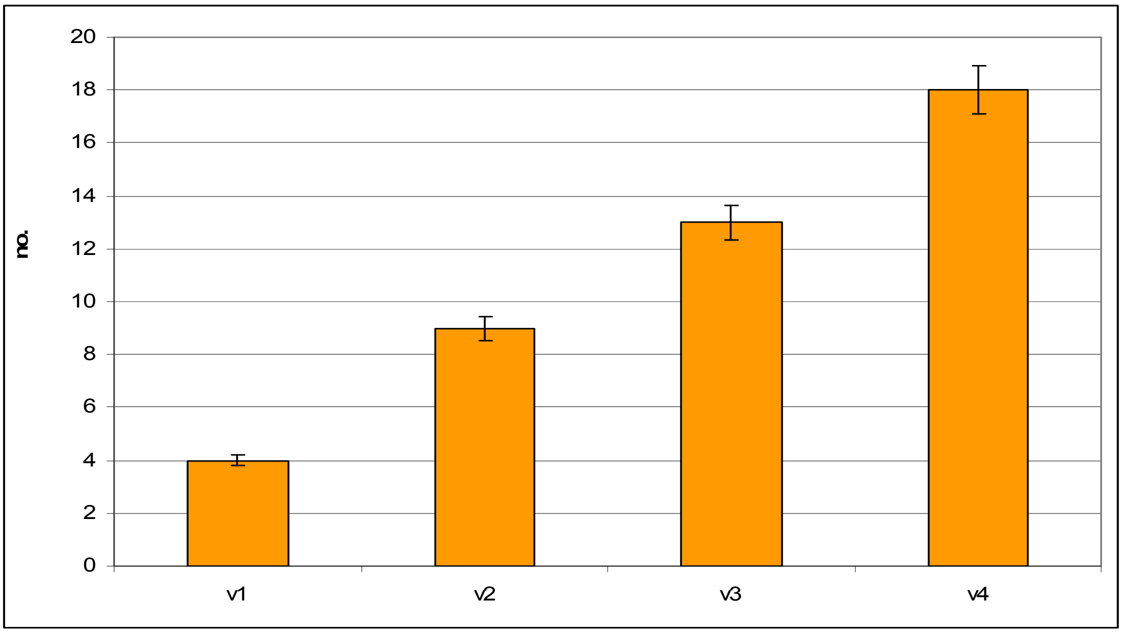


Fig.1. Results of experiments biological activity assessment method: the field convetional: v1 - 4 straw blurred v2 - September straw moved, in the environmental field: v3 - 13 straw moved, v4 - 18 straw moved.

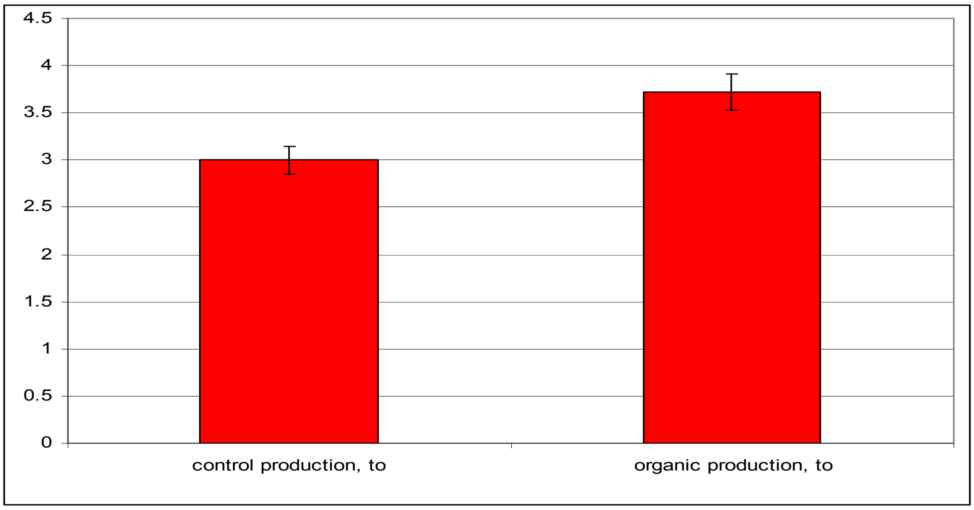


Fig. 2. Tomato production achieved through organic cultivation on an area of 0.1 ha convetional blank culture.

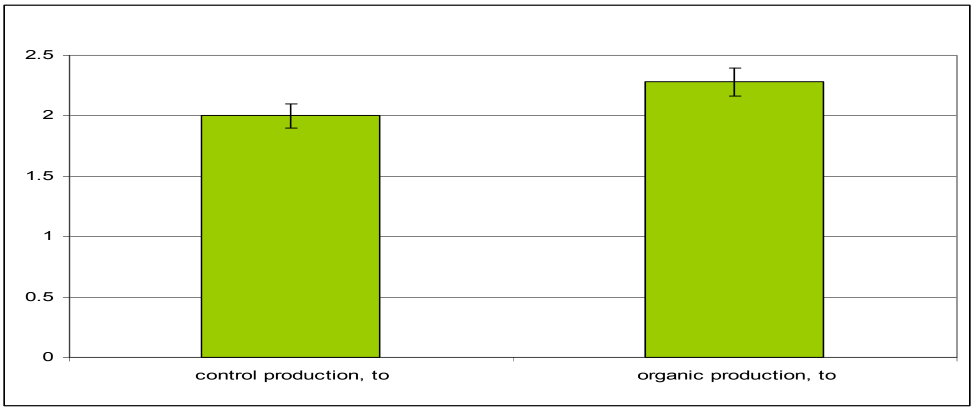


Fig.3. Production of plants obtained by organic cultivation on an area of 0.05 hectares with blank conventional culture

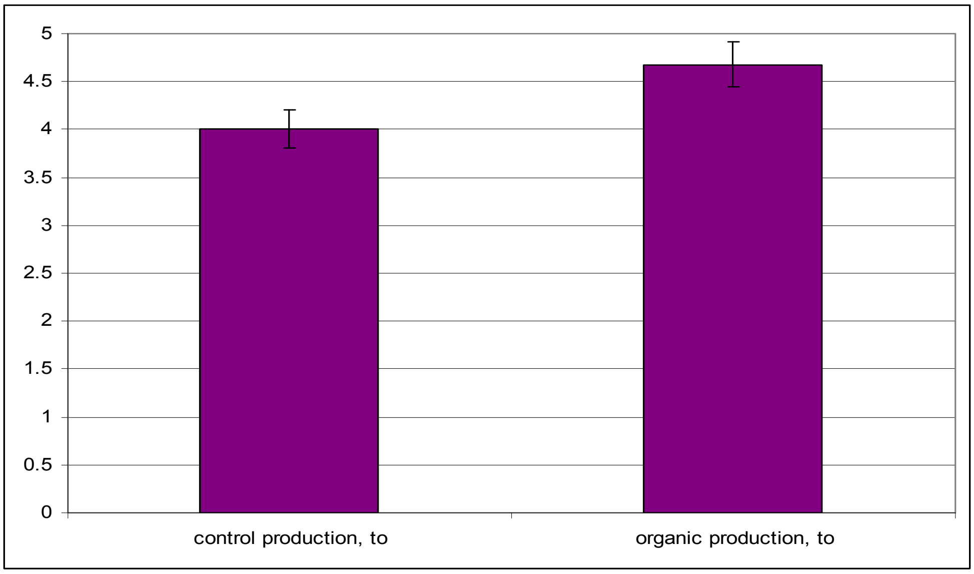


Fig.4. Pepper production achieved through organic cultivation on an area of 0.05 hectares with blank conventional culture

The study of eggplant ability for cultivations in tunnels in ecological agriculture conditions

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Keywords: cultivars, yield, assortment, hybrid, variety.

ABSTRACT

The experimentations were accomplished at S.C.D.L. Bacau during 2007 – 2009. In 2007, the hybrids Falcon F1 (83,0 t/ha), Topaz F1 (93,2 t/ha) obtained higher production comparing with the control Contesa (78,8 t/ha). In 2008, the hybrids: Aragon F1 - 80,4 t/ha, Tudela F1 - 57,3 t/ha, Black Pearl F1 - 76,4 t/ha, Edna F1 - 56,3 t/ha, Mirabelle F1 - 46,0 t/ha registered superior productions than Contesa (control) – 51,4 t/ha. In 2009 the hybrids: Mirabelle F1 - 68,4 t/ha, Edna F1 - 78,1 t/ha, Black pearl F1 - t/ha 88,4, Epic F1 - 96,9 t/ha had superior productions than Contesa (m) - 51,4 t/ha. In 2007 the hybrids had a greater weight of fruits (Falcon F1 - 322,1 g/fruit; Topaz - F1 371,4 g/fruit) comparing with the fruit's weight of Contesa variety - 200,5 g/ fruit. In 2008 the fruits of the following hybrids Aragon F1 - 370,1 g/fruit; Tudela F1 - 586,8 g/fruit; Black Pearl F1 - 409,5 g/fruit; Edna F1 - 429,4 g/fruit; Mirabelle F1 - 244,8 g/fruit had a higher weight than the fruits of Contesa variety - 195,4 g/fruit. In 2009 Mirabelle F1 - 163,8 g/fruit, Edna F1 - 315 g/fruit, Black Pearl F1 - 244,8 g/fruit, Epic F1 - 295,9 g/fruit had a higher weight than Contesa - 201,2 g/fruit.

INTRODUCTION

The cultivation of eggplants in ecologic/organic/biologic agriculture has a large perspective (Glos, 2004; Henry, 1994; Davis et al., 2008).

In this field of activity, the study of variety and hybrid`s ability to be cultivated in ecologic agriculture conditions has a tremendous importance, the factor variety or hybrid influencing significantly the quality and quantity of yields obtained (Lawande and Chavan. 1998; Klugherz et al. 2004; Rubatzky and Yamaguchi, 1996; Salunkhe and Kadam, 1998; Shukla and Naik, 1993; Goo et al., 2000).

In Romania, the assortment of cultivated eggplants expanded during the last years, through the introduction of new hybrids and varieties created in our country or abroad. As a result, at V.R.D.S. Bacau during 2007-2009 a study of eggplants assortment cultivated in biologic agriculture was accomplished. This study was realized according with the legal communitarian frame from the European Community Regulation no. 834/2007. The purpose of researches is the establishment of an assortment of eggplants varieties and hybrids that are able to accomplish superior productions from quality and quantity point of view, in plastic houses, in ecologic agriculture system.

MATERIALS AND METHODS

The experimentations were accomplished in the polygon of biologic agriculture from V.R.D.S. Bacau, certified for the ecologic quality of production.

The assortment studies were realized in 3 plastic houses mono arc with a surface of 900 m^2, utilizing the methods and practices specific to ecologic agriculture.

In the present study we tested hybrids with different origin and different consumption destinations, the experimental results being compared with Contesa, our variety.

The following cultivars were tested:
2007: Falcon F1, Topaz F1, Contesa;
2008: Aragon F1, Tudela F1, Black Pearl F1, Edna F1, Mirabelle F1, Contesa
2009: Mirabelle F1, Edna F1 (m), Black pearl F1, Epic F1, Contesa.
Data of planting: 17.04.2007, 28.04.2008. 28.04.2009.

The observations were oriented for the following features: dynamic of blossom; dynamic of fruits settlements; quantity, quality and dynamics of yielded production; sensibility to pests and diseases attack.

RESULTS AND DISCUSSIONS

The experimental results, regarding the average production obtained and its significance were compared with the control, Contesa variety. The yields of eggplants cultivars are presented in table 1.

The date of first harvest: 01.06.2007, 01.07.2008, 09.06.2009.

The date of last harvest: 31.08.2007, 02.09.2008, 29.09.2009.

In 2007, the hybrids Falcon F1 (83,0 t/ha), Topaz F1 (93,2 t/ha) obtained higher production comparing with the control Contesa (78,8 t/ha).

In 2008, the hybrids: Aragon F1 - 80,4 t/ha, Tudela F1 - 57,3 t/ha, Black Pearl F1 - 76,4 t/ha, Edna F1 - 56,3 t/ha, Mirabelle F1 - 46,0 registered superior productions than Contesa (control) – 51,4 t/ha.

În 2009 the hybrids: Mirabelle F1 - 68,4, Edna F1 - 78,1, Black pearl F1 - 88,4, Epic F1 - 96,9 had superior productions than Contesa (m) - 51,4 t/ha.

The average weight of fruits varied in large limits (fig. 1, 2, 3).

In 2007 hybrids Falcon F1 322,1 g/fruit; Topaz F1 371,4 g/fruit had a higher weight than the fruits of Contesa variety - 200,5 g/ fruit.

In 2008 hybrids Aragon F1 370,1 g/fruit; Tudela F1 586,8 g/fruit; Black Pearl F1 409,5 g/fruit; Edna F1 429,4 g/fruit; Mirabelle F1 244,8 g/fruit had a higher weight than the fruits of Contesa variety 195,4 g/fruit.

In 2009 Edna F1 315 g/fruit, Black Pearl F1 244,8 g/fruit, Epic F1, 295,9 g/fruit, had a higher weight than the fruits of Contesa variety - 201,2 g/fruit.

CONCLUSIONS

In 2007, the hybrids Falcon F1 (83,0 t/ha), Topaz F1 (93,2 t/ha) obtained higher production comparing with the control Contesa (78,8 t/ha).

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In 2009, Edna F1 315 g/fruit, Black Pearl F1 244,8 g/fruit, Epic F1, 295,9 g/fruit, had a higher weight of fruits than the weight of Contesa variety fruits - 201,2 g/fruit.

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*** REGULAMENTUL (CE) NR. 834/2007.

TABLE AND FIGURES

Table 1

The synthesis of production results

Nr. crt	Variant	Production t/ha	Production Difference t/ha	Relative production %	Significance of differences
2007					
1	Falcon F1	83,0	+4,2	105,3	**
2	Topaz F1	93,2	+14,4	118,3	***
3	Contesa (m)	78,8	0	100	-
2008					
1	Aragon F1	80,4	37,4	186,9	***
2	Tudela F1	57,3	14,3	133,3	***
3	Black Pearl F1	76,4	33,4	177,7	***
4	Edna F1	56,3	13,3	130,9	***
5	Mirabelle F1	46,0	3,0	107,0	*
6	Contesa (m)	43,0	0	100	-
2009					
1	Mirabelle F1	68,4	17,0	133,1	***
2	Edna F1	78,1	26,7	151,9	***
3	Black pearl F1	88,4	37,0	172,0	***
4	Epic F1	96,9	45,5	188,5	***
5	Contesa (m)	51,4	0	100	-

2007	2008	2009
DL5% = 2,30 t/ha	DL 5% = 2,85 t/ha	DL 5% = 7,9 t/ha
DL 1% = 3,48t/ha	DL 1% = 4,05 t/ha	DL 1% = 11,4 t/ha
DL 0,1% - 6,31 t/ha	DL 0,1% - 7,18 t/ha	DL 0,1% - 16,7 t/ha

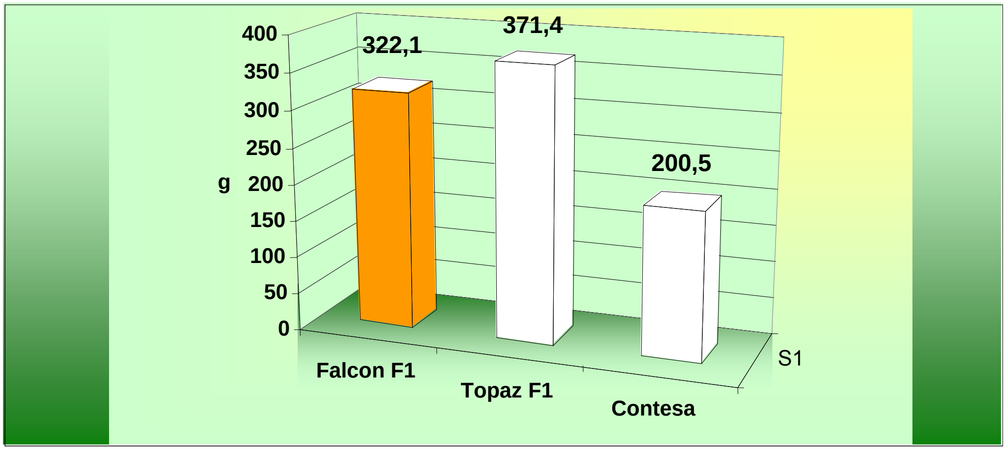

Fig. 1 The average weight of eggplant fruits in 2007

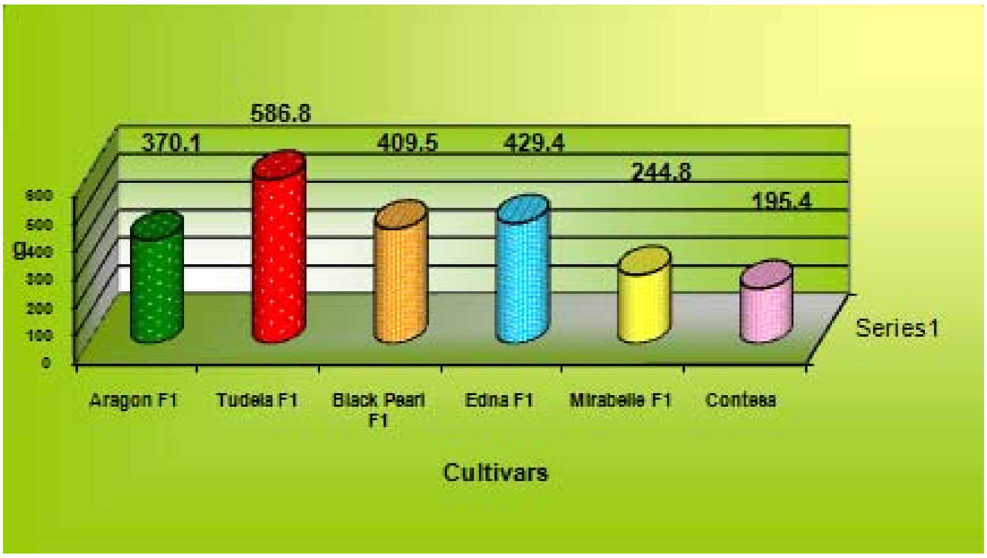

Fig. 2 The average weight of eggplant fruits in 2008

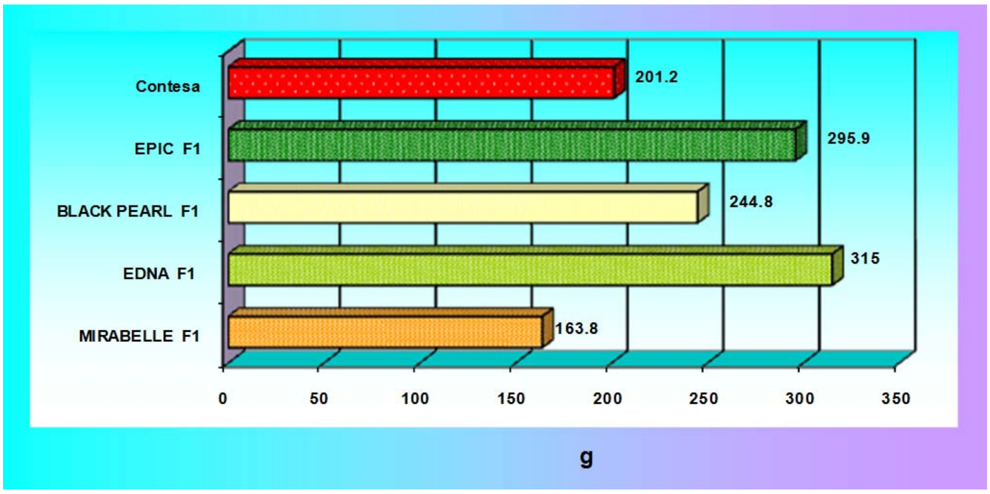

Fig. 3 The average weight of eggplant fruits in 2009

New technological elements in setting up an asparagus plantation (*Asparagus officinalis* L.)

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Keywords: asparagus cultivars, seedling age, technology of plantation

ABSTRACT

Asparagus has been used from early times as a vegetable and medicine, owing to its delicate flavor and diuretic properties. There is a recipe for cooking asparagus in the oldest surviving book of recipes, Apicius's third century AD De re coquinaria, Book III. It was cultivated by the ancient Egyptians, Greeks and Romans, who ate it fresh when in season and dried the vegetable for use in winter. Asparagus is pictured on an Egyptian frieze dating to 3000 B.C. France's Louis XIV had special greenhouses built for growing it. It lost its popularity in the Middle Ages but returned to favor in the seventeenth century.

INTRODUCTION

Asparagus (*Asparagus officinalis L.*) is perennial, geophytes, unisexuat dioecious, with the origin from the Europe steppe and from Far East. Today, Asparagus (*Asparagus officinalis L.*) is widely cultivated in countries with advanced agricultural technology.

Asparagus (*Asparagus officinalis L.*) was used form ancient times as a vegetable and as a medicine. The eatable part of Asparagus is represented by young shoots, etiolated or green which have a high level of vitamins (C, A, PP, B complex), mineral salts (Ca, Fe, P, K) and have a high nutritive value. The green shoots, in comparison the etiolated ones, are superiors because they have two times more quantity of vitamin C, carotene and a smaller quantity of cellulose which gives them accentuated tenderness.

This plant is used in medical and pharmaceutical practice, due to the determinant therapeutic properties and to biochemical content, as diuretic, laxative, stimulant for renal activity, remineralizing, sanguine fluidizing, depurative, calming, hepatic drained.

The request of plant regarding the environmental factors are quite rustics, withstand prolonged heat, moderate humidity and harsh winters.

The economical time of an asparagus plantation (*Asparagus officinalis* L.) is of 6-8 years, no need of high specialized work, which conduct to production expenses really small.

Asparagus (*Asparagus officinalis L.*) is well known in Romania, but in last years the cultivated areas and the production obtained in Romania are insignificant.

The market has small request regarding this product which is included in the offer of all hypermarkets in small quantities and for short periods of time.

We underline the fact that in Romania don't exist specialized seedlings producers to give high quality seedlings as in countries with this tradition from West Europe.

Through the established subject of the doctorate work we proposed the followings:

- behavior testing in Romania conditions of some asparagus cultivars (*Asparagus officinalis L.*) which are used with excellent results in countries as Holland, France or England;
- he establishment of seedlings age upon the time of first harvest;
- the establishment of the influence of planting distances upon the production and its quality of the asparagus shoots harvested from plantations with heaps or without heaps.;
- the development of some efficient control measures for weeds from plantation;
- the establishment of some irrigation norms – fertirrigation to favor the production of big and high quality asparagus;
- some lab researches regarding the possibility for producing through meristems culture of the male seedlings from autochthones and abroad varieties;

- the establishment of production differences and of harvest periods for the cultivated variants with or without heaps;
- the development of some culture technology for the South zone of Romania, updated to the specific technological link of asparagus plantation;
- some biochemical determinations regarding the turions quality harvested form plantation with or without heaps;
- the organization of some asparagus tasting for establishing through organoleptic way the turions particularities from different varieties, etiolated or green.

MATERIALS AND METHODS

Asparagus culture (*Asparagus officinalis L.*) was established in Dambovita county, Morteni commune, on 1500 m^2, on a forest brown-reddish soil. The agrochemical parameters are presented in the soil analysis bulletin from Table 2.

The studied variants are presented in Table 1 where we can observe 3 cultivars of different age:

- Grolim cultivar (figure 2) of 1 year to which are associated rusticity and productivity. Vigorous plant, which has thick turions of 20 mm caliber, insensitive to turions redness. For growing the variety potential and for reducing the harvest costs is recommended the increase of culture density (4-6 crowns/ml). Grolim cultivar is suitable also for etiolated shoots production and also for green ones. The genetic origin is the hybrid F1, 100 % male. The plants are of season.
- Gijnlim cultivar (figure 5) is vigorous, very productive, of a very good quality, is suitable for etiolated and green asparagus culture and the genetic origin is from hybrid F1 100% male. The plants are precocious.
- D'Argenteuil cultivar (figure 1) is suitable for etiolated asparagus culture.

The soil was plowed at 50 cm in depth, in autumn, was added super phosphate 16% (700 kg/ha) incorporated in soil.

Shredding was conducted before planting, after the terrain was marked, were opened the ditches for planting (40 cm width and 35 cm depth). Before planting the bottom of the ditches were loosening for 10 cm in depth. The seedlings were planted at 2 m between rows and 0.2-0.25-0.3 m between plants/row.

The plantation consists of putting each seedling on a heap in such way that the roots to be in normal position, covering with 10 cm of soil chopped and compressed manually, for assuring the vertical position. After plating, each plant was irrigated with 1-2 liters of water.

At 3-4 weeks after planting the gaps were filled with seedlings from reserve. The weeds and crust were controlled manually per rows and manually and mechanical between rows.

During the vegetation were done 2 irrigations in dried periods with 15 l water/plant.

RESULTS AND DISCUSSIONS

In the experimental plot were done observations and determinations with the following results:

Grolim cultivar

The data from Table 4 underline the following aspects:

- the number of shoots per plant were stabilized after spring growths at 2.8 remaining constant till the end of vegetation period;
- the growth in height was continuous, slower in the first part of heat period (figure 4);
- at the beginning of August, the growth in height was reduced. At this date, the

shoots over 1.5 m had similar dimensions as specified in literature regarding the vigor of the shoots for this variety.

Gijnlim cultivar

The data from the Table 5 shows the following aspects:

- the number of the shoots per plant was stabilized after the spring growth at 2,4 and remained constant till the end of the vegetation period;
- the growth in height was continuous (figure 3), observing an alert rhythm of growth in June and August.

D'Argenteuil cultivar

The data from Table 6 underline the followings:

- the number of the shoots per plant was stabilized after the spring growth at 1,8 and remained constant till the end of the vegetation period;
- the growth in height was constant during the vegetation period, being observed a slower rhythm in August and September.

CONCLUSIONS

- The different age of the seedlings influence the biometric data of those of 1 year old which are superior in comparison with those of 2 years old; the biometric determination that were done on planting time will be correlated in the following years with turions production obtained using the different age seedlings.
- The shoots number, their height and diameter are different during the vegetation period in 2010 is underlined from this point of view the cultivar Grolim for which were used 1 year old seedlings. This contradict the information from the specialized literature which say that better performances are obtained in plantation set up with 2 years old seedlings.
- The presented results show that the experimental cultivars worked with was very good adapting in the first year of plantation at the specific ecological conditions from Morteni, Dambovita County.
- We consider necessary the research to be continued for establishing the optimum variant for setting up and exploitation of asparagus culture (*Asparagus officinalis L.*) realized in the South zone of Romania with biological material and with new technology elements similar to those practiced in France.

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TABLES AND PHOTOS

Table 1

The studied variants

Variant	Cultivar	Seedlings age (years)	Origin	Destination	
				System culture	For consume
V1	Grolim	1	France	With & without heap	Etiolated and green shoots
V2	Gijnlim	1	France	With & without heap	Etiolated and green shoots
V3	D'Argenteuil	2	France	With & without heap	Etiolated and green shoots

Table 2

Soil analysis bulletin

No.	Specification	pH	Soluble slats %	Content, ppm			
				N-NH	N-NO	P-PO	K
1	Soil	7.13	0.1011	10.65	27.6	28.3	58.9
2		7.06	0.049	7.85	33.25	32.2	62.3

Table 3

Seedlings biometric determination at plantation

Variant	Cultivar	Average weight of seedlings (g)	No. of roots (variability limits)	Roots length (cm)	Bud number
V1	Grolim	182.5	27-46	11-95	7-14
V2	Gijnlim	117	14-30	8-78	3-13
V3	D'Argenteuil	106	24-50	7-80	6-15

Table 4

Biometric determination – Grolim cultivar

Measurements	Date			
	5.06	**9.07**	**8.08**	**8.09**
No. of shoots	2,2	2,8	2,8	2,8
Dynamic of growth in height of shoots (cm)	98,7	116,2	143,4	145,9
Internod number dynamic	36,2	52,4	56,3	56,3
Shoot basis diameter dynamic (cm)	0,76	0,84	1,04	1,05

Table 5

Biometric determination – Gijnlim cultivar

Measurements	Date			
	5.06	**9.07**	**8.08**	**8.09**
No. of shoots	1,3	2,4	2,4	2,4
Dynamic of growth in height of shoots (cm)	96,2	115,2	142,6	143,7
Internod number dynamic	34,1	46,8	52,3	52,3
Shoot basis diameter dynamic (cm)	0,72	0,92	0,98	0,99

Table 6

Biometric determination – D'Argenteuil cultivar

Measurements	Date			
	5.06	**9.07**	**8.08**	**8.09**
No. of shoots	1,2	1,8	1,8	1,8
Dynamic of growth in height of shoots (cm)	55,6	72,4	92,6	95,7
Internod number dynamic	29,2	42,9	49,4	49,4
Shoot basis diameter dynamic (cm)	0,57	0,69	0,82	0,84

Aspects from the filed – asparagus culture

Comparative study regarding the agronomic performance and mitotic activity at *Capsicum annuum* L. plants regenerated *in vitro* versus seed-born plants

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Keywords: pepper, somaclonal, genetic, fidelity

ABSTRACT

The cultivation of different explants on nutritive media "in vitro" is often related with an increase in the frequency of structural chromosomal alterations as well as an increase in the frequency of gene mutations. How these factors are related to one another and how they cause changes in the chromosome and gene mutation rates are not well understood. However, the fact that all these external agents cause similar changes and indicate a broad fundamental process may be a primary cause of mutations. These mutations and changes from genetic level are translated in the phenotype of the plants with effect in the agronomic performance of regenerants. In the present study we focused on a number of phenotypic and genetic features in order to establish if there are any changes in micropropagated plants comparing with seed grown plants. The phenotypic features analyzed in the present study are: plant's height, number of leaves, number of inflorescences, number of flowers, number of fruits, percent of setting out the fruits, production. The genetic analyses refer to mitotic activity (mitotic index and percentages of cells with chromosomal aberrations). In the analysis accomplished in the present study we differentiated the micropropagated plants depending on the originated explant (from which the plant were regenerated).

INTRODUCTION

Capsicum genus is formed from about 25 wild and 5 domesticated species. These five domesticated species are *Capsicum annuum* L., *Capsicum frutescens* L., *Capsicum chinense* Jacq., *Capsicum baccatum* L., and *Capsicum pubescens* R & P. (IBPGR, 1983). Three of them, *C. annuum*, *C. frutescens* and *C. chinense* are closely related species and grouped under the *C. annuum* complex (Pickersgill, 1997). *Capsicum* species have 2n=2x=24 chromosomes. Among the cultivated species, *Capsicum annuum* is wide spread all over the world due to its economical, nutritional and biological values. The nutritional value of pepper fruits is due to the high content in carbohydrates, malic and citric acids, some of the B complex vitamins and vitamin C. Capsicum fruits (especially in dried forms) are an excellent source of tocopherols.

The cultivation of different explants on nutritive media "in vitro" is often related with an increase in the frequency of structural chromosomal alterations as well as an increase in the frequency of gene mutations. How these factors are related to one another and how they cause changes in the chromosome and gene mutation rates are not well understood. However, the fact that all these external agents cause similar changes and indicate a broad fundamental process may be a primary cause of mutations. These mutations and changes from genetic level are translated in the phenotype of the plants with effect in the agronomic performance of regenerants.

Somaclonal variation (that may affect the "in vitro" regenerated plants) can pose a severe threat to the genomic integrity of regenerated plants, which is particularly required during the genetic transformation experiments. For the multiplication techniques, one important goal is to achieve genetic uniformity of the propagules and to maintain with fidelity the genetic structure of mother plants. Somaclonal variation can either bring the changes at the DNA level or it may induce changes in chromosome numbers. For most of the micropropagated crops only 5 % somaclonal variation is permitted (Leela *et al.* 2003).

Karyotype aspects have been studied in wild and domesticated species (Pickersgill 1971, 1977, 1991, Limaye and Patil 1989, Moscone 1990, 1993, 1999, Bertão 1993, Moscone *et al.* 1993, 1995, 1996, Tong and Bosland 1997, 2003, Ferreira 1998, Park *et al.* 2000).

Meiotic behavior evaluation has been performed in wild and domesticated species as well as in some hybrids, aiming at verifying genomic diversification during evolution as well as possible inter-specific phylogenetic relations (Otha 1961, Lippert *et al.* 1966, Shopova 1966a, 1966b, Carluccio and Saccardo 1977, Pickersgill 1971, 1977, 1991, Saccardo and Ramulu 1977, Egawa and Tanaka 1984, Mirkova and Molchova 1985, Kumar *et al.* 1987, Raghuvanshi and Saxena 1991, Moscone 1992, Bapa Rao *et al.* 1992, Lanteri and Pickersgill 1993, Tong and Bosland 1999, Panda *et al.* 2004).

Although reports are available for propagation of pepper *via* tissue culture, relatively few results are available on the agronomic performance and mitotic activity of plants that were regenerated „in vitro".

In the present study we focused on a number of phenotypic and genetic features in order to establish if there are any changes in micropropagated plants comparing with seed grown plants. The phenotypic features analyzed in the present study are: plant's height, number of leaves, number of inflorescences, number of flowers, number of fruits, percent of setting out the fruits, production. The genetic analyses refer to mitotic activity (mitotic index and percentages of cells with chromosomal aberrations). In the analysis accomplished in the present study we differentiated the micropropagated plants depending on the originated explant (from which the plant were regenerated).

MATERIAL AND METHODS

The experiments were performed in the Laboratory of Tissue Culture at Vegetable Research and Development Station Bacau, Romania. The genotypes utilized in the present study belong to Vegetable Research and Development Station Bacau and are represented through two pure varieties of pepper Siret and Ceres.

Tissue-cultured plants were obtained from explants (apexes, hypocotyls) that were obtained from aseptically grown one-week-old seedlings and buds harvested from mother plants grown in greenhouse conditions. The explants were inoculated on a regeneration medium consisting of Murashige Skoog basal medium (MS, 1962) supplemented with with BA - 8.8 μM and 2.9 μM IAA. and 3 % sucrose. After 4 weeks, regenerated shoots were transferred to a multiplication medium of Murashige and Skoog (MS) supplemented only with BA – 6.7 μM. Cultures remained on the multiplication medium for 4 weeks before the shoots were separated and transferred to the rooting medium consisted of MS medium, 3% sucrose, 0.8% agar–agar and 4.8 μM NAA.

After another 4 weeks of growth on the rooting medium, rooted shoots were removed from the tissue culture tubes, thoroughly washed to remove any traces of agar and then transferred to potting trays containing vermiculite, peat moss and sand (2:1:1; v/v).

In the greenhouse, twenty plants each of tissue-cultured and seed-grown plants were planted according to a completely randomised design. The seedlings were irrigated via drop irrigation system. Seeds of Siret and Ceres plants were sown at the same time as the tissue-cultured plants were transplanted. The seeds germinated in two weeks and the seedlings attain the similar height as tissue-cultured plants had at the time of planting within two weeks time.

The cytogenetic studies were accomplished in meristematic root cells, stained in Carnoy fixing solution for 24 hours at 4^0C then hydrolyzed with HCl for 7 minutes and colored with the basic coloring solution Carr. The root meristems were displayed using squash technique and for each genotype and variant 2000 cells were counted. Chromosome slides were then observed microscopically. Numbers of dividing cells at different levels of mitosis were recorded. Mitotic data were subjected to statistical analysis by calculating the mitotic index (% cells in division per total number of examined cells and percentages of cells with chromosomal aberrations).

RESULTS AND DISCUSSIONS

The results obtained in the present study prove that tissue culture derived plants maintain the agronomic properties of mother plants. No phenotypic abnormalities in vegetative, flowering or fruit-related characteristics were observed amongst the tissue-cultured plants. As it is illustrated in tables 1 and 2 the values of the main morpho-physiologic indices of tissue culture plants are similar with the values obtained for seed-growing plants.

No significant differences between the seed-grown and tissue-cultured plants were found for genotype Siret. All the studied parameters of pepper plants regenerated via in vitro culture have the same values with the seed born plants.

For both genotypes lower results were obtained at plants regenerated from hypocotyls. The other two types of explants produced plants that have no alteration of phenotypic traits.

Regarding the genetic analyses, mitotic data were subjected to statistical analysis by calculating the mitotic index (% cells in division per total number of examined cells) and percentages of cells with chromosomal aberrations. The results obtained showed that for both genotypes the mitotic index was similar or slightly higher at plants obtained from apex, at plants regenerated *in vitro* and at seed born plants. In tables 3 and 4 are presented the values obtained for each genotype.

The main types of abnormalities in the root cells of tomatoes seed born plants and vitroplants are ana-telophases with inter-chromatin bridges – fig. 4, metaphases with lagging chromosomes, expelled chromosomes, ring chromosomes, retard chromosomes multipolar ana-telophases, as well as binucleate cells and interphases with micro-nucleuses.

For all the plants studied the highest incidence was observed in ana-telophases. The most common abnormalities were ana-telophases with simple or multiple bridges, expelled or late chromosomes and multipolar ana-telophases. The second phase which presented a higher percentage of abnormalities is metaphases that were abnormally organized, with ring chromosomes, minutes, expelled chromosomes, fragment, etc – figure 6.

In a smaller number we detected prophases that presented different types of chromosomal aberrations like late prophases, with ring chromosomes, expelled chromosomes.

CONCLUSIONS

In the conditions tested in the present study, tissue-cultured plants did not show any phenotypic abnormality for either vegetative or reproductive traits reflecting a non-occurrence of any genetic or epigenetic changes.

There is an important step that has been followed during the development of this propagation protocol. Due to the fact that hormones may induce the formation of calli instead of direct development of shoots, the concentrations and the types of plant growth regulators that may induce the development of calli were avoided and the cultures were not subcultured for many cycles. This may be one of the factors that assured the maintaining of genetic fidelity of tissue-cultured plants. If different hormones or concentration are use there is the possibility that the plants regenerated from tissue culture could show morphological and genetic variations. Another factor that may affect the genetic fidelity of tissue cultured plants is the period of sub-culture that should be maintained to a minimum number.

This study demonstrates that if the *in vitro* protocol is proper (certain types of hormones, low number of subcultures, the utilization of a certain type of explant), the performance of resulting tissue-cultured plants would be comparable with those raised from seeds.

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TABLES AND FIGURES

Table 1

The value of some morpho-physiologic features of pepper plants cultivated in greenhouse - genotype Siret

Origin	Plant's height (cm)	Fruit's position	Colour of imature fruit	Colour of mature fruit	Pericarp's hickness (mm	Fruit's weight (g)
V1	40	pendulum	green-yellowish	dark red	9-10	220
V2	38	pendulum	green-yellowish	dark red	8-9	200
V3	30	pendulum	light green	light red	8-9	200
V4	40	pendulum	green-yellowish	dark red	9-10	230

V1 – apex, V2 – bud, V3 – hypocotyl, V4 – seed born plants

Table 2

Values of seed production at regenerants and seed born plants of pepper – genotype Siret

Origin	Seed production		
	Prod. of seeds in fruit - g	Prod of seeds/plant - g	Relative production %
V1	**1,55**	**6,90**	**164,3**
V2	**1,42**	**5,65**	**136,7**
V3	**1,30**	**5,50**	**130,9**
V4	**1,55**	**6,85**	**163,1**

V1 – apex, V2 – bud, V3 – hypocotyl, V4 – seed born plants

Table 3

The value of some morpho-physiologic features of pepper plants cultivated in greenhouse - genotype Ceres

Origin	Plant's height (cm)	Fruit's position	Color of imature fruit	Color of mature fruit	Pericarp's thickness (mm)	Fruit's weight (g)
V1	**38**	**intermediary**	**green-yellowish**	**red**	**8**	**180**
V2	**38**	**intermediary**	**green-yellowish**	**red**	**8**	**150**
V3	**36**	**intermediary**	**green-yellowish**	**red**	**8**	**120**
V4	**38**	**intermediary**	**green-yellowish**	**red**	**9**	**170**

V1 – apex, V2 – bud, V3 – hypocotyl, V4 – seed born plants

Table 4

Values of seed production at regenerants and seed born plants of pepper – genotype Ceres

Origin	Seed production		
	Prod. of seeds in fruit - g	Prod of seeds/plant - g	Relative production %
V1	1,60	6,75	168,75
V2	1,51	5,70	152,5
V3	1,50	4,90	142,5
V4	1,52	5,70	152,5

V1 – apex, V2 – bud, V3 – hypocotyl, V4 – seed born plants

Table 5

Results of genetic investigations realized at seed born plants and plants regenerated *in vitro* at Siret genotype

Origin	Total cells	Cells in interphase	No of dividing cells	Mitotic index	% aberrations
V1	5557	4923	619	11,14	0.182
V2	5434	4884	595	10,94	0.170
V3	5753	5184	579	10,06	0.990
V4	5571	4977	619	11,11	0.173

V1 – apex, V2 – bud, V3 – hypocotyl, V4 – seed born plants

Table 6

Results of genetic investigations realized at seed born plants and plants regenerated *in vitro* at Ceres genotype

Origin	Total cells	Inter-phase	No of dividing cells	Mitotic index	% aberra-tions
V1	5873	5113	759	12,92	0.53
V2	5663	4952	718	12,67	0.55
V3	5683	5051	662	11,64	0.79
V4	5699	4968	739	12,96	0.59

V1 – apex, V2 – bud, V3 – hypocotyl, V4 – seed born plants

Fig. 1 – Pepper plants in greenhouse conditions – genotype Siret

Fig. 2 – Pepper plants in greenhouse conditions – genotype Ceres

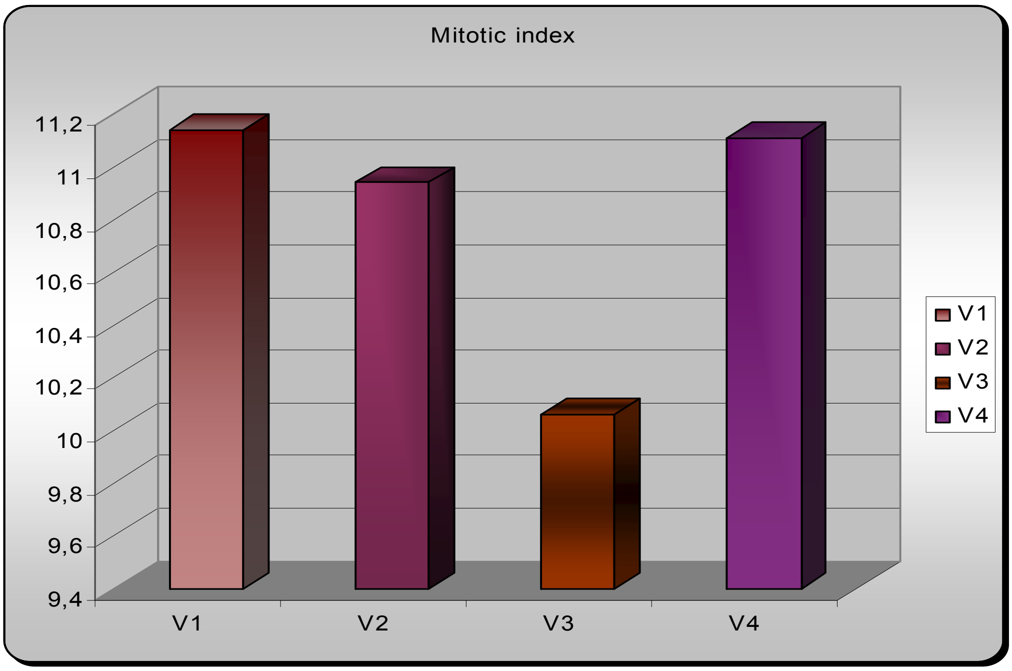

Fig. 3 – Graphical representation of mitotic index variation at regenerated and seed born plants at Siret genotype

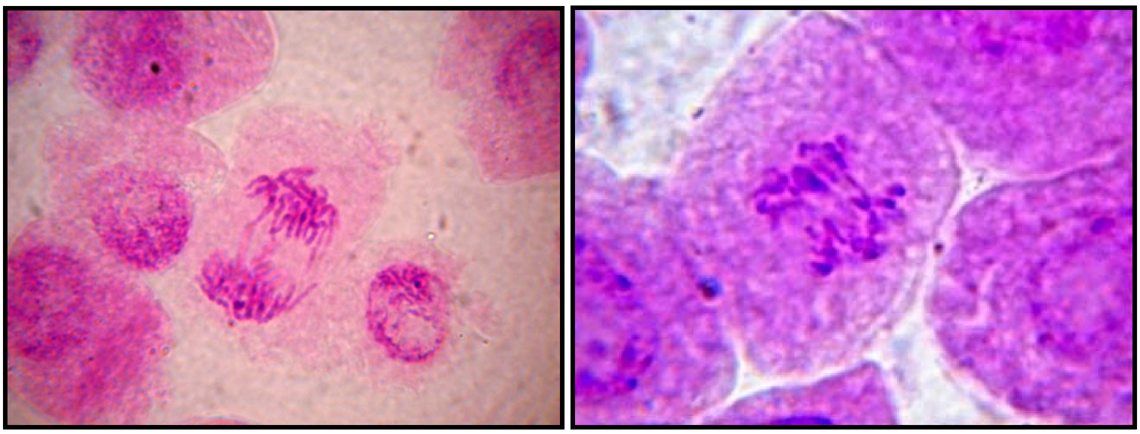

Fig. 4 – Ana-telophase with inter-chromatin bridges at Siret genotype

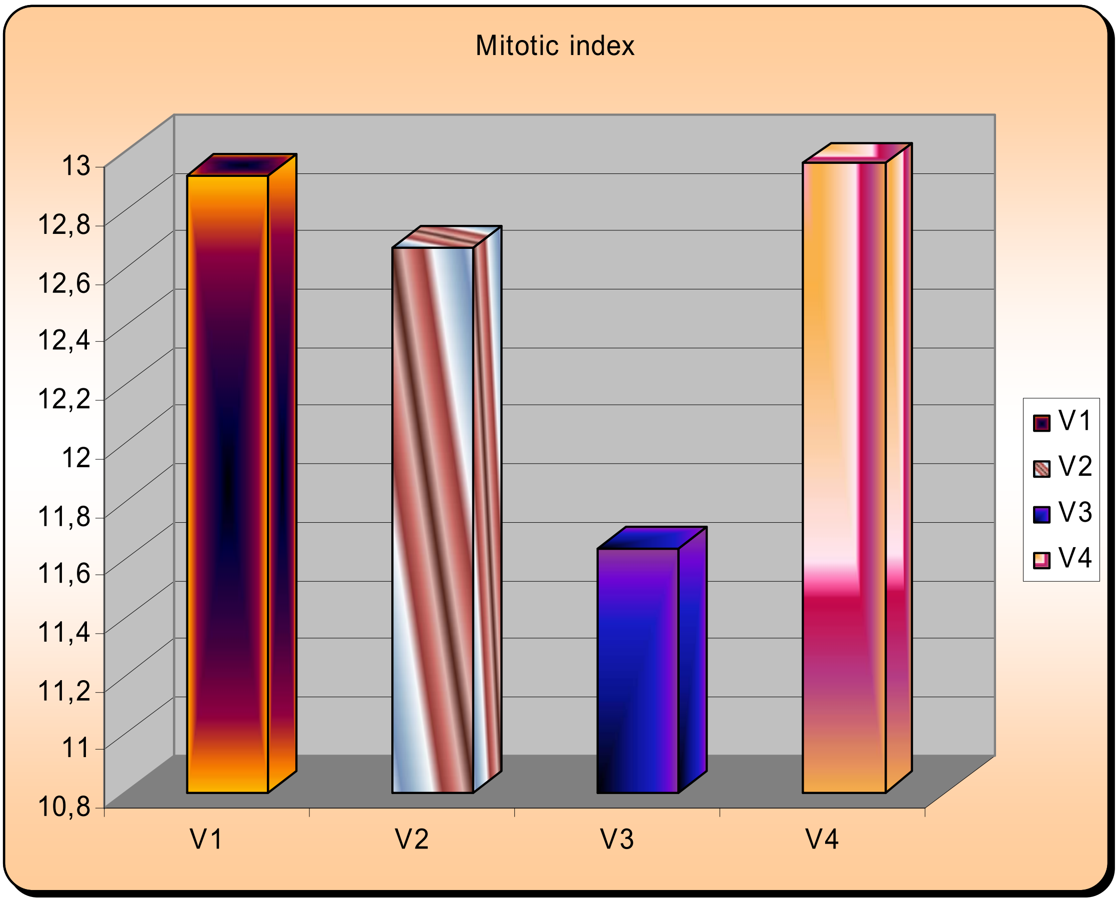

Fig. 5 – Graphical representation of mitotic index variation at regenerated and seed born plants at Ceres genotype

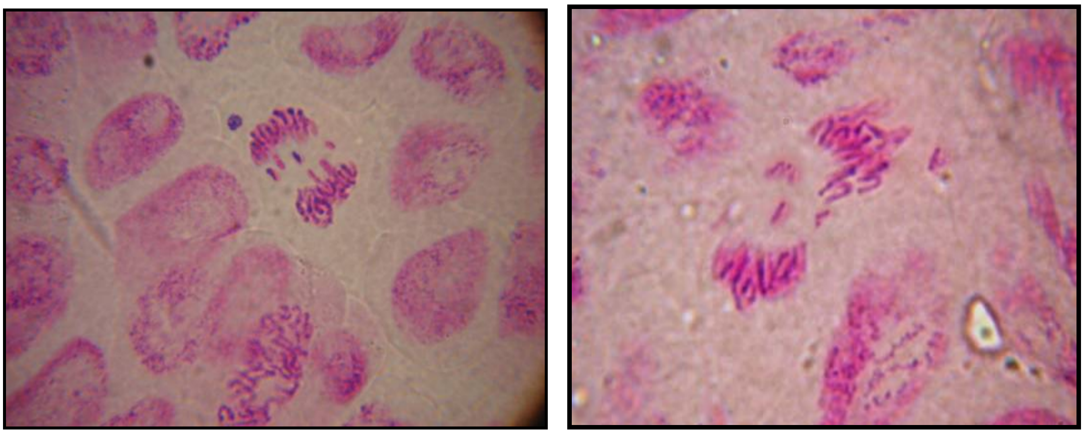

Fig. 4 – Ana-telophases with late chromosomes and micronucleus

The effect of organic products in the approving process on eggplant seed germination

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Keywords: eggplant seeds, organic product, germination

ABSTRACT

The study was conducted in the Laboratory of Vegetable and Ornamental Plants, Faculty of Horticulture, University of Agricultural Sciences and Veterinary Medicine - Bucharest, 2010. Research results have shown that the wetting of eggplant seeds for 60 minutes before sowing in solutions of different concentrations BioSeed 3 + resulted in a shorter period of germination. Also, we observed improved seedlings.

INTRODUCTION

BioSeed 3 + is a new product, plant Derived wholly, made from 100% natural plant-fruit extracts and oils, designed for use in horticulture. Starting All materials come from a closed ecological cycle Produced Without agents or chemical or synthetic fertilisers. Producer: Wise International BV Holland.

The test for determining eggplant seed germination was carried out in the Laboratory of Vegetable and Ornamental Plants of the Faculty of Horticulture, University of Agricultural Sciences and Veterinary Medicine - Bucharest, in 2010.

The purpose of this study was to test the product BioSeed 3 + and to recommended the best concentration for shortening and economic eggplant seed germination.

MATERIALS AND METHODS

The study was made at the Horticulture Faculty Bucharest during 2010 at the Department of Vegetable crops and Ornamental plants. We used seeds of eggplant, Luiza cultivar to testing the germination, in controlated condition, in germinator. Product tested: BioSeed 3+, in three different concentrations defined here in as C1, C2 and C3.

BioSeed 3+ is a new product, wholly plant derived, made from 100 % natural plant-fruit extracts and oils, designed for use in horticulture. All starting materials come from a closed ecological cycle produced without synthetic or chemical agents or fertilisers. Producer: WiseUse International BV Holland. The BioSeed 3+ composition: Ca: 9,6 – 19,2 mg/l; Co: 19,2 – 24 mg/l; Cu: 0,048 - 0,01mg/l; Fe: 0,56 – 0,8mg/l; Mg: 1,6 -2,4mg/l; K: 88 – 120 mg/l; S: 16 – 32 mg/l; Urea: 0,8 – 1 mg/l; Essential Oils - 28 mg/l; Acid Oils: 0,02 – 1,2 %; Ph: 9,4; Density: 1,05kg/l

Experiment: Humectation with BioSeed 3+ for 60 minutes.

The experimental variants were: V1 – Control Group – seeds dampened in distilled water; V2 – Seeds dampened in C1 concentration; V3 - Seeds dampened in C2 concentration; V4 - Seeds dampened in C3 concentration;

The germination was tested in a germinator at 30 ^{o}C during the daytime and 20 ^{o}C during the night-time, in conformity with the germination determination standard for eggplant seeds. Data was retrieved after 6 days for the registration of the germination energy and for the final data after 14 days.

The following was determined:
- The number of germinated seeds after 3, 6, 8 and 15 days;
- The length of the roots;
- The height of the stems;
- The growth rhythm of the roots and stems

- The statistical interpretation of the results using the variance analysis

RESULTS AND DISCUSSION

Upon analyzing the seed germination we noted that 3 days after sowing V4 – C3 produced the highest amount of germinated seeds. Six days after sowing all the treated variants presented a germination percentage between 62% (V3 – C2) and 80% (V4 – C4). This is a very positive result considering that eggplant seeds have quite a long germination period. Practically, six days after sowing the seeds germinated at a percentage of 70,45% (V3 – C2) and 85,61% (V4 – C3) as per the final date of retrieving data, when the germination was at its maximum. From 21.07.2010, after 8 days, the seeds germinated in a high percentage for the treated variants, between 72,09% for V3 and 85,11% for V4. The variant 4 – C3 presented the maximum percentage of germination on the 21st, practically 7 days earlier compared to V1 –Control (see Tables 1).

Statistically there is a significant difference between the percentages of germinated seeds 6 days after sowing (see Table 2).

For the experimental treatment in which seeds were dampened 60 minutes prior to being sown, notable statistical differences were seen concerning radicle growth. All variants showed a radicle growth larger than that of the untreated control group, as early as 19.07., 8 days after sowing. These differences were maintained even after 8 days (21.07.2010) and after 15 days of sowing (28.07.2010). The radicle growth rhythm was highest for those seeds that were dampened for 60 minutes prior to being sown (see tables 4; 5 and 6).

On 28.07.2010, the eggplant seedlings presented heights between 18 mm for the V1 control group and 48 mm for V4 – C3. All treated variants presented bigger height growths than the control group. The percentage of growth being significant: 211,11% for V2 and 266,67% for V4 (Tables 7 and 8).

CONCLUSIONS

Germination was favored, as such after 3 days V4 – C3 showed a germination percent of 16%, whilst the control V1 showed no germination at all.

Germination time for all treated variants of the eggplant seeds was shortened by approximately 9 days which helps obtain quality saplings earlier. Keeping in mind the species specific requirements regarding the germination temperature and timeframe, this provides an advantage as it saves on the energy required for heating the environment where the saplings are produced.

The forming and growth rhythm of the roots was accelerated for all treated variants. This is a relevant aspect as the development of a vigorous radicular system leads to obtaining an appropriate sapling.

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TABLES AND PHOTO

Table 1

Eggplant seed germination (50 seeds per repetition)

Variant	Germinated seeds 3 days after sowing 16.07.10		Germinated seeds 6 days after sowing 19.07.10		Germinated seeds 8 days after sowing 21.7. 2010		Percentage of germinated seeds - compared to the control group	Germinated seeds 15 days after sowing 28.07.2010		Percentage of germinated seeds - compared to the control group
	Seed pieces	%	Seed pieces	%	Seed pieces	%	%	Seed pieces	%	%
V_1 Ctrl	0	0	6	12	31	62	100,0	42	84	100,0
V_2 - C1	3	6	38	76	46	92	148,4	46	92	109,5
V_3 - C2	0	0	31	62	43	86	138,7	44	88	104,8
V_4 - C3	8	16	40	80	47	94	151,6	47	94	111,9

Table 2

The summary of the seed germination

Seed germination on 19.07.2010

VARIANT	Germination (%)	DIFFERENCE (%)	(%)	SIGNIF
V(0) average	57.50	45.50	479.17	***
V(1)	**12.00**	**0.00**	**100.00**	**Ctrl**
V(2)	76.00	64.00	633.33	***
V(3)	62.00	50.00	516.67	***
V(4)	80.00	68.00	666.67	***

DL5% = 0.980 DL5% in % = 8.1667
DL1% = 1.490 DL1% in % = 12.4167
DL01% = 2.370 DL01% in %= 19.7500

Table 3

The summary of the seed germination

Seed germination on 21.07.2010

VARIANT	Germination (%)	DIFFERENCE (%)	(%)	SIGNIF
V(0) average	83.50	21.50	134.68	***
V(1)	**62.00**	**0.00**	**100.00**	**Ctrl**
V(2)	92.00	30.00	148.39	***
V(3)	86.00	24.00	138.71	***
V(4)	94.00	32.00	151.61	***

DL5% = 10.420 DL5% in % = 16.8065
DL1% = 15.760 DL1% in % = 25.4194
DL01% = 25.120 DL01% in %= 40.5161

Seed germination on 28.07.2010

VARIANT	Germination (%)	DIFFERENCE (%)	(%)	SIGNIF
V(0) average	89.50	5.50	106.55	N
V(1)	**84.00**	**0.00**	**100.00**	**Ctrl**
V(2)	92.00	8.00	109.52	N
V(3)	88.00	4.00	104.76	N
V(4)	94.00	10.00	111.90	N

DL5% = 18.010 DL5% in % = 21.4405
DL1% = 27.250 DL1% in % = 32.4405
DL01% = 43.420 DL01% in %= 51.6905

Table 4

Length growth of the radicle at the eggplant seeds

Variant	Length of radicle on the:				Difference in growth from 16.0 to 19.07	Difference in growth from 19.0 to 21.07	Difference in growth from 21 to 28.07	Difference in growth from 19.0 to 28.07-	Average growth rhythm
	16.07. 2010	19.07. 2010	21.07. 2010	28.07. 2010					
	mm	mm	mm	mm	mm	mm	mm	mm	mm/day
V_1 Ctrl	-	2	8	26	2	6	18	24	2,89
V_2 - C1	-	9	36	38	9	27	2	29	4,22
V_3 - C2	-	4	34	39	4	30	5	35	4,33
V_4 - C3	-	8	32	35	8	24	3	27	3,89

Table 5

Summary of results concerning the length of the radicle on the eggplant seeds 19.07.2010

VARIANT	Length of radicle (mm)	DIFFERENCE (mm)	(%)	SIGNIF
V(0) average	5.75	3.75	287.50	***
V(1)	2.00	0.00	100.00	Ctrl
V(2)	9.00	7.00	450.00	***
V(3)	4.00	2.00	200.00	***
V(4)	8.00	6.00	400.00	***

DL5% = 1.700 DL5% in % = 85.0000
DL1% = 2.580 DL1%in % = 129.0000
DL01% = 4.110 DL01% in %= 205.5000

Table 6

Summary of results concerning the length of the radicle on the eggplant seeds

Summary of results concerning the length of the radicle on the eggplant seeds - 21.07.2010

VARIANT	Length of radicle (mm)	DIFFERENCE (mm)	(%)	SIGNIF
V(0) average	27.50	19.50	343.75	***
V(1)	8.00	0.00	100.00	Ctrl
V(2)	36.00	28.00	450.00	***
V(3)	34.00	26.00	425.00	***
V(4)	32.00	24.00	400.00	***

DL5% = 1.700 DL5% in % = 21.2500
DL1%= 2.580 DL1%in % = 32.2500
DL01% = 4.110 DL01% in %= 51.3750

Summary of results concerning the length of the radicle on the eggplant seeds - 28.07.2010

VARIANT	Length of radicle (mm)	DIFFERENCE (mm)	(%)	SIGNIF
V(0) average	34.50	8.50	132.69	***
V(1)	26.00	0.00	100.00	Ctrl
V(2)	38.00	12.00	146.15	***
V(3)	39.00	13.00	150.00	***
V(4)	35.00	9.00	134.62	***

DL5% = 2.050 DL5% in % = 7.8846
DL1% = 3.100 DL1%in % = 11.9231
DL01% = 4.940 DL01% in %= 19.0000

Table 7

Growth in height of the eggplant strains in the experimental alternatives

Variant	Medium height of the strains on the:				Difference in growth from the 21.07 to 28.07 -	Percentage compared to control group	Medium growth rhythm
	16.07.2010	19.07. 2010	21.07. 2010	28.07. 2010			
	mm	mm	mm	mm	mm	%	mm/day
V_1 Ctrl			3	18	15	100,00	2,57
V_2 - C1			32	38	6	211,11	5,43
V_3 - C2			28	34	6	188,89	4,86
V_4 - C3			41	48	7	266,67	6,86

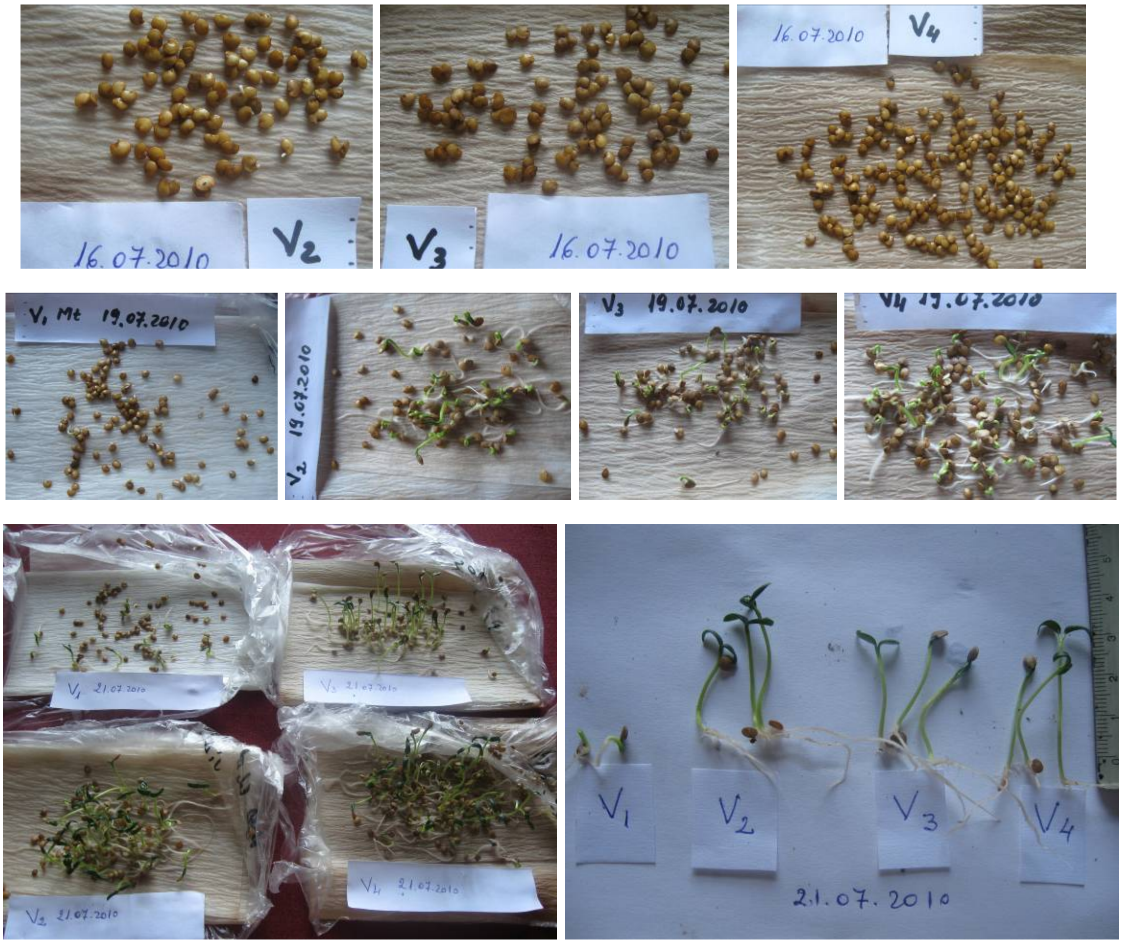
Table 8

Summary of results regarding the height of the eggplant strains on 28.07. 2010

VARIANT	Height of strains (mm)	DIFFERENCE (mm)		SIGNIF (%)
V(1)	18.00	0.00	100.00	Ctrl
V(2)	38.00	20.00	211.11	***
V(3)	34.00	16.00	188.89	***
V(4)	48.00	30.00	266.67	***

DL5% = 1.700 DL5% in % = 9.4444
DL1% = 2.580 DL1% in % = 14.3333
DL01% = 4.110 DL01% in % = 22.8333

Photo 1. The eggplant seeds treated with BioSeed 3^+ in different concentration



The genetic control of pigmentation on summer squash fruits (*Cucurbita pepo* conv. *giromontia* Alef.)

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ABSTRACT

This research was carried out on the Research Development Institute for Vegetable and Flower Growing Vidra, on the Breeding Laboratory field. The purpose was to study if the fruit color to *Cucurbita pepo* conv. *giromontia* **Alef is a dominant and recessive phenomenon on F1 and F2 generations. Crossing white fruit x yellow fruit resulted creamy fruits (intermediary color) in F1 and 1:2:1 segregation rapport in F2, because of semidominant W gene (white) against B1 gene (yellow). Crossing white fruit x green fruit resulted white fruits in F1 and 3:1 segregation rapport in F2, because of dominant W gene (white) and recessive L2 gene (dark green). Crossing green fruit x yellow fruit resulted yellow fruits in F1 and 3:1 segregation rapport in F2, because of dominant B1 gene (yellow) and recessive L2 gene (dark green).**

INTRODUCTION

Nowadays, when the exigency of consumers has increasing, sometimes the color of fruit can be un important element for consumers choosing for vegetable cultivars.

For this reason, the aim of research realized to RDIVFG Vidra, was to study the genetic determinism of color fruits on summer squash.

The genes which determine the fruit color to summer squash was highlighted by researchers from different countries, who studied both genetic determinism and the transmission way to descendants.

So that, Robinson et all. (1976) proposed and published a gene lists to species: squash, pumpkin, cucumbers, melon and water melon.

Shifriss (1981, 1996) described the origin, expression and signification of B genes at *Cucurbita pepo* conv. *giromontia* Alef. He made a description and presented their interaction with other genes. Also, he showed that the environment plays an important role in expression of B genes.

Paris and Nerson (1986) determined the genetic factors affecting the intensity of fruit pigmentation. They proposed that these studies to be made on three development fruit stages:

- 2 – 5 days past anthesis, which is the edible summer squash (young fruit) stage
- 15 – 18 days past anthesis, which is a stage of fruit development intermediate between the summer squash and the mature fruit stage.
- 40 – 44 days past anthesis, mature fruit.

Also, Paris (1989) proposed a revised list of genes (table 1) which influence the exterior fruit color to *Cucurbita pepo* conv. *giromontia* containing a description of effects and interactions of each gene. He identified 8 genetic loci witch influence the external fruit color.

Four from this loci influence only the nuance, while the other four influence both the nuance and the intensity of color.

MATERIAL AND METHODS

For explaining the heredity mechanisms of external fruit color, on the summer squash were made hybridization between 3 lines advanced homozygote, with different color fruits: L273 (white), L 189 (yellow – orange) and L 201 (dark green).

The hybridizations were made on the field under controlled conditions. The seeds obtained were sowed next year and the seedling was planted on the F1 hybrid field.

The seeds obtained by self-pollination to F1 generation, were the base of F2 generation, obtained on the third year from hybridization.

The observations were made only when the fruits were in the young stage, at 2-5 day after anthesis.

There were established the segregation rapports and for its verification were calculated the test„ χ^2" using formula: $\chi^2 = (\sum d^2)/t$, where „d" represent the difference between experimental and theoretical values and „t" the theoretical values.

According on χ^2 value and degree of liberty was determined the P probability (Fisher and Yates).

The observations were made at 2 -5 days after anthesis, at technological maturity, when the external color of fruit must respond both to the consumers' preference or industrialization.

RESULTS AND DISCUSSION

Crossing between white fruit (L273) ♀ x yellow orange fruit (L189) ♂ and the reciprocal crossing yellow orange fruit (L189) ♀ x white fruit (L273) ♂, resulted F1 generation with creamy color fruits (table 2, photo 1).

There were studied the F2 generation for establishing the new phenotypes, frequency of each phenotype and segregation rapport.

The segregation rapport 1:2:1 represent the intermediary action (semi dominant) of genes.

So, from combination between W genes, which induces white color, with B1 gene, which induce yellow color, resulted intermediary color (creamy).

Between these 3 phenotypes it was established 1:2:1 segregation rapport, verified with 70 - 80% probability.

Crossing between white fruit (L 273) ♀ x green fruit (L 201) ♂ and the reciprocal crossing green fruit (L 201) ♀ x white fruit (L 273) ♂, resulted F1 generation with white color (table 3, photo 2).

In F2 resulted 3:1 segregation rapport. Because in F1 all fruits have white color and in F2 the segregation rapport is 3:1, demonstrate the dominant – recession relation between W gene (white) and L2 gene (dark green).

The segregation rapport 3:1 from F2 generation was verified with 90 – 95% probability.

Another crossing was realized between green fruit (L 201) ♀ x yellow orange fruit (L 189) ♂ and the reciprocal crossing yellow orange fruit ♀ x green fruit ♂ (table 4, photo 3).

After that combination resulted F1 generation with yellow orange fruit and in F2 generation was obtained 3:1 segregation rapport.

Resulted obtained in F1 generation, 3:1 segregation rapport in F2 generation and 50 – 70% verification probability, demonstrate a dominant – recession relation between B1 gene (yellow) and L2 gene (dark green).

CONCLUSIONS

1. About external color of fruit, after 2 -5 days after anthesis was realized both semi dominant and dominant heredity.

2. The semi dominant heredity are obtained from combination white (W) with yellow (B1) color. In F1 generation resulted creamy fruits.

Each gene controls one distinct hereditary character.

The study regarding color variability in F2 descendant relieved the appearance of 3 phenotypes: plants with white, creamy or yellow fruits, between them resulting 1:2:1 segregation rapport.

3. The white color of fruits is dominant in F1 generation against green color. In F2, the descendents segregate in 3:1 rapport in the favor of white color, on the heredity character being involved one single gene.

4. The yellow color of fruit is dominant in F1 against green color. In F2 the descendents segregate in 3:1 rapport, because of action of one single dominant gene.

5. For all combination, the probability had values between 50 – 95%, the χ^2 test indicated insignificant deviations so that the segregation hypothesis are right.

6. Knowing and utilization of heredity mechanisms allows obtaining varied colored fruits, according with consumers demands.

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TABLES AND PHOTOS

Table 1

The gene list witch influence the fruit color to *Cucurbita pepo*
(Paris, 1989)

Gene symbol	Synonym	Name
B	-	Bicolor
D	(R)	Dark peduncle, stem and fruit
Ep -1	-	Extender of precious yellow coloration - 1
Ep -2	-	Extender of precious yellow coloration - 1
1 -1, $1 -1^{St}$	c, St	Light fruit coloration -1
1 -2	-	Light fruit coloration -2
W	-	White fruit coloration
Y	-	Yellow fruit coloration

Table 2

Inheritance of summer squash color fruits, combination white (L 273) x yellow (L 189)

Generation	Description	No. plants with fruits			Total	Segregation rapport	χ^2	P%
		white	creamy	yellow				
P1	L 273	20	0	0	20	-	-	-
P2	L 189	0	0	20	20	-	-	-
F1	P1 X P2	0	20	0	20	-	-	-
F1	P2 X P1	0	20	0	20	-	-	-
F1	**Total**	**0**	**40**	**0**	**40**	-	-	-
F2	P1 X P2	10	21	9	40	1:2:1	0,15	90 – 95
F2	P2 X P1	11	22	9	42	1:2:1	0,24	80 – 90
F2	**Total**	**21**	**43**	**18**	**82**	1:2:1	0,52	70 - 80

GL 3 -1 =2 * 2-5 days past anthesis

Table 3

Inheritance of summer squash color fruits, combination white (L 273) x green (L201)

Generation	Description	No. plants with fruits		Total	Segregation rapport	χ^2	P%
		white	green				
P1	L 273	20	0	20	-	-	-
P2	L 201	0	20	20	-	-	-
F1	P1 X P2	20	0	20	-	-	-
F1	P2 X P1	20	0	20	-	-	-
F1	**Total**	**40**	**0**	**40**	-	-	-
F2	P1 X P2	25	8	33	3:1	0,01	90 – 95
F2	P2 X P1	26	9	35	3:1	0,009	90 – 95
F2	**Total**	**51**	**17**	**68**	3:1		90 – 95

GL 2 -1 =1 * 2-5 days past anthesis

Table 4

The heredity color to summer squash fruits, combination yellow (L189) x green (L201)

Generation	Description	No. plants with fruits		Total	Segregation rapport	χ^2	P%
		yellow	**green**				
P1	L 201	0	20	20	-	-	-
P2	L 189	20	0	20	-	-	-
F1	P1 X P2	20	0	20	-	-	-
F1	P2 X P1	2	0	20	-	-	-
F1	**Total**	**40**	**0**	**40**	-	-	-
F2	P1 X P2	30	9	39	3:1	0,76	70 - 80
F2	P2 X P1	31	9	40	3:1	0,13	70 - 80
F2	**Total**	**61**	**18**	**79**	3:1	0,2	50 - 70

GL 2 -1 =1 * 2-5 days past anthesis

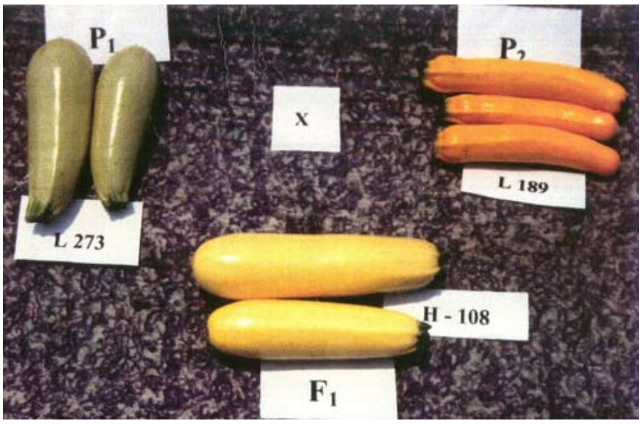

Photo 1. Young fruits of squash L 273, L 189 and their F1 fruits with creamy color

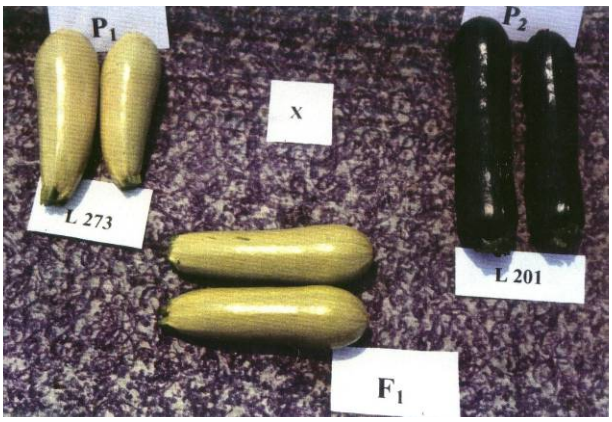

Photo 2. Young fruits of squash L 273, L 201 and their F1 fruits with white color

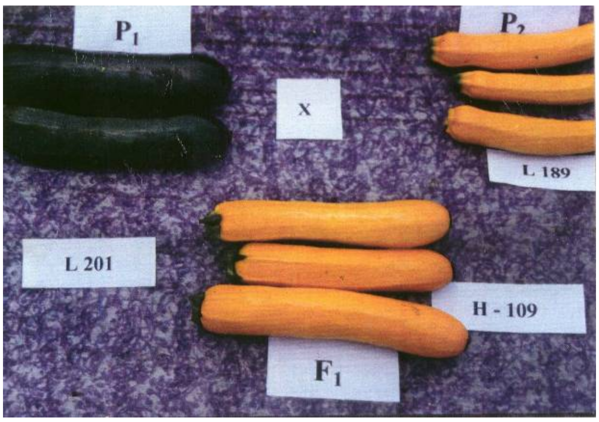

Photo 3. Young fruits of squash L 201, L 189 and their F1 fruits with yellow color

Anatomical studies on single and double grafting of cucumber plants on different types of rootstocks under plastic houses

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ABSTRACT

Experiment was carried out under plastic house conditions during the early summer season of 2005 and 2006 at Sakha Protected Cultivation Site, Ministry of Agric., Kafrelsheikh Governorate. The object of experiment was to study the effect of single and double grafting onto four types of rootstocks (fig leaf gourd, bottle gourd, pumpkin and cucumber, cv. Beit Alpha) on successful grafting (%) and anatomical structure of grafting union. The results are summarized as follows:

1- **Single self-grafting of cucumber and grafting onto fig leaf gourd stock gave the highest successful grafting (%).**
2- **Grafting onto fig leaf gourd stock with either single or double root gave the largest area of vascular tissues (xylem and phloem) in the grafting union.**

INTRODUCTION

A pot experiment carried out under unheated double span plastic house during early summer season of 2006 in Protected Cultivation Site, Kafrelsheikh Governorate. The aim of this experiment was to study the effect of single and double grafting on different types of rootstocks on successful grafting (%) and anatomical structure of grafting union of cucumber (*Cucumis sativus* L.).Cucumber seeds as a scion were sown in seedling foam trays (84 cells), on January 20, while rootstock seeds were sown on Jan. 15 in 2006. Grafting was performed after 15 days from seeding of scion. The grafted plants were transferred into plastic pots of 8 cm diameter filled with the same cultivation media was used in trays.

Treatments used

The experiment included eleven treatments representing cucumber as a scion that was grafted onto four types of rootstocks whether used singly or in double grafting with different combinations in addition to control treatment without grafting. The scion used was cucumber F_1 hybrid, cv. Delta Star (gynoecious). The rootstocks used were fig leaf gourd (*Cucurbita ficifolia*), bottle gourd (*Lagenaria siceraria*), pumpkin (*Cucurbita moschata*) and cucumber, cv. Beit Alpha as follows:

1 Control (cucumber F_1 hybrid, cv. Delta Star without grafting) and signed to as C.
2 Single grafting of cucumber onto bottle gourd then cut root of cucumber and leaving root of bottle gourd. The grafted seedling had a single root and signed to as $(C/B)_1$.
3 Single grafting of cucumber onto fig leaf gourd then cut root of cucumber (scion) and leaving root of fig leaf gourd (rootstock). The grafted seedling had a single root and signed to as $(C/F)_1$.
4 Single grafting of cucumber onto pumpkin then cut root of scion and leaving root of pumpkin, the grafted seedling had a single root and signed to as $(C/P)_1$.
5 Single grafting of hybrid cucumber onto cucumber, cv. Beit Alpha and leaving root of both scion and rootstock. The grafted seedling had double root and signed to as $(C/C)_2$.
6 Single grafting of cucumber onto bottle gourd and leaving root of scion and rootstock, the grafted seedling had double root and signed to as $(C/B)_2$.
7 Single grafting of cucumber onto fig leaf gourd and leaving the two roots (scion + rootstock), the grafted seedling had double root and signed to as $(C/F)_2$.
8 Single grafting of cucumber onto pumpkin and leaving the two roots (scion + rootstock), the grafted seedling had double root and signed to as $(C/P)_2$.
9 Double grafting using bottle gourd as a primary rootstock and bottle gourd also as a secondary one and leaving root of scion and both rootstocks. The grafted seedling had

triple root and signed to as $(C/B + B)_3$.

10 Double grafting using bottle gourd as a primary rootstock and pumpkin as a secondary one and leaving root of scion and both rootstocks. The grafted seedling had triple root and signed to as $(C/B + P)_3$.

11 Double grafting using bottle gourd as a primary rootstock and fig leaf gourd as a secondary one and leaving root of scion and both rootstocks. The grafted seedling had triple root and signed to as $(C/B + F)_3$.

Tongue approach method was used in this study as cucumber plants successfully grafted using this method (**Lee, 1994 and Oda, 1995).**

Data recorded:

1. Successful grafting percentage

It was done after 15 days from grafting and calculated according to the following formula:

$$\text{Successful grafting(\%)} = \frac{\text{No. of successful grafted plants}}{\text{Total number of grafted plants}} \text{ x 100}$$

2. Anatomical structure of the grafting union

The effect of rootstocks on the anatomical structure of grafting union was studied. Plant samples of 10 mm length were collected from grafted cucumber plants on different rootstocks and cucumber F_1 hybrid, cv. Delta Star plants without grafting (control). Two plants from each treatment were picked after 20 and 50 days from grafting. The different samples were fixed for 48 hours in FAA (10 ml formaline, 5 ml glacical acetic acid, 50 ml absolute ethyl alcohol and 35 ml distilled water) and then washed twice in 70% ethyl alcohol. Dehydration was done by passing the samples in a series of the following: Ethyl alcohol concentrations of 70, 85 and 95% followed by three changes of absolute alcohol for four hours. Samples were passed throughout a mixture of xylol and an absolute alcohol of 25, 50 and 75% and pure xylol in at least two changes for four hours in each dilution.

Paraffin shavings reagent containing samples until saturation within 12 hours, two changes of paraffin were done to get rid of all traces of xylol. Samples were taken, embedded in melted paraffin in embedding paper trays, then cooled rapidly with a cold water. Sections (20 microns thick) were done with a rotary microtome (a rotary microtome model-820). Paraffin sections were affixed to the slides with albumin. Slides were left to complete dryness for 25 hours in a dry oven at 50^{o}C. Before staining the slides, they were placed in two changes of xylol for about 10 minutes, and then transferred to a jar containing equal parts of an absolute alcohol and xylol for 5 minutes. Sections were then plunged in close series of descending dilutions of ethyl alcohol ranging from absolute to 5% for 5 minutes for each dilution. Sections were stained for 12 hours in a jar containing 0.5% aqueous safranine, then the excess stain was washed away. Dehydration was done by alcohol series of 25, 50, 75 and 90%. Sections were stained for one minute in a jar containing 1% light green and were then cleared in xylol and mounted in Canada balasam and prepared for microscopic examination (**Ghamrawy and Zaher, 1953**).

The areas of vascular tissues (xylem and phloem) as mm^2 were calculated at 20 and 50 days after grafting from three slides per treatment. Cross sections from scion and stocks were taken below the two cotyledons after 35 days from sowing with the above mentioned method to study their primary structures.

Experimental design and statistical analysis

The experimental design was a complete randomized with four replications. Each replicate contained 33 pots (3 pots for each treatment). All recorded data were statistically analyzed according to the methods described by **Little and Hills (1972)**. Duncan's multiple rang test was used for the comparison among treatments means (**Duncan, 1955**).

RESULTS AND DISCUSSION

The results are introduced to clarify the effect of single and double grafting of cucumber F_1 hybrid, Delta Star cv. (gynoecious) onto four different types of rootstocks (*Cucurbita ficifolia*, *Lagenaria siceraria, Cucurbita moschata* and *Cucumis sativus*, Beit Alpha cv.) in comparison to the control. Data are presented under separate headings which include successful grafting percentage and anatomical structure of scion, rootstocks and grafting union.

Effect of single and double grafting onto different types of rootstocks on

1. Successful grafting percentage

Data in table 1. indicate that there were highly significant differences among grafting treatments in the percentage of successful grafting of cucumber plants as it ranged between 88.4 to 99.5%. Therefore, the highest percentage of successful grafting was obtained from the single grafting of cucumber onto cucumber, Beit Alpha cv. with double root $(C/C)_2$ as it was 99.5% followed by cucumber on bottle gourd $(C/B))_2$ with double root 92% or cucumber on fig leaf gourd with either single $(C/F)_1$92.8% or double root $(C/F)_2$ 92% . In contrast, the lowest percentage was found with double grafting of cucumber on bottle gourd + bottle gourd $(C/B + B)_3$, cucumber on bottle gourd + fig leaf gourd $(C/B + F)_3$ and cucumber on bottle gourd + pumpkin $(C/B + P)_3$ with triple root without significant differences between each other. The other single grafting treatments showed intermediate values between treatments which had the highest and that gave the lowest percentages of this parameter.

The superiority of $(C/C)_2$, $(C/B)_2$, $(C/F)_1$ and $(C/F)_2$ grafting treatments than the others in successful grafting percentage may be due to a complete compatibility between cucumber scion and stocks of cucumber, Beit Alpha cv., bottle gourd and fig leaf gourd comparing to the others. In this concern, **Lee and Oda (2003)** cleared that incompatibility can be affected by tissue and structure differences, physiological and biochemical characters, growth stage of rootstock and scion, phytohormones and the environmental conditions.

The anatomical structure of the grafting union reflects the obtained results of this parameter as shown in Figs. (6 and 9), since the differentiation of callus increased the vascular connection between stock and scion in such grafting treatments. The causes of high successful grafting may be due to that callus tissues in both scion and stock were efficiently connected together and began to differentiate some xylem and phloem elements. In this concern, **Mounir (1965) and El-Semellawy (2005)** found that grafting watermelon on certain stocks caused a special growth in vascular bundles of the stock lying near the scion; such bundles were characterized by the presence of internal cambium which provided the bundles with internal secondary tissue of phloem and xylem. All these tissues were formed on side of the primary xylem opposite to the secondary one produced from the outer intravascular cambium.

In the same tendency, **Kabeel (1999) and Shehata *et al.* (2000)** found that the highest percentage of cucumber successful grafting was achieved with fig leaf gourd rootstock.

2. Anatomical structure of scion, rootstocks and grafting union

Grafting of vegetable crops opened a new field of anatomical studies, so that the compatibility between stocks and scion was considered as a major step to forward successful or failure of grafting. The present study was performed to clarify the possibility of success and failure of grafting cucumber plants on different rootstocks i.e., fig leaf gourd (*Cucurbita ficifolia*), bottle gourd (*Lagnearia siceraria*), pumpkin (*Cucurbita moschata*) and cucumber (*Cucumis sativus*), Beit Alpha cv. The following points of view can help in this respect:

a Primary structure of scion.
b Primary structure of rootstocks.
c Differentiation of connecting vascular tissues (xylem and phloem) between scion and stocks.

a. Primary structure of scion

The grafting part of scion is the hypocotyl. This region showed stem structure including opened bicolleteral bundles, xylem, cambium, phloem and others (Fig. 1). The bicolleteral bundle is a common feature of the family cucurbitacea (**Esau, 1960**). The vascular cambium are divided into internal xylem and external phloem as illustrated in Fig.1

b. Primary structure of rootstocks

The grafting part of rootstock is the hypocotyl. This region showed stem structure as mentioned-above of scion structure. However, number and area of phloem and xylem vascular tissues of rootstocks were different as shown in Fig. 2, 3 and 4. Therefore, Fig. 2 shows that the regions of xylem and phloem in bottle gourd rootstock were larger than in the scion, but less than in the other used rootstocks. In contrast, the area and number of xylem tissues were the highest in fig leaf gourd Fig.3, followed by pumpkin rootstock Fig.4 compared to all other used rootstocks and scion (Fig., 1). On the other hand, Fig.1 cleared that cucumber, Beit Alpha cv., as a rootstock contained the same number and volume of xylem and phloem vascular tissues as in the scion. In this concern, **Tiedmann (1989)** reported that phloem development in the graft union resulted in different numbers of connecting sieve tubes in individual graft, but the average number of sieve tube connection in *Cucumis/Cucurbita* was much lower than in *Cucumis/Cucumis*.

c. Differentiation of connecting vascular tissues (xylem and phloem)

Data presented in table 2 and Figs. 5 to 12 clear that the increase in areas of xylem and phloem tissues at grafting union was highly significant as affected by single and double grafting on different types of rootstocks after 20 and 50 days from grafting. Generally, single grafting treatments gave the best results followed by double grafting treatments and then control without grafting in area of vascular tissues. Therefore, the largest xylem and phloem areas were obtained from single grafting using *Cucurbita ficifolia* (fig leaf gourd) rootstock in both single and double roots [$(C/F)_1$ and $(C/F)_2$]. On the other hand, the control recorded the narrowest xylem area, while such result was obtained from double grafting treatments plus control for phloem area at the two sampling dates. Grafting on the other tested rootstocks manifested an intermediate position in this concern.

The light microscope examination of grafting unions showed that there were different degrees of compatibility between the different tested rootstocks and scion as well as between primary and secondary rootstocks as follow:

1. There was a complete connection between scion and the primary rootstocks of cucumber, Beit Alpha cv., bottle gourd, fig leaf gourd and pumpkin as shown in Figs (6 and 8 to 12). This connection might be formed from callus tissues originated from both cut surfaces of rootstock as well as scion and stocks completely with each other. In this connection, **Shehata *et al.* (2000)** reported that compatibility means rapid callus formation and differentiation and vascular connection between stock and scion.
2. Unconnected areas appeared in some grafting unions such as cucumber grafted on primary rootstock bottle gourd, primary rootstocks bottle gourd grafted on secondary rootstock bottle gourd and primary rootstock bottle gourd grafted on secondary rootstock fig leaf gourd as shown in Figs. 7 and 12 . This may be attributed to that callus tissues of each of scion and rootstocks were covered with superised cells that prevented the normal connection, especially between primary and secondary stocks. In this connection, **Baulbals and Huglin (1950)** found that lack of compatibility between stock and scion was due to failure of vascular connection and formation of impermeable perception between both.
3. Some of adventitious roots were arised form scion to primary stock or form primary stock to secondary stock for helping water and nutrients supply needed from rootstocks as illustrated in Fig. 12. In this respect, **Shehata *et al.* (2000)** stated that such roots are

originated from either paranchyma cells of pericylce or from vascular cambium of scion. The cells divided and formed a mass of meristimatic cells, later differentiated to form roots. The anatomy of roots was characterized by central radial vascular bundles. The developed roots were grown downwards and penetrated the rootstocks.

It is clear from Fig. 12 that there were definite transverse cross sections of roots embedded in rootstock as well as in scion. In this concern, **Mounir (1965)** found that such roots are able to sake their way throughout the stock. In some cases, lateral root developed downwardly throughout the stock tissue until it reached soil. Similar results were found by **Moiseave (1958), Monuir (1965) and Shehata *et al.* (2000)**.

The primary structure of rootstocks in Fig. 5 clear that there were increases in vascular tissues (xylem and phloem from cambium) in the stocks either in their volume or in number compared to scion except for cucumber, Beit Alpha cv. rootstock. This confirmed the merits of using rootstocks in grafting especially single grafting which increased area and outnumbered vascular tissues compared to double grafting in most cases.

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TABLES AND FIGURES

Table 1

Effect of single and double grafting on different types of rootstocks on successful grafting percentage of cucumber seedling during 2006 season.

No.	Grafting Tr.*	Successful grafting (%) 2006 season
1	Control	--------
	Single Gr.	
2	(C/B)1	90.00 cd
3	(C/F)1	92.80 bc
4	(C/P)1	92.00 b
5	(C/C)2	99.50 a
6	(C/B)2	92.00 b
7	(C/F)2	92.00 b
8	(C/P)2	92.40 bc
	Double Gr.	
9	(C/B+B)3	90.75 cd
10	(C/B+F)3	88.40 d
11	(C/B+P)3	90.75 cd
F test		**

* Grafting treatments.
1- Control: Cucumber (C) without grafting.
2-(C/B)1: C. on bottle gourd (single root).
3- (C/F)1: C. on fig leaf gourd (single root).
4-(C/P)1: C. on pumpkin (single root).
5- (C/C)2: C. on cucumber (double root).
6-(C/B)2: C. on bottle gourd (double root).
7- (C/F)2: C. on fig leaf gourd (double root).
8-(C/P)2: C. on pumpkin (double root).
9- (C/B+B)3: C. on bottle gourd + bottle gourd (triple root).
10- (C/B+F)3: C. on bottle gourd + fig leaf gourd (triple root).
11- (C/B+P)3: C. on bottle gourd + pumpkin (triple root).
** Indicates significant differences at P<0.01according to F test.
Means designed by the same latter are not significantly different at the 5% level according to Duncan

Table 2

Effect of single and double grafting on different types of rootstocks on area of vascular tissues at jointed region in cucumber plants.

No.	Grafting Tr.*	Area of vascular tissues (mm^2)			
		Xylem		Phloem	
		Days from grafting			
		20	50	20	50
1	Control	2.27 d	30.22 d	1.10 e	25.13 d
	Single Gr.				
2	(C/B)1	4.20 b	41.07 b	1.90 bc	32.25 abc
3	(C/F)1	5.07 a	53.32 a	2.93 a	35.21 ab
4	(C/P)1	4.06 b	41.42 b	2.10 b	32.16 abc
5	(C/C)2	4.02 b	41.44 b	1.90 bc	32.36 abc
6	(C/B)2	4.13 b	41.39 b	1.63 cd	29.73 bcd
7	(C/F)2	5.22 a	57.00 a	3.13 a	37.35 a
8	(C/P)2	3.83 b	40.17 b	2.13 b	32.01 abc
	Double Gr.				
9	(C/B+B)3	3.80 b	41.13 b	1.47 cde	30.43 bcd
10	(C/B+F)3	3.00 c	34.50 cd	1.20 de	27.06 cd
11	(C/B+P)3	3.90 b	36.46 bc	1.20 de	26.07 d
F test		**	**	**	**

* Grafting treatments.
1- Control: Cucumber (C) without grafting.
2-(C/B)1: C. on bottle gourd (single root).
3- (C/F)1: C. on fig leaf gourd (single root).
4-(C/P)1: C. on pumpkin (single root).
5- (C/C)2: C. on cucumber (double root).
6-(C/B)2: C. on bottle gourd (double root).
7- (C/F)2: C. on fig leaf gourd (double root).
8-(C/P)2: C. on pumpkin (double root).
9- (C/B+B)3: C. on bottle gourd + bottle gourd (triple root).
10- (C/B+F)3: C. on bottle gourd + fig leaf gourd (triple root).
11- (C/B+P)3: C. on bottle gourd + pumpkin (triple root).
**: Indicates significant differences at P<0.01according to F test.

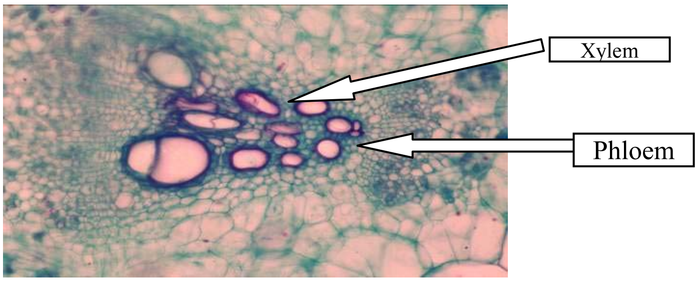

Fig.1: Cross section below the cotyledons showing the primary structure of scion (cucumber) hybrid F_1,Delta Star cv. and the area of xylem and phloem bundles after 35 days from sowing. (x 100).

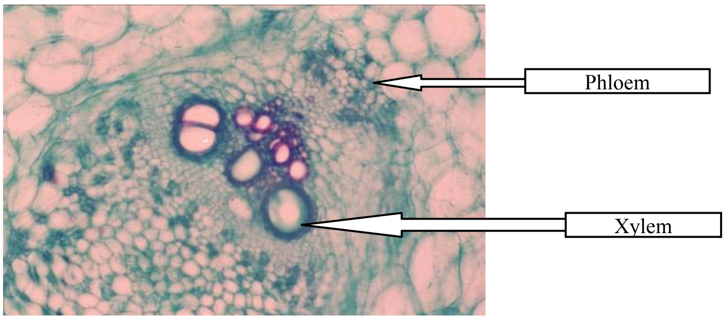

Fig.2: Cross section below the cotyledons showing the primary structure of rootstock (bottle gourd) and the area of xylem and phloem bundles after 35 days from sowing .

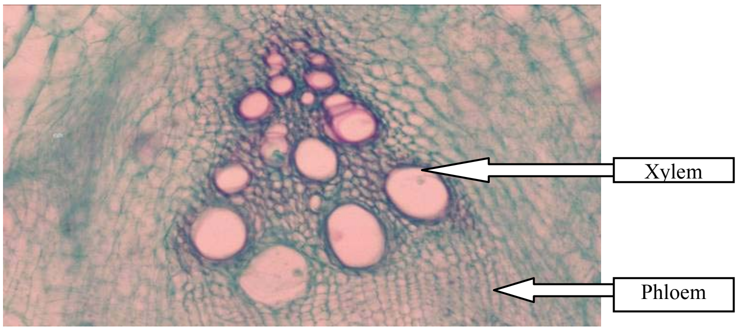

Fig. 3 : Cross section below the cotyledons showing the primary structure of rootstock (fig leaf gourd) and the area of xylem & phloem bundles after 35 days from sowing (x100).

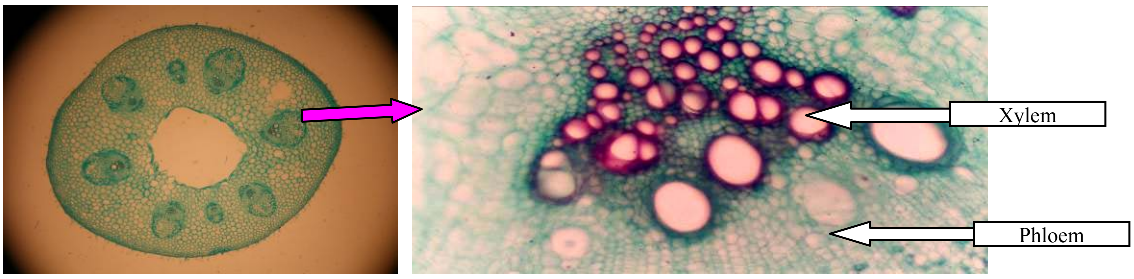

Fig. 4: Cross section below the cotyledons showing the primary structure of rootstock (pumpkin) and the area of xylem and phloem bundles after 35 days from sowing. (x 100).

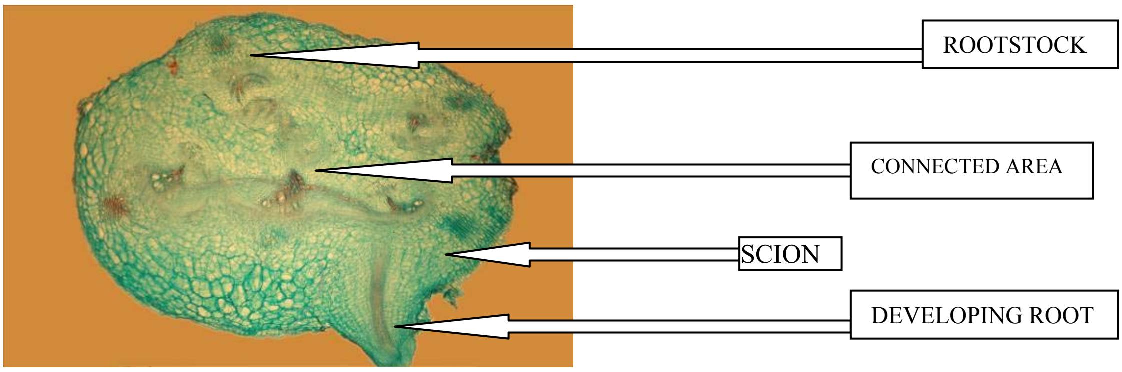

Fig. 5: Cross section of jointed region from grafting scion (cucumber) onto cucumber, Beit Alpha cv. in treatment $(C/C)_2$ after 20 days from grafting.

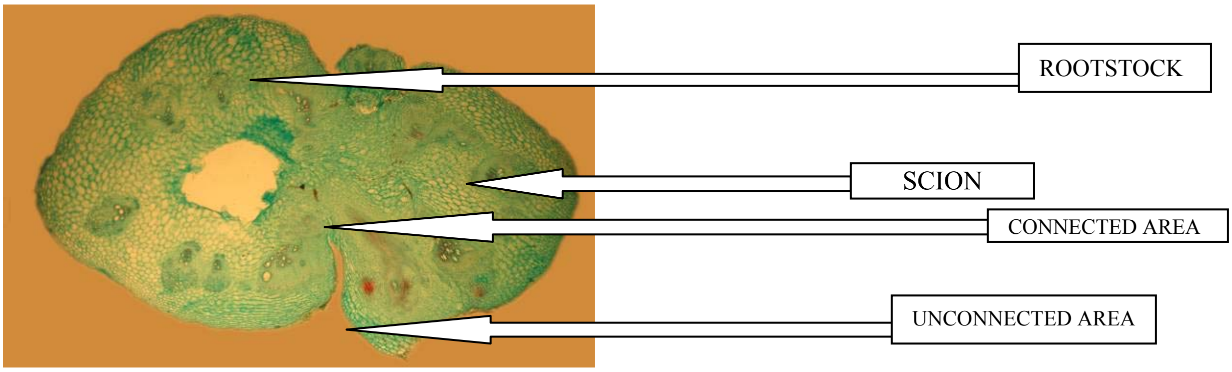

Fig. 6 : Cross section of jointed region from grafting cucumber (scion) onto primary rootstock (bottle gourd) in treatments $(C/B)_1$, $(C/B)_2$, $(C/B+B)_3$, $(C/B + F)_3$ & $(C/B + P)_3$ after 20 days from grafting.

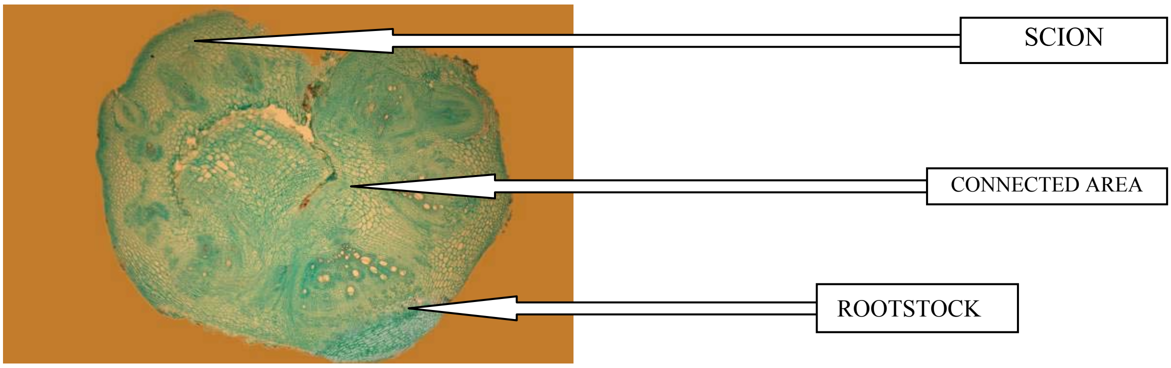

Fig. 7 : Cross section of jointed region from grafting cucumber (scion) onto primary rootstock (bottle gourd) in treatments $(C/B)_1$, $(C/B)_2$, $(C/B+B)_3$, $(C/B + F)_3$ & $(C/B + P)_3$ after 50 days from grafting.

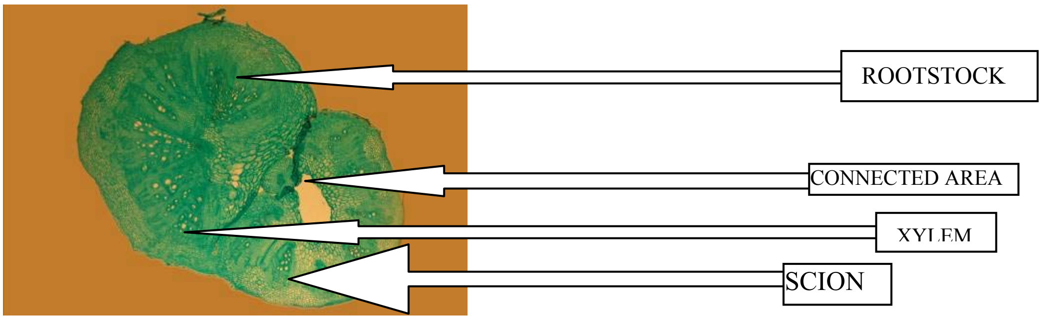

Fig. 8: Cross section of jointed region from grafting cucumber (scion) onto fig leaf gourd in treatments $(C/F)_1$ & $(C/F)_2$, after 20 days from grafting.

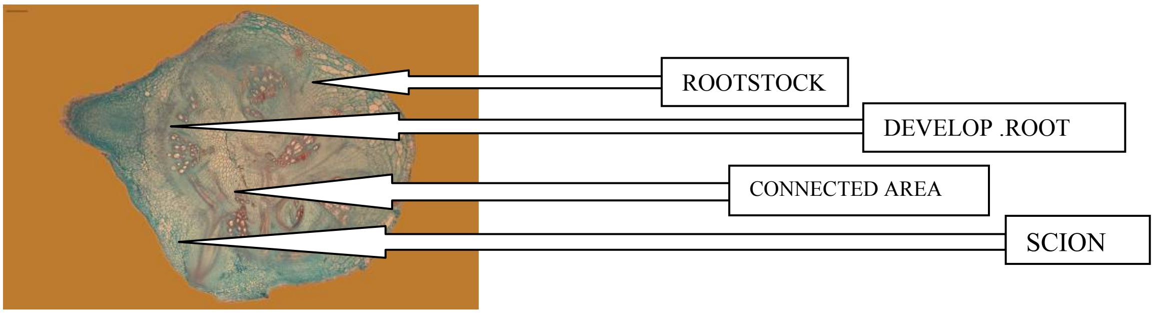

Fig. 9: Cross section of jointed region from grafting cucumber (scion) onto pumpkin in treatments $(C/P)_1$& $(C/P)_2$ after 50 days from grafting.

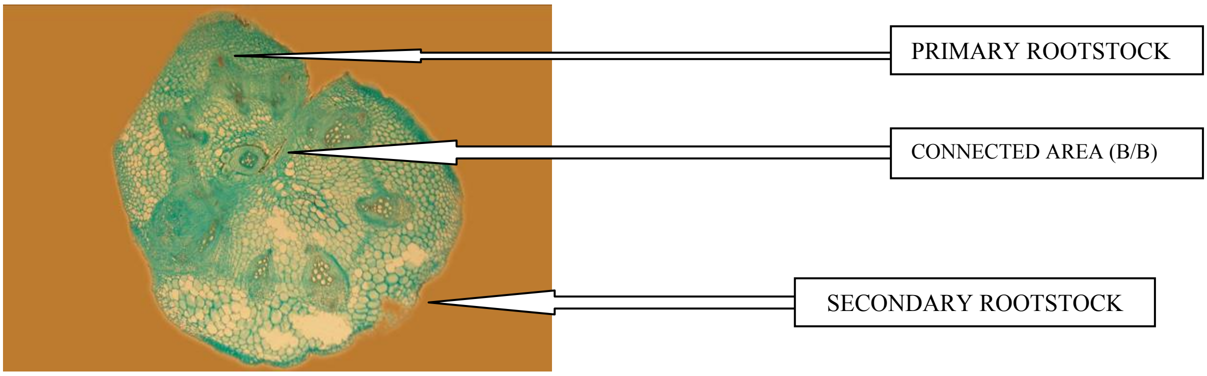

Fig. 10: Cross section of jointed region from grafting primary rootstock (bottle gourd) onto secondary rootstock (bottle gourd) in treatment $(C/B + B)_3$ after 50 days from grafting.

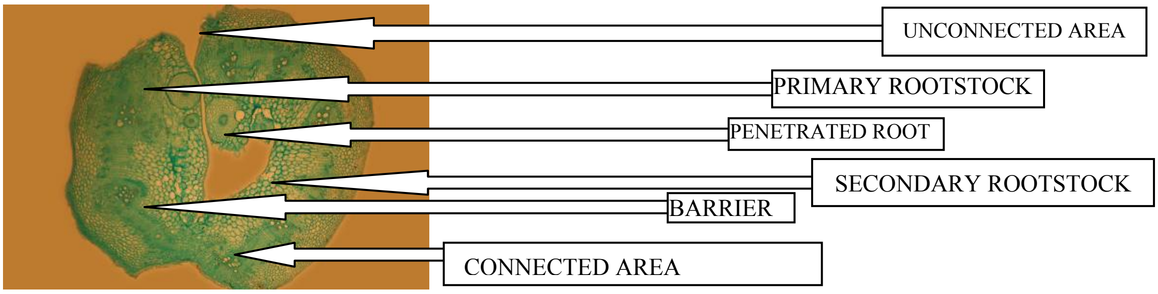

Fig. 11: Cross section of jointed region from grafting primary rootstock (bottle gourd) onto secondary rootstock (fig leaf gourd) in treatment $(C/B + F)_3$ after 20 days from grafting.

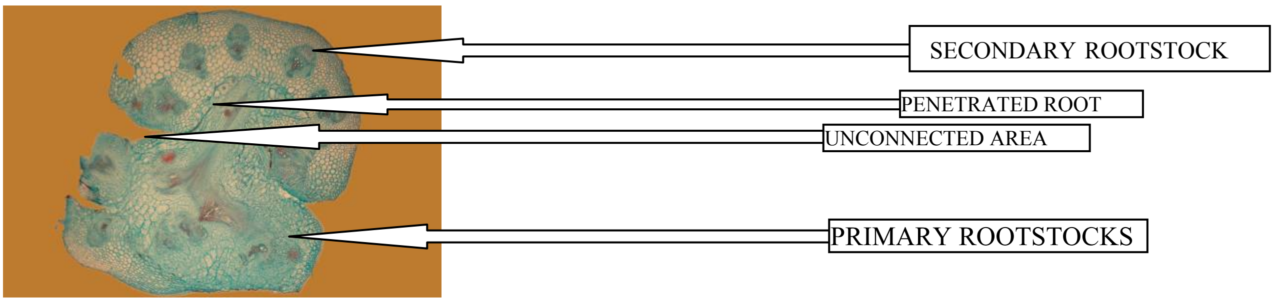

Fig.12: Cross section of jointed region from grafting primary rootstock (bottle gourd) onto secondary rootstock (pumpkin) in treatment $(C/B+P)_3$ after 20 days from grafting.

Studies on single and double grafting of cucumber plants on different types of rootstocks under plastic houses I. vegetative growth

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ABSTRACT

The experiment was carried out under plastic house conditions during the early summer seasons of 2005 and 2006 at Sakha Protected Cultivation Site, Ministry of Agric., Kafrelsheikh Governorate. The object of the experiment was to study the effect of single and double grafting onto four types of rootstocks (fig leaf gourd, bottle gourd, pumpkin and cucumber, cv. Beit Alpha) on, growth, flowering and fruiting, fruit yield and quality of cucumber F_1 hybrid, cv. Delta Star. The results are summarized as follows: all grafting treatments increased vegetative characteristics, earliness of flowering especially plants grafted onto fig leaf gourd in most parameters compared to ungrafted plants.

INTRODUCTION

Cucumber (*Cucumis sativus* L.) is generally cultivated during summer season in the open field. However, in temperate countries and in winter of tropical and subtropical, it is mainly grown under glass or plastic houses. Under protected vegetable crops production, cucumber is considered the main crop due to the high economic value in off-season harvest. The total area of protected vegetable crops and its number of plastic houses in Egypt were 15,204,383 m^2 and 31,915, respectively according to statistics of Ministry of Agric. and Land Reclamation (2008), with an average yield of 13 kg/m^2, while in Kafrelsheikh (KFS) with an average yield of 7.4 kg/m^2. Such productivity is considered low and needs more efforts for improvement. There are some problems concerned with improper conditions for the production of cucumber under plastic houses during early summer season in KFS area such as low soil & air temperature, high soil salinity and diseases infection. The previous problems can be solved by grafting cucumber onto resistant rootstocks (Janowski and Skapski, 1985 and Eguchi and Koutaki, 1986). Oda (1995) mentioned that grafting in vegetable crops was first launched in Japan and Korea in the late of 1920. Little attention was paid to improve and increase grafting processes till 1980. Now, vegetable grafting provided a good alternative tool to increase the yield of vegetable crops without using pesticides. Lee (1989) emphasized that, during the cool season, cucumber plants should be grafted onto fig leaf gourd however, those plants grown during the hot summer season were usually grafted onto Shintozwa rootstocks (inter specific hybrids) or others. Hoyos and Castro (2002) reported that grafting is one of the most promising techniques used for the substitution of the methyl bromide to prevent soil infestation by vascular pests and diseases due to non-rotation cropping. If it compared with the others, such as soilless culture, it is an environmentally friendly technique. Besides, it has many advantages if there are resistant rootstocks when there is a problem in the soil with pathogens, such as nematodes or vascular fungi. At present, growers disinfect soil with methyl bromide, but this causes considerable damages to the environment and had been forbidden after 2005. For this reason, it is necessary to test other more reliable possibilities, in which the use of rootstock is one of the most promising solutions.

Grafting of cucurbitaceous crops including cucumber was previously studied by several investigators and gave promising results whether for productivity or quality of the product (Mounir, 1965; Abd-Alla, 1995; El-Aidy *et al.*, 1996, El-Semellawy, 2005, Mohamed, 2008 and Huang *et al.,* 2009).

Hence, the aim of this investigation was to study the effect of single and double grafting on different types of rootstocks on cucumber plants grown under unheated plastic houses in North Delta area, Egypt. Data were taken on growth analysis, flowering and fruiting, fruit yield and its quality as well as diseases infection and insect's infestation.

MATERIALS AND METHODS

The experiment was carried out under unheated doublespan plastic house during early summer season of 2005 and 2006 at Sakha Protected Cultivation Site, Ministry of Agriculture, Kafrelsheikh (KFS) Governorate.

Treatments used:

The experiment included eleven treatments representing cucumber as a scion that was grafted onto four types of rootstocks whether used singly or in double grafting with different combinations in addition to control treatment without grafting. The scion used was cucumber F_1 hybrid, cv. Delta Star (gynoecious). The rootstocks used were fig leaf gourd (*Cucurbita ficifolia*), bottle gourd (*Lagenaria siceraria*), pumpkin (*Cucurbita moschata*) and cucumber, cv. Beit Alpha as follows:

1- Control (cucumber F_1 hybrid, cv. Delta Star without grafting) and signed to as C.
2- Single grafting of cucumber onto bottle gourd then cut root of cucumber and leaving root of bottle gourd. The grafted seedling had a single root and signed to as $(C/B)_1$.
3- Single grafting of cucumber onto fig leaf gourd then cut root of cucumber (scion) and leaving root of fig leaf gourd (rootstock). The grafted seedling had a single root and signed to as $(C/F)_1$.
4- Single grafting of cucumber onto pumpkin then cut root of scion and leaving root of pumpkin, the grafted seedling had a single root and signed to as $(C/P)_1$.
5- Single grafting of hybrid cucumber onto cucumber, cv. Beit Alpha and leaving root of both scion and rootstock. The grafted seedling had double root and signed to as $(C/C)_2$.
6- Single grafting of cucumber onto bottle gourd and leaving root of scion and rootstock, the grafted seedling had double root and signed to as $(C/B)_2$.
7- Single grafting of cucumber onto fig leaf gourd and leaving the two roots (scion + rootstock), the grafted seedling had double root and signed to as $(C/F)_2$.
8- Single grafting of cucumber onto pumpkin and leaving the two roots (scion + rootstock), the grafted seedling had double root and signed to as $(C/P)_2$.
9- Double grafting using bottle gourd as a primary rootstock and bottle gourd also as a secondary one and leaving root of scion and both rootstocks. The grafted seedling had triple root and signed to as $(C/B + B)_3$.
10- Double grafting using bottle gourd as a primary rootstock and pumpkin as a secondary one and leaving root of scion and both rootstocks. The grafted seedling had triple root and signed to as $(C/B + P)_3$.
11- Double grafting using bottle gourd as a primary rootstock and fig leaf gourd as a secondary one and leaving root of scion and both rootstocks. The grafted seedling had triple root and signed to as $(C/B + F)_3$.

The grafted plants were transferred into plastic pots of 8 cm diameter after grafting had been done. The grafted plants were transplanted in the unheated double span plastic house on February 20 in both seasons. The root of scion in treatments No. 2, 3 and 4 in plastic house was cut off immediately after the appearance of the 4^{th} true leaf. Transplanting took place on both sides of each ridge (1.5m width) at a space of 50cm (planting density was 2.66 plants/m^2). The experimental plot dimension was 1.5 x 5m making an area of 7.5m^2 and contained of 20 plants. Cucumber plants were trained vertically on a single stem, where all lateral branches were removed from cotyledon leaves until the second true leaf. The lateral branches were cut off after two leaves (two fruits) until 60cm height, and then they were cut off after three leaves (three fruits) till the end of the growing season. Organic and mineral fertilizers were added during preparation of soil at the following rates per 935m^2 (area of plastic house): 8m^3 farmyard manure + 25kg ammonium sulphate (20.5% N) + 100kg calcium superphosphate (15.5% P_2O_5) + 25 kg sulphur. The amounts of mineral fertilizers were used as recommended by Ministry of Agriculture and dissolved in the water injected through the drip irrigation system (fertigation method) per day during the growing season. All cultural practices (cultivation, pests and diseases control, … etc.) were carried out whenever necessary.

Data recorded

- Survival of grafted transplants (%):

After 10 days from transplanting, the survival of grafted transplants percentage was recorded in the unheated doublespan plastic house.

- Vegetative growth:

Vegetative growth parameters such as stem length and diameter (cm), and number of lateral branches and leaves were recorded four times at 45 days after transplanting (DAT). Moreover, plant leaf area (dm^2) was determined at 45 DAT using leaf area meter. Shoot fresh and dry weights (g) and plant dry matter (%) were measured at the end of growing season. The previous parameters were estimated from five plants which were randomly chosen from each experimental unit.

- **Total chlorophyll content:**

Total chlorophyll content was determined in the 6^{th} leaf from the growing top, 60 days after transplanting.

- Downy and powdery mildews incidence and leaf miner insects:

Injury levels of downy mildew (*Pseudoperonospora cubensis*) and powdery mildew (*Erysiphe cichoracearum*) as well as leaf miner (*Liriomyza congesta*) were estimated as diseases infection and insect's infestation percentage of leaf area/plant. This was done, 60 days after transplanting from three plants randomly chosen from each plot according to Biswas *et al.* (1992).

Experimental design and statistical analysis

The experiment included 11 treatments which were arranged in a randomized complete blocks design with four replications. Data were tested by analysis of variance according to Little and Hills (1972). Duncan's multiple range tests was used for comparison among treatments means (Duncan, 1955).

Weather data

Minimum/maximum air temperature and air relative humidity (R.H.%) under plastic house were daily recorded by using the thermo-hygrometer (Table 1).

RESULTS AND DISCUSSION

Vegetative growth

- Scion stem length:

Data presented in Table 2 reveal that the differences in stem length were highly significant due to all grafting treatments in both seasons. The longest scion stem was obtained from $(C/F)_2$ treatment while the shortest stem resulted from ungrafted control in both seasons. In this concern, Jifon *et al.* (2006) stated that muskmelon plants grafted on *Cucurbita* rootstocks had longer stems than that grafted on *Cucumis* rootstocks and nongrafted plants. Similar results were obtained by El-Aidy *et al.* (1996), Abd-Alla (2002), Etman *et al.* (2002) and Zhou *et al.* (2007) on cucumber plants and Mohamed (2008) on *Cucumis melo*.

- Scion stem diameter:

Data in Table 2 clear that plants grafted onto different types of used rootstocks with either single or double grafting tended to increase scion stem diameter compared to nongrafted plants particularly for grafting treatments of $(C/P)_2$ and $(C/F)_2$. However, the differences among single and double grafting treatments were mostly nonsignificant in this parameter during both seasons. In the same line were the results of Arisawa *et al.* (1980), Yetisir and Sari (2003) and El-Semellawy (2005).

- Number of branches/plant

Data in Table 2 indicate that the differences among grafting treatments in number of branches/plant were highly significant in both seasons. Generally, single and double grafting treatments outnumbered nongrafted control in this parameter, especially the single grafting ones. However, the positive effect of grafting on number of branches/plant varied somewhat between the two seasons. Therefore, the highest number of branches was obtained from $(C/F)_1$, $(C/F)_2$ and $(C/P)_2$ treatments in the first season, while such result resulted from $(C/F)_1$ and $(C/F)_2$ only in the second one. In contrast, nongrafted control showed the lowest number of branches in both seasons. Similar results were obtained by El-Semellawy (2005) on watermelon plants grafted onto different types of rootstocks and Mohamed (2008) on *Cucumis melo*.

- Number of leaves/plant

Data in Table 2 show that the differences among single and double grafting treatments in this character were considerable in both seasons. Generally, both single and double grafting increased number of leaves per plant, particularly the single one. However, such positive effect on this parameter was more pronounced with $(C/F)_2$ and $(C/P)_2$ in the first season and with $(C/F)_1$ and $(C/F)_2$ treatments in the second one. Control without grafting gave the lowest records of this character in the two seasons. The remainder single and double grafting treatments manifested intermediate values in this concern. The obtained results are confirmed by several investigators such as El-Aidy *et al.* (1996), Gaafer (1996), Abd-Alla (2002), Yetisir and Sari (2003) and El-Semellawy (2005) on different cucurbits.

-Leaf area

Data in Table 2 show that the effect of single and double grafting on different types of rootstocks was highly significant on leaf area/plant during both seasons. Therefore, all single and double grafting treatments increased this parameter over nongrafted control. However, the largest leaf area was obtained from $(C/F)_2$ treatment in both seasons. These results are confirmed by those of Weng *et al.* (1993), El-Aidy *et al.* (1996), Kabeel (1999) and Etman *et al.* (2002) on cucumber.In contrast, El-Semellawy (2005) on watermelon and Yetisir *et al.* (2007).

Total chlorophyll (green colour reading) (SPAD)

Data presented in Table 2 show that single and double grafting treatments had a highly significant effect on SPAD of cucumber leaves in both seasons. Generally, single grafting treatments increased this parameter, followed by double grafting ones and finally nongrafted control which produced the lowest value in most cases during both seasons. However, a nonconstant trend was found in this parameter between the two seasons due to the different grafting treatments. Therefore, the $(C/P)_2$ treatment tended to give the highest content of total chlorophyll in leaves, while the ungrafted control tended to produce the lowest value in the first season. In the second season, the $(C/F)_1$ treatment tended to produce the highest value in this concern compared to the $(C/B)_1$, $(C/C)_2$ and $(C/B)_2$ grafting treatments which tended to achieve the lowest values. In the same line, Weng *et al.* (1993), Abd-Alla (2002) and El-Semellawy (2005) found that grafted cucumber and watermelon plants had higher chlorophyll content of leaves than ungrafted ones.

Fresh and dry weights/plant

Data in Table 2 indicate that the effect of single and double grafting on different types of rootstocks was highly significant on these parameters during both seasons.

Generally, single grafting treatments surpassed double grafting ones and nongrafted control in the fresh and dry weights/plant in both seasons. Therefore, the highest fresh weight per plant was obtained from single grafting treatments of $(C/P)_1$, $(C/F)_2$ and $(C/P)_2$ followed by $(C/F)_1$ in the first season, while such resulted from $(C/P)_2$ only followed by both $(C/P)_1$ and $(C/F)_2$ treatments in the second one. On the other hand, the lowest value of this parameter was achieved with nongrafted control. For dry weight/plant, the highest record was achieved by single grafting of $(C/F)_1$ in both seasons, followed by $(C/P)_1$, $(C/F)_2$ and $(C/P)_2$ treatments in the first season and by $(C/P)_2$ only in the second one. In contrast, nongrafted control plants showed the lowest value of this parameter in both seasons.

In the same tendency, El-Aidy *et al.* (1996), Kabeel (1999) and Etman *et al.* (2002) found that fig leaf gourd was the best root-stock for obtaining the heaviest fresh and dry weights of cucumber plants. Additionally, Chouka and Jebari (1999), Yetisir and Sari (2003) and El-Semellawy (2005) stated that the heaviest plant was obtained from grafting watermelon on pumpkin (*C. maxima & C. moschata*) rootstock.

It is clear from the foregoing results that single and double grafting of cucumber plants onto most of the used rootstocks increased vegetative growth parameters compared to nongrafted control plants. However, single grafting treatments, especially $(C/F)_1$ and $(C/F)_2$ showed more vigorous plant growth compared to double grafting ones in both seasons Also, it was noticed that cucumber plants grown in the second season had more vigorous growth than those grown in the first one.

The reduction in minimum air temperature, especially in the first season (Table, 1) may hasten the growth of fig leaf gourd stock and positively reflected on growth of cucumber plants. In this concern, Xianchang (1999) reported that seedlings of cucumber grafted on *Cucurbita ficifolia* tolerated low temperature stress without reducing photosynthetic function compared to the own-rooted seedlings. In agreement with the previous studies, some investigators mentioned that grafting promoted vegetative growth at different levels as was dependent on rootstock characteristics (Lee, 1989; Ito, 1992). In this connection, Nijs *et al.* (1983) indicated that flow velocity of water transport per leaf area of grafted plants onto *C. ficifolia* was twice as high as that of nongrafted plants indicating a higher activity of root system of the rootstock grafted plants.

Downy and powdery mildews incidence and leaf miner insects

The effect of single and double grafting treatments on some foliage diseases and insects are shown in Table 3. The results indicate that the highest percentage of infected plant leaves by powdery mildew and downy mildew was obtained from ungrafted control treatment, while all the single and double grafting treatments plants were more resistant to both diseases than control ones. Meanwhile, the $(C/F)_1$, $(C/P)_1$, $(C/F)_2$ and $(C/B + F)_3$ exhibited the lowest percentage of the infected leaves by powdery mildew disease, while the same result was produced by the $(C/F)_1$, $(C/P)_1$ and $(C/B + B)_3$ treatments for downy mildew disease.

Concerning leafminer, data in Table 3 show that plants of all single and double grafting treatments were more resistant to leafminer insect than ungrafted plants (control). Meantime, the lowest infested leaves were obtained from both the $(C/P)_1$ and $(C/F)_1$ single grafting treatments (single root). It is obvious that all single or double grafting treatments exhibited more resistance to foliage diseases and more tolerance to the leafminer insect than ungrafted control, due to as vigorous grafted plants were probably more resistant to diseases and insects than ungrafted ones. In a similar tendency, Gu *et al.* (2006) studied the effect of 4 rootstocks including *Cucurbita ficifolia* and found that the incidence and index of downy mildew, whitening and wilt were significantly reduced by cucumber grafting. Also, Sakata *et al.* (2006) indicated that rootstocks including certain pumpkins can alter powdery-mildew resistance or tolerance of cucumber scions at the adult stage.

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TABLES

Table 1

Weekly and monthly average air temperature and relative humidity under plastic house in 2005 & 2006 seasons.

Date	Air temp. (^oC) Max.	Air temp. (^oC) Min.	Relative Humidity (%)	Air temp. (^oC) Max.	Air temp. (^oC) Min.	Relative Humidity (%)
	2005 season			2006 season		
Jan. 15-21	43.0	10.9	65.1	44.7	11.9	66.9
22-28	40.1	11.9	66.7	39.4	16.4	70.1
29-31	39.5	12.4	69.5	40.1	13.7	71.3
Mean	40.9	11.7	67.1	41.1	14.0	69.4
Feb. 1-7	38.9	14.0	56.9	38.5	15.9	60.3
8-14	33.9	12.9	60.0	35.4	12.9	55.9
15-21	30.7	10.0	48.3	29.8	10.1	50.1
22-28	37.4	7.9	58.7	34.9	13.14	53.3
Mean	35.2	11.2	56.0	34.5	13.0	54.9
Mar. 1-7	42.6	10.6	50.4	40.9	9.4	51.2
8-14	37.1	8.9	51.1	37.3	7.6	52.1
15-21	40.0	7.7	50.6	39.0	9.0	50.0
22-28	41.7	7.7	54.0	39.42	11.14	53.1
29-31	45.0	10.7	56.7	38.7	9.7	53.4
Mean	41.3	9.1	52.5	39.1	9.4	52.0
Apr. 1-7	42.7	8.6	51.0	40.7	9.7	53.0
8-14	44.6	9.4	50.7	41.3	10.6	54.2
15-21	44.7	11.3	49.7	41.7	12.7	53.0
22-28	44.0	13.4	52.9	35.9	12.0	52.0
29-30	42.5	11.0	58.0	35.5	14.0	54.0
Mean	43.7	10.7	52.5	39.0	11.8	53.2
May 1-7	42.1	11.7	54.9	32.3	13.3	50.9
8-14	41.1	12.1	54.3	34.1	11.4	56.1
15-21	41.4	12.3	62.7	35.6	10.7	55.7
22-28	44.6	14.9	63.9	40.4	11.9	56.2
29-31	44.0	14.7	64.7	39.0	11.0	56.0
Mean	42.6	13.1	60.1	36.3	11.7	55.0
Jun. 1-7	42.6	15.7	58.4	42.3	12.3	60.1
8-15	45.4	17.7	54.4	44.1	13.2	60.1
Mean	44.0	16.7	56.4	43.2	12.8	60.1

Table 2
Effect of single and double grafting on different types of rootstocks on some characteristics of vegetative growth, dry weight/plant and total chlorophyll of cucumber plant, during 2005 and 2006 season

Grafting. Tr.*	Stem length (cm)	Stem diam. (cm)	No. of branches /plant	No of leaves. /plant	Leaf area /plant (dm^2)	Fresh wt./plant (g)	Dry wt./plant (g)	Total chl. (SPAD)
2005 season								
Control	89.0f	0.92ab	1.63d	16.7d	27.7g	303.3e	43.2f	36.20 d
(C/B)1	101.3d	0.90b	2.53c	20.0cd	44.9f	575.7c	103.5c	39.80 abc
(C/F)1	107.7c	0.95ab	3.40b	24.0abc	58.9b	653.6b	153.6a	38.73 bcd
(C/P)1	100.7d	0.97ab	3.30b	23.3a-d	55.8c	697.5a	137.2b	38.57 cd
(C/C)2	105.0c	0.90b	4.17a	25.0abc	46.1ef	503.3d	100.7c	38.57 cd
(C/B)2	101.0d	0.91ab	3.33b	22.7bcd	49.4d	571.1c	97.5c	41.50 ab
(C/F)2	117.0a	1.05ab	4.33a	27.7ab	65.1a	693.1a	132.0b	40.77 abc
(C/P)2	112.3b	1.07a	4.43a	29.3a	59.6b	707.0a	133.6b	42.57 a
(C/B+B)3	92.3e	0.92ab	3.33b	22.0bcd	44.6f	578.7c	70.3e	39.10 bc
(C/B+F)3	99.3d	1.00ab	2.60c	21.0bcd	49.5d	570.8c	80.0d	39.93 abc
(C/B+P)3	93.3e	1.00ab	2.92bc	19.7cd	47.8de	585.2c	81.3d	40.53 abc
F test	**	*	**	**	**	**	**	**
2006 season								
Control	89.1i	0.85c	1.30g	17.7h	32.9i	390.0g	53.4j	37.08cd
(C/B)1	105.6h	0.90bc	3.25f	23.4g	54.1h	620.0d	107.8f	36.05d
(C/F)1	135.2b	0.98abc	7.80b	34.9c	75.8b	740.0c	162.5a	41.67a
(C/P)1	122.6e	0.95abc	5.70d	32.5cd	65.7d	780.0b	147.5c	41.17ab
(C/C)2	123.7de	0.88bc	4.05ef	31.7de	57.5f	550.0f	115.8e	36.00d
(C/B)2	115.5fg	0.98abc	4.25ef	29.5ef	65.2d	605.0de	100.8g	36.75d
(C/F)2	145.4a	1.01ab	9.70a	43.1a	82.7a	767.5b	140.3d	40.35ab
(C/P)2	129.1cd	1.05a	6.70c	38.4b	68.6c	810.0a	156.5b	39.15bc
(C/B+B)3	111.6g	0.91abc	3.38f	23.8g	55.3g	610.0de	75.0i	37.80cd
(C/B+F)3	131.8bc	0.88bc	4.95de	31.4de	65.6d	600.0e	81.8h	37.40cd
(C/B+P)3	119.1ef	1.01ab	4.10ef	27.8f	58.5e	605.0de	81.5h	38.13cd
F test	**	*	**	**	**	**	**	**

* Grafting treatments.
1- Control: Cucumber (C) without grafting.
2-(C/B)1: C. on bottle gourd (single root).
3- (C/F)1: C. on fig leaf gourd (single root).
4-(C/P)1: C. on pumpkin (single root).
5- (C/C)2: C. on cucumber (double root).
6-(C/B)2: C. on bottle gourd (double root).
7- (C/F)2: C. on fig leaf gourd (double root).
8-(C/P)2: C. on pumpkin (double root).
9- (C/B+B)3: C. on bottle gourd + bottle gourd (triple root).
10- (C/B+F)3: C. on bottle gourd + fig leaf gourd (triple root).
11- (C/B+P)3: C. on bottle gourd + pumpkin (triple root).

** Indicates significant differences at $P<0.01$according to F test.

Means designed by the same latter are not significantly different at the 5% level according to Duncan's test

Table 3

Effect of single and double grafting on different types of rootstocks on some foliage diseases and insects incidence after 60 days from transplanting of cucumber plant during 2005 and 2006 seasons

Grafting Tr.*	Infected leaves (%)		Infested leaves with leaf miner (%)
	Powdery mildew	Downey mildew	
	2005 season	2006 season	
Control	21.70	40.75	13.57
Single Gr.			
(C/B)1	16.83	28.19	7.63
(C/F)1	11.10	24.29	5.50
(C/P)1	11.40	25.92	5.08
(C/C)2	13.57	36.87	6.38
(C/B)2	17.00	32.13	10.10
(C/F)2	11.23	32.91	7.08
(C/P)2	14.07	34.37	10.95
Double Gr.			
(C/B+B)3	16.20	26.54	9.10
(C/B+F)3	11.60	35.28	7.88
(C/B+P)3	16.57	33.66	12.60

* Grafting treatments.

1- Control: Cucumber (C) without grafting.
2-(C/B)1: C. on bottle gourd (single root).
3- (C/F)1: C. on fig leaf gourd (single root).
4-(C/P)1: C. on pumpkin (single root).
5- (C/C)2: C. on cucumber (double root).
6-(C/B)2: C. on bottle gourd (double root).
7- (C/F)2: C. on fig leaf gourd (double root).
8-(C/P)2: C. on pumpkin (double root).
9- (C/B+B)3: C. on bottle gourd + bottle gourd (triple root).
10- (C/B+F)3: C. on bottle gourd + fig leaf gourd (triple root).
11- (C/B+P)3: C. on bottle gourd + pumpkin (triple root).

Research on the development of some processing vegetable technologies as "Mixed vegetables for soups and stew"

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ABSTRACT

The activity of vegetable processing has been a necessity in turning vegetable that could not be recovered economically. First it was vegetables that were eliminated through the multiplication of cultivars, helped by the method of maintenance, since they were outside the ranges of confidence. Also, often, large amounts of fresh vegetables produced in the development sector for exploit, had no buyers or the prices were unprofitable. This gave rise to the decision to carry out the vegetables processing.

INTRODUCTION

Storing vegetables in different ways (Radu I.F., 1971): freezing, drying, pasteurization, etc. To supplement the intake of vegetables for food, especially during the winter months, has become a necessity both in our country and abroad.

At The Resort of Vegetable Research and Development from IERNUT which is engaged in multiplication of some varieties through the seed production obtained from upper links, and improving and creating new varieties and also existed the vegetable conservation which could not capitalize on the basis or for fresh consumption.

The material basis existence, the available of workforce and the demand for vegetables preserved from SCDL IERNUT area were decisive factors in vegetable processing activity. For this were been studied the development of technology-specific recipes. Among the most important recipes takes part the recipes regarding mixed vegetables for stews and soups. Thus prepared, the vegetables can be used throughout the year, shortening the periods of preparation of different kinds of meals.

MATERIAL AND METHODS

In research, the material used was the vegetable species: Solanum lycopersicum, Capsicum annum, Daucus carrota, Petroselinum, Apium graveolens etc.

Regarding conservation technology has been used the sterilization method, having the purpose of microorganisms destruction which cause spoilage. Termoabioza is a heat treatment method used in the boiling mixture of vegetables in sealed jars.

The variants regarding recipes for testing were settle through different quote percentage of vegetables species used in a way to meet consumer taste from several points of view: chemical composition (vitamins, minerals, proteins, sugars, etc..), organoleptic (taste), olfactory (color), biological (without additives producing damage health) etc.

General manufacturing process technology of sterilized canned food vegetables include the following phases: reception of raw materials, packaging, auxiliary raw, sorting vegetables, washing and cleaning vegetables, vegetable division, mixed vegetables, heat processes (quench vegetables), pickle prepare (coating liquid), washing cases, filling cases, closed cases, sterilization cases, storage product (Fig. 1).

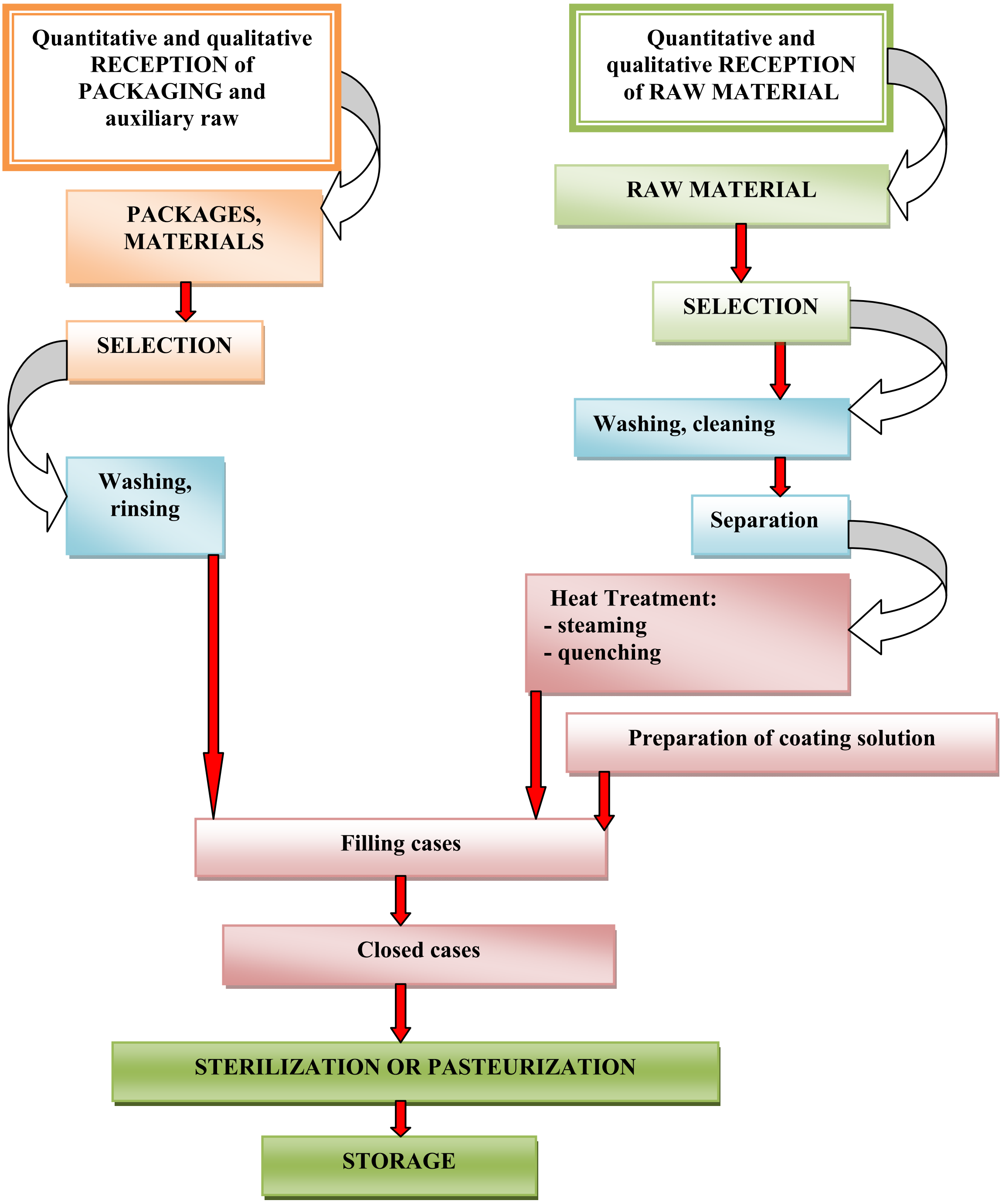

Fig. 1. – Technological flow of preserving vegetables

The mixture was initially heated in boilers duplicate for 5-10 minutes at 95 °. As cases were used jars of 420 ml (440 g mixed vegetables) and 820 ml (830 g mixed vegetables). Sterilization was performed in the following format:

$$\text{Jars (820ml)} = \frac{\text{20min-20min-20min}}{120°C} \times 1{,}6 \text{ atm.}$$

$$\text{Jars (420ml)} = \frac{\text{15min-15min-15min}}{120°C} \times 1{,}5 \text{ atm.}$$

The cooling was made up at 40°C.

Each variant contained a quantity of 100 kg of vegetable mixture.

RESULTS AND DISCUSSION

The main purpose of the experimental variants study was to establish an optimal technologies in production recipes for mixed vegetables to canned food soups (Table 1) and stews (Table 2) that are demanded by consumers, to be more economic and to have a long validity term (from production to consumption).

Table 1

The component of "mixtures for canned soups" experimental variants

Species / Variety	Quantity (kg/ha)				Total (kg)
	V_1	V_2	V_3	V_4	
Solanum lycopersicum Pontica	80	60	50	3	193
Capsicum annum Superior yellow	7	20	30	6	63
Daucus carota Nantes	5	10	10	80	105
Parsnip Long white	3	3	2	6	14
Parsley Sweet	2	3	2	3	10
Celery Maria	2	3	5	1	11
Salt	1	1	1	1	4
Total	100	100	100	100	400

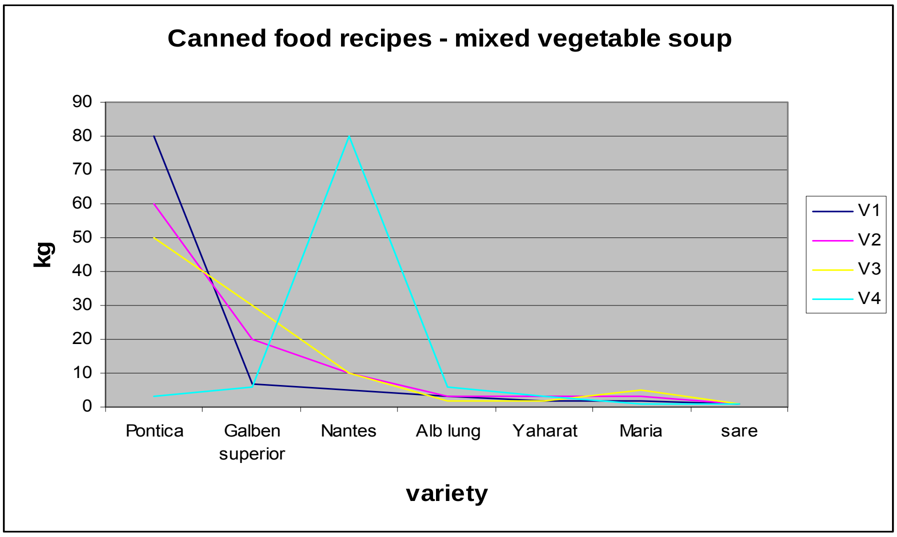

Fig. 2 – Canned food recipes - mixed vegetable soup

All "mixed vegetable soup" variants showed a very good resistance to storage over a period of three years. Experiments were started in 2006, although V1 version was the most balanced and the most requested by consumers from Iernut area was proved to be variant V4 for processing recipes for vegetable soup mixes, which is why this variant led to the technological method of processing vegetables from SCDL Iernut.

All "mixed vegetable stews" variants showed a very good resistance to storage over a period of three years. Experiments were started in 2006 the most requested version, by consumers from Iernut area was proved the V2 variant, which is why this variant led to the technological method of processing vegetable recipes "mixed vegetable stews" from SCDL Iernut. Also, the variants V1 and V3 were agreed by consumers, but less than V2. V4 variant lies on the last place in what concerns using this recipe for stews, though it ranks regarding the recipe for soups.

Table 2

The component of "mixtures for canned stews" experimental variants

Species / Variety	Quantity (kg/ha)				Total (kg)
	V_1	V_2	V_3	V_4	
Solanum lycopersicum Pontica	10	50	20	3	83
Capsicum annum Superior yellow	70	30	50	6	156
Daucus carota Nantes	5	10	20	80	115
Parsnip Long white	5	1	3	6	15
Parsley Sweet	5	2	3	3	13
Celery Maria	5	6	3	1	15
Salt	1	1	1	1	4
Total	100	100	100	100	400

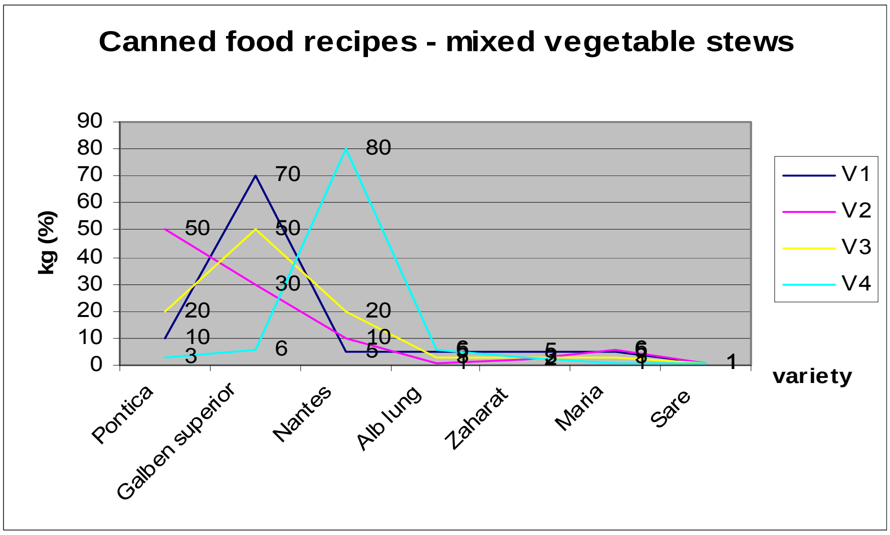

Fig. 3 – Canned food recipes - mixed vegetable stews

CONCLUSIONS

The recipes formula was based on the chemical composition of vegetables, taste, color and flavor.

At first it was processed only the vegetables surplus resulting from the basic activities of SCDL Ienut.

In the present, SCDL Iernut produces a special vegetable variety for processing and to provide additional revenue to cover a part of the unit's budget deficit. Since these canned food are valued by consumers and had a provided market, is required upgrading the technological line for processing vegetables, and to develop other recipes for market diversification.

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Planting period influence on the onion yield obtained from chive-planted crops and directly-planted crops, in the crop region Vinga

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Keywords: seeds, bulbs, variety, population, mechanization.

ABSTRACT

In order to obtain onion yield with costs that are as reduced as possible, the crop technology requires several approaches: for example, crop planting in different seasons (autumn or spring), in concordance with the planting method (chive planting or direct planting) and the possibility of high mechanization (the direct planting method allows total mechanization). The onion production in our country is performed with the application of the three well-known crop technologies: chive planting, seedling planting and direct planting. These methods range widely in terms of crop regions in our country, and also with the agri-ecologic conditions. The Romanian onion growers are reluctant when speaking about the direct planting crop technology, because of the great rigor required by this. The onion crop region from Vinga, a region with tradition in chive-based onion cultivation, and especially in chive production as biological material for multiplication, is known by onion growers due to this occupation for generations. The possibility to obtain bulbs for consumption belonging to the „*local onion population of Vinga*", from directly-created crops, is worth of study, too.

INTRODUCTION

Onion crop technology, in the world and in our country as well, requires several approaches, of which: the utilization of biological reproduction material (chive or seeds) (Horgoş, 2003); utilization of traditional cultivars for the production of bulbs for consumption (varieties and populations adapted to the conditions in our country, adequate especially for crop creation through chive or seedlings); the introduction into crops, especially during the last two decades, of onion hybrids that are adequate for direct-planted crops; crop creation in various seasons (autumn or spring), with consideration for crop initiation method (through chive planting or direct planting); the high mechanization of onion crop, according to planting method (the direct-planting method allows total mechanization).

As regards the onion crop technology relied on direct planting, this supposes several advantages, like: the elimination of weeding risk during the first vegetation period; the reduction of conditions for germination bed preparation in the early spring, when normally the crop is planted, because this is carried out in the autumn, in advance; the harvesting of crop one month earlier, during the summer period with high-temperatures that are favourable for bulb maturation and obviously for the resistance capacity during winter; the increased productivity of the onion „cultivars" adapted to the direct planting technique; the possibility of utilization of high-efficiency work machines and implicitly the increase of work mechanization; the reduction of period between planting and yielding of bulbs for consumption or seeds; the reduction of materials necessary for production and the reduction of technological works during the vegetation period.

Onion production in our country is performed through the application of the three known crop technologies, namely: chive planting, seedling planting and direct planting (Bălaşa, 1970).

These methods range widely in terms of crop regions in our country, and also with the agri-ecologic conditions. The Romanian onion growers are reluctant when speaking about the direct planting crop technology, because of the great rigour required by this. However the extension of this technology is real, because it is necessary to implement in production technologies with superior productive efficiencies.

The modernization of vegetable growing, including the amplification of mechanization, fertilization and irrigation, blurs the advantages generated by the replacement of seeds, as material of plant multiplication through seedling, with chives, too.

The onion crop region from Vinga, a region with tradition in chive-based onion cultivation, and especially in chive production as biological material for multiplication, is known by onion growers just for this occupation for generations. The possibility to obtain bulbs for consumption belonging to the „*local onion population of Vinga*”, from directly-created crops, is worth of study, too.

MATERIAL AND METHOD

The objective of our researches was to determine the influence exerted by planting period (autumn and spring), in the case of chive planting and direct planting of two known varieties (Diamant and Stuttgart) and the local population of Vinga.

The researches in the crop region from Vinga aimed at: the productive level determination in the case of the varieties Diamant and Stuttgart and of the local population of Vinga, under conditions of different planting seasons (autumn and spring); the behavior of these two varieties (Diamant and Stuttgart) and of the local population of Vinga, in terms of productive potential, under conditions of chive planting and direct planting, with consideration for the planting method specific to each variety; the study of the „local onion population of Vinga”, in terms of productive potential, under conditions of chive planting and direct planting, in two different planting seasons (autumn and spring); the preservation capacity, representing the yield losses resulted successive to storage during winter in household conditions, in correlation with onion cultivation based on chive planting and direct planting (with onion seeds), in different seasons (autumn and spring); the loss level according to bulb size category.

Our researches were performed in fields belonging to family farms from Vinga.

In order to accomplish our objectives, we performed a tri-factorial experience with the following experimental factors:

Factor A – Cultivation epoch: a_1 – Autumn; a_2 – Spring.

Factor B – Cultivar: b_1 – Diamant variety; b_2 – Stuttgart variety; b_3 – Local population of Vinga.

Factor C – Cultivation method: c_1- Chive planting; c_2 – Direct planting.

The crop technology applied was the one that is specific to onion crops in field.

The biological material was represented by the varieties Diamant and Stuttgart and the local population of Vinga.

RESULTS AND DISCUSSIONS

Tables 1 and 2 presents the experimental results obtained during our experiment on onion cultivation, from the viewpoints of the three previously mentioned experimental factors. The tables present the technological elements of production, concretized in number of vegetation days, beside the number of bulbs yielded per area unit (ha) and the mean bulb weight, under the interaction of the experimental factors.

The varieties studied are adequate for chive-based planting (Stuttgart and the Local population of Vinga) or direct planting (Diamant - as seed-based planting). This study aimed at the way the „local population of Vinga” behaved, too, under conditions of direct planting (adequate planting distances, optimal fertilization, irrigation, etc.), applied in order to obtain bulbs for consumption.

According to table 1, under the influence exerted by graduation c_1 (chive planting) of factor C (cultivation method), the mean bulb weight during autumn (a_1) is bigger in all cultivars (83.5-90.8 g/piece) than under the influence of c_2 (direct planting), during the same epoch (45.5-67.4 g/piece). We may observe the same situation when we analyze, from the same perspective, onion cultivation in spring (a_2), with the specification that the mean bulb weights are smaller than during autumn (a_1), under the influence exerted by c_1 (chive planting) and c_2 (direct planting) as well.

Table 1 also presents the following aspects: the number of bulbs yielded in the factorial combination $a_1b_{1-3}c_1$ (in the autumn, in all cultivars – chive-based) is smaller (400 – 425 thousand pieces/ha) than in the combination $a_1b_{1-3}c_2$ (in the autumn, in all cultivars – direct planting), namely 450-550 thousand pieces/ha; the same rule is confirmed for spring (a_2); the number of vegetation days during autumn cultivation period (a_1) is comprised between 253 in c_1 (chive-based planting) and 191 in c_2 (direct planting), obviously smaller than in the second graduation, under the technological restriction of planting at the beginning of winter, so that seeds should not germinate until the beginning of spring; the second cultivation period a_2 – spring, maintains the same rule under the influence exerted by factor C (cultivation method), namely 221 days in c_1 (chive planting) and 171 days in c_2 (direct planting).

According to our result analysis, we may conclude that in terms of yield, the variety Diamant (b_1) is the most productive, with a mean yield of 38.4 t/ha under the influence exerted by the experimental factors A and C, compared with Stuttgart (b_2), with 35.7 t/ha and with the „*local population of Vinga*" (b_3), with 28.6 t/ha; the variety Stuttgart (b_2), under the influence of the graduation c_1 – chive-based planting, produces 37.9 t/ha, the biggest yield compared with (b_1) – 36.4 t/ha and the „*local population of Vinga*" (b_3) – 34.9 t/ha; under the influence exerted by the direct planting method (c_2), the biggest yield was produced by Diamant (b_1), with 40.3 t/ha, Stuttgart (b_2), with 33.6 t/ha and the *„local population of Vinga"* (b_3), with 22,2 t/ha; the yield of 22.2 t/ha obtained by the „*local population of Vinga"* (b_3) proves again the inconvenience of the application of direct planting in this variety, while the chive-based planting in this variety produces 34.9 t/ha.

In concordance with the detailed analysis presented in Table 1, the conclusions present deep technological significances given by the behaviour of the varieties studied (Diamant and Stuttgart) and of the „*local population of Vinga"*: the plant losses occurred in the autumn crops (a_1) are dramatically bigger than in the spring crops (a_2); these losses represent more than 40 % in a_1 compared with about 20% in a_2 (spring); the *„local population of Vinga"* behaves like the varieties Diamant (b_1) and Stuttgart (b_2), with differences ranging between ± 50.000 plants/ha; the yields obtained from the crop planted with chives (c_1), in the autumn (a_1), in the variety Diamant (b_1) and the *„local population of Vinga"* (b_3) are smaller than the directly-planted ones (c_2), namely 35.5 t/ha in Diamant, compared with 37.3 t/ha, and 33.4 t/ha in the *„local population of Vinga"*, compared with 36.5 t/ha; the yields obtained by the variety Stuttgart are in inverse correlation – they are bigger in a_1 – autumn than in a_2 - spring (38.6 t/ha compared with 37.1 t/ha); the yields obtained under the influence of the graduation c_2 (direct planting) are smaller in the crops planted in a_1 – autumn than the ones planted in a_2 – spring, in both varieties Diamant (b_1) and Stuttgart (b_2), with up to 4-6.5t/ha; the same situation is available in the case of the *„local population of Vinga"*, with the specification that the differences are bigger, 12.5-13.1 t/ha, proving that this variety is not adequate for direct-planting method, at least in terms of production; the bulb size categories, under conditions of preponderance of the 2nd category (> 80 g/bulb), range between acceptable limits in the three cultivars, with the specification that its percentage under c_1 (chive planting) and c_2 (direct planting), in interaction with a_1 – autumn is bigger than in interaction with a_2 - spring; a special mention should be made with regards to the *„local population of Vinga"* (b_3), whose yield in the 2nd bulb size category (> 80 g/piece) under the influence of c_2 (direct planting) is extremely reduced in both planting epochs (25% in a_1 and 22% in a_2), compared with 60.0-68.7% in $a_1c_1b_{1-2}$ or with 51.9-57.4% in $a_2c_1b_{1-2}$ and with 34.8-39.7% in $a_2c_2b_{1-2}$; in the 2nd size category of the *„local population of Vinga”* (b_3), between c_1 (chive planting) and c_2 (direct planting), the differences are obvious, namely 57.4-60.0% in $a_{1-2}c_1$ (autumn-spring → chive-based planting) compared with 22,0-25,0% in $a_{1-2}c_2$ (autumn-spring → direct planting), proving that the application of the direct planting method (c_2) in both epochs (a_1 – autumn and a_2 - spring) are inadequate; the most significant influence on bulb preservation capacity in all the three cultivars is exerted by cultivation period (factor A); the most reduced losses are recorded in the yield obtained during autumn (a_1), under both cultivation methods (c_1- chive planting and c_2- direct planting), namely between 11.0 and 13.7% compared with the losses of 13.7-16.9% recorded in the yield obtained under a_2 (cultivation in the spring); the biggest losses are recorded in the bulbs belonging to the 2nd category (> 80 g/piece) under the influence of the interactions between the three factors.

Continuing the synthesis analysis of the results achieved in our experiment, presented by tables 2 and 3, we may conclude that: the mean yield obtain under the influence exerted by factor A (cultivation period), under the graduation a_2 – spring, with 35.6 t/ha, is bigger than under a_1 – autumn, with 32.8 t/ha (a 8.5 t/ha growth); yield differentiation according to the 1st and 2nd categories is in the favor of a_1 – autumn, in the case of the 2nd category (> 80 g/piece), of 52.1% compared with 43.0% in a_2 - spring; the losses recorded during winter storage, in the case of the yields obtained in a_2 (spring cultivation), overtake with about 3% the yields obtained from the crops cultivated in a_1 (autumn); the mean yield obtained under the influence exerted by the graduation c_1 (chive-based planting) is 36.4 t/ha (112.5%), compared with 32.0 t/ha under the influence of c_2 (direct planting); the mean yields obtained under the influence exerted by the factor B (cultivar) are: 38.4 t/ha in Diamant (134.3%), 35.7 t/ha in Stuttgart (124.8%) and 28.6 t/ha in the *„local population of Vinga”* (100.0%); in the case of all cultivars, the biggest yields are obtained in the cultivation period a_2 - spring; in terms of 2nd bulb size category (> 80 g/piece) within total yield/ha, the biggest values (46.8-58.2%) are recorded in the autumn (a_1).

Table 3 presents the significance of yield differences, as effect of the inter-dependence between the experimental factors, according to statistical calculations specific to variance analysis method.

According to the unilateral analysis performed at points 1, 2 and 3: the yields obtained under the influence exerted by the factors a_1 (autumn cultivation period) and a_2 (spring cultivation period) are statistically covered, with a significantly positive yield difference between a_2 and a_1, proving the opportunity of onion cultivation in spring, with chive or direct cultivation as well; the significance of the yield differences obtained under the influence of factor B (cultivar), especially of its graduations (b_1- Diamant, b_2-Stuttgart and b_3- local population of Vinga), is distinctly significantly negative in the first case (b_2-b_1) and very significantly negative in the second case (b_3-b_1), proving the superiority of the variety Diamant compared with the variety Stuttgart and the local population of Vinga, in terms of production; the significance of yield differences between b_3-b_2 is very significantly negative and the yields are statistically covered, proving the higher productivity of the variety Stuttgart compared with the local population of Vinga; the yield obtained under the influence exerted by the graduations of factor C (cultivation method) - c_1 (chive-based planting) and c_2 (direct planting) is statistically covered, the yield difference significance between c_2-c_1 being very significantly negative; this proves the opportunity, under these experimental conditions, of the chive-based planting method. The differentiated economic efficiency calculation for the two cultivation methods may decide the opportunity of further promoting of one of the two methods, but not exclusively.

One of the first conclusions resulted successively to the unilateral analysis of the three experimental factors is related to the yield obtained in the crop that is cultivated in the spring, based on chive-planting.

Also, the complex analysis performed at points 4-12 shows yield differentiations that are significantly, distinctly and very significantly positive and negative, according to the bi- or tri-factorial interaction studied.

CONCLUSIONS

1. With regards to production, the variety Diamant (b_1) becomes evident with a mean yield of 38.4 t/ha, under the influence of the experimental factors A and C, compared with Stuttgart (b_2) with 35.7 t/ha and the *„local population of Vinga”* (b_3) with 28.6 t/ha;
2. The variety Stuttgart (b_2), under the influence of the graduation c_1- chive planting, produces 37.9 t/ha, which is bigger compared with Diamant (b_1) – 36.4 t/ha and the *„local population of Vinga”* (b_3) – 34.9 t/ha;
3. Under the influence exerted by the direct planting method (c_2), yields, in their decreasing order, are: Diamant (b_1) with 40.3 t/ha, Stuttgart (b_2) with 33.6 t/ha and the *„local population of Vinga”* (b_3) with 22.2 t/ha;
4. The yield of 22.2 t/ha obtained in the case of the *„local population of Vinga”* (b_3) proves the bad opportunity provided by the direct planting method in this variety, whose yield successive to chive-based planting is 34.9 t/ha.
5. The mean yield obtained under the influence of the factor A (planting epoch) favors the graduation a_2- spring with 35.6 t/ha compared with a_1- autumn with 32.8 t/ha, the growth being 8.5 t/ha;
6. The yield differentiation according to the 1st and 2nd category is in the favor of a_1- autumn, with the preponderance of the 2nd category (> 80 g/piece), of 52.1%, compared with 43.0% in a_2- spring;
7. The losses recorded during winter storage of the yields obtained in a_2 (spring cultivation) overtake with about 3% the losses recorded in the case of the yields obtained in a_1 (autumn);
8. The mean yield obtained under the influence of the graduation c_1 (chive planting) is 36.4 t/ha (112.5%), compared with 32.0 t/ha under the influence of c_2 (direct planting).

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TABLES

Table 1

Experimental results of onion yield in the varieties Diamant, Stuttgart and the Local population of Vinga, in crops created through chive planting and direct planting, in the autumn and spring

Technological specifications		U.M.	Factor B – Cultivar											
			b_1- variety Diamant				b_2- variety Stuttgart				b_3- Local population of Vinga			
			Factor C – Planting method											
			c_1- chive		c_2- direct planting		c_1- chive		c_2- direct planting		c_1- chive		c_2- direct planting	
			Factor A – Planting epoch											
			a_1- Autumn	a_2- Spring	a_1- A	a_2- S	a_1- A	a_2- S	a_1- A	a_2- S	a_1- A	a_2- S	a_1- A	a_2- S
Days of vegetation		no. days	253	221	191	171	253	221	191	171	253	221	191	171
Bulbs yielded		pieces/ha	410	600	550	700	425	570	480	670	400	580	450	685
Mean weight/bulb		g/piece	86.5	62.2	67.4	62.1	90.8	65.1	66.2	52.6	83.5	62.9	45.5	35.0
Mean yield		t/ha	35.5	37.3	37.1	43.5	38.6	37.1	31.8	35.3	33.4	36.5	20.3	24.0
Of which categ.:	I<80	t/ha	11.9	17.9	24.2	30.5	12.1	17.6	17.2	21.3	13.4	15.5	15.9	18.7
		%	33.6	48.1	65.2	70.2	31.3	47.5	54.1	60.3	40.0	42.6	75.0	78.0
	II >80	t/ha	23.6	19.4	12.9	13.0	26.5	19.5	14.6	14.0	20.0	21.0	5.1	5.3
		%	66.4	51.9	34.8	29.8	68.7	52.5	45.9	39.7	60.0	57.4	25.0	22.0
Storage duration		no. days	263	231	183	191	263	231	183	191	263	231	183	191
Losses during storage of total yield/ha		t/ha	4.5	5.1	4.7	7.2	5.3	5.6	3.5	6.0	4.4	5.3	2.3	3.9
		%	12.7	13.7	12.8	16.5	13.7	15.1	11.0	16.9	13.1	14.6	11.4	16.2
Of which categ.:	I<80	t/ha	0.6	1.2	0.9	2.1	0.6	0.9	0.6	1.2	0.5	1.0	0.4	0.9
		%	1.7	3.2	2.6	4.9	1.5	2.4	1.8	3.4	1.4	2.7	2.1	3.9
	II >80	t/ha	3.9	3.9	3.8	5.1	4.7	4.7	2.9	4.8	3.9	4.3	1.9	3.0
		%	11.0	11.7	10.2	16.6	12.2	12.7	9.2	13.5	11.7	11.9	9.3	12.3
Exp. mean Mx	Cultivar (b_{1-3})	t/ha	38.4				35.7				28.6			
	Chive	t/ha	36.4				37.9				34.9			
	Planting	t/ha	40.3				33.6				22.2			
	Autumn	t/ha	36.3				35.2				26.9			
	Spring	t/ha	40.4				36.2				30.3			
Mx for:	Mx – cultivar(B)	t/ha	34.2											
	Chive (c_1)	t/ha	36.4											
	Planting (c_2)	t/ha	32.0											
	Autumn (a_1)	t/ha	32.8											
	Spring (a_2)	t/ha	35.6											
	Mx	t/ha	34.2											

Table 2

Synthesis of the experimental results of onion cultivation through chive planting and direct planting, in different planting epochs

Exp. fact.			Factor C Crop cultivation method						Factor B (Cultivar)							Factor A (Crop cultivation epoch)						
A	B	C	Mean yield (t/ha)	% of c_1	Of which: Categ. I		Categ. II		Mean yield (t/ha)	% of b_1	% of Mxb_{1-3}	Of which: Categ. I		Categ. II		Mean yield (t/ha)	% of a_1	% of Mx	Of which: Categ. I		Categ. II	
					t/ha	%	t/ha	%				t/ha	%	t/ha	%				t/ha	%	t/ha	%
a_1	b_1	c_1	35.5	100.0	11.9	33.6	23.6	66.4	36.3	100.0	94.5	18.1	49.9	18.2	50.1	32.8	100.0	95.9	15.7	47.9	17.1	52.1
		c_2	37.1	104.5	24.2	65.2	12.2	34.8														
	b_2	c_1	38.6	1000	12.1	31.3	26.5	68.7	35.2	97.0	98.6	14.7	41.8	20.5	58.2							
		c_2	31.8	82.4	17.2	54.1	14.6	45.9														
	b_3	c_1	33.4	100.0	13.4	40.0	20.0	60.0	26.9	74.1	94.1	14.3	53.2	12.6	46.8							
		c_2	20.3	60.8	15.2	75.0	5.1	25.0														
a_2	b_1	c_1	37.3	100.0	17.9	48.1	19.4	51.9	40.4	100.0	105.2	24.2	59.9	16.2	40.1	35.6	108.5	104.1	20.3	57.0	15.3	43.0
		c_2	43.5	116.6	30.5	70.2	13.0	29.8														
	b_2	c_1	37.1	100.0	17.6	47.5	19.5	52.5	36.2	89.6	101.4	19.5	53.9	16.7	46.1							
		c_2	35.3	95.1	21.3	60.3	14.0	39.7														
	b_3	c_1	36.5	100.0	15.5	42.6	21.0	57.4	30.3	75.0	105.9	17.1	56.4	13.2	43.6							
		c_2	24.0	65.8	18.6	78.0	5.3	22.0														
a_3 M(x)	b_1	c_1	36.4	100.0	14.9	40.9	21.5	59.1	38.4	100.0	100.0	21.2	55.2	17.2	44.8	34.2	104.3	100.0	18.0	52.6	16.2	47.4
		c_2	40.3	110.7	27.4	68.0	12.9	32.0														
	b_2	c_1	37.9	100.0	14.8	39.1	23.1	60.9	35.7	93.0	100.0	17.1	47.9	18.6	52.1							
		c_2	33.6	88.7	19.3	57.4	14.3	42.6														
	b_3	c_1	34.9	100.0	14.5	41.5	20.4	58.5	28.6	74.5	100.0	15.7	54.9	12.9	45.1							
		c_2	22.2	63.6	17.0	76.6	5.2	23.4														
	*	c_1	36.4	100.0	14.7	40.4	21.7	59.6	*	*	*	*	*	*	*							
	*	c_2	32.0	87.9	21.2	66.3	10.8	33.7														
Exp. mean Mx	-	-	34.0	-	18.0	52.6	16.2	47.4	34.2	-	-	18.0	52.6	16.2	47.4	34.2	104.3	100.0	18.0	52.6	16.2	47.4

Table 3

Synthesis of the experimental results of onion cultivation through chive planting and direct planting, in different planting epochs, in terms of losses during storage

Exp.fact.			Factor C (Cultivation method)								Factor B (Cultivar)								Factor A (Cultivation epoch)							
A	B	C	Mean yield (t/ha)	Storage duration(days)	Losses from yield/ha						Mean yield (t/ha)	Storage duration (days)	Losses from yield/ha						Mean yield (t/ha)	Storage duration (days)	Losses from yield/ha					
					Total		Of which						Total		Of which						Total		Of which			
					t/ha	%	Categ. I		Categ. II				t/ha	%	Categ. I		Categ. II				t/ha	%	Categ. I		Categ. II	
							t/ha	%	t/ha	%					t/ha	%	t/ha	%					t/ha	%	t/ha	%
a_1	b_1	c_1	35,5	263	4.5	12.7	0.6	1.7	3.9	11.0	36.3	223	4.6	12.7	0.8	2.2	3.8	10.5	32.8	223	4.1	12.5	0.6	1.8	3.5	10.7
		c_2	37.1	183	4.7	12.8	0.9	2.6	3.8	10.2																
	b_2	c_1	38.6	263	5.3	13.7	0.6	1.5	4.7	12.2	35.2	223	4.4	12.5	0.6	1.7	3.8	10.8								
		c_2	31.8	183	3.5	11.0	0.6	1.8	2.9	9.2																
	b_3	c_1	33.4	263	4.4	13.1	0.5	1.4	3.9	11.7	26.9	223	3.4	12.6	0.4	1.5	3.0	11.1								
		c_2	20.3	183	2.3	11.4	0.4	2.1	1.9	9.3																
a_2	b_1	c_1	37.3	231	5.1	13.7	1.2	3.2	3.9	10.5	40.4	211	6.2	15.3	1.7	4.2	4.5	11.1	35.6	211	5.5	15.4	1.3	3.7	4.2	11.7
		c_2	43.5	191	7.2	16.5	2.1	4.9	5.1	11.6																
	b_2	c_1	37.1	231	5.6	15.1	0.9	2.4	4.7	12.7	36.2	211	5.8	16.0	1.1	3.0	4.7	13.0								
		c_2	35.3	191	6.0	16.9	1.2	3.4	5.8	13.5																
	b_3	c_1	36.5	231	5.3	14.6	1.0	2.7	4.3	11.9	30.3	211	4.6	15.2	1.0	3.3	3.6	11.9								
		c_2	24.0	191	3.9	16.2	0.9	3.9	3.0	12.3																
a_3 M(x)	b_1	c_1	36.4	247	4.8	13.2	0.9	2.5	3.9	10.7	38.4	217	5.4	14.1	1.3	3.4	4.1	10.7	34.2	217	4.8	13.9	0.9	2.6	3.9	11.3
		c_2	40.3	187	6.0	14.9	1.5	3.7	4.5	11.2																
	b_2	c_1	37.9	247	5.4	14.2	0.7	1.8	4.7	12.4	35.7	217	5.1	14.3	0.9	2.5	4.2	11.8								
		c_2	33.6	187	4.7	14.0	0.9	2.7	3.8	11.3																
	b_3	c_1	34.9	247	4.8	13.8	0.7	2.0	4.1	11.8	28.6	217	4.0	14.0	0.7	2.4	3.3	11.6								
		c_2	22.2	187	3.1	14.0	0.6	2.7	2.5	11.3																
	*	c_1	36.4	247	5.0	13.7	0.8	2.2	4.2	11.5	*	*	*	*	*	*	*	*								
	*	c_2	32.0	187	4.6	14.4	1.0	3.1	3.5	11.3																
Exp. mean Mx			34.0	217	4.8	14.0	0.9	2.6	3.9	11.4	34.2	207	4.8	14.1	1.0	2.9	3.8	11.2	34.2	217	4.8	13.9	0.9	2.6	3.9	11.3

Table 4

Unilateral influences and of the interactions between experimental factors on onion yield

Variant	Mean yield (t/ha)		Relative yield (%)	Difference (±t/ha)	Significance of difference
1. Unilateral influence of planting epoch on onion yield					
a2-a1	35.62	32.78	108.64	2.83	***
DL 5%= 0.81 DL 1% = 1.23 DL 0.1% = 1.98					
2. Unilateral influence of cultivar on onion yield					
b2-b1	35.70	38.35	93.09	-2.65	00
b3-b1	28.55	38.35	74.45	-9.80	000
b3-b2	28.55	35.70	79.97	-7.15	000
DL 5% = 1.50 DL 1% = 2.07 DL 0.1% = 2.85					
3. Unilateral influence of planting method on onion yield					
c2-c1	32.00	36.40	87.91	-4.40	000
DL 5% = 1.59 DL 1% = 2.15 DL 0.1% = 2.87					
4. Influence of the interactions between various planting epochs and the same or different cultivars					
a2b1-a1b1	40.40	36.30	111.29	4.10	***
a2b2-a1b2	36.20	35.20	102.84	1.00	-
a2b3-a1b3	30.25	26.85	112.66	3.40	**
a2b2-a1b1	36.20	36.30	99.72	-0.10	-
DL 5% = 1.91 DL 1% = 2.68 DL 0.1% = 3.79					
5. Influence of the interactions between the same planting epoch and different cultivars					
A1b2- a1b1	35.20	36.30	96.97	-1.10	-
A1b3- a1b1	26.85	36.30	73.97	-9.45	000
A1b3- a1b2	26.85	35.20	76.28	-8.35	000
A2b2- a2b1	36.20	40.40	89.60	-4.20	000
A2b3- a2b1	30.25	40.40	74.88	-10.15	000
A2b3- a2b2	30.25	36.20	83.56	-5.95	000
DL 5% = 2.13 DL 1% = 2.93 DL 0.1% = 4.03					
6. Influence of the interactions between the same planting epoch and different planting methods					
A1c2- a1c1	29.73	35.83	82.98	-6.10	000
A2c2- a2c1	34.27	36.97	92.70	-2.70	0
DL 5% = 2.24 DL 1% = 3.04 DL 0.1% = 4.06					

7. Influence of the interactions between the same cultivars and different planting methods					
B1c2- b1c1	40.30	36.40	110.71	3.90	**
B2c2- b2c1	33.55	37.85	88.64	-4.30	00
B3c2- b3c1	22.15	34.95	63.38	-12.80	000
DL 5% = 2.75 DL 1% = 3.72 DL 0.1% = 4.97					
8. Influence of the interactions between different cultivars and the same or different planting methods					
B2c1- b1c1	37.85	36.40	103.98	1.45	-
B3c1- b1c1	34.95	36.40	96.02	-1.45	-
B3c1- b2c1	34.95	37.85	92.34	-2.90	0
B2c2- b1c2	33.55	40.30	83.25	-6.75	000
B3c2- b1c2	22.15	40.30	54.96	-18.15	000
B3c2- b2c2	22.15	33.55	66.02	-11.40	000
B2c2- b1c1	33.55	36.40	92.17	-2.85	0
DL 5% = 2.46 DL 1% = 3.35 DL 0.1% = 4.52					
9. Influence of the interactions between different planting epochs and the same or different planting methods					
A2c1- a1c1	36.97	35.83	103.16	1.13	-
A2c2- a1c2	34.27	29.73	115.25	4.53	***
A2c2- a1c1	34.27	29.73	115.25	4.53	***
DL 5% = 1.78 DL 1% = 2.46 DL 0.1% = 3.42					
10. Influence of the interactions between the same planting epoch and the same cultivars and different planting methods					
a1b1c2- a1b1c1	37.10	35.50	104.51	1.60	-
a2b2c2- a2b2c1	35.30	37.10	95.15	-1.80	-
DL 5% = 3.89 DL 1% = 5.26 DL 0.1% = 7.04					
11. Influence of the interactions between the same planting epoch and different cultivars and the same cultivation method					
a1b2c1- a1b1c1	38.60	35.50	108.73	3.10	-
a1b3c1- a1b1c1	33.40	35.50	94.08	-2.10	-
a1b3c1- a1b2c1	33.40	38.60	86.53	-5.20	00
a2b2c2- a2b1c2	35.30	43.50	81.15	-8.20	000
a2b3c2- a2b1c2	24.00	43.50	55.17	-19.50	000
a2b3c2- a2b2c2	24.00	35.30	67.99	-11.30	000
DL 5% = 3.47 DL 1% = 4.73 DL 0.1% = 6.40					
12. Influence of the interactions between different planting epochs and the same cultivars and the same cultivation method					
a2b1c1- a1b1c1	37.30	35.50	105.07	1.80	-
a2b1c2- a1b1c2	43.50	37.10	117.25	6.40	***
a2b2c1- a1b2c1	37.10	38.60	96.11	-1.50	-
a2b2c2- a1b2c2	35.30	31.80	111.01	3.50	*
a2b3c1- a1b3c1	36.50	33.40	109.28	3.10	-
a2b3c2- a1b3c2	24.00	20.30	118.23	3.70	*
DL 5% = 3.35 DL 1% = 4.58 DL 0.1% = 6.24					

Study of the impact of foliar fertilizers and fertirrigation modern systems upon the production of some pepper hybrids cultivated in cold Spanish construction solariums

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ABSTRACT

The increase of energy costs (electricity, heating, carburant), used for peppers production in the forced culture system, determined the decrease of surfaces used in this purpose and at the same time growers' conception for obtaining productions in protected spaces, where the production costs are incomparable lower. Evidently there were improved the culture technologies and even modernized those operations that have a major impact upon the production level, among these being the cultivar, the irrigation method, the root and extra-root fertilizing system and finally the culture space, to which the construction costs significantly influences the economical efficiency of the production activity.

INTRODUCTION

The high content of peppers in vitamin C, higher than in any other fruit of 4-5 times more than in lemons and oranges, makes this culture a very important source of vitamins for humans (Andronicescu, 1968). After the 80's until now in the top of pepper producers are fighting for the highest places, with permutations from a period of 10 year to another, countries like China (which stayed in the top), Mexico, Turkey, Spain, U.S.A. and in the area closer to our country, Italy, Holland, Bulgaria and Hungary (Horgoş, 2003). In Romania, in the last 15 years the production of sweet peppers and other vegetables was significant reduced. The production volume of sweet peppers from forced and protected cultures in Romania grew up to 80000 t in 2004 because of the electricity costs, which represented 65% of the production costs (World Organization of Alimentation and Agriculture, Final report concerning cultures in greenhouses in South-Eastern Europe countries, 2004).

With all these and the increase of heating and carburant costs the cultivators started to consider culture technologies of these species in protected spaces where these costs are highly diminished. Evidently there were improved and even modernized those technological processes, which have a major impact upon the production level, among these being the cultivar, the irrigation method, the root and extra-root fertilizing system and finally the culture space, to which the construction costs significantly influences the economical efficiency of the production activity (Voican, 2004).

The results of the study concerning the conjugated action of some modernized technological processes upon the pepper production obtained in a Spanish construction solarium are presented in this paper by showing up the impact of extra-root fertilization as a supplement of fertilizers and stimulation of plants metabolism and flower fastening degree.

MATERIAL AND METHODS

The goal of the studies was to determine the productive and quality potential of two Californian type pepper hybrids form Spain, under the impact of fertirrigation system (Agriplant and Kemira) and to stimulate plants' metabolism and flower fastening by using different extra-root products, cultivated in a special construction solarium, specific for Spanish vegetable culture.

The research goals refer to: studying the productive and quality potential of the two hybrids in different fertirrigation conditions made in vegetation, which are in case of plants' growth and development under the impact of Agriplant and Kemira fertilizers and stimulating their metabolism and flower fastening by applying the foliar fertilizer Bionex, the bio-regulator Solex, the foliar fertilizer Agroleaf and the complex foliar nutrient Cropmax; determining the production elements that influence the quantity and quality of production.

In order to get to the mentioned purpose and goals there was established a three factor experiment, with the following factors:

Factor A – The hybrid: a_1 – Navas F_1; a_2 – Bernal F_1.

Factor B – The fertirrigation system: b_1 – fertirrigation system with Agriplant; b_2 – fertirrigation system with Kemira.

Factor C – Natural or synthesised products used for stimulating plants' metabolism and flower fastening: c_1 – control, not foliar fertilised; c_2 – foliar fertiliser Bionex; c_3 – complex foliar nutrient super-concentrated Cropmax; c_4 – soluble foliar fertiliser Agroleaf; c_5 – bio-regulator Solex.

RESULTS AND DISCUSSIONS

Along the vegetation period there were made biometrical measurements and phonological observations concerning: the number of flowers on each plants' bend, the number of fastening and aborted flowers, the harvestable fruits on the plant, average weight of one fruit and the average production/plant and per hectare under the impact of the three experimental factors.

In table 1 there are presented the experimental results of the two studied hybrids (a_1- Navas F_1 and a_2 - Bernal F_1) under the two fertirrigation systems (b_1 –Agriplant fertirrigation system, b_2 – Kemira fertirrigation system) and under the impact of applying in vegetation the four extra-root products (c_2 – foliar fertilizer Bionex, c_3 – complex foliar nutrient super concentrated Cropmax, c_4 – soluble foliar fertilizer Agroleaf, c_5 – bio-regulator Solex) compared to c_1 – control, not fertilized. It can be seen a strong difference of the number of flowers per plant of the two hybrids, the highest number being in a_1 – Navas F_1, these being with 2-3 more than the other hybrid. The same difference can be seen in case of the number of fastened flowers and harvestable fruits. A higher number of flowers/plant can be observed in most cases under the impact of Solex (c_5) sprayings upon a_1 – Navas F1 in $a_1b_1c_5$ and $a_1b_1c_2$ in case of Bionex sprayings, and also upon a_2 – Bernal F1 in $a_2b_1c_2$ and $a_2b_1c_5$. The number of fastened flowers varies a lot from one graduation to another of factor C, being of 80.6-91.1% for a_1 – Navas F1 and 81.9-92.4% for a_2 – Bernal F1.

The number of harvestable fruits per plant also varies from one hybrid to the other, in general the percentage of fastened flower/plant being between 84.8-93.4% (a_1 – Navas F1 in $a_1b_1c_1$ and $a_1b_2c_1$) and 79.7-92.6% (a_2 – Bernal F1 in $a_2b_1c_1$ and $a_2b_2c_3$). There can be seen a favorable impact of Cropmax foliar nutrient upon the number of harvestable fruits per plant.

The number of harvestable fruits, where there was used Kemira as fertilizer, was higher for both hybrids (93.0% for $a_1b_2c_4$, 93.4% for $a_1b_2c_3$ and 92.6% for $a_2b_2c_3$ compared with 87.1% for $a_1b_1c_4$, 87.3% for $a_1b_1c_3$, 90.0% for $a_2b_1c_4$ and 90.2% for $a_2b_1c_3$). The fruits have an average weight very high, for the first hybrid a_1- Navas F1 surpassing 315 g/piece in al the combinations of B and C factors' graduations. For a_2 – Bernal F1 the average weight surpasses 327 g/piece and it gets to a maximum of 375.1 g/piece in $a_2b_2c_3$ compared to a_1- Navas F1, where the maximum was of 380.1 g/piece in $a_1b_2c_3$.

At the same time, the productions obtained per plant and per hectare are very variable, the lowest values being obtained for both hybrids in Agriplant (b_1) fertirrigation system under the impact of graduation c_1 – control, not fertilized. Foliar fertilizations with Bionex-c_2, Cropmax-c_3 and Agroleaf-c_4 give differentiated production increase for both hybrids in both fertirrigation systems.

Out of tables 2 and 3 in which there is presented the synthesis of the experimental results we can notice a pretty accentuated difference of the average weight of fruits, so that the values in case of those plants where Kemira fertilizer was used were higher with 32.6-35.1 g/piece. The average production per plant and per hectare were higher where Kemira fertilizer was used, significantly surpassing the other values with 0.558-0.813 kg/plant.

The average production per hectare for factor B varies between 148.8-188.0 t/ha in b_1 (fertirrigation with Agriplant) and 159.1-205.5 t/ha in b_2 (fertirrigation with Kemira), the production surpass in b_2 being significant of 7.8%. In fact, the productions of each hybrid obtained in b_2 (fertirrigation with Kemira) were higher with 6.5-9.1%, leading to the conclusion that fertilizing with Kemira product is determinant in obtaining high productions per surface unit.

The average productions obtained under the impact of factor C (c_1 – control, not fertilized foliar, c_2 – foliar fertilizer Bionex, c_3 – complex foliar nutrient super concentrated Cropmax, c_4 – soluble foliar fertilizer Agroleaf, c_5 – bio-regulator Solex) vary a lot for each hybrid, with percentages between 19.0 and 30.8% than c_1 – control, not fertilized foliar.

The average production obtained under the impact of Agriplant fertirrigation in c_2 (foliar fertilization with Bionex) and c_3 (foliar fertilization with Cropmax) is of 187.5 t/ha – 126.0%, respectively 188.0t/ha – 126.3% than c_5 (spraying with Solex bio-regulator) of 177.0 t/ha - 118.9% and than c_1 (control, not fertilized foliar) of 148.8 -100.0%.

The average production obtained under the impact of Kemira in c_4 (fertilization with Agroleaf) and c_3 (foliar fertilization with Cropmax) is of 199.2 t/ha – 125.2%, respectively 205.5 t/ha – 129.2%, than c_1 (control not fertilized) of 159.1 t/ha (100%) and than c_5 (spraying with Solex bio-regulator) de 190.4 t/ha – 119.7%.

A first conclusion is that the impact of spraying products (c_1-c_5) upon the production level of the two hybrids is different according to the fertirrigation system. For both hybrids a_1-Navas F1 and a_2 – Bernal F1 the highest productions are obtained under the impact of b_1 (fertirrigation with Agriplant) when there were applied extra-root fertilizers Bionex (c_2) and Cropmax (c_3). In case of Kemira (b_2) fertirrigation system the highest productions were obtained under the impact of Bionex (c_2) and Cropmax (c_3) fertilizers for Navas F1 hybrid (a_1), while for Bernal F1 hybrid (a_2) they were obtained under the impact of Cropmax (c_3) and Agroleaf (c_4) fertilizers. The average production for factor B was of 189.9 t/ha in case of b_2 – Kemira fertirrigation system (107.8%) than 176.2 t/ha (100.0%) in b_1 –Agriplant fertirrigation system.

Concerning the impact of factor C upon the production we conclude that applying Bionex foliar fertilizer, Cropcare complex foliar nutrient super concentrated and Agroleaf foliar soluble fertilizer compared to the control not fertilized (c_1) is very favorable upon peppers, the production increases being very significant, of 37.6 t/ha (Bionex - c_2), respectively 42.9 t/ha (Cropmax - c_3) and 36.7 t/ha (Agroleaf – c_4) (24.4%, 27.8% and 23.1% more than c_1 – control not foliar fertilized).

The average production per hectare for factor A is differentiated so that for a_2 – Bernal F_1 is 179.0 t/ha, with 14.3% lower than a_1 – Navas F_1 – 187.1 t/ha (100.0%). The average productions obtained are variable, with values between 179.0-187.1 t/ha (97.8-102.2%) compared to the control average value of the experiment a_3 (Mx) (100.0%), which had a production of 183.1 t/ha. In this case, the productions of the two hybrids are with +2.2% and respectively -12.2%, showing up Navas F1 (a_1) with a plus of production of 8.1 t/ha (+14.3%) than Bernal F1 (a_2).

In table 4 there are presented, according to the mathematical statistic calculations, specific for the variance analyze method, the significances of the differences of production obtained with the comparisons made as an effect of the interdependence of experimental factors.

Out of the unilateral analyze of the experimental factors from point 1 it results that the significance of the production difference between a_2 (Bernal F_1) and a_1 (Navas F_1) and between a_3 (Experiment average Mx) and a_1 (Navas F1) and a_2 (Bernal F_1) is very significant negative in the first case, distinct significant negative in the second case and very significant positive in the third case, showing the superiority of Navas F1 (a_1) than Bernal F1 (a_2) and the experiment average (a_3) and the experiment average (a_3) than Bernal F1 (a_2). Out of the same unilateral analyze from point 2 it results that the impact of the fertirrigation system upon the two hybrids is important, so that the significance of the production difference between b_2 (fertirrigation with Kemira) and b_1 (fertirrigation with Agriplant) is very significant positive.

A first conclusion that results after the unilateral analyze of the two factors is the production obtained from Navas F_1 in the fertirrigation system with Kemira (b_2) of 13.825 t/ha, higher than in b_1 – fertirrigation with Agriplant.

Out of the same analyze from point 3 we can notice the productions obtained after applying in vegetation the foliar fertilizer Bionex (c_1), the complex foliar nutrient super concentrated Cropcare (c_2) and the soluble foliar fertilizer Agroleaf (c_3), being statistically covered, the significances of the production differences are very significant positive in the first six cases ($c_2 \rightarrow c_1$, $c_3 \rightarrow c_1$, $c_4 \rightarrow c_1$, $c_5 \rightarrow c_1$, $c_3 \rightarrow c_2$) and very significant negative in the last five cases, which shows the good efficiency of the three foliar fertilizers mentioned above, than the others.

At the same time, out of the complex analyse made at points 4-12, the influences of the interactions between the three factors, it results production differences as being very significant positive and negative, some without significance or significant positive or negative.

CONCLUSIONS

1. The studied hybrids Navas F_1 and Bernal F_1 are new pepper hybrids from Spain, which are tested in order to expand their culture because of their features, being recommended for industrialization but also for fresh consume.
2. The obtained productions are over 145.5 t/ha, noticing hybrid Navas F_1 with a maximum of 214 t/ha, productions that surpass those of the already known hybrids that are being cultivated in our country.
3. It can be noticed that both hybrids Navas F1 and Bernal F_1 had productions of over 180 t/ha in case of fertirrigation with Kemira and the use of any foliar fertilizer.
4. The fertirrigation system with Kemira used at the two hybrids (Navas F_1 and Bernal F_1) is recommended to be used in culture, because the productions obtained under the impact of this factor (b_2) are statistically covered, the production differences being very significant positive.
5. The natural or synthesis products used for stimulating plants' metabolism and fastening of flowers are favorable upon the production of peppers, these being higher than the control not fertilized, with percentages of 19.4-27.8%.
6. We recommend the continuing of researches concerning the behaviour of these hybrids in solariums, concerning the productive and quality potential under the impact of foliar fertilizers used in vegetation.

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TABLES

Table 1

Experimental results concerning peppers hybrids' behavior cultivated in Spanish construction solariums in the Ist cycle prolonged 2008-2009

Experimental factor: A (The hybrid)	B (The fertirrigation system)	C (Extra-root spraying products)	No. of flowers/plant	Of which: fastened flowers No.	%	aborted flowers	Harvestable fruits/plant	Nr.	%	Average weight of one fruit (g/piece)	Average production /plant (kg/plant)	Average production/ha (t/ha)
a_1 – Navas F1	b_1 – Agriplant	c_1 -	35.2	28.4	80.6	6.8	26.9	24.1	84.8	315.7	7.609	152.2
		c_2 - Bionex	38.3	31.0	80.9	7.3		27.6	89.0	339.5	9.370	187.4
		c_3 - Cropmax	35.6	31.1	87.3	4.5		27.9	89.7	340.2	9.492	189.8
		c_4 - Agroleaf	34.9	30.4	87.1	4.5		27.2	89.5	338.9	9.218	184.4
		c_5 - Solex	36.4	31.3	86.1	5.1		27.8	88.8	325.7	9.055	181.1
	b_2 – Kemira	c_1 -	33.5	28.0	83.6	5.5	26.5	24.4	87.1	335.9	8.196	163.9
		c_2 - Bionex	32.4	29.1	89.9	3.3		26.9	92.4	376.8	10.136	202.7
		c_3 - Cropmax	33.2	30.2	91.1	3.0		28.2	93.4	380.1	10.719	214.4
		c_4 - Agroleaf	31.5	28.4	90.2	3.1		26.4	93.0	378.3	9.97	199.7
		c_5 - Solex	32.4	29.2	90.1	3.2		26.8	91.8	364.6	9.771	195.4
a_2 – Bernal F1	b_1 – Agriplant	c_1 -	33.7	27.6	81.9	6.1	26.2	22.0	79.7	330.7	7.275	145.5
		c_2 - Bionex	38.1	33.7	88.5	4.4		28.6	84.8	327.6	9.369	187.4
		c_3 - Cropmax	35.7	32.2	90.2	3.5		27.5	85.4	338.5	9.309	186.2
		c_4 - Agroleaf	34.6	31.1	90.0	3.5		26.5	85.2	329.7	8.737	174.7
		c_5 - Solex	35.9	31.7	88.3	4.2		26.3	82.9	329.6	8.668	173.4
	b_2 – Kemira	c_1 -	31.7	27.0	85.1	4.7	25.0	23.4	86.7	329.5	7.710	154.2
		c_2 - Bionex	29.9	27.6	92.2	2.3		25.4	92.0	370.7	9.416	188.3
		c_3 - Cropmax	30.6	28.3	92.4	2.3		26.2	92.6	375.1	9.828	196.6
		c_4 - Agroleaf	29.6	27.1	91.7	2.5		25.0	92.2	373.3	9.933	198.7
		c_5 - Solex	30.1	27.7	91.9	2.4		25.0	90.3	370.6	9.265	185.3
a_3 – Media exp. (Mx)	b_1 – Agriplant	c_1 -	32.4	28.0	86.3	4.4	26.5	23.0	82.1	323.5	7.441	148.8
		c_2 - Bionex	38.1	32.3	84.7	5.8		28.1	87.0	333.6	9.374	187.5
		c_3 - Cropmax	35.6	31.6	88.8	4.0		27.7	87.7	339.4	9.401	188.0
		c_4 - Agroleaf	34.8	30.8	88.6	4.0		26.9	87.3	334.3	8.993	179.9
		c_5 - Solex	36.0	31.4	87.2	4.6		27.0	86.0	327.7	8.848	177.0
	b_2 – Kemira	c_1 -	32.6	27.5	84.4	5.1	25.9	23.9	87.0	332.7	7.953	159.1
		c_2 - Bionex	31.2	28.4	91.1	2.8		26.2	92.2	373.8	9.794	195.9
		c_3 - Cropmax	31.8	29.2	91.8	2.6		27.2	93.2	377.6	10.274	205.5
		c_4 - Agroleaf	31.5	28.6	90.9	2.9		26.5	92.7	375.8	9.960	199.2
		c_5 - Solex	31.3	28.5	91.0	2.8		25.9	90.9	367.6	9.521	190.4

Table 2

Synthesis of the production results of pepper hybrids cultivated in Spanish construction solariums covered with polyethylene sheet in the I[st] cycle prolonged 2008-2009

A	B	C	Average weight of a fruit (g/piece)	Average production per plant and hectare for:							
				Factor C			Factor B			Factor A	
				kg/pl.	t/ha	%	kg/pl.	t/ha	%	t/ha	%
a_1	b_1	c_1	315.7	7.609	152.2	100.0	8.949	179.0	100.0	187.1	102.2
		c_2	339.5	9.370	187.4	123.1					
		c_3	340.2	9.492	189.8	124.7					
		c_4	338.9	9.218	184.4	121.2					
		c_5	325.7	9.055	181.1	119.0					
	b_2	c_1	335.9	8.196	163.9	100.0	9.762	195.2	109.1		
		c_2	376.8	10.136	202.7	123.7					
		c_3	380.1	10.719	214.4	130.8					
		c_4	378.3	9.97	199.7	121.8					
		c_5	364.6	9.771	195.4	119.2					
a_2	b_1	c_1	330.7	7.275	145.5	100.0	8.672	173.4	100.0	179.0	97.8
		c_2	327.6	9.369	187.4	128.8					
		c_3	338.5	9.309	186.2	127.9					
		c_4	329.7	8.737	174.7	120.1					
		c_5	329.6	8.668	173.4	119.2					
	b_2	c_1	329.5	7.710	154.2	100.0	9.230	184.6	106.5		
		c_2	370.7	9.416	188.3	122.2					
		c_3	375.1	9.828	196.6	127.5					
		c_4	373.3	9.933	198.7	128.9					
		c_5	370.6	9.265	185.3	120.2					
a_3	b_1	c_1	323.5	7.441	148.8	100.0	8.811	176.2	100.0	183.1	100.0
		c_2	333.6	9.374	187.5	126.0					
		c_3	339.4	9.401	188.0	126.3					
		c_4	334.3	8.993	179.9	120.9					
		c_5	327.7	8.848	177.0	118.9					
	b_2	c_1	332.7	7.953	159.1	100.0	9.496	189.9	107.8		
		c_2	373.8	9.794	195.9	123.1					
		c_3	377.6	10.274	205.5	129.2					
		c_4	375.8	9.960	199.2	125.2					
		c_5	367.6	9.521	190.4	119.7					

Table 3

Synthesis of the production results of pepper hybrids as an effect of the interaction between the experimental factors

Experimental factors			**Average production per hectare (t/ha and %) for:**								
A	**B**	**C**	**Factor C**				**Factor B**		**Factor A**		
			Kg/pl.	c_1-c_5	b_{1-2} c_{1-5}	%	b_{1-2}	%	a_{1-3}	% to a_1	% to Mx
a_1	b_1	c_1	7.609	152.2	b_{1-2} c_1 158.1	100.0	179.0	100.0	187.1	100.0	102.2
		c_2	9.370	187.4							
		c_3	9.492	189.8	b_{1-2} c_2 195.1	123.4					
		c_4	9.218	184.4							
		c_5	9.055	181.1	b_{1-2} c_3 202.1	127.8					
	b_2	c_1	8.196	163.9			195.2	109.1			
		c_2	10.136	202.7	b_{1-2} c_4 192.1	121.5					
		c_3	10.719	214.4							
		c_4	9.97	199.7	b_{1-2} c_5 188.3	119.1					
		c_5	9.771	195.4							
a_2	b_1	c_1	7.275	145.5	b_{1-2} c_1 149.9	100.0	173.4	100.0	179.0	95.7	97.8
		c_2	9.369	187.4							
		c_3	9.309	186.2	b_{1-2} c_2 187.9	125.3					
		c_4	8.737	174.7							
		c_5	8.668	173.4	b_{1-2} c_3 191.4	127.7					
	b_2	c_1	7.710	154.2			184.6	106.5			
		c_2	9.416	188.3	b_{1-2} c_4 186.7	124.5					
		c_3	9.828	196.6							
		c_4	9.933	198.7	b_{1-2} c_5 179.4	119.6					
		c_5	9.265	185.3							
a_3	b_1	c_1	7.441	148.8	b_{1-2} c_1 153.9	100.0	176.2	100.0	183.1	97.9	100.0
		c_2	9.374	187.5							
		c_3	9.401	188.0	b_{1-2} c_2 191.5	124.4					
		c_4	8.993	179.9							
		c_5	8.848	177.0	b_{1-2} c_3 196.8	127.8					
	b_2	c_1	7.953	159.1			189.9	107.8			
		c_2	9.794	195.9	b_{1-2} c_4 189.6	123.1					
		c_3	10.274	205.5							
		c_4	9.960	199.2	b_{1-2} c_5 183.8	119.4					
		c_5	9.521	190.4							

Table 4

Unilateral influences and of the interactions between the experimental factors upon peppers' production of Californian type cultivated in Spanish construction solariums in Ist cycle prolonged 2009

Variant	Average production (t/ha)		Relative production (%)	Difference (±t/ha)	Significance
1. Unilateral impact of the hybrid upon the production					
a2-a1	178.97	186.87	95.77	-7.90	000
a3-a1	182.94	186.87	97.90	-3.93	00
a3-a2	182.94	178.97	102.22	3.97	***
DL 5% = 1.62 DL 1% = 2.45 DL 0.1%= 3.94					
2. Unilateral impact of the fertirrigation system upon the production					
b2-b1	189.84	176.01	107.85	13.82	***
DL 5% = 1.08 DL 1% = 1.49 DL 0.1% = 2.05					
3. Unilateral impact of the extra-root spraying products upon the production					
c2-c1	191.46	153.96	124.36	37.50	***
c3-c1	196.76	153.96	127.80	42.80	***
c4-c1	189.38	153.96	123.01	35.43	***
c5-c1	183.07	153.96	118.91	29.11	***
c2-c1	191.46	153.96	124.36	37.50	***
c3-c2	196.76	191.46	102.77	5.30	***
c4-c2	189.38	191.46	98.92	-2.07	000
c5-c2	183.07	191.46	95.62	-8.39	000
c4-c2	189.38	191.46	98.92	-2.07	000
c5-c3	183.07	196.76	93.04	-13.69	000
c5-c4	183.07	189.38	96.66	-6.32	000
DL 5% = 0.85 DL 1% = 1.16 DL 0.1% = 1.55					
4. The interaction impact between different hybrids and the same or different fertirrigation systems					
a2b1-a1b1	173.45	178.55	97.14	-5.10	000
a2b2-a1b2	184.48	195.18	94.52	-10.70	000
a2b2-a1b1	184.48	178.55	103.32	5.93	***
DL 5% = 2.09 DL 1% = 3.04 DL 0.1% = 4.59					
5. The interaction impact between the same hybrid and different fertirrigation systems					
a1b2- a1b1	195.18	178.55	109.31	16.63	***
a2b2- a2b1	184.48	173.45	106.36	11.03	***
DL 5% = 1.87 DL 1% = 2.58 DL 0.1% = 3.55					
6. The interaction impact between the same hybrid and different extra-root spraying products					
a1c2- a1c1	195.05	158.05	123.41	37.00	***
a1c3- a1c1	202.10	158.05	127.87	44.05	***
a1c4- a1c1	192.05	158.05	121.51	34.00	***
a1c5- a1c1	187.08	158.05	118.37	29.03	***
a1c2- a1c1	195.05	158.05	123.41	37.00	***
a1c3- a1c2	202.10	195.05	103.61	7.05	***
a1c4- a1c2	192.05	195.05	98.46	-3.00	000
a1c5- a1c2	187.08	195.05	95.92	-7.97	000
a1c4- a1c3	192.05	202.10	95.03	-10.05	000
a1c5- a1c3	187.08	202.10	92.57	-15.02	000
a1c5- a1c4	187.08	192.05	97.41	-4.97	000
a2c2- a2c1	187.85	149.85	125.36	38.00	***
a2c3- a2c1	191.40	149.85	127.73	41.55	***
a2c4- a2c1	186.70	149.85	124.59	36.85	***
a2c5- a2c1	179.03	149.85	119.48	29.18	***
a2c3- a2c2	191.40	187.85	101.89	3.55	***
a2c4- a2c2	186.70	187.85	99.39	-1.15	-
a2c5- a2c2	179.03	187.85	95.31	-8.82	000
a2c4- a2c3	186.70	191.40	97.54	-4.70	000
a2c5- a2c3	179.03	191.40	93.54	-12.37	000
a2c5- a2c4	179.03	186.70	95.89	-7.67	000
DL 5% = 1.48 DL 1% = 2.00 DL 0.1% = 2.68					

7. The interaction impact between the same fertirrigation system and different extra-root spraying products					
b1c2- b1c1	187.41	148.86	125.90	38.56	***
b1c3- b1c1	188.01	148.86	126.30	39.16	***
b1c4- b1c1	179.56	148.86	120.62	30.70	***
b1c5- b1c1	176.22	148.86	118.38	27.37	***
b1c3- b1c2	188.01	187.41	100.32	0.60	-
b1c4- b1c2	179.56	187.41	95.81	-7.86	000
b1c5- b1c2	176.22	187.41	94.03	-11.19	000
b1c4- b1c3	179.56	188.01	95.50	-8.46	000
b1c5- b1c3	176.22	188.01	93.73	-11.79	000
b1c5- b1c4	176.22	179.56	98.14	-3.33	000
b2c2- b2c1	195.50	159.06	122.91	36.44	***
b2c3- b2c1	205.50	159.06	129.20	46.44	***
b2c4- b2c1	199.21	159.06	125.25	40.16	***
b2c5- b2c1	189.91	159.06	119.40	30.86	***
b2c3- b2c2	205.50	195.50	105.12	10.00	***
b2c4- b2c2	199.21	195.50	101.90	3.71	***
b2c5- b2c2	189.91	195.50	97.14	-5.59	000
b2c4- b2c3	199.21	205.50	96.94	-6.29	000
b2c5- b2c3	189.91	205.50	92.41	-15.59	000
b2c5- b2c4	189.91	199.21	95.33	-9.30	000
DL 5% = 1.21 DL 1% = 1.64 DL 0.1% = 2.19					
8. The interaction impact between different fertirrigation systems and the same or different extra-root spraying products					
b2c1- b1c1	159.06	148.86	106.85	10.20	***
b2c2- b1c2	195.50	187.41	104.32	8.09	***
b2c3- b1c3	205.50	188.01	109.30	17.49	***
b2c4- b1c4	199.21	179.56	110.95	19.66	***
b2c5- b1c5	189.91	176.22	107.77	13.69	***
b2c2- b1c1	195.50	148.86	131.34	46.64	***
DL 5% = 1.53 DL 1% = 2.09 DL 0.1% = 2.83					
9. The interaction impact between different hybrids and the same or different extra-root spraying products					
a2c1- a1c1	149.85	158.05	94.81	-8.20	00
a2c2- a1c2	187.85	195.05	96.31	-7.20	000
a2c3- a1c3	191.40	202.10	94.71	-10.70	000
a2c4- a1c4	186.70	192.05	97.21	-5.35	000
a2c5- a1c5	179.03	187.08	95.70	-8.05	000
a2c2- a1c1	187.85	158.05	118.85	29.80	***
DL 5% = 2.08 DL 1% = 3.01 DL 0.1% = 4.50					
10. The interaction impact between the same hybrid and the same fertirrigation system and different extra-root spraying products					
a1b1c2- a1b1c1	187.40	152.20	123.13	35.20	***
a1b1c3- a1b1c1	189.80	152.20	124.70	37.60	***
a1b1c4- a1b1c1	184.40	152.20	121.16	32.20	***
a1b1c5- a1b1c1	178.97	152.20	117.59	26.77	***
a1b1c3- a1b1c2	189.80	187.40	101.28	2.40	*
a1b1c4- a1b1c2	184.40	187.40	98.40	-3.00	00
a1b1c5- a1b1c2	178.97	187.40	95.50	-8.43	000
a1b1c4- a1b1c3	184.40	189.80	97.15	-5.40	000
a1b1c5- a1b1c3	178.97	189.80	94.29	-10.83	000
a1b1c4- a1b1c3	184.40	189.80	97.15	-5.40	000
a1b1c5- a1b1c4	178.97	184.40	97.05	-5.43	000
a2b2c2- a2b2c1	188.30	154.20	122.11	34.10	***
a2b2c3- a2b2c1	196.60	154.20	127.50	42.40	***
a2b2c4- a2b2c1	198.70	154.20	128.86	44.50	***
a2b2c5- a2b2c1	184.60	154.20	119.71	30.40	***

a2b2c3- a2b2c2	196.60	188.30	104.41	8.30	***
a2b2c4- a2b2c2	198.70	188.30	105.52	10.40	***
a2b2c5- a2b2c2	184.60	188.30	98.04	-3.70	00
a2b2c4- a2b2c3	198.70	196.60	101.07	2.10	*
a2b2c5- a2b2c3	184.60	196.60	93.90	-12.00	000
a2b2c5- a2b2c4	184.60	198.70	92.90	-14.10	000
DL 5% = 2.09 DL 1% = 2.83 DL 0.1% = 3.79					
11. The interaction impact between the same hybrid and different fertirrigation systems and the same extra-root spraying products					
a1b2c1- a1b1c1	163.90	152.20	107.69	11.70	***
a1b2c5- a1b1c5	195.20	178.97	109.07	16.23	***
a2b2c2- a2b1c2	188.30	187.40	100.48	0.90	-
a2b2c5- a2b1c5	184.60	173.47	106.42	11.13	***
DL 5% = 2.65 DL 1% = 3.62 DL 0.1% = 4.91					
12. The interaction impact between different hybrids and the same fertirrigation system and the same extra-root spraying products					
a2b1c1- a1b1c1	145.50	152.20	95.60	-6.70	000
a2b1c2- a1b1c2	187.40	187.40	100.00	0.00	-
a2b1c3- a1b1c3	186.20	189.80	98.10	-3.60	0
a2b1c4- a1b1c4	174.70	184.40	94.74	-9.70	000
a2b1c5- a1b1c5	173.47	178.97	96.93	-5.50	00
a2b2c2- a1b2c2	188.30	202.70	92.90	-14.40	000
a2b2c3- a1b2c3	196.60	214.40	91.70	-17.80	000
a2b2c4- a1b2c4	198.70	199.70	99.50	-1.00	-
a2b2c5- a1b2c5	184.60	195.20	94.57	-10.60	000
DL 5% = 2.80 DL 1% = 3.94 DL 0.1% = 5.64					

Preliminary research regarding the field culture of the bitter cucumber (*Momordica charantia* L.)

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Keywords: plants, cucurbitaceae, technology, diabetes

ABSTRACT

The *Momordica charantia* species was cultivated in field, in Bucharest area, in order to study the behavior of the plant, from the vegetative growth and fructification point of view, as a plant whose fruits are used for consumption. It was cultivated also as an ornamental plant, to form a green wall along a fence, highlighting the aspect of the plant, its leaves, flowers, and fruits in different stages of maturation, through their remarkable aspect, emerald green color and shine in the early stage and vivid orange at full maturation. The contrast between the color of leaves, of flowers and matured fruits, which make this species suitable for this purpose, was observed. In culture, the bitter cucumber reacted very well to the climatic conditions from Bucharest area, being measured by the vegetative growth of the plants and the forming of fruits. This way, the plants had a vegetative growth of more than 2 m, with many leaves (36-38) and 15-16 flowers. Almost half of the flowers formed fruits, their formation being influenced by the environmental conditions of the year 2010. The weight of the fruits reached values of 85-100 g, but the harvesting is made in phases and in different growth stages, which highly influences the fruit weight. From the ornamental point of view, the plants behave very well, have high ramification capacity, are not attacked by diseases, bloom and form very attractive fruits, it gives one a feeling of relaxation.

INTRODUCTION

Momordica is a genus from the *Cucurbitaceae* family (Andrei M.), with 45 species of annual or perennial plants, originating from southern Asia, spread in the tropical areas, including Africa, Australia, Asia, Caribbean and South America, cultivated for the edible fruits, which have multiple medicinal properties.

Momordica charantia is one of the known species and is widely used as a hypoglycemic agent in Asia, Africa and Latin America. In these areas, the plant extract was named the vegetable insulin, and in China and India it has been used as food. It is known as the bitter gourd and Karela in the Asian countries and as the bitter cucumber in Europe, due to its strong bitter taste.

The bitter cucumber is cultivated for its leaves and strains, which are used to prepare tea, soups and beer, but also for the no matured fruits that are consumed fresh in salads or used to prepare assortments of juice. The fruits that reach the physiological maturity can be consumed in salads, being highly appreciated by the consumers, due to the decreased bitter taste. It must be specified that the fruits can be consumed in salads with other fruits, being easier for the consumers to accept them. The seeds that reach the physiological maturity are used to obtain tinctures.

The chemical composition of the *Momordica* fruit is very complex and contains calcium, magnesium, phosphorus, sodium, potassium, zinc, B1, B2, B3, B6, A, C and E vitamin, proteins and sugars. The bitter cucumber is reach in iron, having twice the quantity of beta carotene than broccoli, twice the quantity of calcium than spinach and twice the quantity of potassium than bananas.

The main therapeutic effects of the plant are: lowers blood sugar, enriches the body with mineral elements, ensures the necessary vitamins, protects against viruses and parasites, improves the immune system, lowers the risk of breast cancer and other types of cancer (Beloin N) etc. The increase in the insulin level of the body is one of the primary health benefits of the bitter cucumber. Besides the insulin production, the bitter cucumber is also used to treat wounds, eczema, skin infections and even leukemia (Das P.). Many researches show that this vegetable increases the production of beta cells in the pancreas, which leads to an improvement in the insulin production of the body.

MATERIALS AND METHODS

The research was made in Bucharest area, in the year 2010, being the first cultivation year of the species.

The biological material that was used was represented by the *Momordica charantia* species, the bitter cucumber, known for its therapeutic effects.

The planting stocks were produces in heated greenhouse, the seeding being made on 8th March, in small boxes with soil mixture. When the plants formed the first real leaf, they were moved into patchworks with the side of 7 cm, using the same technique that is used for all vegetable species.

The preparation of the land was made through usual works.

The field planting was made on 26th April, at a distance of 80 cm/50 cm, resulting a density of 25000 plants/ha, the plants being supported on plastic strings.

During the research, measurements and observations regarding the behavior of the plants from the vegetative growth and fruit forming point of view were made. For this purpose, technological works in greenhouse and field were made regarding the production of planting stock of *Momordica charantia*, planting and maintaining them in field.

The measurements that were made were represented by the height of the plants, the number of formed leaves, the number of flowers and the number of fruits.

The *Momordica charantia* species was cultivated also as an ornamental plant, along a fence, in order to create a green wall and highlight the beauty of the aspect of the plant, its color, shape and the aspect of the fruits in different stages of maturity.

RESULTS AND DISCUSSION

From a technological point of view, it can be said that this species reacted very well to the environmental factors from the Bucharest areas, in all stages of growth and evolution.

The sprouting of the seeds was very good, specific to the cucurbits, with a percentage of more than 90%, in 4-5 days, in greenhouse. The plants were moved into patchworks in the phase of the appearance of the first real leaf, 10 days after, reacting very well. The growth of the planting stocks was very good, optimum temperature and lightning conditions being ensured in the first stages.

After planting them in the permanent place in the field, the plants had, for the beginning, a slower evolution, due to the temperature fluctuations specific to the spring of 2010 and to the high quantity of water at the planting place at the beginning of the culture. When the unfavorable factors stopped manifesting, the growth of the plants was significant.

Thus, over a period of three weeks of observations and measurements, it can be appreciated that the plants formed an average number of 11,4 leaves at the beginning of June, reaching the value of 18,3 leaves after two weeks (Table 1).

The height of the plant, when the first measurements were made at the beginning of June, was reduced, respectively until 30 cm, being influenced by the less favorable environmental conditions of the year 2010. Subsequently, the vegetative growth of the plants was more emphasized, being a species with rapid growth (Table 2).

Over the next observing weeks, the height of the plants reached values between 40,8 cm and 172 cm depending on the age, thus confirming the rapid growth of the *Momordica charantia* species.

The first flowers (with total opening) appeared fast enough, being known the fact that for the species from the *Cucurbitaceae* family the growing process unfolds in the same time as the fructification process. Shortly, the fruits were formed, respectively in the first decade of June, 42 days since planting.

At the beginning, the number of flowers per plant was very small, but as the plants grew, it continued to increase, the average number being 15,8 flowers per plant (Table 3).

The forming of fruits was good, being influenced by the characteristics of the species, but also by the environmental factors, such as temperature and light. Weak or inappropriate lightning conditions (for example, very rich vegetative mass) can affect the blooming of the plants. On a plant, the number of formed fruits was 8-9 fruits. The average fruit weight had values between 85 and 100 g, being highly influenced by the size of the fruit when harvested. At consumption maturity, the fruits become orange, are dehiscent and contain big, brown seeds covered in a red, mucilaginous tissue, their number being 30-35 seeds in a fruit.

From a decorative point of view, *Momordica charantia* is a species that behaves very well. The plant has a high capacity of vegetative growth, a high degree of ramification, forming 4-5 I order shoots, 7-8 IInd order shoots and 3-4 IIIrd order shoots and strains with heights higher than 3 m, which allows cultivating the species along fences, in order to create a green wall. It decorates with the large number of leaves and the very attractive shape, which is palmate, and with the fact that during the vegetation period no stains appear on the leaves that could degrade the decorative aspect of the foliage. The number, the shape of the flowers, but especially their yellow color ensures a pleasant décor being in contrast with the green color of leaves. Particularly decorative are the fruits, both in the early stage, with their shine and emerald green color, with curly appearance, prominent rough, and in the maturity stage, when they become orange.

CONCLUSIONS

The *Momordica charantia* species is a less known species in our country, although its therapeutic properties are a true miracle for the human body.

The researchers are only at the beginning; they will continue in order to make the plant known, the type of culture and its effects. From the measurements and observations made, it can be said that the *Momordica charantia* species is a species that adapts well to the climatic conditions from the Bucharest area, having a very good vegetative growth (the average height of the plants was between 215-239 cm during the observation period, but the height could easily reach values higher that 3 m), has a very rich foliage, a very high ramification capacity (cultivated as vegetable plant, it must have a plant management system consisting of picking the shoots in order to decrease the number of fruits; cultivated as an ornamental plant, it can be managed with two strains, without any green intervention, has a very high ramification capacity, ensuring a pleasant decor; in this type of situation, the weight of a plant is around 2 kg, which demonstrates that it has a rich vegetative mass), forms many flowers, if there is enough light, forms fruits in phases after 42 days since planting, which ensures a fresh consumption over a long period of time, respectively from June until September and even October, if the climatic conditions allow the vegetation to continue.

It was observed that it has a very good disease resistance which allowed leaves to maintain the entire vegetation period without stains.

The seeds of the *Momordica charantia* species respond very well to the germination process, like the other species from the *Cucurbitaceae* family.

From the ornamental point of view, it is a very suitable species for disguising the fences or some less attractive objects, it even lends to arches, having dense and rich foliage. The strains are long and form many shoots, which define the species for this type of usage.

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TABLES

Table 1

The dynamics of leaf appearance at *Momordica charantia* species

Repetition/ Date	Average number of leaves per plant							
	01.06	**08.06**	**15.06**	**22. 06**	**29. 06**	**6. 07**	**13. 07**	**20. 07**
R1	8,4	11,8	15,6	17,9	22,3	25,5	31,2	36,4
R2	14,1	17,8	20,0	23,1	25,8	29,6	32,1	37,8
R3	11,6	15,0	19,2	23,3	25,9	28,4	34,6	38,5
Average	11,4	14,8	18,3	21,4	24,7	27,8	32,6	37,6

Table 2

The dynamics of the height of the plants at *Momordica charantia* species

Repetition/ Date	Average height of the plant (cm)							
	01.06	**08.06**	**15.06**	**22 06**	**29 06**	**6 07**	**13 07**	**20 07**
R1	24,6	35,9	66,6	79,2	88,7	120	172	215
R2	26,4	42,8	75,5	86,3	93,5	121	183	239
R3	29,4	43,8	76,7	89,1	98,7	128	178	222
Average	26,8	40,8	72,9	84,9	93,6	127	181	232

Table 3

The dynamics of flower appearance at Momordica charantia species

Repetition/ Date	Number of flowers						
	8 06	**15 06**	**22 06**	**29 06**	**6 07**	**13 07**	**20 07**
R1	1,8	2,9	4,8	8,1	11,3	13,1	15,7
R2	1,4	2,4	4,4	9,4	13,2	14,8	16,3
R3	1,6	2,7	4,2	9,9	10,4	12,6	15,3
Average	1,6	2,7	4,5	9,1	11,6	13,5	15,8

The influence of stimulating the artichoke seeds upon their germination

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Keywords: Moistening, chemical stimulation, emergence, varieties

ABSTRACT

The hard tegument of the artichoke seeds is responsible for the slow germination and the reduced value of their faculty of germination. The results presented in this paper prove the beneficial impact that the stimulation of seeds has on their germination parameters. By moistening the seeds in water for 72 hours, the value of germination has grown up to 98% for the Unirea variety, 75% for the Green artichoke and 47% for the Red one. The results obtained by the stimulation with Atonik are not as good as the ones previously presented, the values of the germinating power being lower for all the varieties analyzed. By stimulating the seeds, the number of days necessary for the emergence of artichoke (15-16 days) can be reduced by two to five days. The artichoke varieties have specific reactions to different methods of stimulating the germination of the seeds, the most influenced species being Unirea and the Green artichoke.

INTRODUCTION

There is little worldwide and national research on the technology of cultivating artichoke as a vegetable plant, and there are more references regarding its phytotherapeutical properties.

The main target of this work paper was to establish some methods to stimulate the germination of the seeds and make the plants emerge while the nursery transplant is being produced or when the culture is obtained by sowing directly in the field. The specific aims corresponded to those technological measures which can influence the germination and emergence of the plant, such as: choosing the varieties, the moistening or the chemical stimulation of the seeds.

The necessity of reaching these aims comes out of the well-known difficulties regarding the slow germination of the seeds as a sequence of their hard tegument (Pârvu, 2000, Ciofu and al., 2003), a most important factor in the great decrease of the value of germination faculty.

Cynara scolymus belongs to the Asteraceae family and presents morphological features specific of this family (Krug, 1991, Săvulescu, 2007). The fruit, practically named „seed" is an oblong laterally flat grey-brownish achene with dark spots and of medium size (50/g). Its germination power is of 65 - 70 % and lasts from 7 to 10 years. (Ciofu R. şi al., 2003).

Olympus (1994) mentions that in Greece the seeds grow mature in July and August and when they are harvested, all their inflorescences are picked up and kept in storehouses where they shed their petals. According to this author 25 seeds weigh 1 gram, and their germination will last 6 years at most.

In America the persons authorized for artichoke seeds trade have to provide a minimum quantity of 60% with a guaranteed germination faculty (http://cdiserver.mba-sil.edu.pe/mbapage/Boletines Electronics).

MATERIAL AND METHODS

With a view to the calculation of the artichoke seed germination parameters, at The Agronomical Science and Veterinary Medicine University of Bucharest several experiments were made in greenhouses and laboratories. The materials used corresponded to the variants studied and the methods specific of the observations and calculations which were made.

In 2009 there was a study of how some species react to the moistening of seeds as a method to stimulate germination. The experiment was made with the autochthonous species

Unirea and two foreign ones: 656, from Italy, and Talpiot, from Spain. The seeds were moistened in water at the room temperature and after 72 hours they were sowed in plastic recipients filled with nutrious mixture. They had four repetitions of 25 seeds germinated for each species. The sowing was made on February 24th.

In 2010 there was a bifactorial experiment which studied the influence of some treatments for stimulation on the germination process of different species of artichoke. On March 17th they had the following species germinated: Talpiot, Unirea, Green Artichoke, Red Artichoke. According to the experimental variants, part of the seeds were moistened, for 72 hours, in water at the room temperature, and the others were put in Atonik for two minutes. During the experiment the temperature in the germinator was 22 degrees Centigrade.

The results regarding the germination of the stimulated seeds were compared with the ones obtained in the case of the witness-seeds, which were unmoistened.

The determination of the germinating power was made through calculating the main parameters of germination: the number of days necessary for germination (appreciated from the moment the first seeds appeared until this number no longer changed in two sequent calculations); GP – the germinating power (by relating the number of the germinated seeds to the total); EG - germinating energy (calculated for a number of days reduced by a third of the number necessary to germination).

The determinations were made by four repatitions of 25 seeds for each experimental variant.

RESULTS AND DISCUSSIONS

The results concerning the peculiarities of the artichoke seed germination as shown in fig. 1, mainly present the general feature of the *Cynara scolymus* species, which is that of having a low power of germination. From this point of view, artichoke is to be classified as bearing the general features of the *Asteraceae* family, to which it belongs (Krug, 1991; Săvulescu, 2007).

According to our experiment, the maximum value of the germination power reached 67%, placing itself within the limits mentioned by different authors (65-70% according to Pârvu, 2000; Ciofu and all, 2003, Voican, 2006).

In what concerns the growing speed, this depends on the peculiarities of each species, which led to greatly different values. So, on the first place came the Romanian variety Unirea, the seeds of which emerged in a 38% proportion on March 10th (14 days after the sowing) and, consequently, 67% from the plants rose within the interval of a month (March 24th).

Comparing, the 656 variety had a half reduced germinating energy (18% from the germinated seeds in the first 14 days) and a much more reduced emergence power (only 51%). Although the Talpiot variety that came from Spain had high quality value indicators mentioned on the envelope, it did not rise but much later (on March 20th, after they had been sowed three weeks before), and the emergence percentage of the seeds was of only 6% .

The results concerning the impact of stimulating the process of germination in different artichoke varieties are to be seen in table 1 and figures 2 and 3.

From the data presented in table 1, one can see the differences induced by the methods of stimulation upon the speed of germination and its specific parameters regarding different varieties of artichoke.

As long as the optimal germinating temperature (22 degrees Centigrade) is supplied by the germinator during the whole experiment, on the first place were the variants whose seeds had been moistened in water, followed by those stimulated with the Atonik solution.

The germinating energy expressed through the percentage of seeds germinated in one third of the time necessary to reach the germinating faculty level (in this case on March 23rd), was of 26-65 % regarding the variants moistened in water, unlike the percentage of 0 regarding the control variants and the ones stimulated with Atonik.

Regarding the moistening of seeds, the Unirea variety will leave the others far behind In its case, 13% of the seeds germinated in only two days, and the germinating energy (5 days after the seeds were set to germinate) was of 65%. On the second place within the group of these variants comes the Green artichoke with a germinating energy of 26%. Comparing, when it came to the Talpiot and Red artichoke the seeds started to germinate later, namely the seventh day (7% and 20%).

The germinating faculty was of 20-67% for the control variant, which were untreated with maximum values in the case of Unirea and Green artichoke and minimum values in that of Talpiot and Red artichoke (fig.2).

The moistening of the seeds in water for 72 hours had as a result the strongest stimulation of germination. The germinating faculty level of these variants reached 98% in case of Unirea and was of 47-75% in what concerned the Green and Red artichoke.

The stimulation by Atonik did not have as good results as the ones above, the germinating power levels being of 26% for Talpiot, between 46-30% for the Green and Red artichoke and 73% for Unirea. We appreciate these results may be a consequence of the short treatment time, as the two minutes of moistening are not enough for the hard tegument to be softened .

In figure 3 we can clearly see the specific reaction of the species to the different methods seed germinating stimulation. The strongest impact of stimulation was found about the Unirea variety, followed by the Green artichoke, while the Red artichoke and Talpiot reacted far more weakly.

The influence of the methods of stimulation of seeds upon the emergence of parameters regarding different varieties of artichoke is presented in figure 4, from which we can see the changes induced. The number of days necessary to emergence, which was of 15-16 in the case of the witness variants (V1-V4) decreased especially in the case of the variants the seeds of which were moistened in water (V5-V8) and whose germination took place within 10-14 days. The strongest reaction was that of Unirea, whose number of days was reduced by 5 when the seeds were moistened in water (V5) and by 2 when they were stimulated with Atonik (V9).

CONCLUSIONS

Artichoke has a low germination faculty of seeds (maximum 67% regarding Unirea) and a specific value regarding different varieties, much reduced in case of the foreign ones.

The moistening of seeds in water for 72 hours led to the strongest stimulation of germination, a increase of the germinating faculty value up to 98% regarding Unirea, 75% at the Green artichoke and 47% at the Red artichoke.

The stimulation by Atonik had not very good results, the values of the germinating power being lower for all the species analyzed.

By stimulating the seeds, the number of days necessary for emergence (15-16) can be reduced by up to 5 regarding Unirea in case of moistening the seeds in water.

The varieties of artichoke reacted specifically to the different methods of stimulation of the germination, the strongest of which having been observed in the case of Unirea and Green artichoke.

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TABLE AND FIGURES

Table 1

The influence of the stimulation of seeds upon the germination speed for some species of artichoke, 2010

Date			March								April	
Treatment	Species	Var	19	22	23	24	26	27	30	31	01	02
control untreated	Unirea	V1	0	0	0	20	47	50	54	65	**67**	67
	Talpiot	V2	0	0	0	0	7	9	13	13	18	**20**
	Green Artichoke	V3	0	0	0	7	33	45	60	62	**64**	64
	Red Artichoke	V4	0	0	0	0	7	8	10	13	20	**27**
moistening in water	Unirea	V5	13	33	65	86	93	**98**	98	98	98	98
	Talpiot	V6	0	0	0	7	20	22	26	**30**	30	30
	Green Artichoke	V7	0	0	26	27	56	61	**75**	75	75	75
	Red Artichoke	V8	0	0	0	20	22	25	29	**47**	47	47
stimulatig with Atonik	Unirea	V9	0	0	0	7	53	65	**73**	73	73	73
	Talpiot	V10	0	0	0	0	0	0	20	20	23	**26**
	Green Artichoke	V11	0	0	0	0	7	13	20	33	**46**	46
	Red Artichoke	V12	0	0	0	0	0	0	20	26	28	**30**

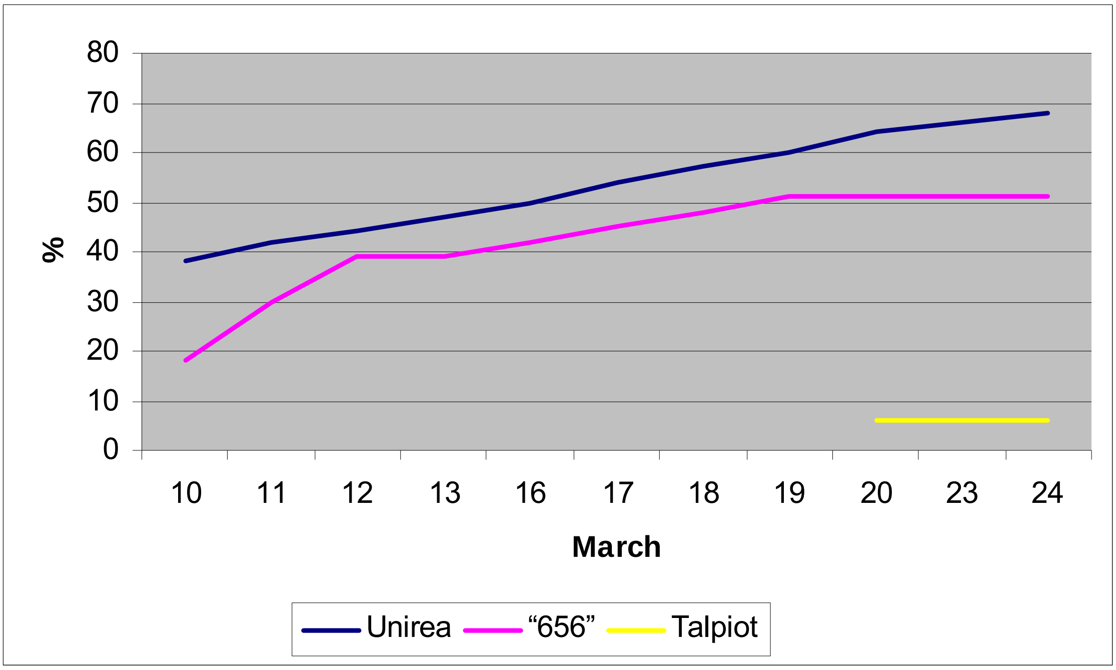

Fig. 1 - The speed of rising for different varieties of artichoke

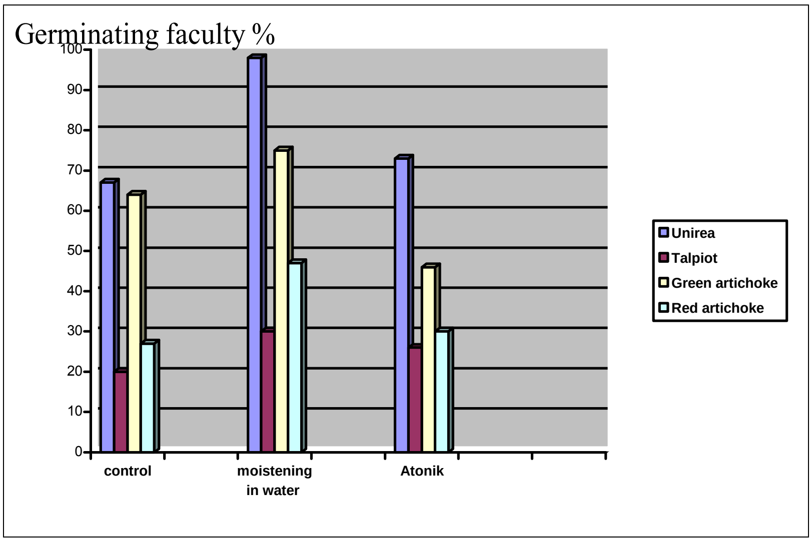

Fig. 2 - The influence of the methods of stimulation of seeds upon the germinating power

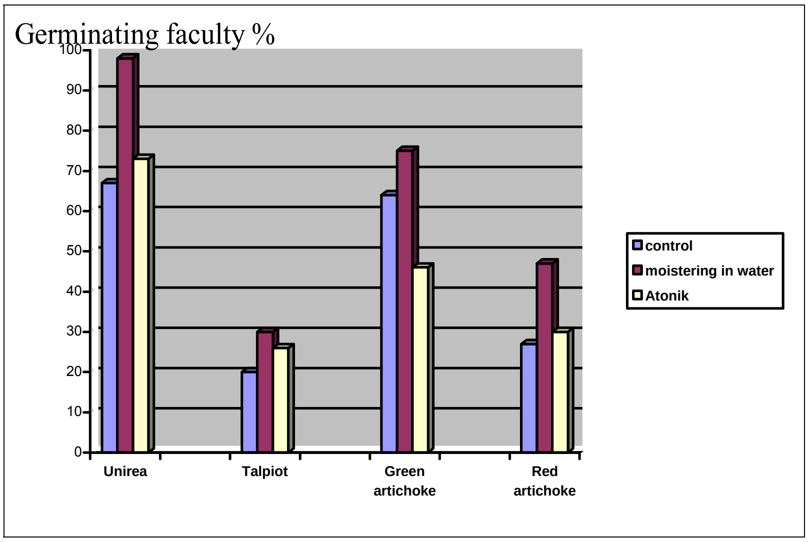

Fig. 3 - The reaction of some species of artichoke to the stimulation of their seeds

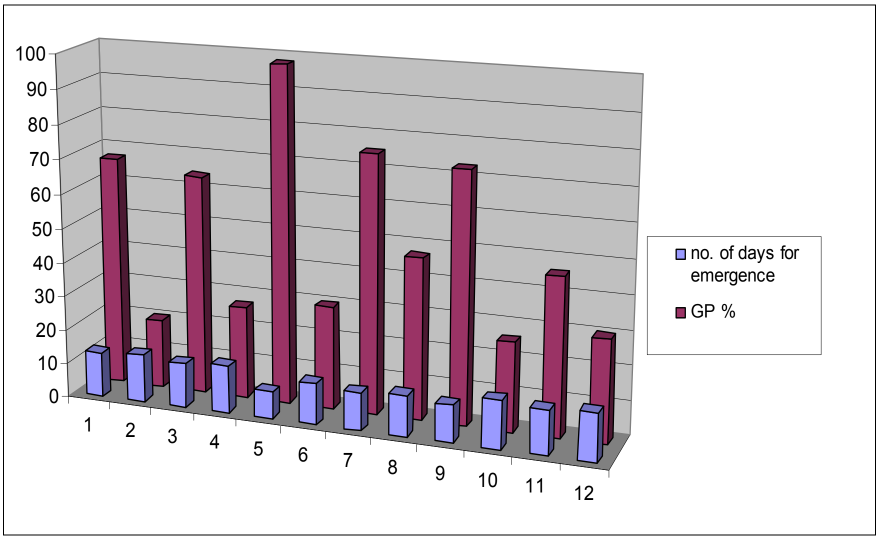

Fig.4 - The influence of the seeds stimulating methods upon the emergence parameters

Research on early production and total production in varieties of sweet peppers (Hó F_1 Julianus F_1, Campona F_1) by fertilization and irrigation method in greenhouses

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Keywords: peppers, fertilization, Bactofil, Alginit, irrigation, drip, microsprinkler, Hó F_1, Julianus F_1, Campona F_1, organic.

ABSTRACT

The role of the organic ecological farming system is to produce much cleaner food, more appropriate to human metabolism, but in complete correlation with environmental conservation and development, respect for nature and its laws. One of the main goals of organic farming is to produce food with authentic and attractive taste, texture and qualities. We must consider the high rate of the population growth globally that compels us to a more efficient exploitation of the existing opportunities, to identify and promote new solutions, that have yet to respond to the new requirements tailored to the economic potential of farmers in Romania. These considerations motivated the choice of the research theme and we intend to improve pepper culture on an organic substrate, a mixture of earth, using natural fertilizers (Alginit and Bactofil) and two irrigation systems (drip and sprinkler) with three varieties of pepper (Hó F_1 Julianus F_1 and Campona F_1).

INTRODUCTION

Romanian horticultural heritage, in terms of total planted area, is ranked on the 6^{th} place after France, Spain, Poland, Italy and Germany.

In Romania, horticulture is a traditional activity of great economic importance, developed over time, as a result of favorable natural conditions that it encounters, especially in south, southeast, west, Moldova, Dobrogea and central Transylvania (Acsa, 2009) areas.

Romania can produce annually about 4.9 million tons of horticultural products, of which 45% vegetables, grapes 15% and fruit 40%. In terms of area, the private sector controls most of it, approx. 98%, the rest being administered by the state or government research stations of State Domains (Eurostat, 2009).

Average pepper yield per hectare varies between 7886 kg /ha in 1990 and 13106 kg/ha in 2004.

A growing amount of the global sweet peppers production reaches the international market. Thus, international trade in 2008 included 2,1 million tons (8% of global production), which is 34% more than in 2003. During the same period, the value of exports of pepper increased by a more advanced rate (65%), amounting in 2008 to 3.9 billion U.S. $. World average price at which export transactions were made (fob) has increased from $ 1,521/ton in 2003 to $ 1,908/ton in 2008 (25%) (Acsa, 2009).

MATERIALS AND METHODS

The research was conducted during 2003-2005, as a poli-factorial research with three, two and four graduations each, placed in four randomized repetitions.

To achieve the doctoral thesis entitled “Research on the growth and development of peppers depending on fertilization and irrigation method in greenhouses”, the research had as main objectives:

- the effect of the new fertilizers (Alginit, Bactofil) on the growth and development of peppers,
- to determine the effect of irrigation methods on the growth and development of peppers,
- to follow the dynamics of growth, development and fruit growing of peppers,

- to determine the pepper production according to the fertilization and irrigation method,

- to determine the quality of pepper production according to the fertilization and irrigation method,

- to determine the economic efficiency of the fertilization system and irrigation method.

Factor A: Variety - three graduations:

Hó F_1, Julinaus F_1, Campona F_1

Factor B: watering system - with two graduations:

- Drip irrigation system (1l/h/drip pressure of 1 atm.)
- Watering system by micro sprinkle (tip. Tornado, Green 1.2)

Factor C: Fertilization base - four graduations:

- **Bactofil** (natural fertilizers based on bacterial products - 100 ml bacterial suspension/10 l substrate)
- **Alginit** (natural fertilizers, natural mineral preparations - 2 kg Alginit for 10 liters substrate),
- **Bactofil+Alginit** (100 ml of bacterial suspension + 2 kg Alginit at 10 l substrate)
- **Unfertilized** (control).

By combining the three factors, 24 experimental variants resulted, which were placed in plots divided by four repetitions in randomized plots.

The experimental field was established in the city of Târgu-Mureş, the Sapientia University Campus, at an altitude of 310 m. I chose this location because I have been teaching here. To organize the research, I have chosen an unheated greenhouse covered with polyethylene film, 12 m long, 5m wide and 4m high. The greenhouse was built at 50 meters from the building of the Sapientia University, Faculty of Technical Sciences and Humanities in Târgu-Mureş.

Early production was calculated for the period June 1 to 15, when he obtained the first harvest period until June 15 to 30 inclusive. Data collected in the form of the second period were collected and statistically processed. In the first phase we analyzed the influence of irrigation method and fertilizer used on varieties of peppers (Hó F_1,Campona F_1 and Julianus F_1), use the experience.

The results of different cultivars were evaluated with analysis of variance (ANOVA - Past program) and LSD. Fort the statistic evaluation of the basic data, we used the logarithm with a decimal basis, reducing the dispersion.

We talk about significant differences between the stock and the improved combination if:

The value of ***p***	Level of the significant difference	Significant difference that can be conformed
p<0.05	* the difference is significant	95%
p<0.01	** the significant difference is high	99%
p<0.001	*** the significant difference is too high	99.99%

RESULTS AND DISCUSSION

1. Influence of the pepper variety on the early production in the research years 2003-2005.

Early production was calculated as of 1st of June to 15th of June, when the first harvest took place, until the 15th to 30th of June included. Data collected during these two periods were collected and statistically processed.

In the first phase, we analyzed the influence of the irrigation method and of the fertilizers used on the varieties of peppers (Hó F_1, Campona F_1, Julianus F_1) used in the research. The behavior of the three studied pepper varieties is also an important factor in this research.

In 2003 (Table 1.), a variety registered of very significant positive variation from the control (Campona F_1), the Hó F_1 variety, with an early production of 1^{st} quality of 2.581 kg/m^2. The Hó F_1 pepper variety has registered a 113.5% compared to the witness variety and of 101.27% compared to the Julianus F_1 pepper variety.

In 2004 (Table 2.), we had the largest total as well as early production of first quality. In this context, the Hó F_1 variety registered that year a very significant positive difference compared to the control variety (Campona F_1), an increase of 111.89 %.

The year 2005 (Table 3.) closely resembled 2004, with the difference that in 2005 the early production was relatively lower, but the Hó F_1 variety registered that year to a very significant positive difference compared to the control (Campona F_1), precisely an increase of 112,05%.

2. Influence of the fertilizers and of the irrigation method on the total output in the research years 2003-2005

The data in Table 4, points out that the highest average productions taken separately for the three years of the research were considered the average of the three years and they were encountered in the Alginit+Bactofil fertilization version, both in the case of the drip watering and in that of the microsprinkler watering. The average yield of the three years for the Alginit+Bactofil fertilizer in drip irrigation conditions is of 11,6 kg/m^2, which exceeds not only the average of the control (9.1 kg/m^2), but also the two other variants respectively Bactofil (11.5 kg/m^2) and Alginit (9.9 kg/m^2).

In the case of microsprinkler irrigation, the average multi-annual production of the Alginit+Bactofil variant is of 11.3 kg /m^2, exceeding the Bactofil (10.4 kg/m^2) and Alginit (9.6 kg/m^2) versions.

Table 5 presents the total yields obtained for the three years for the Julianus F_1 variety of peppers and it shows that the variant of drip irrigation with Alginit+Bactofil fertilizer produced the highest total production in 2004 (11.06 kg/ m^2) as well as in 2005 (10.91 kg/ m^2), the exception being the 2003 version of drip irrigation with Bactofil fertilizer (10.04 kg/ m^2). According to the average, we can state that the variant with drip irrigation and the Alginit+Bactofil fertilizer produced the highest total production of 10.61 kg/m^2.

Table 6 points out that the highest average productions taken separately for the three years of the research were considered for the average of the three years and they were produced by the Alginit+Bactofil fertilization version, both for drip watering and for the microsprinkler watering.

Average yield for three years for Alginit+Bactofil fertilizer in drip irrigation conditions is of 10.11 kg/m^2, which exceeds not only the average of the control (7.95 kg/m^2), but also the two other variants respectively Bactofil (10.05 kg/m^2) and Alginit (8.68 kg/m^2). In case of the microsprinkler irrigation, the average multi-annual production of the Alginit+Bactofil variant is of 9.89 kg/m^2, exceeding the Bactofil (9.09 kg/m^2) and Alginit (8.40 kg/m^2) version.

CONCLUSIONS

1. Influence of irrigation method and fertilizer on early production in the varieties studied (Hó F_1, Julianus F1 and Campona F_1); we can say that in 2004 we had the highest early production (2,795 kg/m^2) and the highest total production (11.189 kg/m^2), which was recorded within the drip watering and Alginit+Bactofil fertilization variant for the Hó F_1 variety. For this variant, the early production is 24.99% of the total production. Good results were also obtained for the F_1 Julianus variety, with drip watering and fertilization with Alginit+Bactofil, 2.524 kg/m^2, where the total production was of 11.06 kg/m^2 and the percentage of the early production of first quality of 22.82%.

2. Influence of the pepper variety on the early production during the years 2003-2005; we can say that the Hó F_1 variety obtained very significant positive differences from the control (Campona F_1) and in 2004 we had the largest total output, both for the early and for the first quality production. In this context, the Hó F_1 variety registered that year a very significant positive difference compared to the control (Campona F_1), an increase of 11.89%.

3. As far as the influence of the fertilizer and irrigation method on the total output during the years 2003-2005 is concerned, we noticed that in 2003 for all the fertilization variants, the drip irrigation method ensured positive production differences compared the method of watering by microsprinkler. The difference is statistically assured only in the case of the Bactofil fertilizer. 2004 and 2005 show similar results to 2003, the drip irrigation method has provided a higher total production than the microsprinkler watering method.

4. The comparison of the total production of the Hó F_1 variety of pepper depending on the method of watering and on fertilization during the years 2003 to 2005 of the research shows that the highest average yields taken separately for the three years of the research, were considered the average of the three years and they were obtained by the Alginit+Bactofil variant of fertilization, both for drip watering and for watering by microsprinkler. The average yield for the three years for the Alginit+Bactofil fertilizer in drip irrigation conditions is of 11.6 kg/m^2, which exceeds not only the average of the control (9.1 kg/m^2), but also the two other variants respectively Bactofil (11.5 kg/m^2) and Alginit (9.9 kg/m^2).

The Julianus F_1 variety shows us that the variant of drip irrigation with Alginit+Bactofil fertilizer resulted in the highest total production both in 2004 (11,06 kg/m^2) and 2005 (10.91 kg/m^2), with the exception of the 2003 version of drip irrigation with Bactofil fertilizer (10.04 kg/m^2). Taking into consideration the average production, we can say that the variant of drip irrigation with Alginit+Bactofil fertilizer resulted in the highest total production of 10.61 kg/m^2.

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TABLES

Table 1

Influence of the variety on the early production in 2003

Variety	Average early production quality I, kg/m^2	Difference		Semnification
		kg/m^2	%	
Campona F_1	2,281	0,00	100,00	Control
Hó F_1	2,581	0,30	113,15	***
Julianus F_1	2,310	0,02	101,27	-

LSD $_{(p\ 5\%)}$: 0,09
LSD $_{(p\ 1\%)}$: 0,16
LSD $_{(p\ 01\%)}$: 0,28

Table 2

Influence of the variety on the early production in 2004

Variety	Average early production, 1st quality, kg /m^2	Difference		Semnification
		kg/m^2	%	
Campona F_1	2,498	0,00	100,00	Control
Hó F_1	2,795	0,29	111,89	***
Julianus F_1	2,524	0,02	101,04	-

LSD $_{(p\ 5\%)}$: 0,08
LSD $_{(p\ 1\%)}$: 0,14
LSD $_{(p\ 01\%)}$: 0,27

Table 3

Influence of the variety on the early production in 2005

Variety	Average early production, 1st quality, kg /m^2	Difference		Semnification
		kg/m^2	%	
Campona F_1	2,464	0,00	1000,00	Control
Hó F_1	2,761	0,29	112,05	***
Julianus F_1	2,496	0,03	101,30	-

LSD $_{(p\ 5\%)}$: 0,04
LSD $_{(p\ 1\%)}$: 0,14
LSD $_{(p\ 01\%)}$: 0,27

Table 4

Total production obtained of the Hó F_1 variety of peppers between 2003-2005

Variety/watering method/ fertilizer	Total production kg/m^2	Total production kg/m^2	Total production kg/m^2	Total average production kg/m^2
	2003	***2004***	***2005***	***2003-2005***
Hó F_1/drip/Bactofil	11.00	11.85	11.69	11.5
Hó F_1/microsprinkler/Bactofil	10.02	10.71	10.52	10.4
Hó F_1/drip/Alginit	9.40	10.31	10.11	9.9
Hó F_1/microsprinkler/Alginit	9.19	9.98	9.69	9.6
Hó F_1/drip/Alginit+Bactofil	10.79	12.04	11.92	11.6
Hó F_1 /microsprinkler/Alginit+Bactofil	10.65	11.75	11.59	11.3
Hó F_1/drip/control	8.91	9.31	9.11	9.1
Hó F_1/microsprinkler/control	8.70	8.92	8.74	8.8

Table 5

Total production obtained for the Julianus F_1 variety of peppers between 2003-2005

Variety/watering method/fertilizer	Total production kg/m^2	Total production kg/m^2	Total production kg/m^2	Total average production kg/m^2
	2003	*2004*	*2005*	*2003-2005*
Julianus F_1/drip/Bactofil	10,04	10,89	10,70	10,54
Julianus F_1/microsprinkler/Bactofil	9,15	9,84	9,63	9,54
Julianus F_1/drip/Alginit	8,58	9,47	9,25	9,10
Julianus F_1/microsprinkler/Alginit	8,39	9,17	8,87	8,81
Julianus F_1/drip/Alginit+Bactofil	9,85	11,06	10,91	10,61
Julianus F_1/microsprinkler/Alginit+Bactofil	9,72	10,80	10,61	10,38
Julianus F_1/drip/control	8,14	8,55	8,34	8,34
Julianus F_1/microsprinklerr/control	7,94	8,20	8,00	8,05

Table 6

Total production obtained for the Campona F_1 variety of peppers between 2003-2005

Variety/watering meth./fertilizer	Total production kg/m^2	Total production kg/m^2	Total production kg/m^2	Total average production kg/m^2
	2003	*2004*	*2005*	*2003-2005*
Campona F_1/drip/Bactofil	9,50	10,45	10,19	10,05
Campona F_1/microsprinklerr/Bactofil	8,66	9,45	9,17	9,09
Campona F_1/drip/Alginit	8,12	9,09	8,82	8,68
Campona F_1/microsprinkler/Alginit	7,94	8,80	8,45	8,40
Campona F_1/drip/Alginit+Bactofil	9,32	10,62	10,39	10,11
Campona F_1/microsprinkler/Alginit+Bactofil	9,20	10,36	10,11	9,89
Campona F_1/drip/control	7,70	8,21	7,94	7,95
Campona F_1/microsprinkler/control	7,52	7,87	7,62	7,67

The influence of treatments with some fungal extracts on plants of strawberry grown under field conditions

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Keywords: *strawberry, extract, Botrytis cinerea*

ABSTRACT

The study was carried out in the field from the Department of Vegetable and Ornamental Plants, USAMV Bucharest during 2008-2010. In this study we used the strawberry as biological material, variety Senga Sengana. The experimental variants consisted in treatments with chemicals and fungal extracts applied on plants and soil. After inoculation with pathogen we found that plants in variants treated with fungal extracts showed increased resistance to *Botrytis cinerea* as compared with the untreated control. All fungal extracts induced resistance to *Botrytis cinerea* in strawberry plants more efficiently when administrated on leaves. They can be used for plants protection in the context of sustainable agriculture.

INTRODUCTION

By applying friendly products we can help to reduce environmental and plants pollution. Biocontrol represents an environmentally friendly approach to the management of plant diseases. Biocontrol refers to the use of natural organisms, or genetically modifiers genes, to eliminate the effects of undesirable organisms in favor of organisms that are beneficial to humans, including crops, trees and beneficial microorganisms. Accordingly, understanding the biocontrol mechanisms is critical to obtaining the most effective as well as commercially acceptable biocontrol agents (Papavizas, 1985, Chet, 1987).

Identifying products that induce plant resistance to reduce chemical treatments costs, in this way we contribute to a sustainable agriculture (Ghisalberti, 1991, Burges, 1998, Deng, 2007).

The aim of the study was testing the influence of fungal extracts on improving the resistance of strawberry plants to pathogen *Botrytis cinerea.*

MATERIALS AND METHODS

The study was carried out during 2008-2010, but in 2010 we controlled the efficiency of extracts directly in the field. The experiment was made in the didactic field from USAMV Bucharest. The biological material was Senga Sengana variety, sensible to grey mould.

The experimental variants were: V1 – control; V2 - chemical treatment; V3 – treatment with Extract 1; V4 - treatment with Extract 2; V5 - treatment with Extract 1 and chemical treatment and V6 treatment with Extract 2 and chemical treatment. The chemical fungicides and fungal extracts were applied on plant (leaves) and on soil. All vegetative factors (light, temperature and humidity) were daily monitored. The chemical and biological treatments and doses administrated are presented in Tables 1, 2 and 3.

The observations and determinations made: the dynamic of height plant; number of leaves; the growth rhythm; the evolution of attack after 24, 48, 72 and 168 hours; foliar surface; number of affected leaves; percent of affected leaves. The data were compared by means of statistical analysis of variance.

RESULTS AND DISCUSSION

After examining the effect of treatment, we found that the percentage of affected leaves was lower at all variants treated on plant and soil with chemical products and extracts as compared with control. The treatment made with fungal extract E1 combined with the chemical treatment (in V5) on plant and soil showed the best resistance of plants to *Botrytis cinerea* (Table 4).

The observations showed that all variants treated with Extracts on the leaves had stopped the attack after 48 hours, respectively 72 hours. In control variant, percentage of attack to total leaf area was highest after 48 hours (8.28 %) respectively after 168 hours (22.59%). In the variant 3, the leaves have not been affected (Table 5).

We remarked that when applying the treatments on soil all variants treated with fungal extract have provided a better protection of plants, but less efficient than treatment on plant The percentage of leaves affected was low in the treatment on soil with products (Table 6).

The percentage of fruit affected was low in all variants treated chemical, with Extracts and with the combination between Extracts and fungal products (table 7 and 8).

CONCLUSIONS

1. Biological control agents represented by fungal extracts had beneficial effects on strawberry plants that were better protected against infection with *Botrytis cinerea* than non-treated plants or treated with chemical fungicides
2. The effect of biological agents for pathogen control was the best when applied by spraying on plant leaves than on soil
3. In the case of the treatment applied on plant and soil the best protection was observed at variant 5.
4. The efficiency of pathogen control treatments in the experiment was: Extract 1 + chemical treatment > Extract 2 + chemical treatment >Extract 1>Extract 2>Chemical fungicides.

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TABLES AND PHOTOS

Table 1

The chemical treatments applied by spraying on leaves and on soil

The days	Products - spraying on leaves	Dose ml/plant	Products applied on soil	Dose ml/plant
Day 1st	Captan +Teldor	10 ml	Topsin +Rovral	10 ml
Day 4th	Captan +Teldor	10 ml	Topsin +Rovral	10 ml
Day 6th	Captan + Batron	10 ml	Topsin	10 ml
Day 8th	Captan + Batron	10 ml	Topsin	10 ml

Table 2

The fungal extracts applied by spraying on leaves and on soil

The days	Extracts - spraying on leaves	Dose ml/plant	Products Applied on soil	Dose applied on soil ml
Day 1st	1 and 2	10 ml	1 and 2	10 ml
Day 4th	1 and 2	10 ml	1 and 2	10 ml
Day 6th	1 and 2	10 ml	1 and 2	10 ml
Day 8th	1 and 2	10 ml	1 and 2	10 ml

Table 3

The fungal extracts and chemical treatment applied by spraying on leaves and on soil

The days	Extracts and chemical treatment - spraying on leaves	Dose applied on plant ml/plant	Extracts and chemical treatment Applied on soil	Dose applied on soil ml/plant
Day 1st	Extract 1 and chemical treatment	10 ml	Extract 1 and chemical treatment	10 ml
	Extract 2 and chemical treatment	10 ml	Extract 2 and chemical treatment	10 ml
Day 4th	Extract 1 and chemical treatment	10 ml	Extract 1 and chemical treatment	10 ml
	Extract 2 and chemical treatment	10 ml	Extract 2 and chemical treatment	10 ml
Day 6th	Extract 1 and chemical treatment	10 ml	Extract 1 and chemical treatment	10 ml
	Extract 2 and chemical treatment	10 ml	Extract 2 and chemical treatment	10 ml
Day 8th	Extract 1 and chemical treatment	10 ml	Extract 1 and chemical treatment	10 ml
	Extract 2 and chemical treatment	10 ml	Extract 2 and chemical treatment	10 ml

Table 4

Total leaves, total leaves affected and the percent of leaves affected from total leaves

Experimental variants	Treatments applied on:	Total number of leaves per plant	% to control	Signif.	Leaves affected	% of leaves affected from total leaves
V1 - Control	V1 Mt	17	100.00	Mt	3.8	100
V2 – Treatment	V2 - Plant	17.3	101.76	N	0.7	18.4
	V2 - Soil	18.5	108.82	N	2.7	71.1
V3 - Extract 1	V3 - Plant	18.7	110.00	N	0.1	2.6
	V3 - Soil	21.2	124.71	**	0.2	5.3
V4 - Extract 2	V4 - Plant	23.2	136.47	***	0.2	5.3
	V4- Soil	20.7	121.76	**	0.2	5.3
V5 - Extract 1 and chemical treatment	V5 - Plant	19.7	115.88	*	0.0	0.0
	V5 - Soil	18.3	107.65	N	0.05	1.3
V6 - Extract 2 and chemical treatment	V5 - Plant	21.2	124.71	**	0.5	13.2
	V5 - Soil	20,8	122.35	**	0.79	20.8
	DL5% = 2.140 DL5% in % = 12.5882 DL1% = 3.050 DL1% in % = 17.9412 DL01% = 4.410 DL01% in %= 25.9412					

Table 5

Foliar surface and the percent of surface affected from total foliar surface (treatments applied on plants)

Experimental variants Treatments applied on plant	**Foliar surface**	**Surface affected of pathogen from the total foliar surface (%)**		
		48 hours	**72 hours**	**168 hours (7 days)**
V1 - Control	447.1	8.28	9.17	22.59
V2 – Treatment	484.9	0.62	1.86	4.08
V3 - Extract 1	516.0	0	0	0.58
V4 - Extract 2	369.6	0.81	0.81	0.81
V5 - Extract 1 and chemical treatment	457.25	0.11	1.27	1.38
V6 - Extract 2 and chemical treatment	432.6	0.60	1.29	1.90

Table 6

Foliar surface and the percent of surface affected from total foliar surface (treatments applied on soil)

Experimental variants Treatments applied on soil	**Foliar surface**	**Surface affected of pathogen from the total foliar surface (%)**		
		48 hours	**72 hours**	**168 hours (7 days)**
V1 - Control	447.1	8.28	9.17	22.59
V2 – Treatment	444.4	2.48	3.94	14.58
V3 - Extract 1	326.3	0	0.91	0.91
V4 - Extract 2	405.8	0	0.96	0.96
V5 - Extract 1 and chemical treatment	511.2	0.16	1.33	1.49
V6 - Extract 2 and chemical treatment	475.6	0.53	3.11	3.64

Table 7

The percentage of fruits affected (treatment on plants)

Variants Treatment on plants	**Attack evolution (in percent - %)**				
	48 hours	72 hours	168 hours	**% to control**	**Signif.**
V1 - Control	8.66	21.00	27.66	**100.00**	**Ctr.**
V2 - Chemical treatment	5.11	6.27	11.45	**41.40**	**OOO**
V3 - Extract 1	2.17	2.87	4.11	**14.86**	**OOO**
V4 - Extract 2	1.80	2.10	3.01	**10.90**	**OOO**
V5 - E1+ chemical treatment	2.82	0.51	3.33	**12.04**	**OOO**
V6 - E2+ chemical treatment	2.63	1.18	3.81	**13.77**	**OOO**
		DL5% = 1.480 DL5% in % = 5.3507 DL1% = 2.330 DL1% in % = 8.4237 DL01% = 3.970 DL01% in %= 14.3529			

Table 8

The percentage of fruits affected (treatment on soil)

Variants Treatment on soil	**Attack evolution (in percent - %)**				
	After 48 hours	After 72 hours	After 168 hours	**% to control**	**Signif.**
V1 - Control	8.66	21.00	27.66	**100.00**	**Ctr.**
V2 - Chemical treatment	4.30	5.10	8.85	**32.00**	**OOO**
V3 - Extract 1	3.10	3.80	5.60	**20.25**	**OOO**
V4 - Extract 2	1.56	2.37	3.25	**11.75**	**OOO**
V5 - E1+ chemical treatment	3.86	2.01	5.87	**21.22**	**OOO**
V6 - E2+ chemical treatment	3.82	1.01	4.83	**17.46**	**OOO**
		DL5% = 1.480 DL5% in % = 5.3507 DL1% = 2.320 DL1% in % = 8.3876 DL01% = 3.960 DL01% in %= 14.3167			














Influence of planting material on plant growth and production of sweet potatoes

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Keywords: Methods for rooting, cuttings, varieties, production potential

ABSTRACT

Given that seed potatoes are not the conditions of our country, crop establishment is by rooted cuttings, roots obtained from the mother, forced to advance. The results presented in this paper shows that these sequences defining technology for culture, influence plant growth and production potential of the different varieties of potatoes. In general, variants created by forcing root cuttings derived from soil and rooted in water, the number of shoots was higher and the variety Victoria IANB was more vigorous than Crux variety. Cuttings rooted in water have led to the doubling of the variety Crux roots and root mass increased in both varieties. Productions were obtained roots from 24.16 to 27.21 t/ha, significantly influenced by variety and method of rooting cuttings, peaking at Crux variety when cuttings were planted roots coming from the forced peat and rooted in water.

INTRODUCTION

This paper presents some partial results of research on sweet potatoes (sweet potato - *Ipomoea batatas* Poir.), subject to the author's doctoral thesis. One of the objectives of the studies undertaken was the establishment of this plant specific cultural method, such as obtaining cuttings used as foundation material cultures.

Today, sweet potatoes are grown in 95 countries and the FAO Statistical Yearbook (Statistics, 2006) indicates a busy area in the world of over 9.5 million ha and an annual average production of 138 million tons.

In tropical and subtropical countries, where average yields per hectare of cereals provide a very small, sweet rice together constitute a basic food source, because dry matter content exceeds 35% and chemical composition (10% total sugar 20% starch, 1.2 to 2.7% fat, 3.5% protein, minerals potassium, calcium, phosphorus, magnesium, vitamin C, various organic acids, enzymes, pigments and others) Chaux and Foury, 1995; Gherghina and others, 2000; Ciofu and others, 2003).

In Romania, sweet little known plant is grown sporadically, and expansion in culture will lead to a diversification of existing vegetable assortment

Special nutritional value of the roots (Chaux, and Foury, 1995; Ciofu and others, 2003), made the sweet potatoes are used in obtaining various dishes: smoothies, soups, desserts, French fries, dessert, etc. (Ciofu and others, 1987).

Due to the remote origin, seed potatoes are not the conditions of our country and the creation of cultures is possible only by vegetative shoots grown using cuttings obtained from the roots made forced (Maier, 1969; Ciofu 2005).

Results on the influence of different specification methods used to produce cuttings have on plant growth and their productive potential.

MATERIAL AND METHODS

In 2008, experiments were performed in teaching and research field inside U.S.A.M.V. Bucharest. As biological material we used two varieties of sweet potatoes roots Romanian: Victoria IANB and Crux.

During the research, have made many observations and measurements using specific working methods, namely:
- *morphometric measurements*: the number and length of main shoots, number and average weight of roots were carried out at about 10 plants per repetition (three repetitions), calculating the average for each variant;
- determination of the productive potential: for each technological option and variety, the roots obtained from five nests in each repetition, a total of 15 nests per variant were analyzed under the following aspects: number of roots, average root mass by quality (similar with those of red edible beets: <100g, 100-300g, 300-600g,> 600g), the production of edible roots (kg/litter; t/ha).Production results were interpreted statistically using Duncan test (multiple comparisons).

Experience of technology practiced in the recommendations of the literature (Maier, 1969; Ciofu, 2005) and included specific work pursued in the study, carried out under the proposed variants:
- roots of sweet potatoes from the previous year's harvest, forcing themselves to sit in the warm greenhouse in late February or in loose soil in the greenhouse than either large pots filled with peat;
- rooting cuttings was staged, as the emergence of shoots, in bottles with water, or pots (pots) filled with peat;
- 8-10 days before planting, and - has shaped the land based billons width of 30-50 cm, 25-28 cm high and 70cm apart;
- field planting was done on June 19 in a row on “bilon” 70/50 cm (28,500 plants per hectare). Mud and cuttings have been planted on the ridge of “bilon”;
- works were applied to current care (a weeding, watering the furrows; partial fertilization and special paper to lift off the ground haulm;
- harvesting roots was carried out on 12 November, before the fall frost.

RESULTS AND DISCUSSION

After planting in the field, we studied how the cuttings used in establishing how culture has influenced plant growth. The results presented in Table 1 shows the differences recorded the number of shoots formed per plant. Note that regardless of the derivation of the shoots, the variety Victoria has formed a greater number of shoots (2.68 to 4.60) compared with the variety Crux (2.37 to 2.85). In general, variants created by forcing root cuttings derived from soil and rooted in water, the number of shoots was higher than the variants that use peat.

Before the end of vegetation (October 1), the most vigorous shoots, with a maximum length of 90 cm were recorded for the variety Victoria, the culture established with cuttings collected from the roots of forced and rooted in peat soil (V4).

During September, the growth of shoots was higher at the variants cuttings rooted in water, the fastest rate that is typical of the variety Victoria cuttings were collected from the roots of forced peat (V2).

Influence of planting material on plant growth of sweet potatoes, the production was reflected in the results achieved.

From Table 2 and Figure 1, we see that at harvest, haulm weight was higher in the 1-3 variants were cuttings rooted in water (387-722 g/litter) compared to 4-6 variants in which cuttings were rooted in peat (391-576 g/nest). Most vegetative mass production was obtained from V2-variety culture founded by Victoria derived from cuttings rooted in peat and forced rooted in water.

Great differences were recorded in the number of roots formed nest. In both varieties, when rooting cuttings in water (V1-V3), was formed to double the number of roots embedded in peat variants (V4-V6), the best results being obtained at Crux variety.

The same differences between variants of obtaining seedlings and varieties were maintained and if the mass of roots, which in the same variety was much higher variations in water from peat rooting i.e., 1.8 times the variety Crux and 2.2 to 2.4 times in Victoria IANB, depending on the mode of forcing the roots.

The variety and type of cuttings used for planting had a specific influence on the quality assessed by spreading their roots in size categories according to STAS. From Table 2 it can be seen that the cuttings rooted in water have increased the share of large and medium-sized roots of the quantity of harvested roots. These variants represented STAS root production under less than 100 g, broken, etc. Represent only 45-50% of the total, compared to 52-58% at the variants rooted cuttings were planted in peat.

Results on the influence of methods for obtaining cuttings on the yields achieved in the two varieties of sweet potatoes are presented in Table 3 and Figure 2.

Compared with the average experience representing the biological potential of plants grown in fields in the Conditions; potatoes from South Plain of Romania, at the variants were planted cuttings rooted in water, biological production was 4-38% higher, the best results (44.68 t/ha) occurring in Victoria if the variety coming from the roots of forced cuttings in peat. By comparison, the rooted cuttings in peat variants, results were obtained with 20-37% lower than average experience.

Variants 1-4, gave superior results in terms of average experience and haulm yields per hectare and roots made. The V3 (variety Crux - the root cuttings rooted in peat and forced water) have the highest rates of total root production (27.2 t/ha) and recoverable roots (13.6 t/ha). Compared to the average experience in the production of roots capitalization of over 100 g/piece represented 49% of the total production of roots, the variants that were planted cuttings rooted in water, gave superior results (50-55%) ranked first topping variety Victoria.

Statistical analysis of production results carried out using Duncan test (Table 4) shows that the studied varieties of potatoes yields have significantly different to that culture conditions, which demonstrates the potential of specific biological production.

Compared to the average experience, the best yields were obtained from cuttings rooted in water variants, and especially the variety CRUX (with significant differences over 8 tones per hectare), the differences were very significant to all variants of rooting in peat. Victoria IANB Variety also gave higher yields, with distinct differences significant.

CONCLUSIONS

The sweet potato does not form seeds in the conditions of our country and for the establishment of cultures using cuttings obtained from parent shoots on roots grown forcibly made.

Substrate variety and forcing the roots, the rooting of cuttings that influences affect plant growth and productive potential.

Forcing derived from root cuttings in soil and rooted in water, increase the number of shoots.

Variety Victoria IANB more vigorous was than Crux, regardless of the cuttings used for Planting.

Cuttings rooted in water have led to the doubling of the roots of the variety Crux. and increased root mass in both species.

Productions were obtained roots from 24.16 to 27.21 t/ha, significantly influenced by variety and method of rooting cuttings, peaking at Crux variety when rooted cuttings were planted in water.

Methods for obtaining quality seedlings influenced productions, cuttings rooted in water have led to an increasing share of large and medium roots and recoverable yields than those rooted in peat and media experience.

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TABLES AND FIGURES

Table 1

Influence of planting material on plant growth of sweet potatoes

Variant	Variety	Type of cuttings root/Restraint	Shoots trained on the plant (No.)	The maximum length of shoots (cm)			Growth rate cm/day
				04 sept	01 oct.	dif.cm	
V1	Victoria	water/soil	4,60	55,30	76,00	20,7	0,77
V2	Victoria	water/peat	3,66	55,52	84,66	29,14	1,08
V3	Crux	water/peat	2,37	49,54	64,15	14,61	0,54
V4	Victoria	peat/soil	3,83	56,31	90,10	33,79	1,25
V5	Victoria	peat/peat	2,68	54,37	71,08	16,71	0,62
V6	Crux	peat/peat	2,85	44,16	73,50	29,34	1,09

Table 2

Influence of variety and planting sweet potatoes on the productive potential

Variant / specification	Weight haulm g/nest	Nr. root/ nest	Root mass g/nest	Root Quality % of total			
				> 600 g	300-600 g	100-300 g	under STAS
V1 – Victoria-water/soil	386,80	6,0	796,83	13	21	19	47
V2 – Victoria-water/peat	721,83	5,5	847,66	24	18	13	45
V3 – Crux - water/peat	535,88	7,3	954,66	9	22	19	50
V4 – Victoria-peat/soil	391,25	3,8	329,83	3	17	22	58
V5 - Victoria - peat/peat	575,65	3,5	381,83	10	14	20	56
V6 – Crux - peat/peat	392,50	3,7	519,50	14	18	16	52

Table 3

Influence of variety and planting on the production of sweet potatoes

Variant	Organic production		Haulm production		Total production of roots		Production of roots recoverable	
	t/ha	%	t/ha	% din p.biol.	t/ha	% din p. biol.	t/ha	% din p. răd.
V1 – Victoria-water/soil	33,73		,02	33	22,71	67	12,04	53
V2 – Victoria-water/peat	44,68	138	20,52	46	24,16	54	13,29	55
V3 – Crux - water/peat	42,48	131	15,27	36	27,21	64	13,60	50
V4 – Victoria-peat/soil	20,54	63	11,14	54	9,40	46	3,95	42
V5 - Victoria - peat/peat	27,34	84	16,46	60	10,88	40	4,77	44
V6 – Crux - peat/peat	25,96	80	11,17	43	14,79	57	7,09	48
V7- media experience	32,45	100	14,26	44	18.19	56	8,91	49

Table 4

Production of roots of sweet potatoes - November 2008
(Multiple comparisons test - Duncan)

Crt Nr.	Variant	Production		Variants crt. nr.						
				7	6	5	4	3	2	1
		t/ha	%	9,40	10,88	14,79	18,19	22,71	24,16	27,21
1	V3 – CRUX water/peat	27,21	149,6	xxx 17,81	xxx 16,33	xx 12,42	x 8,79	x 4,50	3,05	-
2	V2 –Victoria water/peat	24,16	132,8	xxx 14,76	xx 13,28	xx 9,37	x 5,97	1,45	-	
3	V1 - Victoria water/soil	22,71	124,8	xx 13,31	xx 11,83	x 7,92	x 4,52	-		
4	***Media experience***	18,19	100	x 8,79	x 7,31	3,40	-			
5	V6 - CRUX peat/peat	14,79	81,3	x 5,39	3,91	-				
6	V5 - Victoria peat/peat	10,88	59,8	1,48	-					
7	V4 - Victoria peat/soil	9,40	51,7	-						

DL 5% = 4,18 t/ha DL 1% = 9,07 t/ha DL 0,1% = 14,53 t/ha

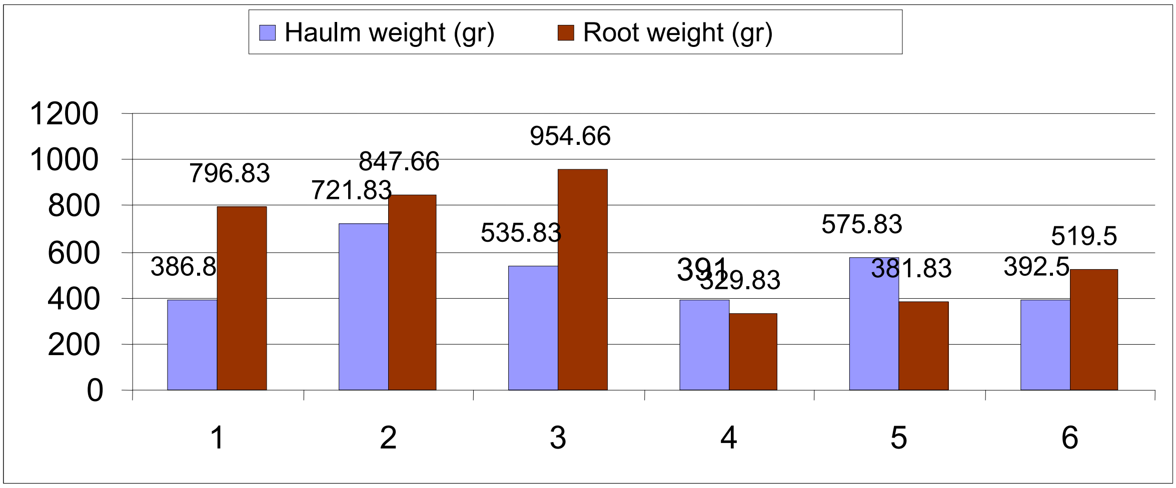

Fig. 1 - Influence of variety and planting on the potential biological

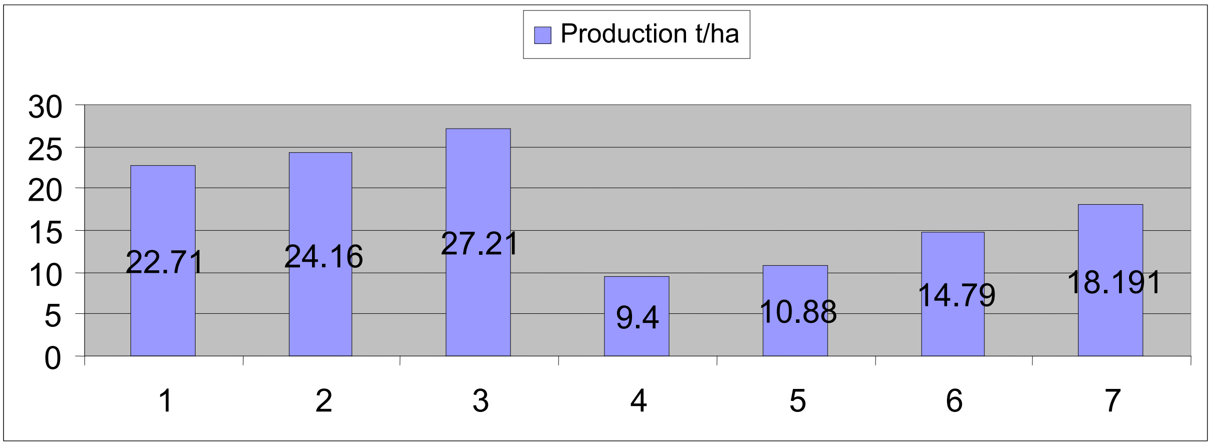

Fig. 2 - Influence of variety and planting on root production in sweet potatoes

The evolution of qualitative characteristics of new tomato cultivars during vegetation period

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Keywords: tomatoe, solarium, cultivar

ABSTRACT

Tomato production in Romania is provided by the cultures made in the field, greenhouses and solariums. The diversity of cultivars increased offerings of different companies after 1990. This diversity has resulted in quality and variety in consumer behavior and is useful to check the plants from transplant to fruition. The choice of a particular cultivar should be taken after a preliminary technical information so those who sell seed and the growers who have tried these cultivars. New cultivars are introduced initially in small areas and then after checking the quality and production results are put on large areas. This study was conducted in order to know the behavior of tomato cultivars in the solar crop in our country. Cultivars tested were Marisa F1, F1 Katerina, Birdie F1, Abellus F1 and Alboran F1. During the harvest period were analyzed tomato fruit in terms of their quality in three periods namely: the early ripening fruit, the maximum harvest period at the end of the harvest. Analysis of elements N, P, K unchanged presents information on the quality of tomato consumption and the intake of elements necessary for human metabolism by eating those fruits. To determine the quality has been considered the Order No. 1 of Ministry of Health from 2002. Such determinations were made on the content of heavy metals, nitrates and nitrites during the harvest period. The results show a different behavior of cultivars on the charge of elements necessary for human consumption but also the dangerous elements.

INTRODUCTION

Breeders to create concern biological material was adapted to these conditions as a primary goal the development of cultivars with resistance to disease in some pests (nematodes), for tomato crops in greenhouses and solariums.

Not all cultivars of tomato seed supply is marketed crops in greenhouses and solariums have resistance to all pathogens that attack tomato plants. As such, a professional grower must give room for seeds from the market those hybrids that are suitable for culture system, which would be employed [Ciofu et al., 1992; Tudor, 1995].

It is expected that in perspective for an assortment of tomatoes from the greenhouses and solariums with resistance and tolerance to diseases and pests to create hybrids whose fresh fruit consumption to taste identical to those produced in cultures performed with seeds traditional varieties widely appreciated for balanced and pleasant taste.

MATERIAL AND METHODS

Researches were carried out in 2009 and test the recently introduced five cultivars for vegetable market in our country. Cultivars chosen for research are presented in Table 1.

Culture was conducted in a solar village Bărcăneşti, county Prahova. The beginning of culture was performed with seedlings made the same solar scheme establishing culture was 70/45 cm for each hybrid in part, resulting in a total of 40,000 plants/ha.

Basic fertilization was conducted with manure 40 t/ha manure demidecompouse and 50 kg/ha application of complex fertilizers 15:15:15 as basic fertilization. Incorporate fertilizer was made basic with 20 cm deep plowing.20/03/2009 due to very hot climates they started to plant the transplants. From each hybrid were planted 25 plants each. Analysis of Solar agrochemical soil has a pH of weak acid soil, an average content of nitrogen, low phosphorus and low potassium.

Watering plants was twice a week at each plant separately.

Phyitosanitary treatments consisted of 1 treatment with Captan and 2 treatments against *Trialeurodes vaporariorum* with Mospilan 20SP, 0.025% and Applaud 25 WP, 0.1%.Limiting growth in height of plants was performed twice.

During the harvest period were analyzed tomato fruit in terms of their quality in three periods namely:

- The early ripening fruit 11. 05. 2009
- The maximum harvest period 13.06. 2009
- The end of the harvest. 05.07. 2009

Analyzes were nitrate content, phosphorus and potassium unchanged drug (1:20 acetic acid extraction, dosing colorimetric nitrate and phosphorus and potassium in flamfotometric) and total forms of chemical elements (wet mineralization and dosing by the Kjeldahl method in nitrogen, colorimetric in phosphorus, potassium and AAS and flamfometric for the other mineral elements).

RESULTS AND DISCUSSION

Analysis of **nitrate** levels during the harvest period is presented in Fig. 1. Presented higher values in the first period of analysis, values oscillate between 98 and 142ppm. On 13.06.2009 nitrates recorded lower values than 79-113ppm Marisa variant that has accumulated high levels of nitrate so that the average has reached 146ppm. Towards the end of harvest due to nitrogen metabolism in protein, levels decreased nitrate ranging between 82 and 105ppm.

Analyzing these values in terms of value of 150ppm limit specified by Order of the Ministry of Health nr.1/2002 [2] the fresh tomatoes consumed in the nitrate accumulation was observed that in all cases the amount considered potentially toxic.

Phosphorus has been low in all cultivars analyzed, the accumulation of this element is the value indicated by the literature as a good supply of 200-400ppm respectively P-PO4. Low accumulation can be put to the expense of low-phosphorus in the soil from solar examined (Fig.2.).

Potassium, another important factor in the quality of tomatoes (Fig. 3) has accumulated high amounts of tested cultivars reaching and sometimes exceeding the value of 2500ppm K, the value specified in the literature as a good supply of tomatoes for this item. High potassium content ensures a good quality of tomato marketing and intake increased consumer demands

Total forms analyzed chemical elements, macro and micro plant necessary but people (table3) have accumulated in tomatoes in normal quantities, quantities that fall within the limits specified in the literature. These amounts accrued assure quality of tomato consumption and recommended as these cultivars to be introduced in culture in solarium and greenhouses in our country.

CONCLUSIONS

Research conducted in 2009 in some tomato cultivars recommended for greenhouses in our country in terms of their productive capacity and potential showed the following:

1. Fruit quality in terms of the nitrate content of tomatoes varied with time of harvest and cultivation. Accumulation of nitrate was in low quantities unaffected the quality of tomatoes for consumption;
2. The content of nitrate accumulated in the three harvest periods was below the maximum permitted level specified by the Ministry of Health of 150ppm for tomatoes; 3. Phosphorus has been low in all cultivars analyzed, the accumulation of this element is the value indicated by the literature as a good supply of 200-400ppm respectively P-PO_4. Low accumulation can be put to the expense of low-phosphorus in the soil from solarium analyzed;
3. Potassium was accumulated in high quantities in tomatoes of cultivars tested reaching

and sometimes exceeding the value of 2500ppm K, the value specified in the literature as a good supply of tomatoes for this item. High potassium content ensures good quality tomatoes for marketing and an increased contribution to human requirements of consumers;

4. The content of macro and micro elements of tomato accumulated is appreciably ensuring high quality consumer tomato;
5. In terms of quality cultivars investigated are batty identically with consumer requirements can be introduced into crops

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TABLES AND FIGURES

Table 1

The cultivars used in the research

Variant	Characteristics *
Marisa	Extraearlyer with indeterminate growth, 4 to 5 fruits per inflorescence, color of uniform red fruit, average fruit weight 110-120g, resistance to tobacco mosaic virus resistance, *Verticillium*, *Fusarium*
Katerina	Extraearlyer, the average force, 6-8 fruits per inflorescence, average fruit weight between 110 - 140g, full color, high resistance to storage and transport, resistance to tobacco mosaic virus, *Verticillium*, *Fusarium*, nematodes
Birdie	Extraearlyer, vigorous, very productive with 5.7 fruit blossom, color intense red fruit, round to slightly flattened, resistance to tobacco mosaic virus, *Verticillium*, *Fusarium* and nematodes
Alboran	Early, productive, vigorous with 5-6 fruits per inflorescence, color of deep red fruit, round, resistance to tobacco mosaic virus, *Verticillium*, *Cladosporium*, *Fusarium*
Abellus	Extraearlyer, 6-8 very productive fruit blossom, color intense red fruit, round to slightly flattened, with average fruit weight of 160 to 180 g/fruit, resistance to tobacco mosaic virus, *Verticillium*, *Cladosporium*, *Fusarium* and nematodes

Table 2

Some agrochemical characteristics of soil used in the experiment

Variants	pH	Soluble slats (%)	ppm content			
			$N\text{-}NH_4$	$N\text{-}NO_3$	P	K
Solarium soil	6.92	0.048	10.72	25.15	13.56	35.00

Table 3

Results regarding chemical analyses of mineral elements, total forms from tomatoes fruits

Cultivar/ Element	Marisa	Katerina	Bierdie	Alboran	Abellus
Nt. %	2.03	2.33	2.03	2.35	2.03
Pt. %	0.23	0.27	0.25	0.24	0.21
Kt. %	2.07	2.20	2.20	2.23	2.17
Cat. %	3.16	3.86	3.73	3.73	3.73
Mgt. %	0.39	0.46	0.40	0.47	0.37
Fet. ppm	167.33	240.67	240.67	167.67	240.67
Bt. ppm	15.33	25.33	35.33	20.33	18.33
Mnt. ppm	61.27	81.07	61.07	57.73	75.07
Cut. ppm	13.77	11.77	14.77	14.10	10.02
Znt. ppm	26.67	27.20	27.80	37.80	28.33

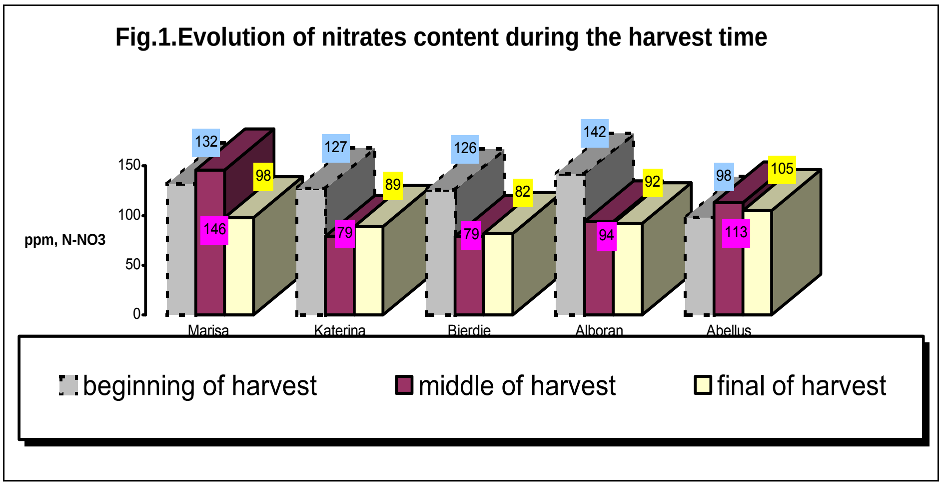
Fig.1.Evolution of nitrates content during the harvest time
ppm, N-NO3
150
100
50
0
132
146
98
127
79
89
126
79
82
142
94
92
98
113
105
Marisa
Katerina
Bierdie
Alboran
Abellus
beginning of harvest
middle of harvest
final of harvest

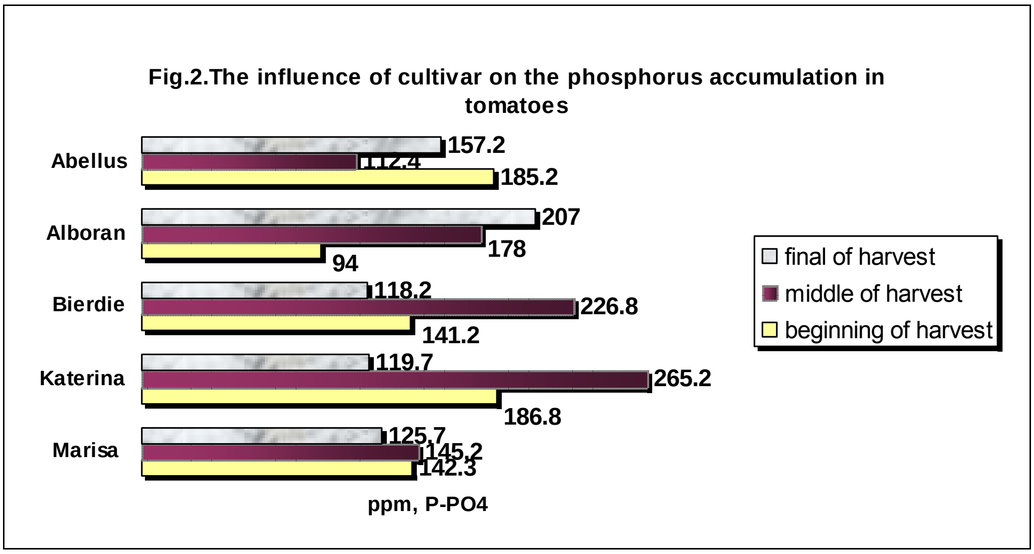
Fig.2.The influence of cultivar on the phosphorus accumulation in tomatoes
Abellus
157.2
112.4
185.2
Alboran
207
178
94
Bierdie
118.2
226.8
141.2
Katerina
119.7
265.2
186.8
Marisa
125.7
145.2
142.3
ppm, P-PO4
final of harvest
middle of harvest
beginning of harvest

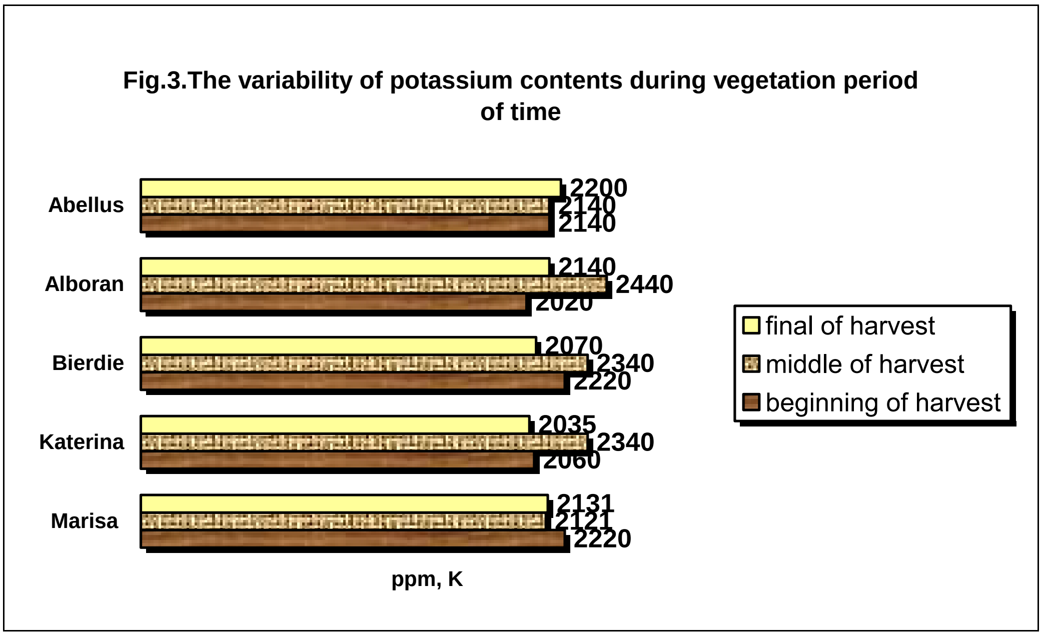
Fig.3.The variability of potassium contents during vegetation period of time
Abellus
2200
2140
2140
Alboran
2140
2440
2020
Bierdie
2070
2340
2220
Katerina
2035
2340
2060
Marisa
2131
2121
2220
ppm, K
final of harvest
middle of harvest
beginning of harvest

Biochemical characteristics and yield obtained at tomato cultivars

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Keywords: tomatoe, solarium, cultivar

ABSTRACT

Both globally and in our country tomatoes grow on 70 - 75% of surfaces used in the production of vegetable greenhouses and solarium. Currently growers in Romania used almost exclusively as a biological material of foreign origin, F1 hybrids of European countries such as Holland, France, Israel. These cultivars should be tested before making recommendations on their culture as they pursue the possibility of acclimatization tests in the climatic conditions of our country but also their production capacity and their capacity for consumption. The experiments took place in a solarium Bărcăneşti common, Prahova county and experimental variants that were tested are cultivars Marisa F1, Katerina F1, Birdie F1, Abellus F1 and Alboran F1. During the growing season were made determinations on the characteristics and taste of tomatoes harvested production was monitored developments. The results have brought relevant information on the recommendations made to elect a competitive cultivar.

INTRODUCTION

In production, the majority of crop species of botanical varieties or hybrids are represented by trade. In their international nomenclature was given the name of cultivars. Cultivar is given a value of productive potential, expressed through the maximum exploitation of natural factors in culture and technology and their conversion into production obtained. Thus in recent years priority has been to achieve objectives cultivars resistant to pests and diseases and secondly to obtain products with high production and quality characteristics [Neata et al., 2003; Indrea et al., 2007]. In our country have been introduced in many cultivars of tomato production but the quality and production results were not expected. Thus check the culture of different cultivars but also enables small and large producers to be informed about their performance. The research presented in this paper focuses on verifying the five cultivars: Marisa, Katerina, Bierdie, Alboran and Abellus in solarium culture.

MATERIALS AND METHODS

The research was conducted in 2009 and followed the testing of five cultivars recently introduced in our country in vegetable market. Culture was conducted in a solar village Bărcăneşti, county Prahova. The beginning of culture was performed with seedlings made the same solarium scheme establishing the culture was 70/45 cm for each hybrid in part, resulting in a total of 40,000 plants/ha. Was made a basic fertilization with manure 40 t/ha manure 50kg/ha semidecompouse and application of complex fertilizers 15:15:15 as basic fertilization. Incorporate fertilizer was made to 20cm deep plowing. On 20.01.2009 due to hot climates was switched to planting culture transplants. From each cultivar were planted every 25 plants.

During the harvest were analyzed tomato fruit in terms of biochemical characteristics at three periods, namely:
- At the beginning of fruit ripening 11/05/2009
- The maximum harvest period 13.06. 2009
- At the end of harvest. 05.07. 2009

Biochemical characteristics analyzed were:
- Total carbohydrate content using the colorimetric method with DNS;
- Vitamin C content by volumetric method
- Acidity by volumetric method with NaOH

During the harvest the crop was registered.

RESULTS AND DISCUSSIONS

Among the most important biochemical characteristics to the consumption of tomatoes are sugar, acid and vitamins C. Analysis of total carbohydrates (Table 1) harvesting at three periods indicates a good content similar to that provided in the specific literature 5.20% [Davidescu and Davidescu, 1999].

Sugar accumulation occurs in both the genetic potential of tomatoes but in particular climate characteristics namely sunlight and outside temperatures can hasten ripening and may affect the accumulation of carbohydrates. High content of nitrogen, medium in phosphorus and high in potassium and other conditions were favorable in high accumulation of carbohydrates.

If we analyze data on the total carbohydrate, content of cultivars tested is noted that the best results on the accumulation of such a characteristic flavor were obtained from Bierdie and Alboran. Other cultivars have accumulated fewer carbohydrates and thus their pleasant sweet taste is affected.

Vitamin C (Table 1), another taste characteristics accumulated in quantities of 9.50 to 19.05 mg/100g fresh tomato Higher amounts have accumulated steadily and in considerable quantities at Alboran and Bierdie cultivars. Marisa cultivar has accumulated the lowest amounts of vitamin C at all periods of analysis [3].

Acidity (Table 1), of the hybrids are accumulated in small quantities below the quantity from scientific literature presented [3] as a maximum value for this

Vegetables, this ensures a good quality tomato taste.

Crop results. Analysis of crop kg/m^2 obtained from the five tomato hybrids is observed that most production has been obtained with Birdie cultivar 11.656 kg/m^2, and then lies nearby Marisa with a production of 11.045 kg/m^2. Lowest production was obtained at Alboran with 4.9765 kg/m^2(Fig.1.).

This production was achieved due to the weight of fruit. Thus, the weight of fruit produced was located mainly in weight classes 120 - 70g/fruct. Fruit larger than 200g were obtained only at Birdie. Fruit is also a high weight respectively 170-200g/fruct were obtained at Marisa and Birdie in greater numbers, and at Katerina, and Birdie was in small numbers. Abellus cultivar although it had a high number of fruit, however due to their low weight was recorded lower production.

Statistical interpretation of results was done using the Fisher test (Table 2) since there is only one variable in cultivation. For statistical analysis was taken at random as the cultivation Marisa witness.

Production results provide a strong assurance insignificant production of tomato cultivars Katerina, Alboran and Abelus as production increases were negative compared with Marisa cultivation. The only cultivar that achieved a very significant addition is Bierdie production of 5.53%.

CONCLUSIONS

Research conducted in 2009 in some tomato cultivars recommended for solariums in our country in terms of their productive capacity and flavor said:

1. Total carbohydrate content is higher in cultivars tested was at Alboran and Bierdie. Other cultivars have accumulated fewer carbohydrates and thus their pleasant sweet taste is affected;

2. Vitamin C, another taste characteristic accumulated in quantities of 9.50 to 19.05 mg/100g fresh product. Higher amounts have accumulated steadily and in considerable quantities at Alboran and Bierdie cultivars. Marisa cultivar has accumulated the lowest amounts of vitamin C at all periods of analysis;

3. Acidity, a characteristic of the cultivar is accumulated in small quantities below the values presented by the scientific literature as a maximum for this vegetable. This provides a good tomato taste quality;

4. Statistical interpretation of results shows that production results provide a strong assurance insignificant production of tomato hybrids Katerina, Alboran and Abelus as production increases were negative compared with Marisa cultivar.

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TABLES AND FIGURE

Table 1

The tomatoes quality experimentated in 2009 from the point of view of glucide contents, %

Cultivar	Total glucide content, %			Vitamin C, mg/100gp.p.			Acidity,%		
	At the beginning of harvest	Maximum harvest	Final harvest	At the beginning of harvest	Maximum harvest	Final harvest	At the beginning of harvest	Maximum harvest	Final harvest
Marisa	5.187	5.034	5.037	9.50	10.08	9.87	0.39	0.36	0.38
Katerina	5.056	5.044	5.102	10.39	17.87	15.05	0.35	0.22	0.29
Bierdie	5.187	5.193	5.210	18.50	15.39	17.56	0.37	0.29	0.32
Alboran	5.119	5.250	5.230	17.87	18.19	19.05	0.31	0.24	0.32
Abellus	5.056	5.187	5.087	11.34	17.24	18.75	0.33	0.25	0.21

Table 2

Statistical interpretation of crop results

Cultivarul	Total crop Kg/m^2	Diferences +/-	Crop %	Significance
Marisa	11.045	Mt	100.00	Mt
Katerina	8.9112	-2.1338	80.68	ooo
Birdie	11.656	+0.611	105.53	***
Alboran	4.9765	-6.0685	45.05	ooo
Abellus	7.324	-3.721	66.31	ooo

DL 5%= 0.135kg/m^2 DL 1% = 0.213kg/m^2 DL 0,1% = 0.362 kg/m^2

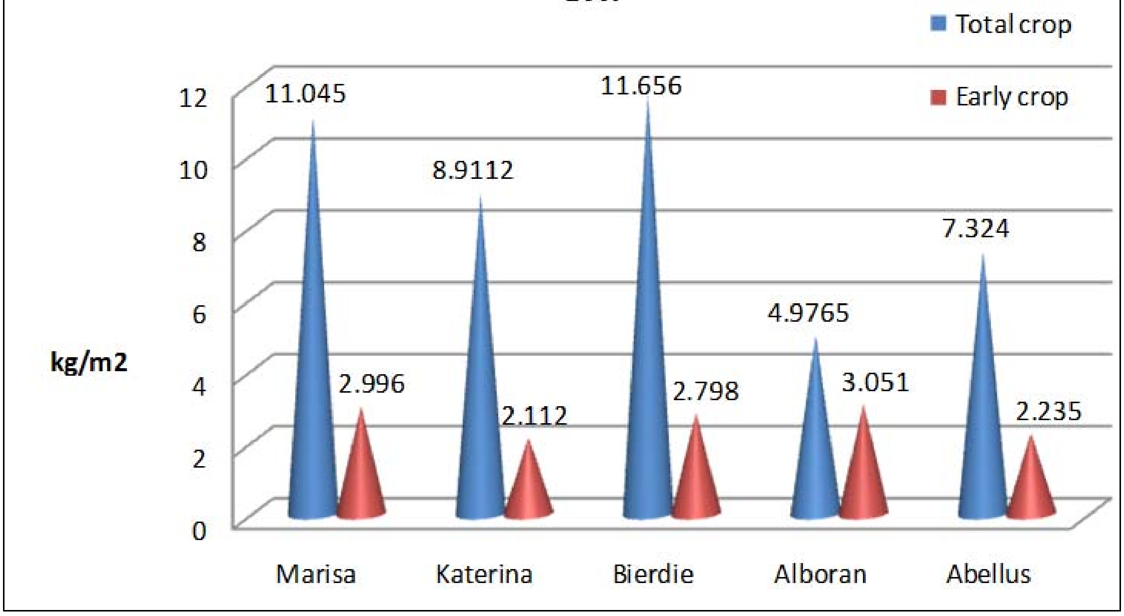

Fig. 1. Total and earlier crops from research cultivars 2009

Researches concerning the foliar fertilization of potato culture on salted soil

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Keywords: foliar fertilizer, FOLIMAX, doses, production, quality

ABSTRACT

The work presents the results obtained on potato summer culture in Ialomita district, on salted soil, using a foliar fertilization with FOLIMAX. It was studied the effect of this fertilization, using 3 progressive concetrations as compared to the unfertilized witness. The greatest productions have been obtained at those variants at which was applied the foliar fertilzer FOLIMAX in a dose of 8l/ha. In this case, as compared to the unfertilized witness, the number of tubers for each hole increased with 1,2, the mass of the tubers increased with 2,4 and the growth of production was of 130%. The foliar fertilization also contributed to the improvement of the production quality as it was proved by the prevalence of the tubers from the superior comercial categories (12-18 very big tubers and 44-47 big and middle tubers).

INTRODUCTION

The fertilization represents an extremely important technological sequence, which can constantly provide the supply of the plants with the necessary nourishing elements. The administration of the fertilizers in 2-3 phases provides food for the plants in all phases of growth and development and it determines an extension of the period of vegetation, and in consequence, an increase of the production (Berindei,1984; Ianoşi, 2002; Ciofu, et.al., 2003).

On salted soil, the plants can suffer a stress due to the fact that they are unable to get their water and mineral elements and therefore they have a reduced growth and development, their leaves turn black and their extremities get burnt (***, 2004). For the potatoe culture it is recommended a salts level lower than 2 DS/m (Sandu et. al., 1986).

For salted soil, which presents a low degree of rendering soluble the chemical elements, the use of the foliar fertilization ensures the potato plants with the necessary elements, thus surpassing the deficiences which may occur (Davidescu, D., Velicica Davidescu, 1992, Benavides M.P., 2001, Rusu Mihai and colab., 2005). Alongside of the agrotechnical specific works such as: the breaking up, the moulding, the destroying of the weeds and pest control, the foliar fertilization represents a means to obtain profitable and economical potato productions (Berar, and Popescu, 2003).

FOLIMAX is a foliar fertilizer with microelements which was produced at I.C.L.F. VIDRA, and it is a product recommended for the foliar fertilization of the potato, due the multiple advantages it presents: it covers the necessary microelements and macroelements, it helps plants to surpass the critical phases, and thus being eliminated the possible lacks of balance which may appear in nutrition. It is ecological as it significantly reduces the risk of polluting with unmetabolized ions the soil and the plants. As it is not toxic, polluting or corosiv, the product is economical as it reduces the costs by reducing the doses of granulated chemical fertilizers applied on the soil, through the posibility of associating it with fito-sanitary treatments, the lack of any special measures of transport, manipulation and work protection at the moment of administration.

The main objectiv of the experiments developed was to determine the effect of the foliar fertilization with FOLIMAX upon the formation of the tubers, upon the level of production and its quality at the potato culture on salted soil.

MATERIAL AND METHOD

The experiment took place in GAZ Farm Amara, at 2 km far from Slobozia city, the district of Ialomita, in the year 2006.

The analysis of the soil performed in October 2005 revealed the following caracteristics: a slight alkaline reaction (pH – 7.6); a reduced supply with organic material (MO - 5%); a concentration of soluble salts above the optimal level for the potato culture (CS – 5,5 DS/m, as compared to 2 DS/m, după Sandu et.al., 1986).

It was experimented the Santé variety of potato, semitardif, with a vegetation period of 100-120 days, due to be consumed in summer and autumn-winter.

The experiment was situated in a 10 000 square metres parcel, in production conditions, being realised a good isolation from side effects.

According to the rules of the experimental technique, it was realized a monofactorial experiment following the method of random blocks, with 4 repetitions. The repetitive parcel had 13 square metres, each variant having a 52 square metres for harvest, the whole surface of the experiment having 208 mp.

The experimental variants consisted in different doses of FOLIMAX which had been applied in 2 phasic fertilizations (4,0 ; 6,0 ; 8,0 l/ha) and which had been compared to the unfertilized witness.

FOLIMAX has the following composition: total nitrogen - 44 g/l (N); phosphorus - 105 g/l (P_2O_5): potassium - 80 g/l (K_2O); magnesium - 5 g/l (MgO); boron - 52 g/l (B); molybdenum - 18 ppm (Mo); ferrum - 155 ppm (Fe); manganese - 100 ppm (Mn); 6 essential and biostimulators aminoacids.

The planting took place on the 20th of April, on moulded soil, with a density of 47600 plants/ha. In the vegetation period all the technological phases of the potato culture have been followed (the works of the soil, the hygiene of the culture, the phitosanitary protection). The fertilization took place in 2 moments: at blossoming and before blossoming. The harvest took place on the 12th of September.

At harvest, determinations had been made in order to highlight the influence of different doses of FOLIMAX upon the potato production and thus:

- the number of tubers for each hole: there were counted the tubers from 10 bushes on each parcel of repetition and it was calculated the average for each variant.
- the total mass of the tubers: for each repetition the tubers from 10 potato bushes were weight and there was calculated the average for each variant;
- the medium mass of the tubers: it was calculated for each repetition and for each variant of the experiment;
- the production obtained: by measuring the tubers from each parcel of repetition, the calcul of the average for each variant, the reference to ha and the statistical analysis of the results obtained using the multiple comparisons (the Duncan test);
- the quality of the production was analysed by expressing in procents the production for each comercial category depending on the tubers diameter, as according to STAS: < 6 cm; 6-10 cm; > 10 cm. It was calculated the average for 10 bushes of potatos from each parcel of repetition and variant.

For the mathematical analysis of the production results it was used the Duncan test – multiple comparisons, there were calculated the determination coefficients and it was established the level of the significances for the correlations existing betwen the various paramaters that had been studied.

RESULTS AND DISCUSSION

The administration of the foliar fertilizer FOLIMAX on potato culture influenced the plants capacity of producing tubers. (Table 1)

The medium number of tubers for a nest increased with 1,1 – 1,2 in the case of the variants fertilized with FOLIMAX as compared to the witness which was not fertilized in vegetation, the greatest growth (23 %), being achieved at the dose of 8 l/ha..

The fertilization with FOLIMAX influenced at a higher rate the medium mass of the tubers which increased proportional to the administrated doses, with 30-94% as compared to the unfertilized witness (aproximatively 2 times at the variant with 8l/ha).

As a result of the combination of these influences the mass of the tubers formed at one nest increased with 0,4 – 1,32 kg in the case of the fertilized variants, as compared to the witness. The growths between 42% and 139%, are proportional to the increase of the doses of chicken manure applied in the phasic fertilization.

There are direct linear correlations between the doses of FOLIMAX and the parameters concerning the capacity of producing tubers at potato culture on salted soil (fig. 1 and 2). The value of the determination coefficients shows that the significance of the correlations is very big both in what concerns the number of the tubers for a plant and in what concerns the medium mass of the tubers (r^2 = 0,9831 and r^2 = 0,9835). As it can be seen in figure 3 there is also a direct significant correlation between the doses applied in the foliar phasic fertilization and the level of the potato productions (r^2 = 0,9844).

The mathematical analysis of the production results reveals (table 2) the strong influence of the fertilization with the foliar fertilizer FOLIMAX. In comparison to the average of the experiment which shows a potential of production of 72,77 t/ha, at the Santé variety in the conditions of salted soil, the variants fertilized with bigger doses (V3 şi V4) determined the increase of the productions with 20 % and respectively 36 %, which is very significant in the case of the 8 l/ha dose. In comparison, the unfertilized witness variant had inferior productions with significant differences as compared to the average of the experiment and to the variants that were fertilized with big doses. V2 fertilized with 4 l/ha Folimax was situated on the last but one place with productions significantly smaller as compared to the big doses of FOLIMAX. Irrelevant differences of production have been registered between the variant fertilized with 8 and 6l/ha.

There was recorded a favourable influence of the phasic fertilizations on the potato culture with FOLIMAX in what concerns the quality of the production, depending on the unifomity of the diameter (fig 4). After the harvest of the potatoes and after their sorting in accordance to the comercial qualities as specified in STAS, it resulted that at those variants fertilized with FOLIMAX there prevaled the category of medium tubers, with a 6-10 cm diameter(44 -47 % from the total) and big tubers were obtained, with a diameter over 10 cm (12-18%).

At the variants of fertilization with doses of 6 and 8l/ha the category of small tubers was of 35-37%. In comparison, in the case of the unfertilized witness the small tubers prevaled, with a diameter fewer than 6 cm (57 %) and no big tubers were obtained.

CONCLUSIONS:

The phasic administration of the foliar fertilizer with microelements FOIMAX on potato culture influenced the growth and the plants capacity of producing tubers. The medium number of the tubers for a nest increased with 1,1 – 1,2 and the medium mass of the tubers with 30 – 94 % as compared to the unfertilized witness, there being a direct correlation with the doses applied.

The fertilization with Folimax had strongly influenced the potato production which increased proprotional to the applied doses, as compared to the production potential of the Santé variety and with significant differences to the unfertilized witness. In the case of 6 and 8l/ha doses there were obtained increases of the production with 20-36 %.

Folimax had favourably influenced the quality of the tubers estimated by their average mass and the prevalence of the comercial categories of big and very big tubers relating to the total production, which were superior to the unfertilized control.

In order to obtain sustainable and quality productions on salted soils, it is recommended the phasic fertilization with FOLIMAX, in doses of 6-8l/ha.

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TABLES AND FIGURES

Table 1

The influence of FOLIMAX upon the tuberization

Variants	Number of tubers		The mass of the tubers			
	pieces/hole	%	g /piece	%	kg/hole	%
V1- Mt, unfertilized	14,4	100	65,97	100	0,95	100
V2 – 4 l/ha Folimax	15,7	109	85,99	130	1,35	142
V3 - 6 l/ha Folimax	17,0	118	114,70	174	1,95	205
V4 - 8 l/ha Folimax	17,7	123	128,25	194	2,27	239

Table 2

The analysis of the production in the conditions of chicken manure fertilization (multiple comparisons – Duncan test)

Clasiffication	Variant (Folimax l/ha)	Production (t/ha)	The difference as compared to place:			
			V	IV	III	II
I	V4 – 8	99,230	56,076 ***	37,538 ***	26,458 **	12,219
II	V3 – 6	87,011	43,857 ***	25,319 *	14,239	-
III	The average experience	72,772	29,618 ***	11,080	-	
IV	V2 - 4	61,692	18,538	-		
V	V1 - Mt	43,154	-			

Dl 5% = 19,508 t/ha; Dl 1% = 26,133 t/ha; Dl 0,1 % = 37,115 t/ha;

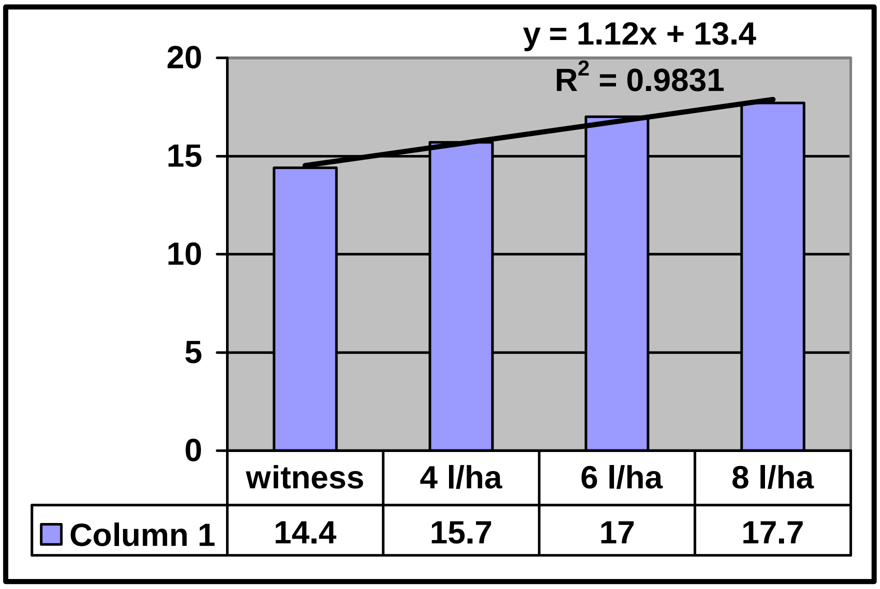

Fig. 1. The influence of the phasic fertilizaton with Folimax upon the number of tubers per nest

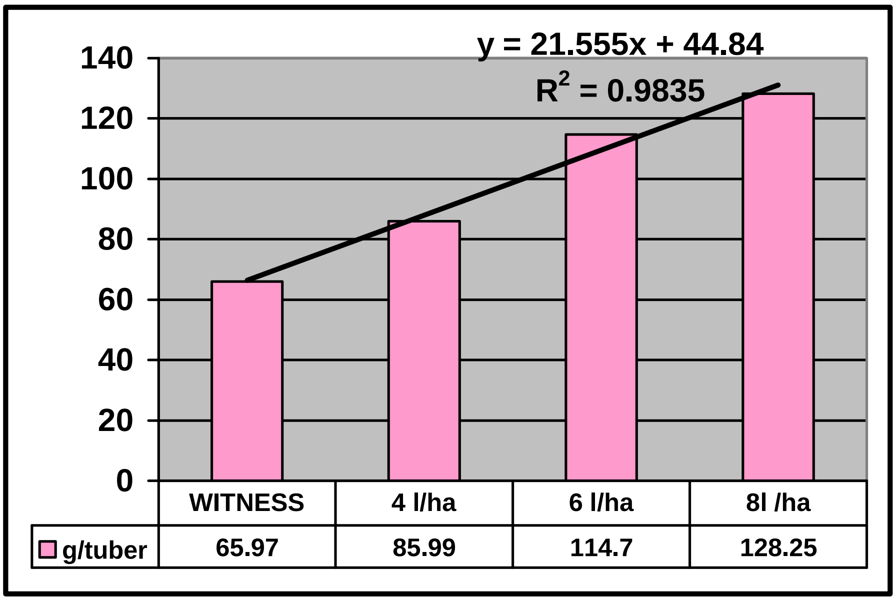

Fig. 2. The influence of the phasic fertilizaton with Folimax upon the average mass of the tubers (g/tuber)

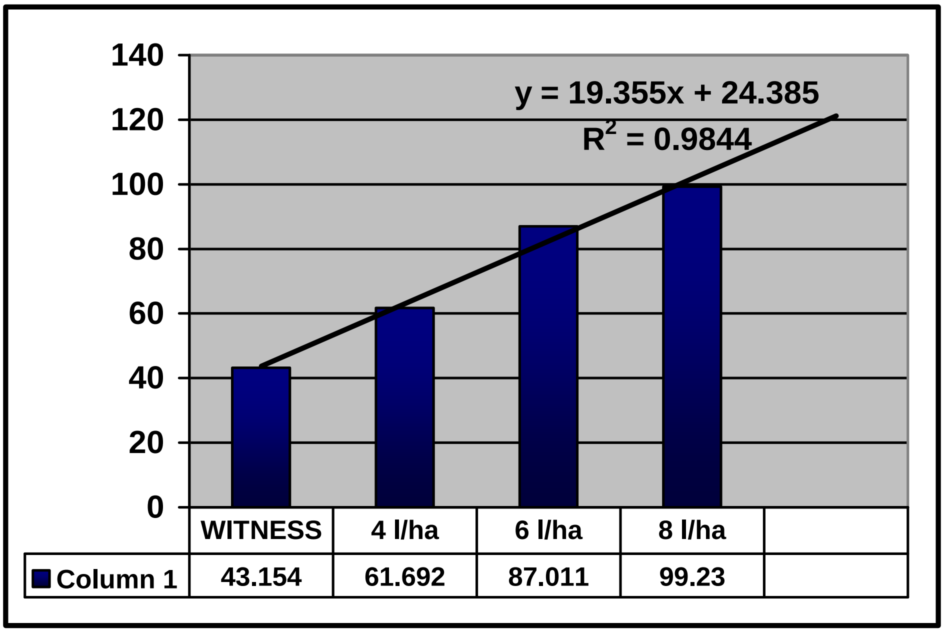

Fig. 3. The influence of the phasic fertilizaton with Folimax upon the production of potato (t /ha) - Santé variety

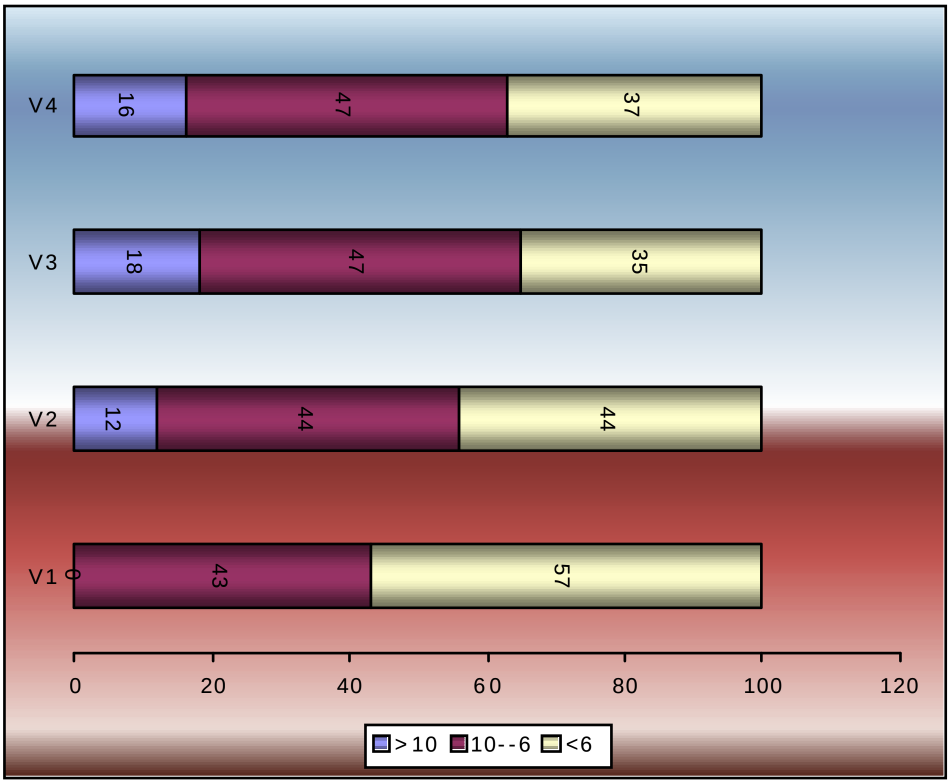

Fig. 4. The influence of the phasic fertilizaton with FOLIMAX upon the pevelance of different quality categories of tubers

Researches on the postharvest quality preservation of the melons *(Cucumus melo)*

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Keywords: melon, refrigeration, postharvest treatments

ABSTRACT

The research purpose was to prolong the preservation of commercial quality of the melons. In this case have been studied the influence of refrigerated storage conditions and local treatments with fungicides applied on peduncular scar area, the most vulnerable to the pathogens attack. For experimentation have been used melons from internal production, belonging to Polidor variety. The refrigeration (at 8-10°C) of the melons determined the prolongation with 13 days of the period of storage in comparizon with the ambiental conditions (30-32°C in the harvesting time). At the same time the application of a fungicide paste on the area of peduncular scar, reduced almost four times the decay losses in that zone of the melons, during storage period, and had a favourable influence on the quality parameters (pulp fermness and soluble solids content).

INTRODUCTION

The melons are very apreciated for their various tastes, aromas, colours and shapes that give them an exotical aura. Because of the climate conditions in our country, the melons were considered for a long period of time a seasonal produce, being commercialized at full maturity stage from July to September, depending on the precocity of the cultivated varieties or hybrids.

In the free market conditions with many imports the comercialization of melons have had important changes. The diversification of cultivars and hybrids grown in our country and the import of different types and varieties of mellons that asure almost a permanent market supply are only a part of them.

But the marketing of melons grown in the country is still inadequate. In the most cases the melons are transported and exposed to the consumer in bulk and in the open air being thus subjected to various damages and ambiental high temperature that hasten the quality deterioration of the produce. In addition at that no postharvest treatment is applied to the melons to reduce the specific decay losses that appear during marketing chain, even if the most imported slip type melons are treated with fungicide paste in the peduncle scar area.

In order to keep the quality of the most commercial types of melons (excepting the Cantaloup type) is recommended 7-10°C storage temperature (Hardenburg and colab., 1990).

Regarding the decay caused by pathogens Bucur and colab., 1975, consider that in most cases the infection of the melons takes place at a temperature higher than 21°C during harvesting, conditioning, handling, transport and storage. The authors recommend for the prevention of deseases development a temperature of 7-10°C.

Jamba and colab., 2002 show that the melons are very sensitive to the fixing and development of different pathogens after harvesting and that the losses registered during storage can easely rise above 25%. The authors appreciate that the diseases attack can be reduced by postharvest treatments with fungicides.

The research purpose was to specify the influence of refrigeration and fungicide treatments applied in peduncular scar area on the quality preservation implicitly on storage and marketing period.

MATERIALS AND METHODS

For experimentation have been used Polidor variety melons procured directly from the farm. The melons were carefully sorted in the field, being selected only fruits with no shape defects, healthy, firm, with the same maturity degree, same size with no lesions, blemishes or abnormal colour (Romanian Standard 3653/2003), the research material being as uniform as possible.

The storage temperature and the fungicide treatments stood at the base of research organization as presented in the table 1.

The melons layed in crates were stored in experimental rooms in different storage conditions: at ambiental temperature (30-33°C) and refrigeration (8-10°C).

For the variable with fungicide treatments there were obtained two antifungical pastes, one based on copper sulphate and Folpan 50WP in equal parts and another on Mancozeb 800. The preparation of fungicide pastes, with adequate adhesive power and consistency and that is easy to be applied on the melons, required a big number of determinations and laboratory trials.

The researches had the following determinations:
- weight and decay levels of losses;
- firmness evolution în different pulp zones ;
- soluble solids content evolution.

For weight and decay losse daily have been done weighings and observations on the appearance and development of decayed areas. The fermness was determined by numerous penetrations done in three pulp zones (Z1- near the rid, Z2-middle of the pulp and Z3-near the seed cavity) by using a table OFD penetometer with, the results being expressed in penetrometric degrees (1 GP = 0,01 mm). The soluble solids content was determined by ABBE refractometer in three zones with means for each variable, expressed in ° Brix.

RESULTS AND DISCUSSION

The data regarding the weight losses of melons in accordance with the storage temperature and fungicide treatment are presented in the figure 1.

From the data rezults that at the variant V1 with melons stored at the ambiental temperature, the period of quality preservation was 7 days with 7,41% weight losses.

The melons kept in refrigerated room at a temperature of 8-10°C could stay 20 days in store registering in this time the following weight losses: 8,64% (V2), 6,86 % (V3) and 6,32% (V4). Thus, the daily weight losses where 1,06% at the melons stored in ambiental conditions, 0,43% at refrigerated melons and 0,32-0,34% at refrigerated and fungicide treated ones.

The refrigerated storage, immediately after harvest, determined almost a triplation of the storage period, local treatments with fungicide pastes in peduncular scar zone reducing in addition with 1,8-2,3% the weight losses in comparizon with notreated melons. The results regarding the influence of storage temperature and local fungicide treatments on the decay losse in peduncle scar area are presented in a graph in the figure 2.

The data show that at the variant V1, with melons stored at ambiental temperature, the decay losses grew to 25%, the melons being attacked by different pathogens, frequently by Rhizopus stolonifer, Sclerotinia sclerotiorum, Rhizoctonia spp. şi Penicillium spp. The melons stored in refrigerated conditions (V2) registered after 20 storage days 20,8% fruits with decay in peduncular scar area.

The melons previousely treated with fungicide pastes and stored in refrigerated conditions (V3 and V4) presented after 20 days 4,2% decay losses. The results show the efficacy of the local fungicide treatments applied after harvesting that reduced about four times the disease presence and decay losses on melons. The both funcicide pastes gave similar results, the efficacy of the substances used at the preparation of the pastes being comparable.

The results regarding the influence of the temperature and fungicide treatments on the evolution of the pulp firmness during storage period are presented in the table 2.

The data obtained show that the initial firmness of the pulp is different inside the fruits. Thus, it is higher near the rid and lowers near the seed cavity.

The pulp firmness generally regressed during storage period, but in different way depending on the temperature and fungicide treatment. The melons of variant V1 had a high decrease of the pulp firmness. After 7 storage days at ambiental temperature the firmness decreased with 25,6-49,6%, depending on the penetration zone, a more intense softening taking place in zone Z1 near the rid. At the melons stored 20 days in refrigerated room (V2) the pulp firmness decreased with 10,8-32,5% according to the penetration zone, in the zone Z1 near the rid, the softening of the pulp being more pronounced. At the melons from the variable V3, the pulp firmness decreased with 5,1-21,9% according to the penetration zone and at the variable V4 it decreased with 8,9-25,6% according to the penetration zone. At these variables with fungicide treatments of the melons, the firmness in the zone Z1, near the rid, had also a faster decrease than other zones. The smallest changes were registered in the zone Z2 in the middle of the pulp.

The data show that the refrigeration slowed down to a certain extent the postmaturation of the melons but additional treatments with fungicide pastes in peduncular scar area, reduced to a great extent this process. In this way, the closing of the gases exchange in peduncular scar area by using fungicide pastes induced a decrease of metabolic process, determining a good preservation af the pulp firmness during storage.

The data regarding the evolution of soluble solids content are presented in the table 3. The results show that during storage there were small changes of the soluble solids content of the pulp, that rised with 0,1-0,5°Brix according to the variable. It meens a growth with 1,25-6,25% in comparizon with the initial level. The melons stored at the environmental temperature (V1) had the highest growth, being followed by melons stored in refrigerated conditions (V2). The smallest changes were registered at the variables with fungicide treatments (V3 followed by V4). The results on the evolution of soluble solids confirm the secundary effect of these treatments, the slowing down of the postmaturation of the melons kept in refrigerated storage conditions.

CONCLUSIONS

The maximum storage period of the melons from Polidor variety, kept in ambiental conditions, was about 7 days with 7,41% weight losses and 25% decay losses produced in peduncular scar area.

The refrigeration determined the prolongation with 13 days of the period of storage, the diminishing with 20% of the decay losses and a slow reduction of the postmaturation process proved by a high fermness of the pulp and a reduced growth of soluble solids content in this period.

The treatments with fungicide paste, applied in the peduncular scar area had a special effect on the melon quality preservation. Besides the diminishing of the weight losses and the reduction of over four times the peduncular scar decay, these determined also the keeping of firmness and soluble solids content close to initial values.

The refrigeration storage and application of fungicide pastes in peduncular scar area asure optimum conditions for keeping the quality of slip type melons.

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TABLES AND FIGURES

Table 1

Research organization schema

Variable	Storage conditions (temperature)	Local fungicide treatments (fungicides used)
V1	Ambiental (30-33°C)	-
V2	Refrigeration (8-10°C)	-
V3	Refrigeration (8-10°C)	Fungicide paste 1 (copper sulfate +Folpan 50 WP)
V4	Refrigeration (8-10°C)	Fungicide paste 2 (Mancozeb 800)

Table 2

Evolution of pulp firmness during storage

Specification	Penetration zones					
	(Z1)		(Z2)		(Z3)	
	Pulp firmness Gp	Pulp firmness decrease (%)	Pulp firmness Gp	Pulp firmness decrease (%)	Gp	Pulp firmness decrease (%)
Initial firmness	75.8	-	96.6	-	101.4	-
V1 Ambiental temperature	113.4	49.6	122.4	26.7	136.2	25.6
V2 Refrigeration	100.4	32.5	120.6	24.9	116.0	10.8
V3 Refrig.+fungicide paste 1	92.4	21.9	100.1	3.6	106.6	5.1
V4 Refrig.+fungicide paste 2	95.2	25.6	102.8	6.4	110.4	8.9

Legend: Z1= near the rid, Z2= middle of the pulp, Z3= near the seed cavity
Gp= penetration degree (1Gp=0,1mm)

Table 3

Soluble solids evolution during storage

Variable	Soluble solids (°Brix)		Soluble solids growth rate (%)
	Iniţial	Final	
V1	8,0	8,5	6,25
V2	8,0	8,4	5,0
V3	8,0	8,1	1,25
V4	8,0	8,3	2,5

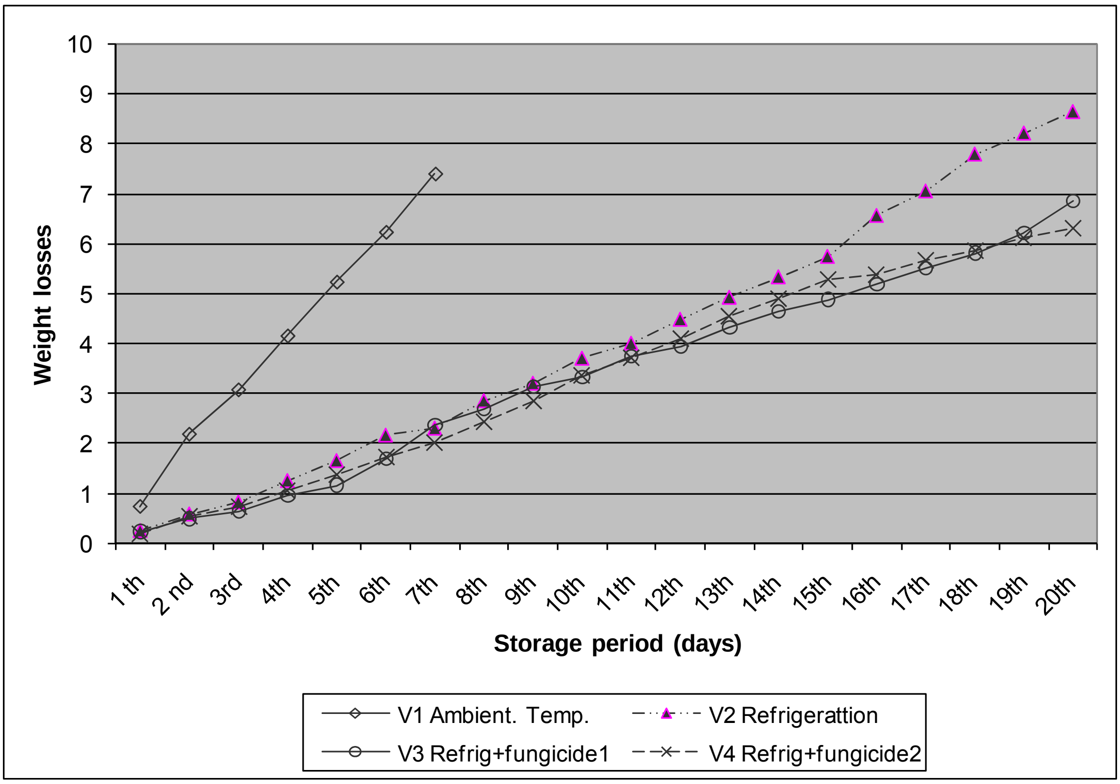

Fig.1 Weight losses during storage

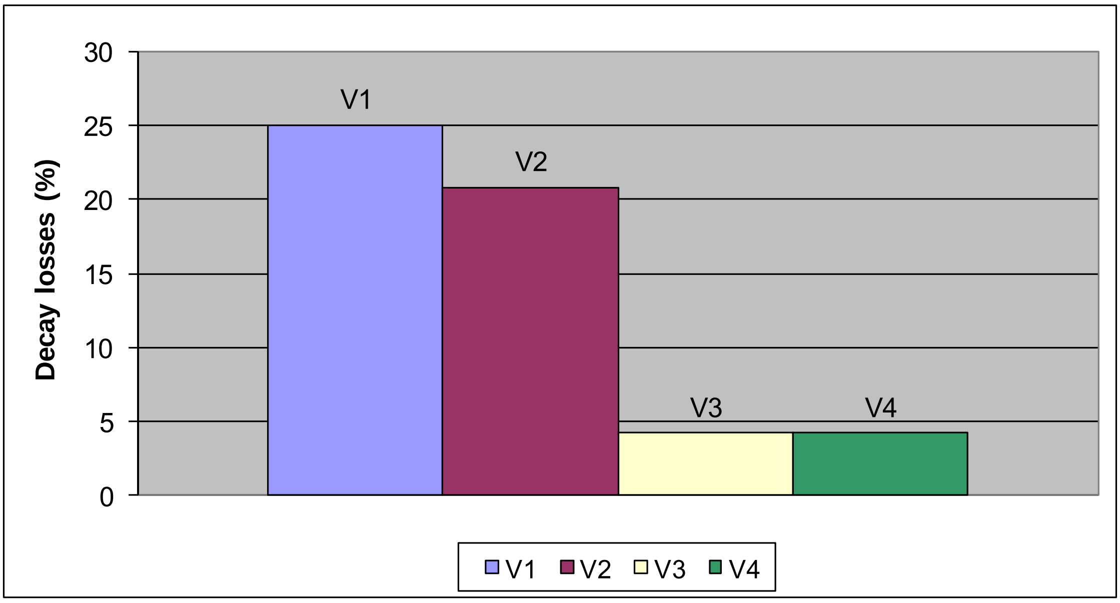

Fig.2 Decay losses during storage

Research on the behavior of certain potato varieties in the minituberization using industrial substrates

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Keywords: soiless cultures, minitubers, plantlets, substrates, cultivar

ABSTRACT

In the years 2009-2010 were a series of experiences polifactorials mounted in protected areas belonging to the National Institute of Research and Development for Potato and Sugar beet Brasov. For culture substrates, soil was used as a control, and perlite and clay balls were used as industrial substrates and biological material was composed of minitubers and plantlets obtained „in vitro". At the end experiences were recorded minitubers number and weight of the four sizes, respectively: <15 mm 15-25 mm 25-35 mm 35-45 mm.

INTRODUCTION

Soiless cultures are now a reality high performance of technologies that have already gained a leading position in global agriculture crop production (Atanasiu 2007).

Obtaining of minitubers can be achieved by planting of microplants or microtubers in particular solid or liquid (hydroponic solution), in the "insect proof" (spaces in which aphids can not penetrate - the main vectors of viruses - from external sources).

The potato minituber production is the classical intermediate stage enabling field use of potato materials with an *in vitro* origin. This production of minitubers may be achieved through various techniques (Rolot, 2002).

The appeal on the hydroponic technique for the production of potatoes minitubers was envisaged as alternative in the traditional technology using one mixture of peat and humus or sand. Main objectives are an increase of guarantees of health quality of production and one discount of production costs (Rolot, 2002).

Potato growing in large countries with traditions in potato cultivation technology was switched to modern technologies for the production of seed potatoes for shortening cycle of upper links. Thus, in Belgium was passed minitubers production technology, using hydroponic systems.

Culture systems that use solid substrates for plant roots using two groups of materials:

- Inert inorganic materials as such in kind (sand, gravel, lava tuffs) or obtained from simple industrial processes (expanded clay, perlite, vermiculite) or complex (mineral wool);
- Organic matter (peat, compost of trees bark, sawdust, coir etc.) used alone or in mixtures; mixtures for unconventional prepare from two or more organic materials, or by mixing an organic material (peat) with an inorganic material (perlite) (Atanasiu 2007).

As "hidroculture" (Walter culture) are grouped by culture systems which use non-conventional solid rooting substrates (Atanasiu 2007).

A modern method of obtaining minitubers is applied by combining "NFT" technique (Nutrient Film Technique) - to distribute nutritional solution with "Gravel Culture" technique – for supporting plants and creating a solution of tuberization outside areas of solution (Draica and colab., 2004).

Using hydroponic method for minitubers producing was concerned and as an alternative to traditional manufacturing technique using organic substrate.

Soiless cultures have as a starting point vitroplants. It intends to make a production of minitubers by superior health quality, using hydroponic method. Main objective is to increase security sanitary quality and decrease in production costs.

Objectives of this research focuses on improving quality and quantity of seed potato material earlier and semi-earlier, acting over some specific technological links for seed potato crop, taking into account the newest methods in vitro, under specific conditions of NIRDPSB Brasov, leading to obtain minitubers, at the desired economic threshold, 2009-2010.

Objectives of the research consisted in tracing the influence of precocity cultivar minitubers production capacity and their weight in this system.

Our researches have been made to obtain, potato, at the end of the flow, a healthy material, free of disease, material which will be the starting point in producing minitubers (obtained "in vivo") which are then planted direct in the field to determine the genotype by its characteristics best suited to current economic and technological requirements.

MATERIALS AND METODS

To achieve theme set have been investigated experimental variants shown in table 1.

In these trifactorial experiments, type 3 x 3 x 2 has been achieved by combining three experimental factors, subdivided parcels located after method, the number of variants studied was 18, and the number of repetitions was 4.

Experience was installed in 2009, in greenhouses NIRDPSB Brasov, including variations exhibited in the table 1.

From the results the fact that trifactorial experience type 3 x 3 x 2, with 18 variants was performed using the following graduations in four repetitions.

- **Factor A**, cultivar, with three graduations:
  - a 1 – Ostara
  - a2- Christian (figure 1.a.)
  - a3 – Roclas (figure 1.b.)
- **Factor B**, substrate, with three graduations:
  - b_1 - soil
  - b_2 – perlite (Ungaria)
  - b_3 – expanded clay (Ungaria)
- **FactorC**, biological material
  - d1 – minitubers
  - d2 –„in vitro” plantlets

Nutritious solution was distributed on the tables of culture in form of 1 to 1,5 cm in thickness.

pH of solution is maintain on 5,8 by adding of clorhidric acid or hydroxide of potassium. Plants were cultivated in individual pot.

Soil was used as control, and clay and perlite were used as industrial substrates, to obtain minitubers with a high sanitary quality and a high production, and they represent pre-base material.

We compare the number and the weight of minitubers (figure 1, 2) obtained from plantlets and from minitubers on different substrates.

Organization (location of experience)

On the greenhouse tables of NIRDPSB Brasov, sat trays with pots with industrial substrate, which were planted either minitubers or plantlets.

In the 12 trays with a size of 90/90 and 10 cm height, 16 pots were placed. The experimental scheme is represented in figure 3.

Results of research on technology of potato culture in hydroponic system from minitubers and plantlets

The experience of the two industrial substrates, perlite and expanded clay, varieties and other biological material influenced the production of potatoes. Soil was taken as control. The best results were obtained when where used minitubers for Christian cultivar on perlite substrate, with a number of tubers by 8.63 and for Roclas cultivar on clay with a number of tubers by 9.38.

In case of plantlets, high yields were obtained from Roclas cultivar on clay with 8.25 minitubers and 7.94 for Christian cultivar on perlite with minitubers. Small number of minitubers was obtained when using minitubers and plantlets of Ostara cultivar. The number of minitubers, is depending by cultivars and biological material (figure 4).

Analyzing the average number of tubers per cultivar is observed that best results were obtained from Christian with a number of 7.26 tubers, in case of the substrate best results were obtained in expanded clay with an average of 7.60 tubers and planting material for best results were obtained in minitubers (figure 5).

1. Statistics interpretation on the number of tubers results, obtained from the experience achieved in hydroponic system.

Statistical interpretation of results were considered as variable cultivar, substrate and planting material. The results are presented in tables 2, 3 4.

When examining the influence of cultivar on the number of tubers produced on research shows that compared to average results, Christian cultivar have very significant results provided statistically significant, Roclas has just provided results, and Ostara presents very significant negative differences (table 2).

In case of substrate influence culture, results are only meaningful to expanded clay and insignificant for perlite, in comparison with the average results taken as a control (table 3).

In case of the influence of biological material used in the experience, the results are significant for minitubers and negative significant for plantlets which means that use of minitubers led to obtain visible differences between the number of tubers produced (table 4).

Comparing the results of planting material used shows that **higher weights** were obtained from minitubers of Ostara, Christian and Roclas cultivars, respectively 100.10 g 83.54 g and 74.68 g. When planting material were plantlets, results were much lower, with 20g, almost all varieties, Ostara 56.09 g, Roclas 61.32 g and Christian 45.13 g.

Following varieties influence, is observed that best results were achieved at Ostara with 78 095 g, then Christian with 72.43 g and 59.91 g Roclas (figure 6).

Analyzing the average values obtained on cultivar (see figure 7) Ostara cultivar is seen clearly that is first in terms of average tuber weight value of 78,10 g. In case of substrate it can be observed that the expanded clay ascertained in obtaining higher tuber weight (79.27 g) and in case of minitubers were able to produce tubers of greater weight.

Statistical interpretation of results on the average weight of tubers obtained from experience achieved in hydroponic system

The statistical interpretation is trifactorial type and the relevant factors are: cultivar, the biological material used in planting and substrate used in experience.

Tuber weight was not significantly influenced by Christian cultivar and had distinct significant negative effect on Roclas cultivar (table 5).

Substrates used, perlite and clay influenced very significantly weight of tubers produced in experience (table 6).

Comparison of biological material used for planting material is insignificant for plantlets compared with the control provided of minitubers (table 7)

CONCLUSIONS

Number of minitubers produced per plant, varied in funcyion of the cultivar, the substrate used, and the material used to planting.

The highest number of minitubers was obtain on the Christian cultivar (7.20 minitubers/ plant) and the lowest number is obtained from Ostara (5.64 minitubers/plant).

The highest number of minitubers was obtained on clay substrate, with an average of

7.60 the lowest number of minitubers is obtained on the soil (taken as control), with an average of 5.09 minitubers/plant, the results are similar to clay, for perlite with an average of 7.27 minitubers/plant.

Analysis of average weight of tubers produced in hydroponic experience shows that most high value of 134.59 g, was obtained from Ostara cultivar using perlite substrate and lowest weight (17.25 g /soil taken as control) was made at Roclas cultivar.

Following the influence of varieties on average weight of minitubers, it appears that best results were achieved at Ostara (78.095 g), followed by Christian cultivar (72.43 g) and Roclas (59.91 g).

In case of the substrate influence is apparent that expanded clay caused greater difficulty obtaining 79.27 g of tubers and in terms minituberculii were able to seed tubers weighing more than

In case of the substrate influence is apparent that the expanded clay ascertained obtaining higher tuber weight (79.27 g) and in terms of planting material, minitubers were able for obtain heavier tubers.

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TABLES AND FIGURES

Table 1

Variations experienced by various cultures substrates (INCDCSZ Brasov, 2009)

Variant	Cultivar (a)	Substrate (b)	Biological material (c)
V_1	Ostara (a_1)	Soil (b_1)	Minitubers (c_1)
V_2			"In vitro" plantlets(c_2)
V_3		Perlite (b_2)	Minitubers (c_1)
V_4			"In vitro" plantlets(c_2)
V_5		Expanded clay (b_3)	Minitubers (c_1)
V_6			"In vitro" plantlets(c_2)
V_7	Christian (a_2)	Soil (b_1)	Minitubers (c_1)
V_8			"In vitro" plantlets(c_2)
V_9		Perlite (b_2)	Minitubers (c_1)
V_{10}			"In vitro" plantlets(c_2)
V_{11}		Expanded clay (b_3)	Minitubers (c_1)
V_{12}			"In vitro" plantlets(c_2)
V_{13}	Roclas (a_3)	Soil (b_1)	Minitubers (c_1)
V_{14}			"In vitro" plantlets(c_2)
V_{15}		Perlite (b_2)	Minitubers (c_1)
V_{16}			"In vitro" plantlets(c_2)
V_{17}		Expanded clay (b_3)	Minitubers (c_1)
V_{18}			"In vitro" plantlets(c_2)

Table 2

Influence of cultivar on the number of tubers produced in hydroponic experience (NIRDPSB Brasov, 2009)

Variant	Number of tubers		Difference	Significance
	No	%	No	
Ostara	5,64	85,87743	-0,9275	ooo
Christian	7,260417	110,5507	+0,692917	***
Roclas	6,802083	103,5719	+0,234583	*
Average (Ct)	6,5675	100	-	-

DL 5%=0,2113 tub.
DL 1%=0,28322 tub.
DL 0,1%=0,3738 tub.

Table 3

Influence of substrate on the number of tubers produced in hydroponic experience (NIRDPSB Brasov, 2009)

Variant	Number of tubers		Difference	Significance
	No	%	No	
soil	5,0875	77,46971	-1,479583	ooo
perlite	7,02	106,8968	+0,452917	ns
expanded clay	7,59375	115,6335	+1,026667	**
Average (Ct)	6,5670	100	-	-

DL 5%=0,56468 tub.
DL 1%=0,7926 tub.
DL 0,1%=1,1190 tub.

Table 4

Influence of planting material on the number of tubers produced in hydroponic experience (NIRDPSB Brasov, 2009)

Variant	Number of tubers		Difference	Significance
	No	%	No	
minitubers	7.093056	107,833	+0,5152	**
plantlets	6.0625	92,166	-0,5152	oo
Average (Ct)	6,57777	100,00	-	-

DL 5%=0,4572 tub.
DL 1%=0,8396 tub.
DL 0,1%=1,8604 tub.

Table 5

Influence of cultivar on the weight of tubers produced in hydroponic experience (NIRDPSB Brasov, 2009)

Variant	Average weight		Difference	Significance
	g	%	g	
Ostara	78,10	100,00	-	-
Christian	72,43	92,74	- 5,67	ns
Roclas	59,91	76,71	- 18,19	oo

DL 5%=10,3098g
DL 1%=14,4716g
DL 0,1%=20,4305g

Table 6

Influence of substrate on the weight of tubers produced in hydroponic experience (NIRDPSB Brasov, 2009)

Variant	Average weight		Difference	Significance
	g	%	g	
soil (Ct)	53,63	100,00	-	-
perlite	77,54	144,58	23,91	***
expanded clay	79,25	144,77	25,62	***

DL 5%=8,2024g
DL 1%=10,9904g
DL 0,1%=14,5057g

Fig. 1.a. Christian cultivar planted on clay

Fig. 1.b. Roclas cultivar planted on perlite

Fig. 2.a. Ostara cultivar on clay

Fig. 2.b. Christian cultivar on perlite

Fig. 2.c. Roclas cultivar on clay

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Fig. 3. Experimental scheme (NIRDPSB Brasov, 2009)

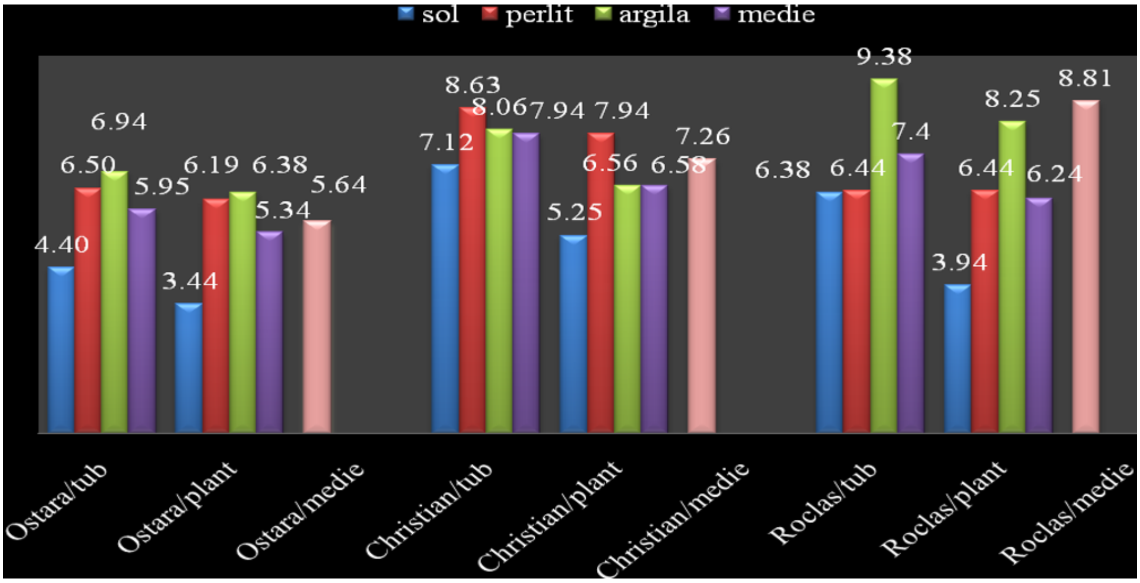

Fig. 4. The number of tubers produced in hydroponic experience (NIRDPSB Brasov, 2009)

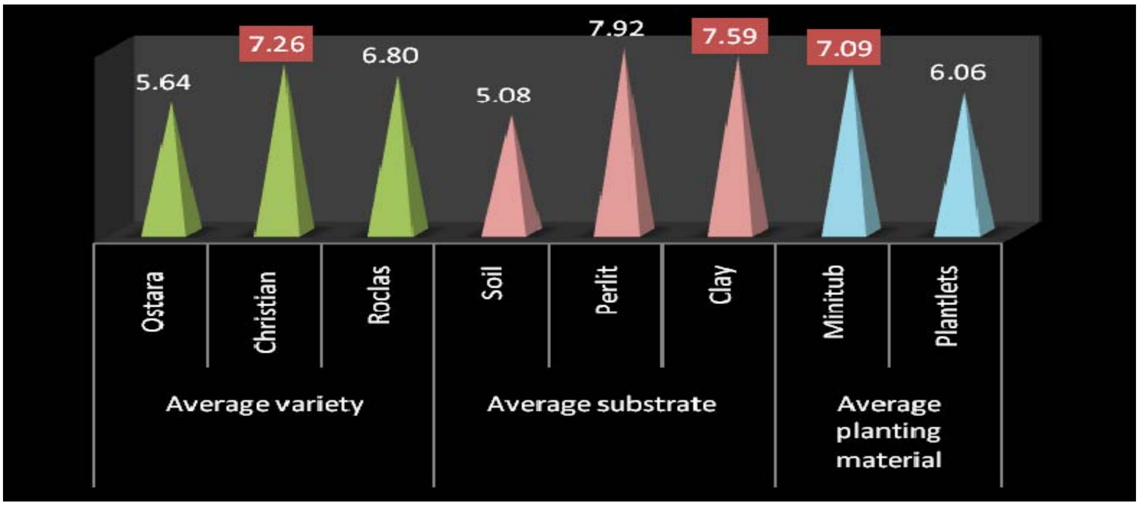

Fig. 5. The number of tubers produced in hydroponic experience, average value on cultivar, the substrate and planting material (NIRDPSB Brasov, 2009)

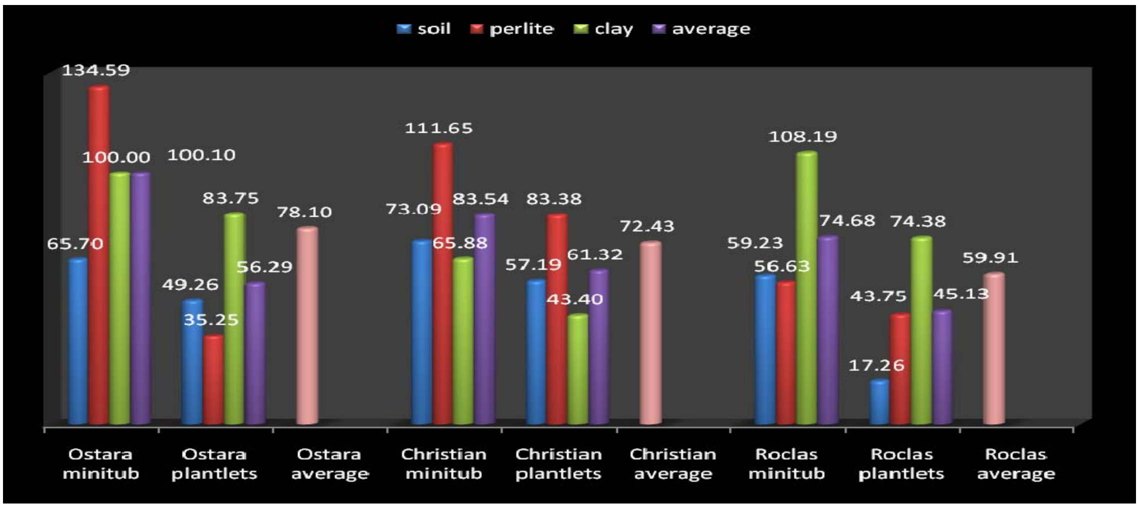

Fig. 6. Average weight of minitubers (NIRDPSB Brasov, 2009)

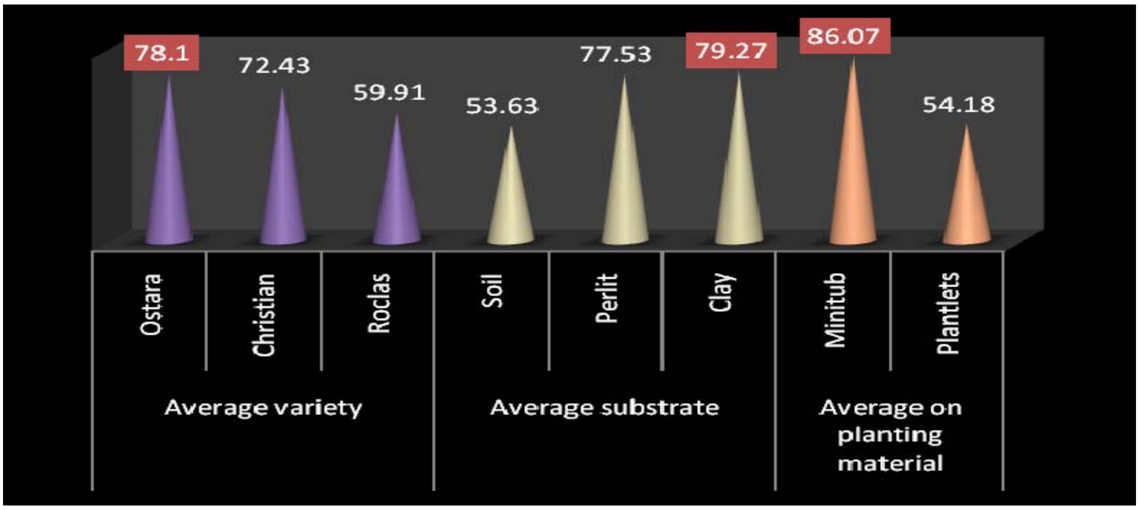

Fig. 7. Average weight of tubers produced in hydroponic experience on average cultivar, the substrate and planting material (NIRDPSB Brasov, 2009)

Research on the influence of culture conditions, for certain potato cultivars in the first clonal link Lăzarea - Harghita County, 2008-2009

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Keywords: minitubers, tunnels "insect proof", planting density, planting size

ABSTRACT

In this experience we watch increasing the coefficient of potato propagation by seed, planting, using different classes minitubers calibration varieties of early, mid early and semitardive: Ostara, Christian, Roclas, Desiree; valorification of planting material with a high biological value of the fraction <25 mm, from the greenhouse (mini-tubers) compared with 25-35 mm fraction; development of differentiated technological cultivation to produce superior clonal material link in protected areas, such tunnels "insect proof", depending on variety, growing conditions, reliable ecological conditions; obtain virus-free planting material (without infection); obtain a bigger amount of seed.

INTRODUCTION

Potatoes are grown in Romania, using as material seed tubers produced in closed areas.

The main problem in conventional seed production program is the low rate of multiplication of potato grown in potato field and susceptibility to disease, which can be transmitted through potato tubers. Multiplications of potato in each field, the risk of infection with viruses, bacteria or other pathogens increase (Ranalli et al., 1994).

To potato, as in other species with vegetative propagation, there is risk of contamination of many pathogens and their transmission to future generations. After a number of generations (depending on the susceptibility to certain diseases) may be infected all potatoes (100%), with dramatic repercussions, cutting production by up to 80% (ex. leaf rolling virus and virus Y). Furthermore, diseases caused by viruses and bacteria that live and grow in the vascular tissues can not be controlled with chemicals, special measures are necessary.

As such should be increased research on alternative seed potato production by using techniques "in vitro" and in Romania.

In Romania, in 1996 was proposed a new system for seed potato production by using minitubers, which can reduce the rate of virus infections and obtaining planting material of better quality (Draica, et al., 1997, quoted by Rusu 2007). Rapid multiplication used "in vitro" and in Romania in recent years, is trying to move to a new strategy by reducing the propagation of nine years to five years.

NIRDPSB Brasov passed to a new scheme for seed potato production by which the field of choice from classical scheme was replaced with minitubers produced by micropropagation (propagation method in vitro), representing original material free of pathogens, from a tuber or plant segment.

Minitubers and the first three clonal stages (A, B, C) occur in grenhouse, that high altitude (over 1000m), the Giurgeului and Gurghiului Mountains (Center of Clonal Material Production, Lazarea, Harghita County), under the closed area and clones D and E (Prebase category) in the specialized departments for seed potato production from NIRDPSB Brasov. In this way the goal is to reduce the period of seed potato production in the field of 9 years within 5 years and for Prebase from 6 years in two years before, with the benefits specified.

Minitubers is a way of pre-basic material production by planting microplantlets on protect environment (spaces "insect-proof") (Chiru and colab., 1997).

Because minitubers are produced from plantlets or microtubers, obtained from crops of meristems, in aseptic conditions, they have a higher vigor, are free of pathogens and transmit faithfully varietal character (Bărdaş, 2001).

Biogical material used in the experiment consisted of four varieties Ostara, Christian, Roclas and Desiree.

Other materials: For experimental work were used:

- minitubers of the two size fractions from Lazarea
- fertilizer
- NPK fertilizers 15:15:15 (90:90:90 kg s. of./ha), superphosphate P_2O_5 18%
- manure
- herbicides – DANCOR 70 kg WG (1 kg/ha)
- fungicides, insecticides and aficide: Mospilan, Secure, Regent, Altima, Ridomil
- desiccant - REGLONE
- mesh “insect proof”

Experimental biological material in the years 2008-2009, were the minitubers of the two size fractions: 15-25mm, 25-35mm

The number of minitubers obtained in 2008-2009

Comparing the results obtained in tunnels "insect proof” and free field, shows that in all cases, all cultivars, planting in the free field induced the highest number of harvested tubers.

Smallest results were obtained for Ostara cultivar, in the tunnel "insect proof" with an average of 4.17 tubers at planting size fraction 15-25 mm, and the best results were obtained from Christian cultivar, grown in free field with a number of seed tubers by 7.88 tubers/nest at planting 25-35 mm fraction (fig. 1).

The differences obtained on tunnels “insect proof” and free field were interpreted statistically.

Studying the influence of culture tehnology (Table 1), shows that differences obtained by the number of tubers/between the two types of culture are provided statistically significant negatively.

In case of planting density, the second experimental variant, the statistical analysis carried out, indicates significant difference from 1.2950 tub./nest of fraction planting by 25-35 mm comparative with fraction 15-25 mm (Tabelul 2).

The third variable was the variety used, the influence was statistically analyzed and differences between Christian and Roclas cultivars are very substantial, by 2.37 and respectively 2.00 tubers/nest and the Desiree cultivars presented a significant difference compared with witness Ostara (0.90 tub./nest) (Table 3).

Analyzing the combined influence of planting and technology (Table 4) results show that the size of 25-35 mm ascertained achieving the best results, with very significant difference, (by 1.09 and 1.50 tubers from the nest) and differences in technology are small, insignificant statistically assured.

Number of minitubers/nest obtained in 2009

Experience made in 2008 was repeated in conditions at Lăzarea, Harghita County in 2009 with the same experimental variants.

Analyzing the effect of cultivar on the number of tubers/nest on tunnels „insect proof”and free field (see Fig. 2) it can be observe, that Roclas cultivar, is the most productive with an average of 7,435 tubers /nest, followed by Christian cultivar with an average of 6,69 tubers /nest and lowest results were achieved for Ostara with a number of 4,6825 tubers/nest.

Because on year 2009, the experiences took place in tunnels "insect proof" and also on free field, for view the reaction of potato cultivars in different culture conditions, it requires statistical analysis of data obtained.

Results on the number of tubers obtained/nest on tunnels “insect proof” and field indicates that on free field were obtain a higher number of tubers/nest than on tunnels “insect proof”, so that the differences on experience on tunnels “insect proof” is very significant negative effect (a difference of 0.69 tub./nest) (table 5).

Another factor that determines the number of tubers produced is planting density. It can be noted that the largest number of tubers was obtained at a density of 5 tub./linear meter and the lowest average number at 8 tub./linear meter. Statistical analysis shows that the differences are very significant negative effect on 8 tub./linear meter (-1.23 tub./nest) and separate all the significant negative (-0.82 tub./nest) to 6 tub./linear meter (table 6).

Examination results of the average number of tubers on nest by four varieties (Table 7) have the best results (7.44 tub./nest) for Roclas cultivar, followed by Christian cultivar with 6.69 tub./nest, Desiree cultivar with 5.62 tub./nest and the last place with 4.68 Ostara cultivar tub./nest. Statistical interpretation of differences shows that cultivars Roclas and Christian obtained differences very significant (2.76 and respectively 2 tub./nest).

In case of combined influence of planting density and culture conditions (Table 8) on first place, for determining the number of tubers was density, because the differences were very significant from both types of technology culture for lower density (five tub./linear meter).

Combined influence of variety and culture technology, shows that the variety used had the greatest influence so that the differences are very significant for Christian and Roclas cultivars, with values of 2.02 and 1.27 tubers/nest on tunnels “insect proof” and 2.74 and 3.49 tubers/nest on free field (Table 9).

Summary results from the 2008-2009 of tubers number

Summary of results on the tubers number produced per year to nest and varieties used in research is presented in table 10.

In case of Ostara variety average of results for two-years shows that the average number of tubers is higher in the classical field, at planting densities of 5 and 6 tubers/linear meter, at the use of planting tuber from fraction 25-35mm respectively, contained between 5.69 and 5.25 tubers/nest.

For Christian variety, tubers number produced is much higher than values obtained for Ostara variety, over 6 tubers/nest. Comparing the results obtained in the tunnels and the field shows that the results obtained from field crops are greater with a maximum of 10.12 tubers/nest at planting density of 5 tubers/linear meter, and size at the planting of 25-35 mm.

Roclas variety, in conditions of experience from Lăzarea, presented a number of tubers on the nest with values ranging from 5.68 to 10.29 tubers. Comparing the two cultures, fields and tunnels, the result to the field are superior to culture in the tunnels with 8 and 6 minitubers/linear metres.

In case of Desiree variety, average of two-year shows that the number of tubers obtained ranged from 4.64 and 7.30 tubers. If we examine the results from the viewpoint of the planting density is observed that best results were obtained at a density of 5 tubers/linear meter and from the viewpoint of planting material dimension used, the best results were obtained for size 25-35mm.

CONCLUSIONS

- The number of tubers was higher in all sorts of experimentation in field conditions;
- Followed closely by the Christian variety, Roclas variet achieved the highest values of both the number of tubers in field experience (ie 7.53 and 7.36 tubers) and in tunnels (6.61 respectively 6.40tubers)
- The best density in both free field and tunnels “insect proof” is with tuber/linear meter;
- The size most suitable for planting is 25-35mm.

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TABLES AND FIGURES

Table 1

Influence of culture tehnology on number of tubers/in tunnels "insect proof and field (Lăzarea, 2008)

Culture tehnology	Number of tubers/nest		Dif.	Significance
	Nr	%		
On free field (Wt)	6,24	100,00	-	-
On tunnels „insect proof"	5,77	92,46	-0,47	o

DL 5% = 0,2521 tubers/nest
DL 1%= 0, 5667 tubers/nest
DL 0,1%=0,7435 tubers/nest

Table 2

Influence of planting material size on the number of tubers obtained/nest on tunnels "insect proof" and free field

Size of planting material (mm)	Number of tubers/nest		Dif.	Significance
	Nr	%		
15-25 (Wt)	5,3600	100,00	-	-
25-35	6,6550	124,16	+1,2950	***

DL 5% = 0,9794 tubers/nest
DL 1%= 1,1487 tubers/nest
DL 0,1%=1,2162 tubers/nest

Table 3

Influence of varieties tested on obtaining the number of tubers formed to nest in tunnels "insect proof" and free field (Lăzarea, 2008)

Cultivar	Number of tubers/nest		Dif.	Significance
	Nr	%		
Ostara (Wt)	4,69	100,00	-	-
Christian	7,06	150,53	+2,37	***
Roclas	6,69	142,64	+2,00	***
Desiree	5,59	119,18	+0,90	*

DL 5% = 0,8802 tubers/nest
DL 1%= 1,0945 tubers/nest
DL 0,1%=1,1283 tubers/nest

Table 4

Combined influence of planting material and the technology used on obtaining the number of tubers/nest on tunnels "insect proof and free field (Lăzarea, 2008)

Culture tehnology/ Size of planting material (mm)	Tunnels „insect proof", a1			Free field, a2			Dif.
	Nr	Dif	Signific	Nr	Dif	Signific	a1-a2
15-25 (Wt)	5,23	-	-	5,49	-	-	-0,26 ns
25-35	6,32	+1,09	***	6,99	+1,50	***	-0,67 ns

DL 5% =0,7706 tubers/nest 0,6850 tubers/nest
DL 1%= 0,8327 tubers/nest 0,7364 tubers/nest
DL 0,1%=0,9706 tubers/nest 0,8084 tubers/nest

Table 5

Difference growing influence on the number of tubers produced (Lăzarea, 2009)

Culture tehnology	Number of tubers/nest		Dif.	Significance
	Number	%		
On free field (Wt)	6,45	100,00	-	-
On tunnels „insect proof”	5,76	89,30	-0,69	ooo

DL5% = 0,2452 tubers/nest
DL 1%= 0,3549 tubers/nest
DL 0,1%=0,5658 tubers/nest

Table 6

Influence of planting density of tubers on the number of tubers produced

Planting density (number of minituber/ linear meter)	Number of tubers/nest		Dif.	Significance
	Number	%		
5 (Wt)	6,79	100,00	-	-
6	5,97	87,92	-0,82	oo
8	5,56	81,88	-1,23	ooo

DL 5% = 0,3502 tubers/nest
DL 1%= 0,6721 tubers/nest
DL 0,1%=0,9185 tubers/nest

Table 7

Selected cultivars influence over the number of tubers obtained (Lăzarea, 2009)

Cultivar	Number of tubers/nest		Dif.	Significance
	Nr.	%		
Ostara (Wt)	4,68	100,00	-	-
Christian	6,69	142,94	+2,01	***
Roclas	7,44	276,00	+2,76	***
Desiree	5,62	120,00	+0,94	*

DL 5% = 0,8871 tubers/nest
DL 1%= 1,1311 tubers/nest
DL 0,1%=1,3867 tubers/nest

Table 8

Combined influence of technology and planting density on number of tubers produced (Lăzarea, 2009)

Culture tehnology/Planting density (minitubers number/linear metre)	Tunnels “insect proof”, A1			Free field, A2			Difference
	Nr of tuber/ nest	Dif. (nr of tuber/ nest)	Sig.	Nr of tuber/ nest	Dif. (nr of tuber/ nest)	Sig.	a1-a2 (nr of tuber/nest)
8 (Wt)	5,19	-	-	5,93	-	-	-0,74 o
6	5,75	+0,56	ns	6,19	+0,26	ns	-0,44 ns
5	6,36	+1,17	***	7,23	+1,30	***	-0,87 ooo

DL 5% =0,6235 (tubers/nest) 0,5423 (tubers/nest)
DL 1%= 0,7412 (tubers/nest) 0,6554 (tubers/nest)
DL 0,1%=0,8256 (tubers/nest) 0,7412 (tubers/nest)

Table 9

Combined influence of technology on the variety and number of tubers produced (Lăzarea, 2009)

Culture tehnology/ Cultivar	Tunnels "insect proof", a1			Free field, a2			Differences
	Nr of tubers/ nest	Dif. (nr of tuber/ nest)	Signif	Nr of tubers/ nest	Dif. (nr of tubers/ nest)	Signif	a1-a2 (nr of tubers/nest)
Ostara, C1 (Wt)	4,75	-	-	4,62	-	-	+0,13 Ns
Christian, C2	6,02	+1,27	***	7,36	+2,74	***	-1,34 ooo
Roclas, C3	6,77	+2,02	***	8,11	+3,49	***	-1,34 ooo
Desiree, C4	5,52	+0,77	*	5,73	+1,11	***	-0,21 ns

DL 5% =0,7194 (tubers/nest) 0,8107 (tubers/nest)
DL 1%= 0,8973 (tubers/nest) 0,8762 (tubers/nest)
DL 0,1%=1,0706 (tubers/nest) 0,9373 (tubers/nest)

Table 10

Summary results of tuber number/ nest in the soil and climate conditions from Lăzarea, District Harghita (2008- 2009)

Cultivation tehnology	Fraction size (mm)	Density (buc/m)	Number of tubers/nest/Cultivars Average 2008-2009			
			Ostara	Christian	Roclas	Desiree
Free field	15 - 25	8 tubers/linear meter	3,88	6,01	6,33	5,00
		6 tubers/linear meter	4,60	6,46	6,49	5,01
		5 t tubers/linear meter	4,72	6,76	6,55	5,20
	25 - 35	8 tubers/linear meter	4,82	6,89	7,67	5,64
		6 tubers/linear meter	5,25	7,90	7,80	5,96
		5 tubers/linear meter	5,69	10,12	10,29	7,30
Tunnels "insect proof"	15 - 25	8 tubers/linear meter	4,19	5,38	5,62	4,64
		6 tubers/linear meter	4,35	5,73	5,68	4,92
		5 t tubers/linear meter	4,66	6,00	6,16	5,19
	25 - 35	8 tubers/linear meter	4,33	6,06	5,78	5,71
		6 tubers/linear meter	4,51	7,14	7,46	6,09
		5 tubers/linear meter	5,28	7,97	8,92	6,66

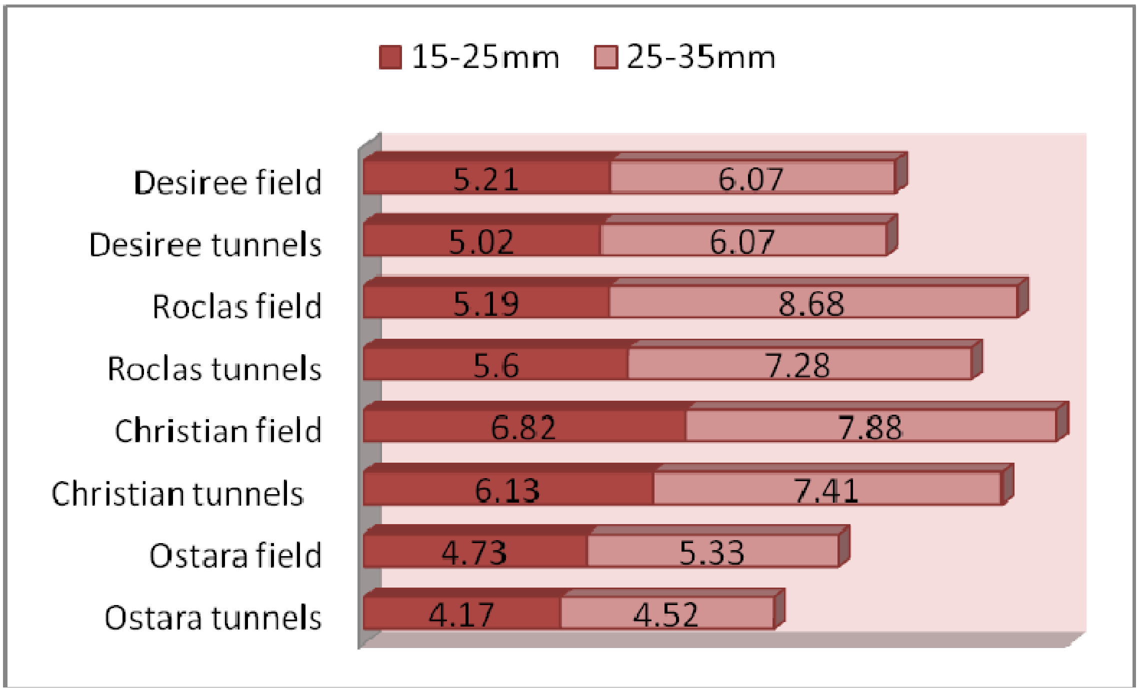

Fig. 1. Average number of tubers formed to nest in tunnels "insect proof" and free field (Lăzarea, 2008)

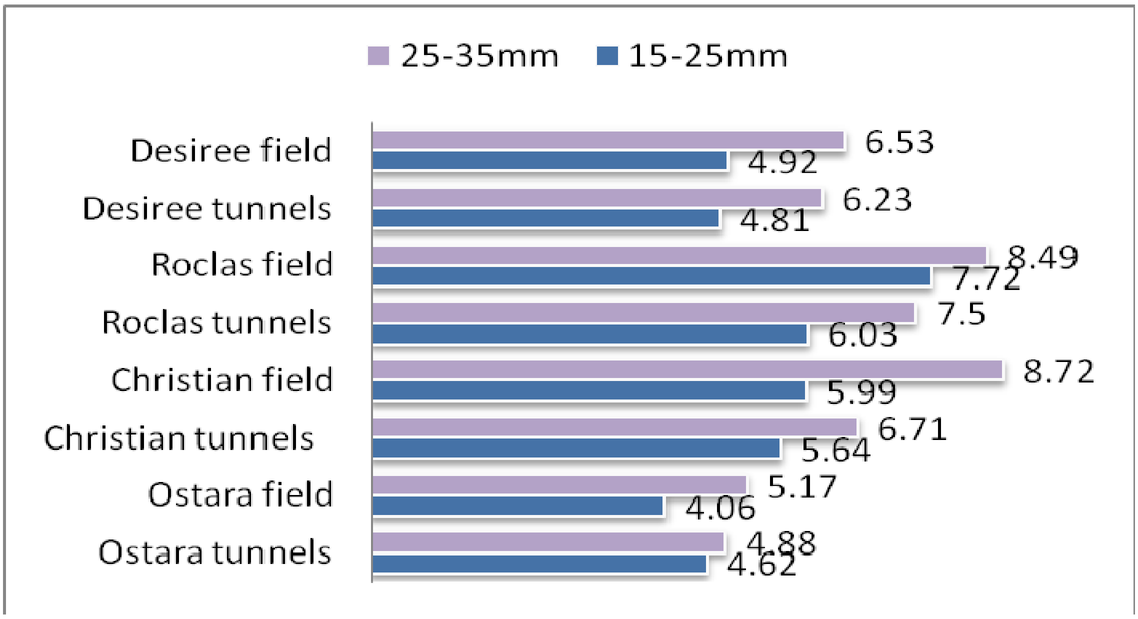

Fig. 2. Average number of tubers produced in the experience with tunnel "insect proof" and free field (Lăzarea, 2009)

Sweet corn growing in sandy soil

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Keywords: Yield quality, nutrient supply, overdose NPK

ABSTRACT

In our experiment we have studied the effect of nutrient supply, as an important technological element, on earlier sweet corn. In the same time we searched the answer, if the double incresing of nutrient elements (NPK) dosis, more than recomanded by nutrient balance approach system, we can improve yield's quantity and quality of sweet corn. The treatment without fertilization – based on symptoms, because of nitrogen deficiency – produced weak results, but in case of sugar content it has the highest values. The plants from fertilized treatments didn't produce any deficiency or overdose symptoms. Compared to control treatment, the application of higher fertilizer doses didn't influence significantly crop's development, so we consider adequate to apply, in similar growing circumstances the fertilizer dosis included into control treatment. Double increased NPK dosis didn't increased significantly the yield of sweet corn. In this experimental year, 2007, we could not reach the planned yield quantity.

INTRODUCTION

The sweet corn is the vegetable grown on the largest acreage in Hungary. In 2003 the growing area was 38,000 hectares according to the Hungarian Interprofessional Organization for Fruit and Vegetables and Product Board. After 2003 however a sudden and sharp decline took place and this way in 2005 production was carried out only on 24,000 hectares, while in 2006 over 30,000 hectares, again.

The nutrient supply is perhaps the most important component of the cropping system in plant production. Berzsenyi and Györffy (1995), after the analysis and evaluation of a long term trial over 35 years, concluded the fertilization 31% and the genotype to be the most important yield increasing factors, followed by the optimal plant density, attentive plant care and tillage. Nagy (1995) ranked the cropping system components according to the impact on corn yields as follows: fertilization 48%, irrigation 28%, and tillage 18% and plant density 6%. A continuous fertilization influences not only the nutrient processes of the current year but will modify the soil nutrient processes during the subsequent years which is to be considered in determining fertilizer rates (Lásztity and Csathó, 1994).

Among the three main nutrients, it is the nitrogen that is considered to have the biggest importance, as it has a decisive influence on yield, but in the event that a dose of over 60-120 kg/ha is applied, depending on soil type, a harmful accumulation of NO_3 may occur (Sárvári, 1995). The movement of P and K fertilizers differs from that of N fertilizers. According to Szirtes and Gál (1980) P and K fertilizers should be tilled into the soil to a depth of 15 to 25 cm. In point of sugar content, after Herrmann (2001) notification 100g fresh kernels contents about on average 2,16g (1,6-2,7) g sucrose.

MATERIAL AND METHODS

The experiment was set up in 2007 on an area equipped for irrigation at the Experimental Farm of the Faculty of Horticulture of the Corvinus University of Budapest. The soil sample collected from the site of the trial prior to the direct seeding had a pH of 8.03, an organic material content of 1.31%, a plasticity index according to Arany <30, an ammonium lactate soluble P_2O_5 content of 293 mg/kg, an ammonium-lactate soluble K_2O content of 205 mg/kg and $CaCO_3$ <1%.

The test variety was Spirit, a normal sweet corn variety with a very early growing period (85 days) and yellow kernels.

The method of propagation was direct seeding, at a depth of 3 cm on April 26th. The cornstand was formed to have a plant spacing of 75 by 22 cm (60,607 plants per hectare) in accordance with the recommendations of the owner of the variety. Each treatment had an area of 6x7 m (8 parallel rows and 30 seeds sown in each row). The edge was the outer 2 rows, respectively on both sides, of the 8 rows of the plot. 4 replications were applied.

The treatments were applied by way of fertilizers. No farmyard manure was applied. A combination of ammonium nitrate (34%), superphosphate (19.5%) and potash (60%) was used for the treatments and approximately half of the N rate and the total of the P and K rates were applied as starter fertilization on April 13th, while the remaining part of the N rate was applied in two parts as top dressing: at the 6 to 7 leaf stage (June 9th) and at tasselling (June 16th). The treatment G3 was an exception where the 2N fertilization, besides the aforementioned dates, was applied on two further occasions (May 28th and June 2nd). The area received one herbicide application (April 30th) and one mechanical weed control treatment (June 12th). A crop protection took place on May 23th, using Decis (0.15 l/ha).

The following treatments (active ingredients) were applied during the experiment besides the untreated control (no fertilizer application):
G1 = untreated control N_0, P_0, K_0.
G2 = $N_{222.5}$, $P_{22.5}$, K_{143}
G3 = N_{445}, P_{22}.5, K_{143}
G4 = $N_{222.5}$, P_{45}, K_{143}
G5 = N_{445}, $P_{22.5}$, $K_{143.}$

The NPK requirement according to the soil test was determined in the system using the nutrient balance approach, with **a (planned) unhusked ear yield of 16 tons per hectare**. The harvest was carried out on July12th. In the course of the harvest the ears were picked together with their husks and then 20 ears were selected from each treatment in a random fashion and the following measurements were carried out:

- unhusked ear weight (gram),
- husked ear weight (gram),
- length of seeds (mm),

as well as determining possible parameters through calculation from these data: average yield per unit area and netto ear weight ratio.

One of the most important internal quality component, total sugar content (= compound sugars, mainly sucrose, was determined also).

The statistical analysis of the results was carried out by using the programme *RopStat 1.1.* When the standard deviations were identical the mean values were compared by pairs using the *Tukey-Kramer* test, while in the case of the non identical standard deviations the means were compared using the *Games-Howell* test (Vargha, 2007).

RESULTS AND DISCUSSION

The first parameter measured after picking was the weight of unhusked ear, which results are illustrated on Figure 1.

Based on the figure it can be seen that the ears of the treatment G3 had the greatest weight as compared to the other treatments. There was no significant difference between the husked ear weight measured in the other treatments, on the other hand, the result of all treatments had significantly, at ($p<0,01$ level), higher weight than the untreated control G1.

After removing the ear husks, the husked ears were measured, illustrated by Figure 2.

By this measured parameter we found the same tendences as by unhusked cob weight, so treatment G3 results was the highest. Compared to K1 all treatment's cob weight neto results were significantly at ($p<0,01$ level) higher (Figure 3).

In case of another important measured parameter, length of seeds (Figure 3), the best results was produced by G3 treatment. The nullkontroll (G1), was overtaken by every treatment. Between G3 and G5 treatments we found significant difference at ($p<0,01$ level), confirmed by statistics. Between treatments K3 and K4, the difference was significantly at ($p<0,1$ level).

Based on the results of the measurements, the average yield per unit area is illustrated in Figure 4.

Relative to the *average yield*, the greatest yield in terms of weight was obtained in treatment G5, which was calculated on the basis of unhusked ear weight. Interestingly, the statistical analysis failed to reveal any significant differences between the treatments. On the other hand, compared to the untreated control, all treatments resulted in a significantly higher yield (Figure 5).

The *netto ear weight ratio* is another important data (Figure 5) which was calculated through dividing the husked ear weight by the unhusked ear weight, and this time the treatment G5 was found to produce the best ratio. However, no statistically demonstrable significant difference was evident between the treatments.

On figure 6 is rerepresented the complex sugars (especially sucrose) quantity.

We measured the highest average quantity of complex sugars by untreated kontroll (G1). The results, excepted treatment G2, were significant higher, at ($p<0,01$ level), compared to the other treatments.

CONCLUSIONS

Based on the results of the experiments, in 2007, the following conclusion can be made:

Relative to *the untreated control* (G1) (no fertilization) it can be concluded that it is not possible to have profitable production without any artificial supply of nutrients, due to the low average yield.

For all the parameters measured, significantly lower values were measured than in the other treatments, but in case of sugar content it produced the highest values.

No markedly different results were found in the *N:P:K (G2) treatment*, either in the positive or in the negative sense in comparison with the other treatments.

The *2N:P:K (G3) treatment* produced good results in terms of unhusked ear yield, husked ear yield and length of seeds. The favourable result, on the other hand, was not in harmony, either from economical considerations or from the point of environmental protection, with the amount of the fertilizer applied.

The results of the *N:2P:K (G4) treatment* are somewhat similar to the results or the treatment G2, the treatment did not manage to be the best in any of the parameters.

The highest yield quantity were measured in the *N:P:2K (G5) treatment* and therefore the net ear weight ratio was the best.

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FIGURES

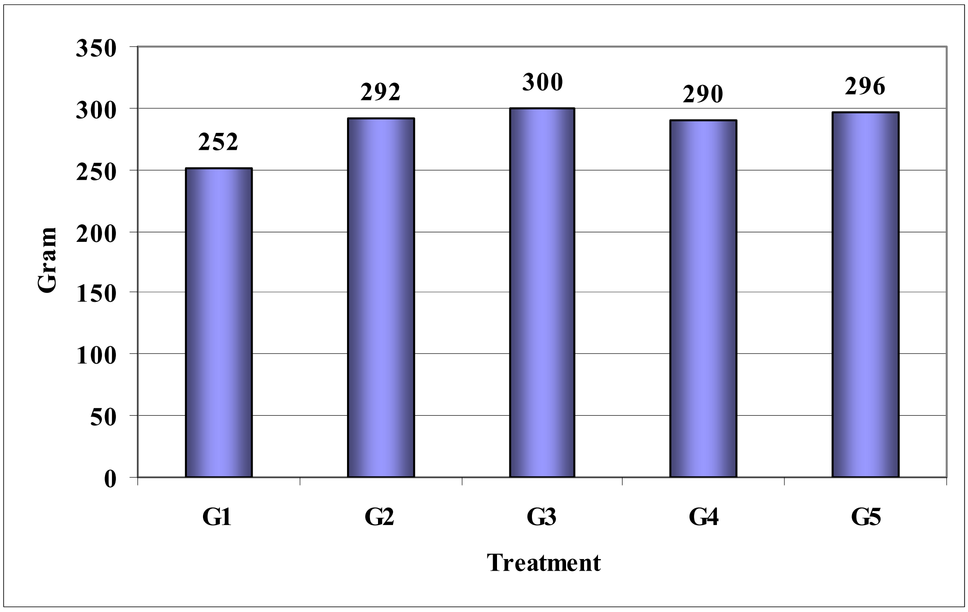

Fig. 1: Unhusked ear weight

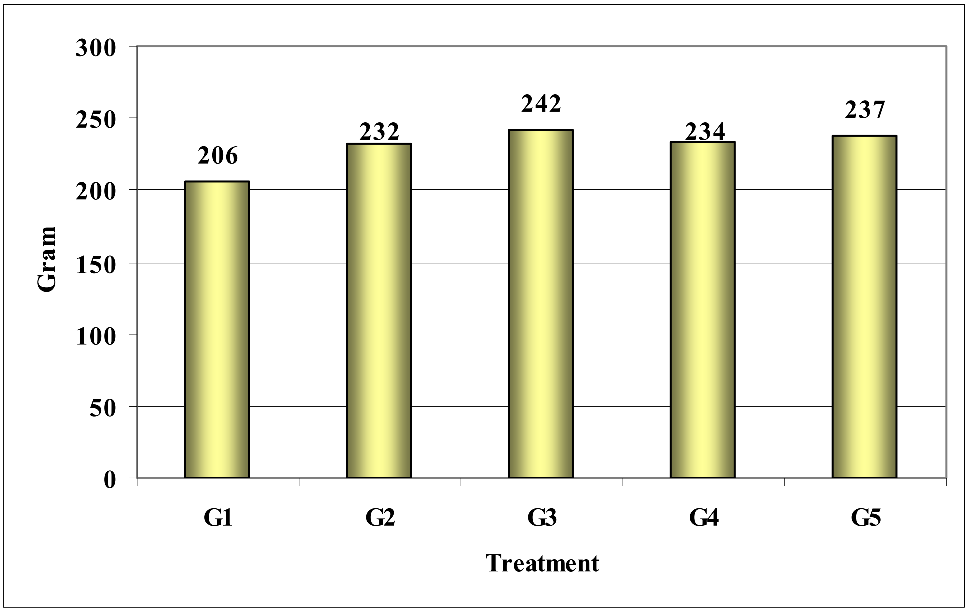

Fig. 2: Husked ear weight

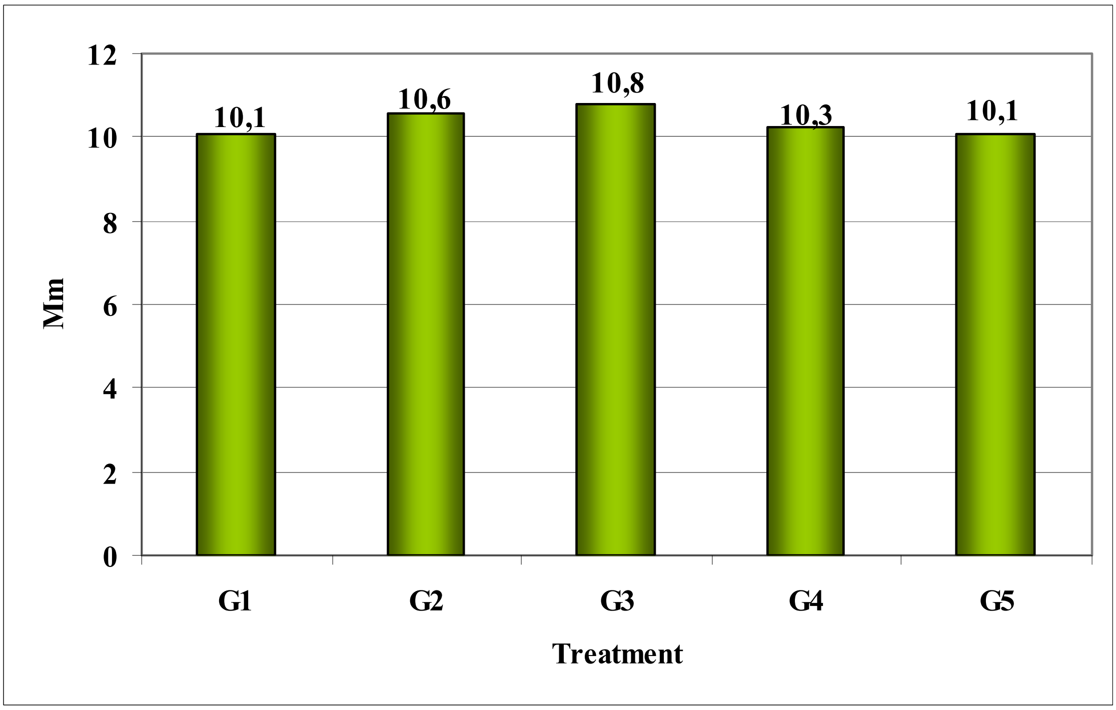

Fig. 3: Length of seeds

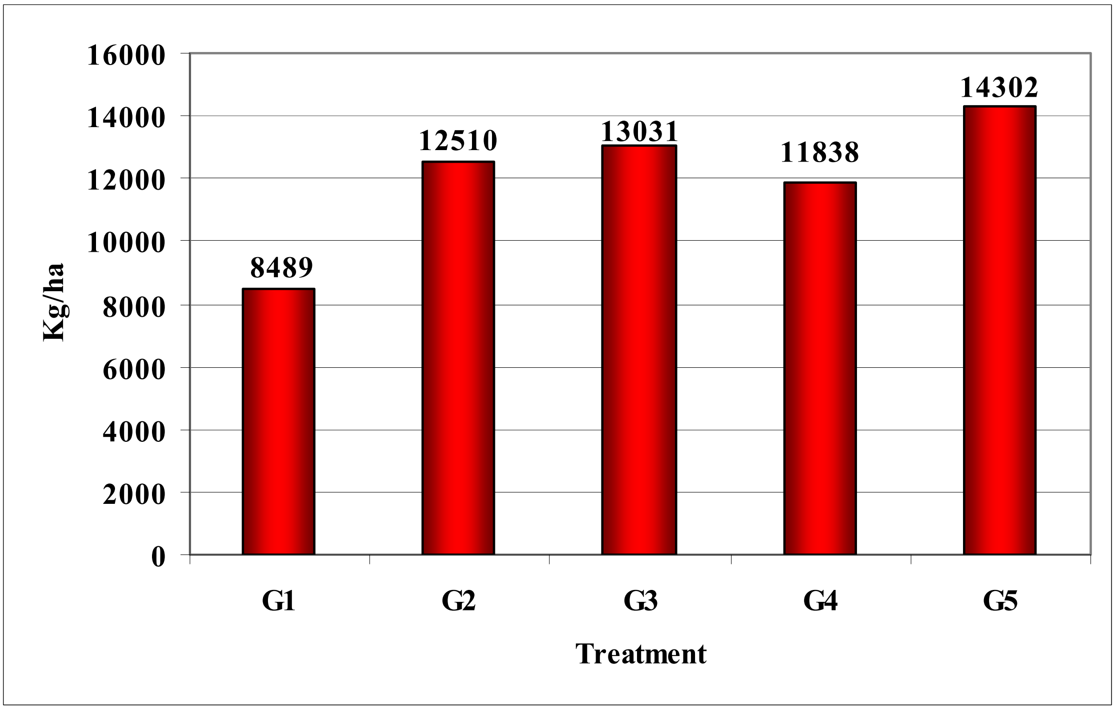

Fig. 4: Average yield

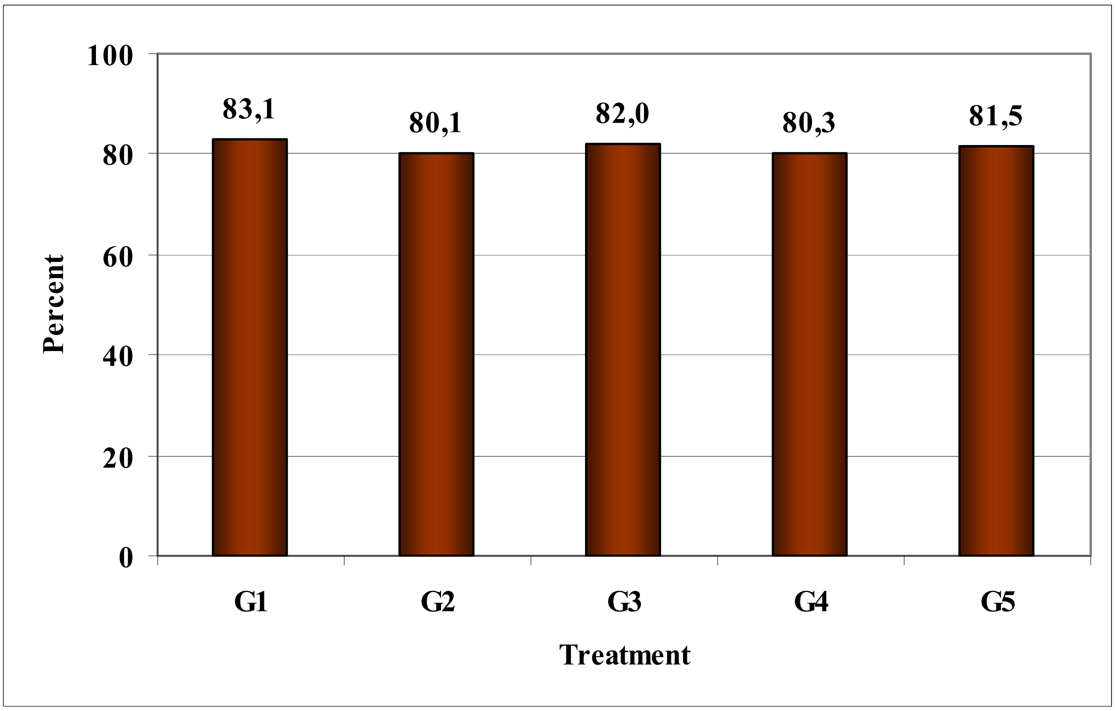

Fig. 5: Netto ear ratio (husked/unhusked ear weight)

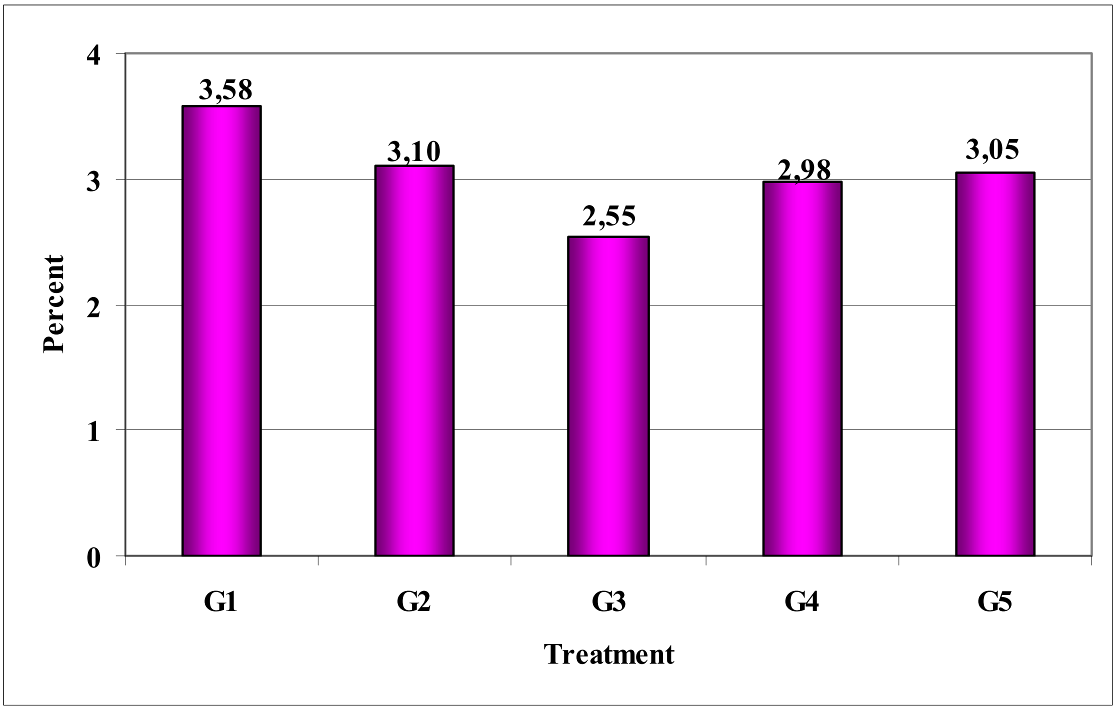

Fig. 6: Complex sugar content

Comparative study of new tomato cultivars for introducing high yield capacity and very early maturity varieties in vegetable production area of Matca

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Keywords: very early maturity, productivity, Israeli hybrids

ABSTRACT:

Seven new tomato varieties (*Licopersicum esculentum* Mill.), hybrids F1 (Amanda F1, Lady Rosa F1, Rosaliya F1, Tovi Roca F1, TL-90664 F1, TL-90665 F1 and VT-60990 F1), with indeterminate growth, Israeli origin from Zeraim Gedera seed company have been tested for their yield capacity and earliness characteristics compare with Menhir F1 (Netherlands, Nunhems seeds company) as control variety. The tests have been made in the experimental plots of SC MARCOSER SRL from vegetable production area of Matca, Galati County. The productivity (Total Tomato Yield) was quite high at all varieties studied (over 80 tons/ha with an exception of TL-90664) and with Amanda F1 the productive results was over 100 tons/ha in conditions of only 3 clusters cycle in very early spring transplanted. The most earliness varieties was found Amanda F1 with the first harvest at only 77 Days after transplanting (DAT) and Lady Rosa F1 at 81 DAT. Also the total time of harvesting was the lowest at Amanda F1 and Lady Rosa F1 with 22 days respectively 24 days between first and last harvest. After this study it was successfully introduced as commercially varieties Amanda F1 for very early spring cycle and Lady Rosa F1 and Tovi Roca F1 for early spring cycle.

INTRODUCTION

The increasing demands of the market and high exigent for quality of Romanian consumers to have as early as possible local fruit tomato, request enlargement of the range of tomatoes varieties by testing and introducing new hybrids with very early maturity in spring, high yield capacity, strong disease resistances and long shelf-life.

The yield capacity depends on the hereditary base of the cultivars and on the environmental conditions, including the conditions of culture (Gould, 1992). It also depends on the interaction between the genotype and the environmental conditions (Bletsos and Goulas, 2002; Susic et al., 2002; Ciofu et al., 2003).

From these reasons the tests was concentrates on Israeli hybrids, from Zeraim Gedera Seeds Company, which has ones of the most valuable genetic base and hybridation lines for tomatoes.

More new tomatoes varieties was tested compare with well-known variety in Matca technology culture and conditions: protected crops in cold greenhouses, very short cycle of only 3 clusters in early spring planting.

MATERIALS AND METHODS

The tests was taken place at SC MARCOSER SRL experimental plots, in in the biggest cold greenhouse vegetable production area in Romania, in Matca village, located in Galati county in the East part of the country.

Between 2009 and 2010, at MARCOSER experimental plots 7 new tomato cultivars was studied compare with a control variety. The origin and main traits are presented in Table 1.

Distance between rows: 60 x 90 cm.
Distance between plants: 30 cm
Surface of repetition plot: 18 m^2
Number of plants used: 240.
Density: 45 000 plants/ha.

Model: in line blocks with three repetitions (Figure 1).

The technology of cultivation was standard with small particularities of Matca area technology: sowing in 30-31 December, planting in unheated greenhouse in 5-15 march, very early cycle of only 3 clusters.

As control variety was used Menhir F1 from Nunhems seed company and the data was calculated statistically by ANOVA test.

RESULTS AND DISCUSSIONS

From the data presented in Tabel 2, it can be observed the differences between vegetative parameters of the new studied Israeli tomato varieties compare with control variety Menhir F1.

The appearance of first cluster oscillated between 8-9 leaves at Lady Rosa F1 and 10-11 leaves to VT-60990 F1. The number of leaves till first cluster and the number of leaves between clusters directly influenced the final height of the plant. Compared to control variety Menhir F1 the highest plant was VT-60990 with 120 cm and the smallest was found Tovi Roca F1 variety with 95 cm.

The fruits setting, no of fruits per plant and the average fruit weights are presented in Table 3.

The number of fruits per plant has an oscillation from 14,5 fruits at TL-90664 F1 to 18,5 fruits at TL-90665 F1. The smallest fruits was registered at TL-90665 F1 with 108,2 gr and the biggest was 130,2 gr at Amanda F1. Compared with the control variety Menhir F1 the biggest fruits registered was at Amanda F1 and Lady Rosa F1 varieties.

Regarding the earliness of the varieties tested the results presented in Tabel 4 relieves big difference from 72 days after transplanting (DAT) at Amanda F1 to 88 days after transplanting at VT-60990 F1. Compare to control variety the most early maturity varieties are Amanda F1 and Lady Rosa F1 with 10 and respectively 8 days earlier. Also the most compressing time of harvesting was found on Amanda F1. Because in Matca village immediately after the removing the 1st crop is planted the 2nd crop the total time of harvesting is a very important parameter involve in farmers choosing of tomato varieties.

Regarding productivity, all varieties has proved a good Total Tomato Yield taken in consideration the very short cycle of only 3 clusters and the early spring climate conditions with the observation that with Amanda F1 and Lady Rosa F1 the results was excellent: 103,1 t/ha and respectively 98,6 t/ha.

A significant positive and strong correlation was registered between starting of harvest and the finish of harvesting (r=0,981) for all varieties tested (Figure 2)

We found positive and good correlation between the number of the fruits per plant and the Total Tomato Yield (r = 0,664) and also there is a positive and good correlation between the mean weights of the fruits and the Total Tomato Yield registered (r = 0,577) (Figure 3 and Figure 4). Similar results for tomatoes were obtained by Susic et al. (2002) who identified important positive correlation between the productions of fruits per plant, the weight of the fruits, the height and their diameter.

An interesting result of this study is the negative and strong correlation between the 1st harvesting, the time of harvesting (from the 1st harvest till last harvest) and the Total Tomato Yield.

These results demonstrates the differences between the very early varieties, special adapted to the conditions of short cycle and planted in winter or early spring and the rest of varieties which has need more time and better climate conditions for an optimum development.

CONCLUSIONS

With the 7 tested new tomato varieties from Israel (Zeraim Gedera) was obtained different results compared with the control variety from Netherland (Nunhems). The most vegetative development it was registered at varieties VT-60990 F1, TL-90664 F1, TL-90665 F1 and also these varieties had the lowest earliness. For the very short cycle in early spring are recommended to be used varieties with small vegetative growth and early maturity so from these points of view VT-60990 F1, TL-90664 F1, TL-90665 F1 are not suitable to be introduced as commercially varieties.

From all varieties tested the most productive was Amanda F1 (103,1 t/ha) and Lady Rosa F1 (98,6 t/ha) followed by Tovi Roca F1 (93.3 t/ha) and Rosaliya F1 (90,6 t/ha). Rosaliya F1 had small fruits on 1st and 2nd clusters and also the time of 1st harvest was late (85 DAT) so not this variety is suitable for be used in very early spring and short cycle.

The most earliness varieties were found Amanda F1 with 77 days from transplanting and Lady Rosa F1 with 81 days from transplanting. Also these two varieties had the shortest total time of harvesting: 22 days for Amanda F1 and 24 days for Lady Rosa F1. Also Tovi Roca F1 has good results regarding the earliness (79 DAT) and a good productivity (93,3 t/ha).

The results registered in these tests were proved the good adaptability at climate conditions from very early spring in Romania, very good earliness and an excellent productivity of 3 varieties: Amanda F1, Lady Rosa F1 and Tovi Roca F1 and in this moment are introduced as commercially varieties in all country.

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TABLES AND FIGURES

Table 1

Cultivars: origin and growth characteristics

Nr. Crt.	Cutivars (Varieties)	Type of cultivar	Origin	Type of growth
1	Amanda F1	Hybrid F1	Zeraim Gedera (Israel)	Indeterminate
2	Lady Rosa F1	Hybrid F1	Zeraim Gedera (Israel)	Indeterminate
3	Rosaliya F1	Hybrid F1	Zeraim Gedera (Israel)	Indeterminate
4	Tovi roca F1	Hybrid F1	Zeraim Gedera (Israel)	Indeterminate
5	TL-90664 F1	Hybrid F1	Zeraim Gedera (Israel)	Indeterminate
6	TL-90665 F1	Hybrid F1	Zeraim Gedera (Israel)	Indeterminate
7	VT-60990 F1	Hybrid F1	Zeraim Gedera (Israel)	Indeterminate
8	Menhir F1 (control variety)	Hybrid F1	Nunhems (Netherland)	Indeterminate

Tabel 2

Some physical characteristics of studied tomatoes

Nr. Crt.	Variety	Leaves below 1st cluster	Leaves between 1st and 2nd cluster	Average Height at 3 clusters
1	Amanda F1	9,6	2,4	110 cm
2	Lady Rosa F1	8,8	3,1	112 cm
3	Rosaliya F1	9,3	3,5	115 cm
4	Tovi Roca F1	9	2,3	95 cm
5	TL-90664 F1	9,9	3,6	118 cm
6	TL-90665 F1	8,9	3,9	117 cm
7	VT-60990 F1	10,4	4,2	120 cm
8	Menhir F1 (control)	9,1	3,4	116 cm

Table 3

The generative characteristics of the tomato varieties

Nr. Crt.	Variety	fruit setting at 1st cluster	fruit setting at 2nd cluster	fruit setting at 3rd cluster	No. fruits/ plant	Fruit weight (g)
1	Amanda F1	5,8	5,7	6,1	17,6	130,2
2	Lady Rosa F1	5,2	5,8	6,1	17,1	128,1
3	Rosaliya F1	5,1	5,5	6,2	16,8	119,8
4	Tovi Roca F1	5,4	5,1	5,9	16,4	126,4
5	TL-90664 F1	4,3	4,8	5,4	14,5	121,1
6	TL-90665 F1	6,1	6,2	6,2	18,5	108,2
7	VT-60990 F1	4,3	5,2	6,0	15,5	124,2
8	Menhir F1 (control)	5,2	5,4	5,8	16,4	112,4
DL 5% =		0,8	1,1	1,2	2,1	16,8
DL 1% =		1,2	1,5	1,8	2,9	22,1
DL0,1%=		1,4	1,9	2,4	3,8	29,2

Table 4

The earliness and Total Tomato Yield of the tomato varieties

Nr. Crt.	Variety	1st harvest DAT	Last harvest DAT	Days of harvesting	Total Tomato Yield (t/ha)
1	Amanda F1	77	99	22	103,1
2	Lady Rosa F1	81	105	24	98,6
3	Rosaliya F1	85	113	28	90,6
4	Tovi Roca F1	79	105	26	93,3
5	TL-90664 F1	90	117	27	79,0
6	TL-90665 F1	90	117	27	90,1
7	VT-60990 F1	93	120	27	86,6
8	Menhir F1 (control)	87	115	28	83,0

Bp	Bp	Bp	Bp	Bp	Bp	Bp	Bp	Bp	Bp	Bp	Bp
Bp	1	1	1	1	1	1	1	1	1	1	Bp
Bp	2	2	2	2	2	2	2	2	2	2	Bp
Bp	3	3	3	3	3	3	3	3	3	3	Bp
Bp	4	4	4	4	4	4	4	4	4	4	Bp
Bp	5	5	5	5	5	5	5	5	5	5	Bp
Bp	6	6	6	6	6	6	6	6	6	6	Bp
Bp	7	7	7	7	7	7	7	7	7	7	Bp
Bp	8	8	8	8	8	8	8	8	8	8	Bp
Bp	Bp	Bp	Bp	Bp	Bp	Bp	Bp	Bp	Bp	Bp	Bp

Bp – Rows of protection

Fig. 1 Model experiment in the greenhouse, with in line blocks (v=10, r=3)

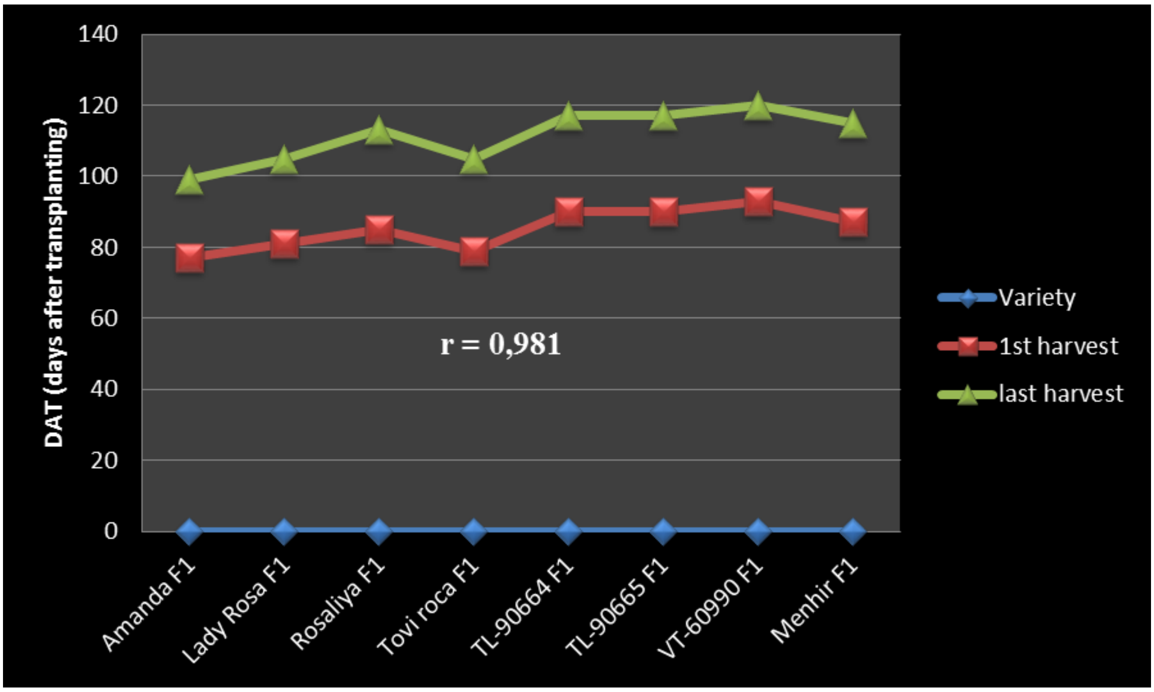

Fig. 2 The correlation between the starting of the harvest and the finish of the harvest

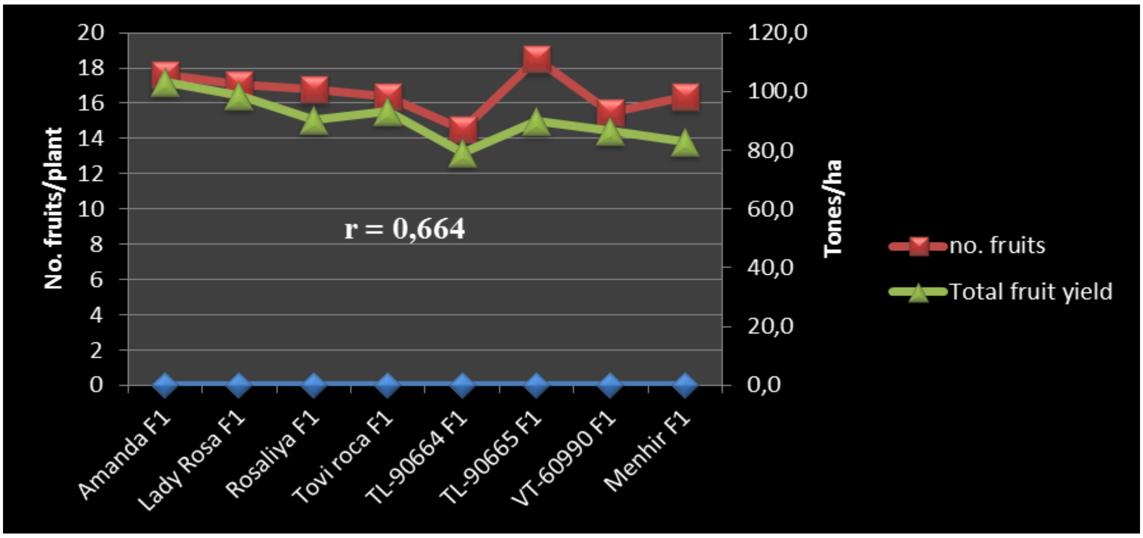

Fig. 3 Correlations between the number of fruits per plant and Total Fruit yield

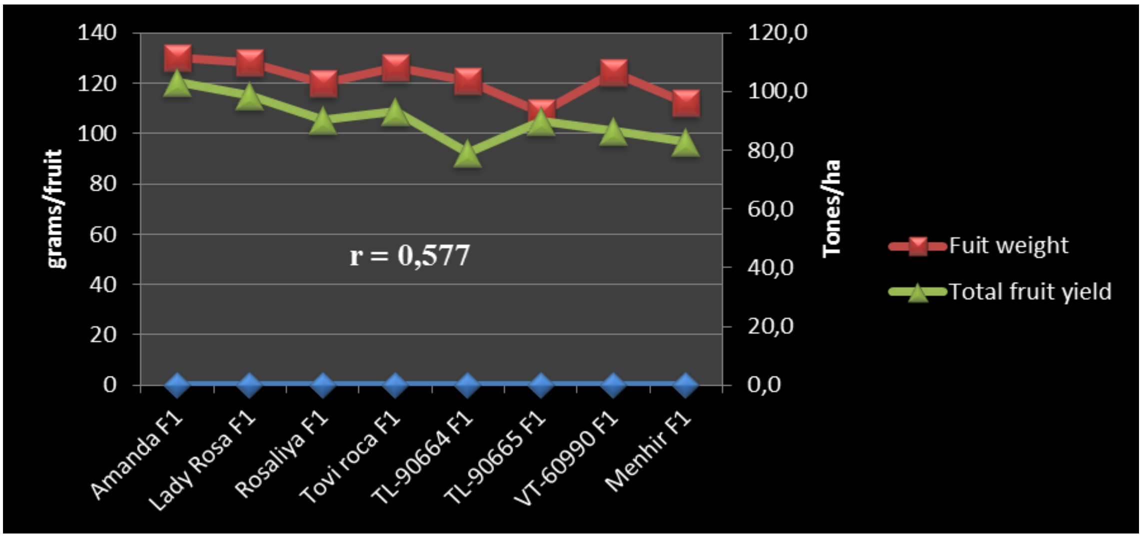

Fig. 4 Correlations between the average fruit weight and Total Fruit yield

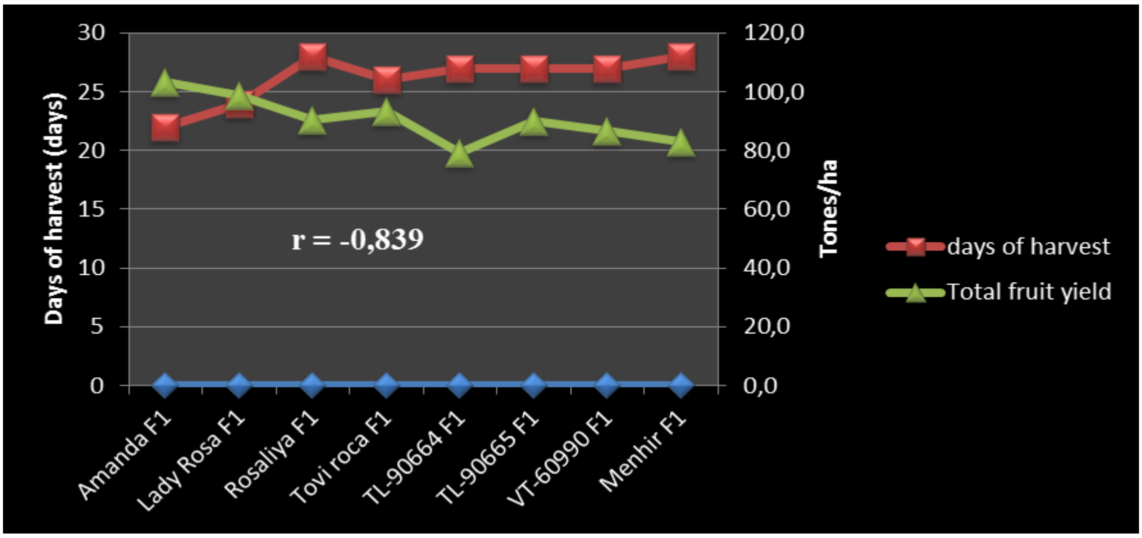

Fig. 5 Negative correlation between the harvest time (days) and Total Fruit YIELD

The study of new modern products used in Matca vegetable area greenhouses in order to increase the earliness and productivity of tomatoes

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Keywords: thermic plastic film, IR additive, thermicity, second cover layer, heat curtain

ABSTRACT

The effects of new type of plastic film with thermicity properties was studied in unheated greenhouses compare with no IR additives plastic film. The thermic plastic film was used as second cover layer of the cold greenhouses from Matca as a "heat curtain" in order to block infrared (7-14µm) radiation to reduce the risk of frost and keep the heat inside. The new plastic film (UV-IR added PE film, 40 microns thickness, 12 months guarantee) tested by MARCOSER in Matca was provided from VATAN PLASTIK, Turkey and was compared with the standard plastic film from Romanian producers. Because of the heat retention during night all physical characteristics studied of the tomato culture was positively influenced: vegetative growth, number of fruits per plant, average weight per plant and also the earliness. The experiment proved the efficiency of thermic plastic film used as second cover layer in greenhouses from Matca compare with standard plastic film. Also the productivity was increased with almost 10% in the greenhouse with thermic plastic film and the first harvest was earlier with 4 days.

INTRODUCTION

In the searching of the new possibilities to advance the traditionally planting dates in Romania in unheated greenhouses (end of March beginning of April – Ciofu et al., 2004) with 10 – 20 days (beginning of March) for achieving a better earliness at tomatoes it was found that it is necessary ability to keep a minimum temperature to avoid the risk of frozen the plants during extreme weather conditions in very early spring. Also it well known that to maintain an optimum temperature and light in the unheated greenhouses in cold early spring will have positive consequences on the plants: they will have a greater vegetative development, earlier harvests of greater quality and more abundance (Bot et al., 1995; Pearce et al., 1993; Adams et al., 2001; Adams and Valde´s, 2002). Using the high quality plastic films to cover the cold greenhouses with special properties such UV photodegradation protection, IR opacity, diffuse, elastic and mechanic resistance (Deltour et al., 1992; Feuilloley et al., 1990) increased the control of climate conditions (temperature and light) in the greenhouses in such a manner that now it is possible to be planted the tomatoes in the begging of the March without the risk of plant frozen.

A new ultrathermic film for second layer cover of the greenhouses was tested compare with the standard Romanian plastic film used in Matca vegetable production area in order to advance the planting date, avoid the risk of plants frozen and maintain an optimum temperature for vegetable development.

MATERIALS AND METHODS

The tests was taken place at SC MARCOSER SRL experimental plots, in in the biggest cold greenhouse vegetable production area in Romania, in Matca village, located in Galati county in the East part of the country.

Between 2009 and 2010, at MARCOSER experimental plots (two 1000m^2 each greenhouses, with 10 m distance between them, same construction type) was tested a new ultrathermic plastic film in one greenhouse as second cover layer compare, in second greenhouse, with Romanian origin standard plastic film. The main characteristics of the two type of plastic film are presented in **Table 1**.

The second cover layer of plastic films is installed inside the greenhouse as a curtain above the plants at 2 m height from the ground like it shown in **Figure 1**.

In both greenhouses was planted a very early maturity, Amanda F1 tomato variety from Zeraim Gedera Seed Company.

Distance between rows: 60 x 90 cm.

Distance between plants: 30 cm

Density: 45 000 plants/ha.

For experiment were monitored 10 plants in 3 random repetitions in both greenhouses. It was measure the height of the plants, number of mature fruits, fruit weight on harvest and the time of first harvest in both greenhouses.

The technology of cultivation was standard with small particularities of Matca area technology: sowing in 30 December, planting in 8 March, very early cycle of only 3 clusters.

In both greenhouses the temperature was measured with temperatures data loggers (CEM DT-171 Temperature Data Logger) with a 60 seconds period of recording and also outside was installed a same data logger with 300 seconds cycle rate of recordings.

RESULTS AND DISCUSSIONS

From the data presented in **Table 1**, it can be observed the differences between thermicity properties of the two types of plastic film: the new one has 48% thermicity effect (according to EN13655) and the standard one has only 4%. This difference is given by the presences in film of some IR additives that blocks the infrared radiation (7 – 14 µm), that means the heat is longer retain in greenhouse during night and prevent the equalization of the outside and inside temperatures. This fact was demonstrated after the analysis of temperature data recordings. In **Figure 2** it can be seen very well the influence of ultrathermic film and standard film used as second cover layer in a greenhouse.

During every night and especially in the morning, when are registered the minimum temperatures, in the greenhouse with thermic effect plastic film the temperatures was bigger with 2 – 3^{o}C than in the greenhouse without thermic film and with 5^{o}C bigger than outside (**Table 2**). Also the average of the temperatures (for 16001 recordings) was higher in the greenhouse with thermic film – 18,99^{0}C – than in the greenhouse with standard film where the average was 16,82^{0}C. Compare with outside (13,64^{0}C) the difference between the average temperatures from the greenhouse with thermic film inside was 5,35^{0}C, which is very close value of difference of the minimum temperatures recorded between them (4,9^{0}C).

Between the temperatures recorded in the two greenhouses and the temperatures from outside was found a very strong and positive correlation with R=0,927 for thermic film greenhouse-outside and R=0,941 for standard film greenhouse-outside.

The differences of vegetative development, production and earliness of the tomatoes culture from the two greenhouses are presented in **Table 3**. All characteristics were improved in the greenhouse with thermic compare with the plants from greenhouse with standard film. The plants were with 5-7 cm higher and also the foliage was more development. In the greenhouse with thermic film the average number of fruits per plant was little higher than in the greenhouse with standard film, also the weight per fruit was higher. Regarding earliness in the greenhouse with thermic film was harvest first time at 77 days after transplanting (DAT) and in second greenhouse the first harvest was with 4 days delay.

CONCLUSIONS

The using of ultrathermic plastic film as second cover layer in the unheated greenhouse from Matca increased the average temperature during culture cycle compare with the greenhouse with standard film with 2,17^{0}C and compare with outside with 5,35^{0}C. The differences of 5^{0}C recorded constantly during all experiment, even when the minimum outside was $3,1^0C$, it will help the plants to not be frozen in eventually of 0^0C or below with 1-3 Celsius degrees outside, so the planting date can be advanced with 1-2 weeks earlier in spring with a smaller risk that the plants would be frozen from below 0 degrees weather.

A constant better retention of the heat in the greenhouses with thermic plastic film means better climate conditions for plants development which will increase the productivity (with almost 10% in this experiment) and the earliness (with 4 days in this experiment).

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TABLES AND FIGURES

Table 1

Main physical characteristics of the plastic films used as second cover layer

Nr. Crt.	Properties	Norm	thermic effect film	standard film
1	Row material		LDPE	LDPE
2	Thickness (microns)	ISO4591	40	80
3	grams per meter		39,2	90
4	Total transmission light (%)	EN2155-5	96	89
5	Thermal effect (%)	EN13655	48	4
6	Guarantee (months)		24	6

Table 2

The differences of average, minimum and maximum temperature between the greenhouse with thermic film, with standard film and outside (11 days and nights)

Nr. Crt.		thermic film	standard film	outside
1	No. of measurements	16001	16001	3202
2	Average temperature (^0C)	18,99	16,82	13,64
3	Min temperature (^0C)	8,00	6,60	3,10
4	Max temperature (^0C)	43,00	39,50	34,00

Table 3

The positive influence of temperatures on vegetative development of plants, production and earliness

Nr. Crt.	Greenhouse	Plant hight (cm)	No. of fruits/plant	fruit weight (gr)	Yield (tones/ha)	First harvest (DAT)
1	with thermic film	1,22	17,6	127,4	100,9	77
2	with standard film	1,15	16,5	123,7	91,8	81

Fig. 1 Second cover layer of a typical greenhouse in MATCA

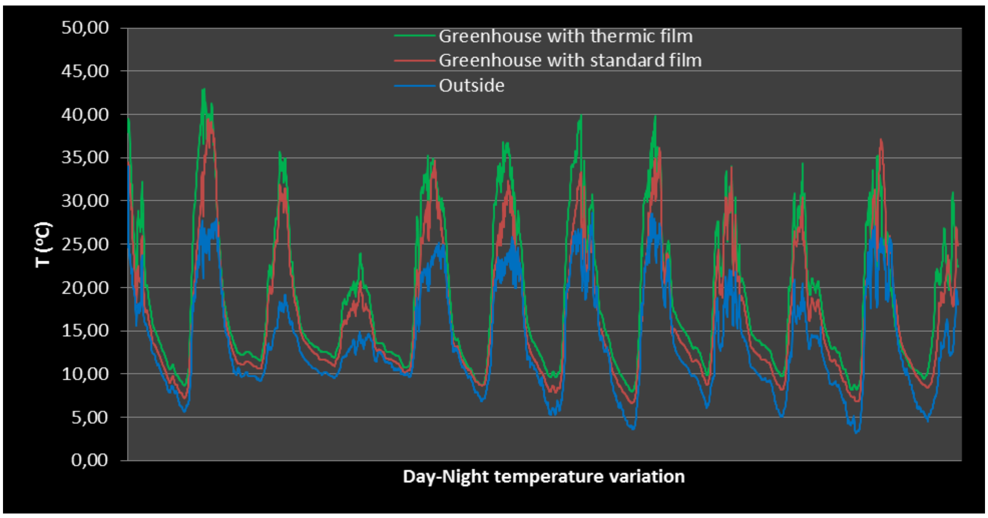

Fig. 2 The 60 second cycle rate recording of temperature for 11 days and nights in the greenhouse with thermic film (green line), greenhouse without thermic film (red line) and outside (blue line)

Contributions to improvement of the onion winter over pass technology in South-East region

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Keywords: cultivar, density, production, frost resistance

ABSTRACT

The researchers aimed to stagger the onion crop for a longer period in the climatic conditions of the south-east of the country and supplying the market with this vegetable species in a poor period. By using this technology the harvesting period has been increased with 30 days. In the south-east area of the country where the autumn is quite long and there are conditions for growing and developing of onion plants, three period of crop establishing have been experimented: 15 August, 1 September and 15 September. The following cultivars have participated to the study: Radar, Swift, Sibir (Bejo), Glob Yellow Danvers (Seminis), Hamasodachi and Swallow (Kaneko Seeds) and the Romanian species Diamant. The best results have been obtained by species Swift and Swallow (frost resistant, increased crops, superior quality, freezing tolerant, high production, high quality). The best moment for establishing the crop following three years experiments is the end of August-beginning of September. By establishing of both the best moment for establishing the crop in autumn and for the cultivars resistant to low temperature, the improvement of winter over pass technology has been realized, technology which was applied by farmers, obtaining higher profits than using the technology by establishing the crop in spring.

INTRODUCTION

The main ratio for producing onion bulbs by using a new winter over pass technology, is that the crop obtained in autumn can be stored (preserved) only until the end of April, beginning of May in order to avoid important losses. Normally at the half of May the stored onion is in a high degree of depreciation (deshidratation, the leaves parchment-like are torn, starting bulb vegetation).

By using such new technology, the onion for bundling (green onion) may be obtained at the beginning of May (phenological phase-beginning of bulb forming) and at the end of May – beginning of June the mature bulbs can be harvested.

Farmers from the south-east of the country have fast assimilated such technology, because even if it's risky (because of low temperature) the bulbs crop has a 50% higher price than in August and September.

We have intended to test such technology in the south-east region of the country, because it is the most favourable region for onion crop, in order to extend it on even greater areas should the desired results are obtained. The experiments have been performed during 2008-2010.

MATERIAL AND METHODS

The experiments have been performed during 2008-2010 on two of the companies with very good economic-financial result.

The researches have aimed the possibility to stagger the onion crop for a longer period in the climatic conditions of the south-east region of the country. The performed experiments have aimed both establishing the best moment of establishing for each cultivar and establishing the cultivars tolerant to low winter temperature, cultivars that should realize superior crops from quantitative and qualitative point of view. Before ploughing, an irrigation has been performed and fertilization has been performed with 400 kg/ha superphosohate. On the ploughed land, before sowing, a quantity of 200kg/ha nitrogenous potassium has been administrated. The sufficient supply with potassium of the soil is necessary because it increases the tolerance to frost of the young onion plants.

In the south-east area of the country where the autumn is quite long, three periods of ploughing have been established: 15 August, 1 September and 15 September.

The following cultivars have participated to the study: Radar, Swift, Sibir (Bejo company),Glob Yellow Danvers(Seminis), Hamasodachi and Swallow and the Romanian species Diamant. The plogh has been made with accurate sowing machine and a density of 800 thousand plants/ha has been realised.

As September is a dry month in this region, irrigations have been performed (irrigation by dripping at Tartasesti-Dambovita and by sprinkler at Poiana-Constanta) in order to establish a fast and uniform germination, a better sprout and a plant development in order to reach the requested parameters (3-4 leaves and 10-15 cm tall) until winter.

RESULTS AND DISCUSSION

The results of the experiments have highlighted the followings: The last three years (2008-2010) have been favourable for using such technology because the frosts followed the covering of the soil with snow and the frost effect has been consequently diminished on onion plants. Precipitations during winter and spring-summer period have contributed to realization of an important saving at crops irrigation.

The studied cultivars (Table 1) have acted differently as regards the production capacity, the highest production being obtained by Swift (62.5 t/ha). Similar results from production and quality point of view have been obtained at Japanese species Swallow (61.8 t/ha). Species Radar and Sibir follows Swift and Swallow. Glob Yellow Danver has realized a 35.8 t/ha production, being very early, the average weight of the bulbs at maturity (the second half of May) being of 50 grams. The lowest production realized by Hamasodachi can be explained by the average weight of the bulbs that did not exceed 20 grames, consequently it is not recommended for such technology. In the presentation of Japanese company Kaneko, the average weight of the bulbs obtained in the origin country is of 250 grams.

Diamant species has realized a low production (26.8 t/ha). This Romanian species has been for a long period of time the best Romanian onion species. By using such technology the results were not good because it is not tolerant to low temperature. Comparatively with species obtaining good results, Diamant species is the latest species.

The second experiment aimed to establish the best moment of culture establishing. For this purpose, the experiments have been established in three moments: 15 August, 1 September and 15 September (Table 2). Swift species has been used, being created by vegetable seeds production company, Bejo, seed norm being of 4 units (one unit=250.000 seeds). The best conditions have been created for a better sprout and for the best development of the plant until winter. Because of the high temperature and the best humidity, the sprout has been realized in best conditions.

The highest quality production has been obtained at the crop established on 1 September (63.99 t/ha). The plants entered in winter having 5-6 leaves and 10-12 cm in height. In this phonological phase they better resisted at the frosts. The losses were only of 13% which did not affect very much the crop level. In case of establishing the crop on 15 August, the plants entered in winter very well developed, having 7-8 leaves and 13-16 cm in height. In this phonological phase they resisted at the frosts in a percentage of 78%. The much lower production (46.56 t/ha) is explained because a 23% of the plants remained in spring formed floriferous stalk, as a result only 480 thousand plants were harvested.

The lower crop (28.16 t/ha) was obtained when establishing the crop on 15 September, when the temperature decreased, and the period between plough and sprout was prolonged with 7-8 days. At the same time, the plants growing and development were more slowly and the plants entered in winter having 3-4 leaves and 7-10cm in height, being more sensitive to low temperature. Both the percentage of plants remained in vegetation (40%) and the average weight of the bulbs have determined the lowest crop.

CONCLUSIONS

Introduction of winter over pass technology gives the possibility to supply the market with fresh onion in a poor period as regards the supply of this important vegetable species.

The most recommended species for this technology are: Swift, Swallow, Radar, Sibir.

Romanian species Diamant is not recommended for such technology, being sensitive at low temperatures and having a vegetation period longer than the four recommended species.

The best moment for establishing the onion crop for winter over pass technology, in the climacteric condition on the south-east of the country is 1 September.

Even if it is a risky technology (very low temperature, the lack of snow can compromise the crop), in the last three years (2008-2010) it has had good results, the farmers obtaining high profits determined by the increased productions and the good price during June-July.

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TABLES

Table 1

Behaviour of 7 onion cultivars ploughed on 1 September – average 3 years

No. crt.	Cultivar	Prod. t/ha	Prod. relative%	Difference of prod. t/ha	Origin
1.	Swift	62,50	233,21	35,70	Bejo
2.	Radar	57,40	214,18	30,60	Bejo
3.	Sibir	51,20	191,04	24,40	Bejo
4.	Hamasodachi	12,00	44,77	- 14,8	Kaneko
5.	Swalow	61,80	230.80	35,00	Kaneko
6.	Glob Yellow Danv.	35,80	133,58	9,00	Seminis
7.	Diamant Mt.	26,80	100,00	-	Romania

Table 2

Influence of the date for establishing the crop in autumn over the bulb production – Swift species

Specification	Density in autumn thousand pl./ha	Density in spring thousand pl./ha	% frozen plants	% plants with floral stalk	Production t/ha
15 August	800	624	22	23	46,56
01 September	800	696	13	-	63,99
15 September	800	320	60	-	28,16

The influence of assortment and fertilization technology on the production of green onions shallots

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Keywords: shallots, assortment, fertilization technology

ABSTRACT

Shallots, a widespread and little cultivated crop in Romania, is also least studied at national level. Therefore we propose, through a series of several studies conducted in 2008-2010, to establish as many aspects of the biology of this species, and also to find a proper growing technology. Through this paper we propose to find if the fertilization technology influences the production of shallots regarding green onion and also to compare the common onion with shallots using it as green onion.

INTRODUCTION

Shallots *(Allium ascalonicum)* is a perennial vegetable species related to common onion, part of the same botanical family *(Liliaceae),* but unlike that formed in the soil more bulbs caught on a common drive.

Shallots', bordering the spice and vegetable, is grown for its leaves which are eaten in early spring fresh, as such, or used to prepare salads, chopped or sliced thin (University of Graz, www.uni-graz.at)

From shallots the bulbs, which are smaller and more pungent than the common onion, are also consumed as seasoning various dishes and canned vegetables. (Ruxandra Ciofu and collab., 2004).

Nowadays shallots are grown on large areas in Asia, such as Indonesia, Philippines, Thailand, Sri Lanka and India. In Europe the countries with the largest growing areas with shallots are: France with 2231 hectares with a yield of about 20t/ha, Spain 2000 hectares with an average yield of 18t/ha, Greece 2116 hectares and 12t/ha yield and England with a cultivated area of 2070 hectares and an average yield of only 10t/ha. (FAO STAT, 2007)

In our country shallots are grown on small areas at household level, in Transylvania, Carpathian areas of Muntenia and Oltenia, and northern Moldavia, generally for their own consumption. (Ruxandra Ciofu and collab., 2004).

Through the research project named "The influence of assortment and irrigation technology on the production of *shallots"* we intend to establish the effect of irrigation method on the yield of shallots and also the differences between different populations studied.

MATERIAL AND METHOD

Variants studied

In the experimental protocol are included the variants presented in Table 1.
As shown in Table 1, the 16 variants of this experience with two factors were made by combining the following graduations of experimental factors:
Experimental factor a - fertilization technology, with 2 graduations:
a_1 - basic fertilization with **Rosafert 12-12-17 + 2** +**ME** 100g/mp + 2 faziale **fertilization** with **Unicum;**
a_2 – **manure** in the previous year;
Experimental factor b - assortment, with the following 8 graduations:
b_1 - The Rotunda
b_2 - The Breaza
b_3 – The Campulung Muscel
b_4 - The Saparta

b_5 – The Vedea
b_6 - The Valea Mare
b_7 - Conservor F_1
b_8 - Common Onion

Biological material used in experience

Since most of the biological material used in experience is represented by the local cultivars, their descriptions in the literature are not available.

Conservor F_1 is a shallot hybrid, productive, with elongated bulbs and a brownish red coat. Vegetation period is 130 days.

Other materials used in experience

Rosafert 12 - 12 - 17 + 2 (MgO) + ME is a complex granular fertilizer with a perfect grading, 85% of granules having a diameter of 2-4 mm. The product contains nitrate nitrogen and ammonia, easily assimilable, potassium sulphate, magnesium and micronutrients. It is specially recommended for soils with a balanced nutrient content. Due to high solubility is recommended to apply it at crop planting.

Unicum is a complex organic liquid fertilizer that helps to improve the yield in quantity and quality, and to increase plants resistance to stress conditions. This product does not serve to feed the plant directly, but enhances the immune system and is helping to better assimilation of nutrients.

Observations and measurements

In the experience was made the following determinations:

- Plant height which was determined by measuring at different periods along the growing season
- False stem height was determined by measuring after plant removal from the soil and separation of brother bulbs.
- Number of leaves formed on a bulb, was determined by counting.
- Number of brother bulbs formed by a plant, which was determined by counting.

RESULTS AND DISCUSSION

Plant height

Height of plant dynamics is presented in Table 2.

As shown in Table 2 fertilization technology affect plant height, meaning that chemical fertilization give higher plant height compared with plants fertilized with manure in the previous year.

Along the growing season Conservor F_1 had higher plants compared with other variants studied, for both fertilization technologies.

Among chemically fertilized variants, in addition of Conservor F_1 is noted also The Breaza (66.67 cm), The Saparta (63 cm) and The Campulung Muscel (60.33 cm). Common onion plant height was 55 cm and a lower value of plant height had only The Rotunda with 52 cm.

Among the variants fertilized with manure at previous crop Conservor F_1 was the only variety that exceeded 60 cm, followed by populations The Vedea (54.33 cm), The Campulung Muscel (54 cm) and The Breaza (52 cm). The Rotunda, The Saparta and The Valea Mare plant heights were smaller than the common onion.

False stem height

Measurements regarding false stem height and the way how it varied depending of fertilizer technology applied are presented in Table 3.

As shown in Table 3 fertilization technology affect plant false stem height in the way that for chemically fertilized variants the false stem was higher compared with those fertilized with manure at the previous crop. Also the false stem of all studied variants was higher that the common onion for both type of fertilization.

Thus, at chemical fertilized variants the highest false stem was registered by Conservor F $_1$ with a false stem measuring 12.33 cm, followed by The Valea Mare population with 11 cm and The Breaza with 10.33 cm lowest false stem heights were recorded at V_1 the Rotunda with 8.33 cm and V_8 Common onion with 7.5 cm.

Among the variants fertilized with manure in the previous year, the greatest height of the false stem has been registered also at Conservor F $_1$ hybrid with a false stem of 12 cm, followed by populations The Campulung Muscel and The Saparta with heights of the false stem of 9.66 cm and 9 cm. Lowest false stem heights, among the variants without chemical fertilization, have been registered also to common onion and population The Rotunda with 7 cm and respectively 7.66 cm.

Number of leaves formed on a bulb

Number of leaves formed on a bulb is shown in Table 4.

As shown in Table 4 the number of leaves formed on a bulb is predominantly influenced by cultivar and little by fertilizer technology applied.

The largest number of leaves formed on a bulb has been registered at The Campulung Muscel population in chemically fertilized variant, with 7.33 leaf/bulb followed by The Valea Mare populations, chemically fertilized, and The Breaza without chemical fertilizers, both registering a number of 7 leaves.

The lowest number of leaves formed on a bulb has been registered by Conservor F $_1$ and The Rotunda, in chemically fertilized variant, with 5.66 leaves.

Number of brother bulbs formed by a plant

Number of brother bulbs formed by a plant is shown in Table 5.

As shown in Table 5 fertilization technology applied influence the number of brother bulbs formed on a plant, meaning that almost all variants with chemical fertilization had a higher number of brother bulbs than the manure fertilized in the previous year variants.

The largest number of brother bulbs formed on a plant, among chemically fertilized variants, has been registered by The Rotunda with 6 bulbs/plant, followed by The Saparta with 5.33 bulbs/plant and The Breaza with 4,66 bulbs/plant.

Among the variants fertilized with manure in the previous year are noted The Breaza, The Rotunda and The Campulung Muscel with a number of 5, 4.66 and 4 bulbs/plant.

The lowest number of brother bulbs formed by a plant, among the varieties of shallots, has been at Conservor F $_1$ which formed only 2.33 bulbs/plant in both types of fertilization.

The common onion formed a single bulb/plant in both types of fertilization.

CONCLUSIONS AND RECOMMENDATIONS

Following research in 2010 regarding the influence of fertilization technology on production of green onions, at shallots, the following conclusions result:

- The fertilization technology applied influence plant height, meaning that for chemical fertilization results greater plant height compared with plants fertilized with manure in the previous year.
- The plants false stem height, an important indicator in terms of green onions, is also influenced by fertilizer technology applied in the way that chemically fertilized variants have heights of false stem greater than those fertilized with manure in the previous year.
- Compared with the common onion, false stem formed by all variants of shallots studied was higher in both types of fertilization.
- Number of leaves formed on a bulb is mainly influenced by cultivar and little by fertilizer technology applied.
- Number of brother bulbs formed on a plant is influenced mainly by the cultivar but also by fertilizer technology applied in the sense that almost all variants chemically fertilized have

a bigger number of brother bulbs compared with variants fertilized with manure in the previous year.

- Given the larger number of brother bulbs formed from a mother bulb planted and the false stem height is recommended to replace common onions with shallots for green onion production.

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TABLES

Table 1

Variants studied: Shallots, Stoeneşti – Olt County, 2010

Variant	Fertilization	Cultivars	Origin
V_1	a_1 - basic fertilization with **Rosafert 12-12-17 + 2** +**ME** 100g/mp + 2 faziale **fertilization** with **Unicum;**	The Rotunda (b_1)	Local Population
V_2		The Breaza (b_2)	Local Population
V_3		The Campulung Muscel (b_3)	Local Population
V_4		The Saparta (b_4)	Local Population
V_5		The Vedea (b_5)	Local Population
V_6		The Valea mare (b_6)	Local Population
V_7		Conservor F_1 Bulbs (b_7)	Bejo
V_8		Common onion	Local Population
V_9	a_2 – **manure** in the previous year;	The Rotunda (b_1)	Local Population
V_{10}		The Breaza (b_2)	Local Population
V_{11}		The Campulung Muscel (b_3)	Local Population
V_{12}		The Saparta (b_4)	Local Population
V_{13}		The Vedea (b_5)	Local Population
V_{14}		The Valea Mare(b_6)	Local Population
V_{15}		Conservor F_1 Bulbs (b_7)	Bejo
V_{16}		Common onion	Local Population

Table 2

Plant height, cm: Shallots, Stoeneşti – Olt County, 2010

Variant	Fertilization	Cultivars	09.apr	17.apr	29.apr	22.may
V_1	a_1 - basic fertilization with **Rosafert 12-12-17 + 2** +**ME** 100g/mp + 2 faziale **fertilization** with **Unicum;**	The Rotunda (b_1)	7.5	14.6	30.20	52.00
V_2		The Breaza (b_2)	9.2	19.3	32.80	66.67
V_3		The Campulung Muscel (b_3)	7.5	18.7	31.90	60.33
V_4		The Saparta (b_4)	7.8	20.6	30.10	63.00
V_5		The Vedea (b_5)	8.1	17.2	30.80	57.67
V_6		The Valea mare (b_6)	6.7	17.4	29.00	59.67
V_7		Conservor F_1 Bulbs (b_7)	12.8	22.5	37.90	65.33
V_8		Common onion	9	16.3	36.66	55.00
V_9	a_2 – **manure** in the previous year;	The Rotunda (b_1)	7.4	12.6	27.3	46.00
V_{10}		The Breaza (b_2)	8.7	18.2	30.1	52.00
V_{11}		The Campulung Muscel (b_3)	7.5	17.6	28.4	54.00
V_{12}		The Saparta (b_4)	9	17.7	26.9	46.67
V_{13}		The Vedea (b_5)	10.2	18.5	28.7	54.33
V_{14}		The Valea Mare(b_6)	6.4	13.2	25.2	44.33
V_{15}		Conservor F_1 Bulbs (b_7)	11	21.6	36.2	60.67
V_{16}		Common onion	8.7	17.3	32.33	48

Table 3

False stem height, cm: Shallots, Stoeneşti – Olt County, 2010

Variant	Fertilization	Cultivars	False stem height (cm)
V_1	a_1 - basic fertilization with **Rosafert 12-12-17 + 2 +ME** 100g/mp + 2 faziale **fertilization** with **Unicum;**	The Rotunda (b_1)	8.33
V_2		The Breaza (b_2)	10.33
V_3		The Campulung Muscel (b_3)	9.33
V_4		The Saparta (b_4)	9.33
V_5		The Vedea (b_5)	10
V_6		The Valea mare (b_6)	11
V_7		Conservor F_1 Bulbs (b_7)	12.33
V_8		Common onion	7.5
V_9	a_2 – **manure** in the previous year;	The Rotunda (b_1)	7.66
V_{10}		The Breaza (b_2)	8.66
V_{11}		The Campulung Muscel (b_3)	9.66
V_{12}		The Saparta (b_4)	9
V_{13}		The Vedea (b_5)	8
V_{14}		The Valea Mare(b_6)	8.33
V_{15}		Conservor F_1 Bulbs (b_7)	12
V_{16}		Common onion	7

Table 4

Number of leaves formed on a bulb: Shallots, Stoeneşti – Olt County, 2010

Variant	Fertilization	Cultivars	Number of leaves
V_1	a_1 - basic fertilization with **Rosafert 12-12-17 + 2 +ME** 100g/mp + 2 faziale **fertilization** with **Unicum;**	The Rotunda (b_1)	5.66
V_2		The Breaza (b_2)	6
V_3		The Campulung Muscel (b_3)	7.33
V_4		The Saparta (b_4)	6
V_5		The Vedea (b_5)	6.33
V_6		The Valea mare (b_6)	7
V_7		Conservor F_1 Bulbs (b_7)	5.66
V_8		Common onion	6
V_9	a_2 – **manure** in the previous year;	The Rotunda (b_1)	6
V_{10}		The Breaza (b_2)	7
V_{11}		The Campulung Muscel (b_3)	6.33
V_{12}		The Saparta (b_4)	6.66
V_{13}		The Vedea (b_5)	6.66
V_{14}		The Valea Mare(b_6)	6.33
V_{15}		Conservor F_1 Bulbs (b_7)	6.33
V_{16}		Common onion	6.33

Table 5

Number of brother bulbs formed on a plant: Shallots, Stoeneşti – Olt County, 2010

Variant	Fertilization	Cultivars	Number of brother bulbs
V_1	a_1 - basic fertilization with **Rosafert 12-12-17 + 2** +**ME** 100g/mp + 2 faziale **fertilization** with **Unicum;**	The Rotunda (b_1)	6
V_2		The Breaza (b_2)	4.66
V_3		The Campulung Muscel (b_3)	3.66
V_4		The Saparta (b_4)	5.33
V_5		The Vedea (b_5)	3.66
V_6		The Valea mare (b_6)	4.33
V_7		Conservor F_1 Bulbs (b_7)	2.33
V_8		Common onion	1
V_9	a_2 – **manure** in the previous year;	The Rotunda (b_1)	4.66
V_{10}		The Breaza (b_2)	5
V_{11}		The Campulung Muscel (b_3)	4
V_{12}		The Saparta (b_4)	3.66
V_{13}		The Vedea (b_5)	3.66
V_{14}		The Valea Mare (b_6)	3
V_{15}		Conservor F_1 Bulbs (b_7)	2.33
V_{16}		Common onion	1

The influence of assortment and irrigation technology on the production of shallots

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Keywords: shallots, variety, irrigation method

ABSTRACT

Shallots, a widespread and little cultivated crop in Romania, is also least studied at national level. Therefore we propose, through a series of several studies conducted in 2008-2010, to establish as many aspects of the biology of this species, and also to find a proper growing technology. Through this paper we propose to find the appropriate method of irrigation for this crop comparing drip irrigation with sprinkler irrigation.

INTRODUCTION

Shallots *(Allium ascalonicum)* is a perennial vegetable species related to common onion, part of the same botanical family *(Liliaceae),* but unlike that formed in the soil more bulbs caught on a common drive.

Shallots', bordering the spice and vegetable, is grown for its leaves which are eaten in early spring fresh, as such, or used to prepare salads, chopped or sliced thin (University of Graz, www.uni-graz.at)

From shallots the bulbs, which are smaller and more pungent than the common onion, are also consumed as seasoning various dishes and canned vegetables (Ruxandra Ciofu and collab., 2004).

Nowadays shallots are grown on large areas in Asia, such as Indonesia, Philippines, Thailand, Sri Lanka and India. In Europe the countries with the largest growing areas with shallots are: France with 2231 hectares with a yield of about 20t/ha, Spain 2000 hectares with an average yield of 18t/ha, Greece 2116 hectares and 12t/ha yield and England with a cultivated area of 2070 hectares and an average yield of only 10t/ha. (FAO STAT, 2007)

In our country shallots are grown on small areas at household level, in Transylvania, Carpathian areas of Muntenia and Oltenia, and northern Moldavia, generally for their own consumption (Ruxandra Ciofu and collab., 2004).

Through the research project named "The influence of assortment and irrigation technology on the production of *shallots"* we intend to establish the effect of irrigation method on the yield of shallots and also the differences between different populations studied.

MATERIAL AND METHOD

Variants studied

In the experimental protocol are included the variants presented in Table 1.

As shown in Table 1, the 14 variants of this experience with two factors were made by combining the following graduations of experimental factors:

Experimental factor a - irrigation method, with 2 graduations:

a_1 - Drip Irrigation

a_2 - Sprinkler Irrigation

Experimental factor b - assortment, with the following 7 graduations:

b_1 - The Rotunda

b_2 - The Breaza

b_3 – The Campulung Muscel

b_4 - The Saparta

b_5 – The Vedea

b_6 - The Valea Mare

b $_7$ - Conservor F_1

Biological material used in experience

Since most of the biological material used in experience is represented by the local cultivars, their descriptions in the literature are not available.

Conservor F_1 is a shallot hybrid, productive, with elongated bulbs and a brownish red coat. Vegetation period is 130 days.

Other materials used in experience

Turbo Slim drip line having a thickness of 18 mil, with the distance between dripers of 20 cm, and a flow rate of 1.2 liters/hour.

Observations and measurements

In the experience was made the following determinations:

- Plant height which was determined by measuring at different periods along the growing season.
- Number of brother bulbs that was determined by counting simultaneously with plant height.
- Bulbs average weight determined by weighing.
- Total yield determined by weighing.

RESULTS AND DISCUSSIONS

Changes in plant height

Plant height and its variation during the growing season are presented in Table 2.

As shown in Table 2 plant height was determined on April 9, April 17, April 29 and May 22, 2010.

All populations studied showed higher plant height at those variants that are irrigated by drip irrigation compared with those irrigated by sprinklers throughout the growing season.

On May 22, 2010 Conservor F_1 had the highest plants, reaching up to 77.67 cm in drip irrigated variant and up to 60.67 cm in sprinklers irrigated variant.

Among the drip irrigated variants, The Rotunda showed lower plant height, being of 48.67 cm. The other populations studied, showed, in drip irrigated variant, plant heights between 60 and 70 cm.

Among the sprinkler irrigated variants the lowest plant height was recorded by The Valea Mare, with 44.33 cm, followed by The Rotunda population with 46 cm and The Saparta with 46.67 cm. Populations The Breaza, The Campulung Muscel and The Vedea had registered plant height values between 52 cm and 54 cm.

Number of brother bulbs formed by a plant

Number of brother bulbs formed by a plant is shown in Table 3.

As shown in Table 3 the number of brother bulbs formed by a plant is not highly influenced by irrigation method, all variants studied having similar values for this indicator for both irrigation methods

The Rotunda population formed the largest number of brother bulbs in drip irrigated variant, it reached 6.33, followed by populations The Breaza and The Campulung Muscel with 5 brother bulbs per plant. In sprinkler irrigation variant these populations have formed a number of 4.66, 5 and 4 brother bulbs per plant.

The lowest number of brother bulbs was registered by Conservor F_1 hybrid that in both types of irrigation formed 2.33 bulbs per plant.

The average weight of bulbs

Table 4 shows the average weight of bulbs, in grams.

As shown in Table 4 the variants with drip irrigation had values of average weight of bulbs slightly higher compared with variants irrigated by sprinklers.

The highest average weight of bulbs was recorded by Conservor F_1 with 50.31 g in drip irrigated variant and 46.42 g in sprinkler irrigated variant.

Among the drip irrigated variants is also noted populations The Breaza and The Campulung Muscel with average bulbs weight of 37.4 g and respectively 25.88 g. The smaller bulbs among drip irrigated variants were registered by The Valea Mare with an average bulbs weight of 21.09 g

Between local populations studied, among sprinkler irrigated variants is also noted The Breaza and The Campulung Muscel, with average bulbs weight of 21.95 g and respectively 22.96 g. The Rotunda had the lowest average weight of bulbs among sprinkler irrigated variants by 15.94 g.

Total yield

Total yield of variants studied is shown in Table 5.

As shown in Table 5, except for population The Campulung Muscel, all cultivars studied showed higher total yields for those variants drip irrigated compared with those irrigated by sprinklers.

The highest total yield occurred in The Breaza population for both irrigation methods, with total yield of 3.15 kg/m^2 for drip irrigated variant and 2.63 kg/m^2 for sprinkler irrigated variant.

The lowest total yield was registered at The Rotunda population with 1.68 kg/m^2 for drip irrigated variant and 0.67 kg/m ^{2} at sprinkler irrigated variant.

Among drip irrigated variants yield above 2 kg/m^2 were also obtained at cultivars The Saparta, The Vedea and Conservor $F_{1.}$

Among variants irrigated by sprinklers, besides The Breaza is also noted The Saparta with an yield of 2.16 kg/m^2 followed by population The Campulung Muscel with an yield of 2.07 kg/m^2. Populations The Vedea and The Valea Mare had yields of 1.56 kg/m^2 and Conservor F_1 1.08 kg/m^2.

The average yield of drip irrigated variants was 2.26 kg/m^2 and for sprinkler irrigated variants were 1.68 kg/m$^{2.}$

Regarding yield differences between studied variants and average yield, among drip irrigated variants, above-average values were recorded by The Breaza, The Saparta, The Vedea and Conservor F $_{1.}$

Among sprinkler irrigated variants yields above average were registered by populations The Breaza, The Campulung Muscel and The Saparta.

CONCLUSIONS AND RECOMMENDATIONS

Following research in 2010, results the following conclusions:

- The irrigation method used influence the plant height, therefore in drip irrigation method resulted higher plant height compared with sprinkler irrigation;
- Number of brother bulbs formed by a plant is influenced mainly by the variety and in small part by the irrigation method;
- By applying drip irrigation method the average bulbs weight can be higher compared with sprinkler irrigation;
- The highest total yield occurred in population The Breaza in both irrigation variants, with total yield of 3.15 kg/m^2 for drip irrigated variant and 2.63 kg/m^2 for sprinkler irrigated variant;
- The average yield of drip irrigated variants, was 2.26 kg/m^2 and 1.68 kg/m^2 for sprinkler irrigated variants;
- Given the results, the recommended method of irrigation is drip irrigation instead of sprinkler;
- From local populations studied is recommended for growing in Caracal area The Breaza population;

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TABLES

Table 1

Variants studied: Shallots, Stoeneşti – Olt County, 2010

Variant	Irrigation	Cultivars	Origin
V_1	Drip irrigation (a1)	The Rotunda (b_1)	Local Population
V_2		The Breaza (b_2)	Local Population
V_3		The Campulung Muscel (b_3)	Local Population
V_4		The Saparta (b_4)	Local Population
V_5		The Vedea (b_5)	Local Population
V_6		The Valea mare (b_6)	Local Population
V_7		Conservor F_1 Bulbs (b_7)	Bejo
V_8	Sprinkler irrigation (a2)	The Rotunda (b_1)	Local Population
V_9		The Breaza (b_2)	Local Population
V_{10}		The Campulung Muscel (b_3)	Local Population
V_{11}		The Saparta (b_4)	Local Population
V_{12}		The Vedea (b_5)	Local Population
V_{13}		The Valea Mare(b_6)	Local Population
V_{14}		Conservor F_1 Bulbs (b_7)	Bejo

Table 2

Changes in plant height, cm: Shallots, Stoeneşti – Olt county, 2010

Variant	Irrigation	Cultivars	09.apr	17.apr	29.apr	22.mai
V_1	Drip irrigation (a1)	The Rotunda (b_1)	9	13.5	29.8	48.67
V_2		The Breaza (b_2)	9.4	21	33.9	69.00
V_3		The Campulung Muscel (b_3)	8	19.3	31.8	67.33
V_4		The Saparta (b_4)	8.5	18.7	31.1	62.67
V_5		The Vedea (b_5)	10.2	19.3	31.6	69.67
V_6		The Valea mare (b_6)	10	17.8	30.7	64.67
V_7		Conservor F_1 Bulbs (b_7)	15.7	23.9	40.9	77.67
V_8	Sprinkler irrigation (a2)	The Rotunda (b_1)	7.4	12.6	27.3	46.00
V_9		The Breaza (b_2)	8.7	18.2	30.1	52.00
V_{10}		The Campulung Muscel (b_3)	7.5	17.6	28.4	54.00
V_{11}		The Saparta (b_4)	9	17.7	26.9	46.67
V_{12}		The Vedea (b_5)	10.2	18.5	28.7	54.33
V_{13}		The Valea Mare(b_6)	6.4	13.2	25.2	44.33
V_{14}		Conservor F_1 Bulbs (b_7)	11	21.6	36.2	60.67

Table 3

Number of brother bulbs formed by a plant: Shallots, Stoeneşti – Olt county, 2010

Variant	Irrigation	Cultivars	Number of brother bulbs/plant
V_1	Drip irrigation (a1)	The Rotunda (b_1)	6.33
V_2		The Breaza (b_2)	5
V_3		The Campulung Muscel (b_3)	5
V_4		The Saparta (b_4)	3.66
V_5		The Vedea (b_5)	4.33
V_6		The Valea mare (b_6)	4
V_7		Conservor F_1 Bulbs (b_7)	2.33
V_8	Sprinkler irrigation (a2)	The Rotunda (b_1)	4.66
V_9		The Breaza (b_2)	5
V_{10}		The Campulung Muscel (b_3)	4
V_{11}		The Saparta (b_4)	3.66
V_{12}		The Vedea (b_5)	3.66
V_{13}		The Valea Mare(b_6)	3
V_{14}		Conservor F_1 Bulbs (b_7)	2.33

Table 4

The average weight of bulbs, g: Shallots, Stoeneşti – Olt county, 2010

Variant	Irrigation	Cultivars	The average weight of bulbs (g)
V_1	Drip irrigation (a1)	The Rotunda (b_1)	24.7
V_2		The Breaza (b_2)	37.4
V_3		The Campulung Muscel (b_3)	24.88
V_4		The Saparta (b_4)	22.33
V_5		The Vedea (b_5)	23.73
V_6		The Valea mare (b_6)	21.09
V_7		Conservor F_1 Bulbs (b_7)	50.31
V_8	Sprinkler irrigation (a2)	The Rotunda (b_1)	15.94
V_9		The Breaza (b_2)	21.95
V_{10}		The Campulung Muscel (b_3)	22.96
V_{11}		The Saparta (b_4)	20.82
V_{12}		The Vedea (b_5)	16.66
V_{13}		The Valea Mare(b_6)	17.66
V_{14}		Conservor F_1 Bulbs (b_7)	46.42

Table 5

Total yield, kg/m^2: Shallots, Stoenești – Olt county, 2010

Variant	Irrigation	Cultivars	Total yield, kg/m ^{2}	Differences from average	
				Kg/m ^{2}	%
V $_1$	Drip irrigation (a1)	The Rotunda (b $_1$)	1.68	-0.58	74.35
V $_2$		The Breaza (b $_2$)	3.15	0.89	139.48
V $_3$		The Campulung Muscel (b $_3$)	1.80	-0.46	79.44
V $_4$		The Saparta (b $_4$)	2.39	0.13	105.70
V $_5$		The Vedea (b $_5$)	2.47	0.21	109.39
V $_6$		The Valea mare (b $_6$)	1.93	-0.33	85.55
V $_7$		Conservor F_1 Bulbs (b $_7$)	2.37	0.11	104.76
		Average yield	2.26	0.00	100.00
V $_8$	Sprinkler irrigation (a2)	The Rotunda (b $_1$)	0.67	-1.01	39.92
V $_9$		The Breaza (b $_2$)	2.63	0.95	156.25
V $_{10}$		The Campulung Muscel (b $_3$)	2.07	0.39	123.20
V $_{11}$		The Saparta (b $_4$)	2.16	0.48	128.40
V $_{12}$		The Vedea (b $_5$)	1.56	-0.12	93.01
V $_{13}$		The Valea Mare(b $_6$)	1.56	-0.12	92.79
V $_{14}$		Conservor F_1 Bulbs (b $_7$)	1.08	-0.60	64.48
		Average yield	1.68	0.00	100.00

Preliminary results on the behaviour of new cultivars of onion in Dobrogea County

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Keywords: direct sown onions, onion chives, cultivars, production

ABSTRACT

Onions are one of the vegetable species grown in large areas of the world, in Europe and Romania. Crops dry bulb onion production is established by planting shallots by direct seeding and planting of seedlings. In recent years the range of cultivars of onion directly sown and diversified areas with this kind of culture in our country have increased, including in areas where the old economic practice, this technology is not culture. This paper presents the results obtained for onion production in Dobrogea County using new cultivars, compared with cultivars using traditional native species.

INTRODUCTION

Reduction of cultivated areas and production of onion in Romania in recent years has fostered the emergence and development of companies specialized in producing perishable vegetables with low-grade printer that has a direct sown onion in the lead. Focus areas of these companies have been favored by the appearance of having skilled technical equipment and latest generation of safe water sources for irrigation Atanasiu, 1990, Aung, 1979, Soare, 2010).

In large areas Dobrogea onions are grown in areas bordering the Danube-Black Sea canal is a reliable source of unpolluted water used for irrigation.

Choosing the optimal cultivar is essential for achieving high yields and quality. Before the expansion in production of new cultivars (F1 hybrids) are tested to identify the early, productivity, with good storage capacity and tolerant and resistant to some disease. Technical and economic results compare with those obtained through use of Stuttgart and Diamond-traditional varieties.

This paper presents comparative results of these tests for the development of onion production in Dobrogea.

MATERIAL AND METHODS

Variants studied (Table 1) includes a variety for cultivation in chives (Stuttgard), a local variety (Diamond) and Dutch cultivars Cortland, Dayton, Tamara, Leone, Banko created and recommended for direct sowing culture.

This variety Stuttgard in this range is motivated by very low prices in year's chives which cost at much as the same surface used for hybrid seed.

To be a credible witness and logical structure of the range was introduced in Diamond variety created SCDL-Buzau.

Cultural objectives were:

- Establishing productivity range with which to work;
-Establishment of vegetation period and calendar period of culture for each cultivar;
- Establishing the dynamics of density and its influence on production in the cultivars included in the experimental grid;

Experimental conditions: experience with four variants fitted rehearsal was organized in 2009, production conditions in a company that cultivates over 400 hectares on the canal bank vegetables Poarta Alba- Navodari in Poiana, bordering Constanta City.

Soil was placed on the experimental culture is a Brown mold, well-structured crust does not form under normal conditions. The place of experiment is generally uneven terrain is not properly equipped for watering the gutter. Under these conditions watering is applied on the whole surface of the culture through sprinklers.

The main elements of the ***specific technology applied*** cutura culture are:

- Pre-carrot culture;
- Work the abolition of culture pre-fall, fertilize with superphosphate 400kg/ha simple and basic plowing to 26-28cm depth;
- Spring work: harrow, basic fertilization with 200kg/ha completing complex fertilizer N: P: K content of 15:15:15 terrain modeling;
- Establishment of cultures in the second decade of March, with a slight delay in 2010, the year based on rainfall in winter and spring.

Chives was planted with MPR-12, using first quality 400kg/ha, normally given to this variant was approximately 400 000 onion chives/ ha planting depth of 4-5 cm.

In direct seeded variants dedicated scheme was used in recent years: five times the width of the canopy layer built 104 cm (150 cm gauge) and the average distance of 3 cm between seeds per row. Seeds of each „row" are distributed in a zig-zag narrow band with two rows placed at 4cm. Following this scheme and considering the spin drive roller sections precision sower, sowing is distributed around 1100000 plants/ha.

Signed the 1.5 cm depth. Emergence it was recorded after 10-12days the chive and onion 20 to 22 days after direct sowing of seed onion.

Care work:

- Loosen the soil and weed control is done by mechanical work and herbicide 4l/ha Treflan PPI with the onion chives with Stomp 330 EC 6l/ha immediately after sowing, followed by herbicide on the crop with Goal 2 CE 1l /ha and - Fusilade Super 1l/ha.
- 4-5 culture-irrigation, sprinkler watering crops applied after treatment with systemic fungicides Ridomil Gold, Aliette 80WP, Acrobat Mz against pest. Were made and other necessary treatments against diseases and common pests-gray rot and onion thrips fly.
- Mechanized harvesting was performed in two stages: dislocation and leaving in the sun for 10 days, followed by filling the bulbs in transport and sorting.

Observations and measurements were performed on the main phenophase data, dynamic density, total production and the quality of its structure.

RESULTS AND DISCUSSION

The most important results are those relating to total production. To determine the total marketable production (STAS), the quantity of the harvested bulbs were sorted, removing, after has been weighed, production under STAS, which is less than 30 mm diameter bulbs. The quantity of bulbs STAS was weighed and the number and types of rehearsal, setting the data according to the average weight of marketable bulbs. Table 2 data reveal that total production STAS varied within relatively large, between 25.86 t/ha in Stuttgart and 39.98 t/ha Leone. All cultivars consistently exceed production because of differences Stuttgart great variety of densities at harvest. These differences are caused by the initial values of this parameter, the variations are much larger seeded directly to the foundation by planting chives. Production quantity and percentage varies under STAS much differently depending on the cultivar.

Production quantity and percentage varies under STAS much differently depending on the cultivar.

CONCLUSIONS

1. Glade area corresponds to the environmentally good for cultivation of onions and shallots to the direct seeded;
2. Variety Stuttgard recorded the lowest total marketable production (25.86 t/ha) due to initial and final density of culture;

3. The average weight of bulbs to new range of Dutch origin is about 70-76g with lower limits of the variability of this character;
4. It highlights in terms of production performance cultivars Leone, Courtland and Dayton (39.98, 36.37, 36.50 t/ha);
5. It is useful to aprofundate the research for our horticultures.

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TABLES

Table 1

Experimental variants: Onion cultivars – Poiana, 2009

Variant	Cultivar	Place	Culture system
1(M1)	Stuttgart	Germany	With bulbs
2(M2)	Diamant	Romania	Direct sow
3	Cortland F1	Holand	Direct sow
4	Daytone F1	Holand	Direct sow
5	Tamara F1	Holand	Direct sow
6	Leone	Holand	Direct sow
7	Banko	Holand	Direct sow

Table 2

Total yield and quality structure: Onion cultivars – Poiana, 2009

Variant	Cultivar	No of bulbs harvested Buc/ha	No of STAS bulbs Buc/ha	Medium weight g/bulb STAS	Total yield STAS t/ha	Yield under STAS t/ha	Total yield t/ha
1(M1)	Stuttgart	376000	317000	81.6	25.86	5.24	31.10
2(M2)	Diamant	478000	322000	93.6	30.14	6.35	36.49
3	Cortland F1	550000	478000	76.1	36.37	5.42	41.79
4	Daytone F1	570000	471000	77.5	36.50	5.28	41.78
5	Tamara F1	572000	484000	67.4	32.62	3.19	35.81
6	Leone	587000	524000	76.3	39.98	2.84	42.82
7	Banko	556000	464000	75.1	34.80	4.12	38.92

Table 3

The synthesis of experimental results total yield: Onion cultivars – Poiana. 2009

Variant	Cultivar	Total yield t/ha	Dif against M1		Signif.	Dif against M2		Signif
			t/ha	%		t/ha	%	
1(M1)	Stuttgart	25.86	0	0	-	-4.28	-16.55	o
2(M2)	Diamant	30.14	+4.28	+16.55	*	0	0	-
3	Cortland F1	36.37	+10.51	+40.64	***	+6.23	+20.06	**
4	Daytone F1	36.50	+10.64	+41.14	***	+6.36	+21.10	**
5	Tamara F1	32.62	+6.76	+26.14	**	+2.48	+8.22	-
6	Leone	39.98	+14.12	+54.60	***	+9.84	+32.64	***
7	Banko	34.80	+8.94	+34.57	***	+4.66	+15.46	*

DL 5% = 3.86 t/ha

DL 1%= 5.36 t/ha

DL 0.1%= 7.82 t/ha

Behaviour of some vegetable species cultivated on different types of soil in BrŁila County

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Keywords: production, tomatoes, onion, cabbage, green pepper

ABSTRACT

Soil's physical, chemical and biological attributes influence their pretability for cultivating certain species of vegetable plants. The four vegetable species: tomatoes, onion, green pepper and cabbage have been cultivated on different types of soil: typical chernozem, saline chernozem, calcareous alluvial soil and saline alluvial soil, analyzing the level of the productions obtained for each and every species. The best results regarding the production had been obtained on typical chernozem for onion species (34.75 t/ha), tomatoes (53.66 t/ha), green pepper (33.43 t/ha). Cultivating these species on the other types of soil had as consequence a decrease in production, being recorded negative differences as against the control sample with statistic coverage. For autumn cabbage, the highest production was obtained on calcareous alluvial soil (90.44 t/ha), cultivating this species on the other types of soil (saline chernozem and saline alluvial soil) lead to obtaining very significant negative differences as against the control sample with statistic coverage. It can be drawn the conclusion that out of the types of soil analyzed, typical chernozem is very well suited for the culture of the following species: onion, tomatoes and green pepper, and for the autumn cabbage culture, the calcareous alluvial type of soil is best suited.

INTRODUCTION

Vegetables occupy a very important place in man's rational alimentation, along with other food products, like: bread, meat, milk, eggs, fish, etc.

The favorable effects of vegetable products used in man's food are determined by a rich content in water 75-95%, by a series of essential components from aliments, like: carbon hydrates (sucrose, glucose, starch), mineral salts based on calcium, iron, potassium, sodium and phosphor, organic acids (oxalic, citric, apple, lactic), aromatic oils, phytocides, vitamins (Dumitrescu and collaborators, 1998).

Tomatoes are cultivated for their fruits that have a good taste and a very high food value. Their nourishing value does not consist in the relatively modest content of carbohydrates, but especially in mineral substances and in vitamins.

White cabbage is considered a medicine-vegetable, even if the food value is reduced; the cabbage is consumed during entire year in fresh or pickled state, due to its content in mineral salts, carbon hydrates and vitamins.

The pepper is a very valuable vegetable that is cultivated for its fruits rich in nourishing substances, mineral salts and especially vitamin C, fruits that can be consumed both in fresh or processed state.

The onion is a powerful diuretic and, due to its content in phytocides, it has antiseptic properties of regulating the micro-intestinal flora, in preventing stomach disorders. It manifests also pectoral, hypoglicemiant properties; it fluidizes the blood. The onion contains a valuable microelement, silicon, in an appreciable quantity, which confers to the arteries their elasticity, consistency and duration, in the human body (Beceanu and collaborators, 2007).

The soils allocated for tomatoes' crop must be characterized by: a medium texture, drained, aerated, with high fertility, with a high content of humus 5-6%, permeable for water and air, pH = 5,5–7. It was observed that the tomato plants cultivated on a compact soil, after a period of time, they dry, as compared with the plants cultivated on an aerated soil, where they normally grow and develop (Ivanov, 1998). Simultaneous applying of water and nourishing substances through fertigation directly at the level of tomato plants roots area reduces the variability of the production due to the type of soil (Liptay, Tan, Jewett, Drury, I. van Wesenbeeck, 1997).

The cabbage valuates very well the soils most fertile, well aerated, newly broken up or fertilized with rother soils and mineral fertilizer, with medium to light heavy-weight texture. There are recommended the chernozems, alluvial soils and even reddish preluvosoils. Fertilizing the cabbage crop on the direction of rows proved to be an efficient method through improving the growth, without any connection with the natural fertility of the soil (Murakami, Okada, Ikoma, 2006)

For pepper crop, there are recommended alluvial soils with different degrees of evolution, chernozems, as well as reddish preluvosoils with loamy-clayish bearing texture.

The onion gives good production on soils that are light, fertile, aerated in depth, permeable for water, with neutral reaction (pH=6-7). There are recommended often alluvial soils, but not always these are adequate, due to the fact that in some meadows, the alluvia contain much clay, which is equally distributed on the soil's profile (Munteanu, 2001).

In order to ensure an optimum and constant rate of humidity in the period of pepper plants' growth, it was observed that it was increased the number of fruits per plant, as compared to the plants grown in conditions of water stress (Pellitero, Pardo, Simón, Suso, Cerrolaza, 1993).

The low level of hydraulic conductivity and of the infiltration's rate determines a weak water stability of structural aggregates, with effect on the soil's air-water regime and implicitly, on the onion production (Ramírez, Rodríguez, 1997).

For vegetables' crop, the best-suited soils are the ones with light texture, sandy and loamy-sandy, which have a content of clay of 10 – 30%, dust 10 – 35% and sand 40 – 45%.

MATERIALS AND METHODS

The vegetables species analyzed were: tomatoes, green pepper, onion and autumn cabbage; these species had been cultivated on four types of soil: typical chernozem, saline chernozem, calcareous alluvial soil and saline alluvial soil.

Onion and tomatoes crops set up had been performed by direct seeding into the field and the green pepper and autumn cabbage crops had been set up through seedling. The crops had been set up in well-known vegetable production units from Braila County, in the year 2009.

The sorts used were: Diamant at onion, Buzău 22 at tomatoes, Galben superior at green pepper and De Buzău at autumn cabbage.

Each vegetable species was cultivated in four repetitions on each type of soil; the surface of a repetition parcel was of 60 m² at onion, tomatoes and autumn cabbage species and of 56 m² at green pepper.

The experiences had been placed onto the field, complying with the norms of experimental technique, for each type of soil; the experimental variants had been mounted into multiple-stores blocks, without randomization.

The results regarding average production of each variant had been statistically interpreted according to the varying analysis method.

Typical chernozem is characterized through the following physical attributes: medium texture, loamy, equally distributed on the entire soil's profile, the small and medium glomerular structure well developed, which ensures an air-water regime favorable for the development of the entire root system. The chemical attributes of this type of soil are: the soil's reaction is slightly alkaline with a pH = 7.81-8.05 on the depth of the soil profile, the humus content of the depth of 0-20 cm is of 3.58%, the soil having a slight supplying with phosphorous and medium supplying with potassium.

Saline chernozem resembles from the point of view of physical and chemical attributes with typical chernozem, but with the particularity that at the depth of 40-50 cm, it is manifested a slightly alkalinization of chloride nature, salinization which has a moderate limitative influence on the production of the analyzed vegetable species.

Calcareous alluvial soil is characterized by a fine, loamy-clayish texture on the entire soil profile, the structure is small grained, slightly developed, and over the depth of 40 cm, the soil is not structured. The chemical attributes are: slightly alkaline reaction of soil with a pH = 7.82-8.13 on the depth of soil's profile, the humus content on the depth of 0-25 cm is of 2.94%, the soil having a slight supplying with phosphorous and medium supplying with potassium.

Saline alluvial soil is characterized by a contrastive texture on the depth of soil's profile, the texture being fine loamy-clayish at the surface, coarse sandy-loamy at the depth of 80-90 cm and medium, loamy at the basis of the profile, at 140-150 cm depth. The structure is small grained and grained slightly developed in the arable layer, over the depth of 40 cm the soil being not structured. The chemical attributes are: slightly alkaline reaction on the entire profile of the soil, with values of pH = 7.78-8.27, the humus content on the depth of 0-30 cm is of 2.74%, the soil having a slight supplying with phosphorous and medium supplying with potassium.

RESULTS AND DISCUSSION

The results regarding the average productions obtained at the vegetable species analyzed, for each and every variant, are presented in table 1 and 2.

The onion recorded the highest production level on the typical chernozem soil, 34,75 t/ha. Cultivating this species on other types of soil had as consequence decreasing the level of production, being recorded negative differences as against the control sample with statistic coverage. On saline chernozem soil, the production decreases as against the control sample with -2,74 t/ha, a significantly distinct negative difference. The negative differences of -15,75 t/ha and -17,38 t/ha as against the control sample, recorded at cultivating this species on calcareous alluvial soil and saline alluvial soil are very significant.

At tomatoes, the highest production level was achieved on typical chernozem soil, 53,66 t/ha. Cultivating the tomatoes on the other types of soil lead to decreasing the level of production, being recorded negative differences as against the control sample with statistic coverage. On the saline chernozem soil type, the production decreases as against the control sample with –3,57 t/ha, a significant negative difference.

The negative differences of -23,02 t/ha and -27,33 t/ha as against control sample, recorded at cultivating the tomatoes on calcareous alluvial soil and saline alluvial soil are very significant.

For green pepper crop, the highest production was recorded on typical chernozem soil, 33,43 t/ha. On the saline chernozem type of soil, the production decreases as against the control sample with – 2,48 t/ha, a negative significant difference. The negative differences of -9,31 t/ha and -12,45 t/ha as against the control sample, recorded at cultivating this species on calcareous alluvial soil and saline alluvial soil are very significant.

At autumn cabbage crop, the highest production level was achieved on calcareous alluvial soil 90,44 t/ha, being recorded a distinctly significant positive difference as against the control sample. On the saline chernozem soil type, the production decreases as against the control sample with –5,26 t/ha, a very significant negative difference. The negative difference of -10,99 t/ha as against the control sample, recorded at cultivating on saline alluvial soil, is very significant.

It was calculated Pearson correlation coefficient between the content in humus of these four types of soil and the analyzed vegetable species production obtained (onion, tomatoes, green pepper and onion). This coefficient has the value of 0.991 for onion, 0.997 for tomatoes, 0.999 for green pepper, showing the existence of a positive linear correlation between the two variables and the value of 0.315 for cabbage, showing the fact that there is no correlation between the two variables. The correlations between those two variables are represented graphically in figure1.

CONCLUSIONS

Out of the types of soil analyzed, it results that the typical chernozem, due to its physical and chemical attributes, it is suited for the culture of all vegetable species analyzed, with mention that the calcareous alluvial soil is best suited for autumn cabbage crop.

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TABLES AND FIGURE

Table 1

The influence of the type of soil on the production at onion and tomatoes

Type of soil	Onion				Tomatoes			
	t/ha	%	Difference t/ha	Significance	t/ha	%	Difference t/ha	Significance
Typical chernozem (mt)	34.75	100	0.00	-	53.66	100	0.00	-
Saline chernozem	32.28	92.89	-2.47	oo	50.09	93.34	-3.57	o
Calcareous alluvial soil	19.00	54.67	-15.75	ooo	30.64	57.10	-23.02	ooo
Saline alluvial soil	17.37	49.98	-17.38	ooo	26.33	49.06	27.33	ooo

DL 5% = 1.28 t/ha | DL 5% = 3.14 t/ha
DL 1% = 1.84 t/ha | DL 1% = 4.52 t/ha
DL 0.1% = 2.70 t/ha | DL 0.1% = 6.65 t/ha

Table 2

The influence of the type of soil on the production at green pepper and autumn cabbage

Tipul de sol	Green pepper				Autumn cabbage			
	t/ha	%	Difference t/ha	Significance	t/ha	%	Difference t/ha	Significance
Typical chernozem (mt)	33.43	100	0.00	-	87.17	100	0.00	-
Saline chernozem	30.95	92.58	-2.48	o	81.19	93.96	-5.26	ooo
Calcareous alluvial soil	24.12	72.15	-9.31	ooo	90.44	103.75	+3.27	**
Saline alluvial soil	20.98	62.75	-12.45	ooo	76.18	87.39	-10.99	ooo

DL 5% = 2.43 t/ha
DL 1% = 3.50 t/ha
DL 0.1% = 5.15 t/ha

DL 5% = 1.32 t/ha
DL 1% = 2.56 t/ha
DL 0.1% = 3.45 t/ha

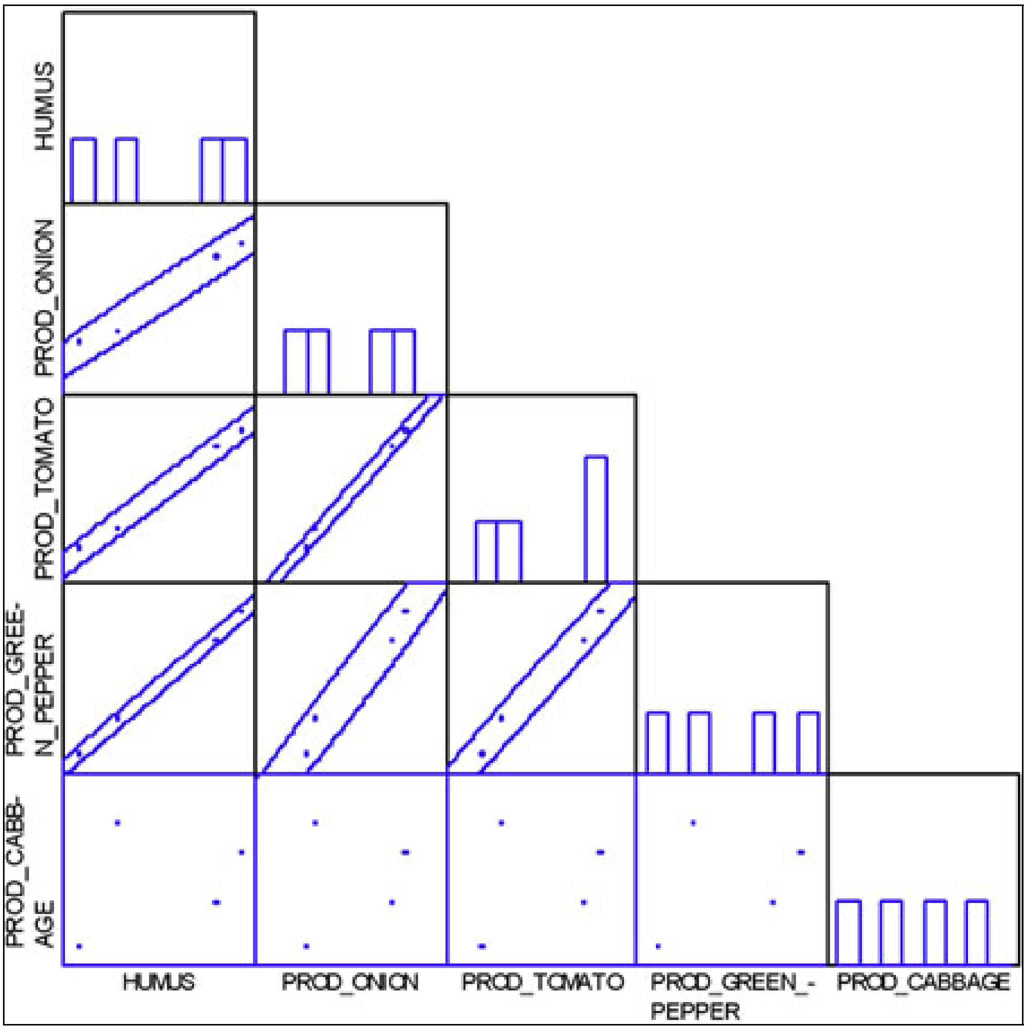

Fig.1. The correlation of humus content at the types of soil analyzed and the level of the productions obtained at onion, tomatoes, green pepper and cabbage

The quality of fruits at some species of solano-fruitful vegetables (tomatoes and pepper) cultivated in BrŁila County

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Keywords: shape index, acidity, C vitamin, pulp, pericarp

ABSTRACT

In order to establish the quality of fruits, there had been analyzed six cultivars of bell pepper (Amis, Belladonna, Yellow yellow, Hungarian, Galben superior and Red Kinght F1) and four sorts of tomatoes (Rio Grande, Kecskemeti, Coral and Benfica) cultivated into the field.

The quality of pepper and tomatoes fruits is given by some physical characteristics, by the chemical composition and the technological characteristics.

Out of the pepper cultivars, from the point of view of the average weight of the fruits, it was remarked the hybrid of red bell pepper, Red Kinght F1 (169.56 g), and at tomatoes, it was remarked Benfica sort (164.53 g). In what concerns the chemical composition, high values of the content in dry substance were obtained at red bell pepper hybrid, Red Kinght F1 (9.90%) and at the cultivar with yellow fruits, Yellow yellow (6.57%), and out of the tomatoes sorts, the highest values were obtained at Rio Grande (4.88%). The content of C vitamin was higher at Galben superior sort (234.08 mg/100 g s.p) and at Coral sort 206.97 mg/100 g s.p., and the titrable acidity had the lowest value of 1.25 at Galben superior sort and the highest at Belladonna F1 (1.50), and out of the tomatoes sorts, the highest acidity was at Kecskemeti (3.60).

Pulp's ratio in the morphological set up of the tomatoes fruits was the highest at the two sorts of Coral (81.85 %) and Benfica (79.99 %), this recommending them for the consumption both in fresh state and for industrialization.

The pulp had values of over 80 % at all cultivars analysed, being remarked Belladonna F1 (86.34 %), Red Kinght F1 (86.30 %) and Galben superior (87.58 %) cultivars, as against the cultivars of Hungarian (81.11 %), Yellow yellow (82.11%) and Amis (82.86 %).

INTRODUCTION

The solano-fruitful vegetables (tomatoes and pepper) are vegetables valuable both from the point of view of nutrition and from the point of view of their preponderance in the structure of vegetables crops.

Bell pepper, a very valuable vegetable, is cultivated for its fruits rich in nutritional substances (soluble carbohydrates 3.3-8.0%; protids 0.7-1.9%; lipids 0.2-0.6%), mineral salts (0.5-0.7%) and especially C vitamin (127-165 mg/100 g), fruits that can be consumed both in fresh state and processed under different forms (products canned in vinegar, thermo-sterilized, frozen or dehydrated).

Tomatoes are cultivated in almost all countries of the world, being the vegetables most consumed from the world. The tomatoes' consumption is varied, thus it is consumed in fresh state, under the form of cans and they enter into frozen vegetables mixes (Beceanu, 2006).

The nutritive value of the fruits does not consist in the relatively modest content of carbohydrates, but especially in mineral substances and vitamins. Out of the vitamins comprised by tomatoes, the most important are: A vitamin, B complex (B1, B2, B5, B6), C vitamin, E vitamin and K vitamin (Indrea, 2007)

On the soils where the potassium is not retained, tomatoes fruits are not uniformously colored, having yellow color and bleach spots, this leading to depreciating their quality (Hartz, Miyao, Mullen, Cahn, 1999).

The quality of pepper and tomatoes fruits, regarded from the perspective of sustainable agriculture, is a permanent concern of ameliorators, concern that leads to creating cultivars superior not only from quantitative, but also from qualitative point of view.

The quality of pepper and tomatoes fruits is determined by physical properties (specific weight, average weight, shape – expressed through the shape index), chemical composition (total dry substance, humidity, soluble dry substance, titrable acidity, ascorbic acid) and technological characteristics (the proportion of the eatable part, the thickness of pericarp at pepper, the ratio between pulp, membrane and seeds at tomatoes).

The value of fruits acidity is influenced also by the plants' water supply; otherwise the lack of water determines an increase in fruits' acidity (Pellitero, 1993).

MATERIALS AND METHODS

The determinations had been made in the year 2009, on tomatoes and bell pepper fruits that reached the consumption maturity. At tomatoes, the following sorts had been used as biological material: Rio Grande, Coral, Kecskemeti and Benfica, and for the bell pepper, the following cultivars had been used: Galben superior, Yellow yellow, Belladona F1, Hungarian, Amis, Red Kinght F1.

Tomatoes fruits had been obtained from summer – autumn crops, set up by seedling into the field, on a typical chernozem soil, the planting being performed in the last decade of May, using 45 days old seedling, on an un-worked field, the distance between rows was 70 cm, and between plants on a row: 20 cm, being ensured a density at planting of about 50.000 plants/ha.

Bell pepper fruits had been obtained through crops set up by seedling into the field, on a typical chernozem soil, the planting being performed in the second decade of May, using 60 days old seedling, on an un-worked field, the distance between rows was 70 cm, and between plants on a row: 20 cm, ensuring a density at planting of about 71.400 plants/ha.

C Vitamin (ascorbic acid) was determined through titrimetic method with 2,6 dichlorophenolindophenol. The extraction of ascorbic acid from the analysis sample was made with a solution of oxalic acid and the titration with 2,6 dichlorophenolindophenol, up to obtaining a coloration of light pink for colorless extracts.

The determination of titrable acidity was performed through the reaction of neutralization with alkaline solutions (hydroxide sodium n/10) up to the equivalence point.

The humidity (the water content) and the total dry substance were determined through the method of entraining the water vapors through distillation, using the Dean Stark distiller. The principle of the method is based on the fact that an organic solvent, following to heating, entrains the water existing in the vegetable tissues. The organic solvent is inmiscible with water (it does not mix), having the relative density smaller than 1 and the boiling point is higher than 100ºC. Distillated in mixture, the solvent (toluene) and the water behaves differently than in the case they would be distilled in pure state. The water and the solvent form an azeotrope mixture, the component fluids passing together into vapors state, condensing together.

The soluble dry substance, expressed in mass percentages, was determined refractometrically and assimilated to a sacharose solution that has the same refraction index as the extract obtained (Beceanu, 2003).

RESULTS AND DISCUSSION

The results of determining the physical characteristics of tomatoes and pepper fruits are presented in table 1.

The average weight of fruits was the highest at Benfica and Coral sorts, which shows that at these sorts, the fruits are bigger, and at Kecskemeti sort, the fruits weight has the smallest value of 74.61 g.

The sub-unitary values of the shape index, but close to unit at Benfica and Coral sorts, show that the fruits have an almost spherical shape, and the super-unitary values at Rio Grande and Kecskemeti sorts show the fruits' elongated shape.

The specific weight varies between 0.75 g/cm³ (Kecskemeti) and 1.03 g/cm³ at Rio Grande sort and has close values at Benfica (0.92 g/cm³) and Coral (0.95 g/cm³) sorts, the value of this characteristic being in relation of reversed proportionality with perishability.

At the pepper cultivars analyzed, the weight of fruits was over 100 g, except for Amis sort, for which the weight of fruits was bellow 100 g. The very big fruits of over 150 g were at Red Kinght F1 hybrid.

The results of the determinations regarding the chemical composition of the tomatoes and pepper fruits are presented in table 2.

Following to the determinations performed, it is observed that the total dry substance had the highest values at Kecskemeti (4.32%) and Rio Grande (4.30%), which are sorts with elongated fruits, the content in dry soluble substance being in direct correlation with the content in total dry substance.

The content in ascorbic acid was of over 200 mg/100 g fresh product at Coral and Benfica sorts, which are sorts with fruits of almost spherical shape and between 110.88-144.14 mg/100g fresh product at sorts with elongated fruits, Rio Grande, respectively Kecskemeti.

At pepper, the content in dry substance has values between 6.21 % (Belladonna F1 and Hungarian) and 6.57% (Yellow yellow) and of 9.90% at Red Kinght F1. Regarding the soluble dry substance, the results show that it varies in direct proportionality with the content in total dry substance, thus varying between 5.87-6.15%.

Titrable acidity has varied between normal limits, having values between 1.25 (Galben superior) and 1.40 (Amis). The content in ascorbic acid (C vitamin) at the cultivars analyzed has varied within quite large limits from one cultivar to another; with a content of ascorbic acid of over 200mg/100 g s.p.; there had been remarked Yellow yellow (232.84 mg/100 g s.p.) and Galben superior (234.08 mg/100g s.p.) cultivars.

It was computed the Pearson correlation coefficient for the total acidity and the content of ascorbic acid, its value being of -0.556, which shows that there is no correlation between the two variables. The graphical representation of the correlation between the two variables is presented in figure 2.

The results regarding determining the technological characteristics for pepper are presented in table 3, and for tomatoes in table 4.

Coral sort had the highest pup percentage (81.85%), and Kecskemeti sort had the smallest pulp percentage (75.94 %). The ratio of seeds into the fruits had the highest value at Rio Grande sort (11.41%), and the smallest at Coral sort (6.34%).

The pulp had proportions of over 80% at all pepper cultivars analyzed, being remarked Belladonna F1 (86.34%), Red Kinght F1 (86.30%) and Galben superior (87.58%) cultivars, as against Hungarian (81.11%), Yellow yellow (82.11%) and Amis (82.86 %) cultivars.

It was computed the Pearson correlation coefficient between three variables: average weight, total dry substance and the percentage of pulp at the tomatoes and pepper cultivars analyzed, being obtained the following values: 0.236 at the correlation between the average weight of fruits and the total dry substance, 0.314 at the correlation between the average weight and the percentage of pulp and 0.658 at the correlation between the total dry substance and pulp, values of Pearson correlation coefficient that shows that there is no correlation between the three variables. The graphic representation of the correlation between the three variables is presented in figure 1.

CONCLUSIONS

At the sorts with elongated fruits, Rio Grande and Kesckemeti, the content in total dry substance is higher than at Coral and Benfica sorts (sorts with almost spherical fruits), fact that recommends them for industrialization.

Out of the cultivars analyzed, it was remarked Red Kinght F1 from the point of view of fruits' weight, 169.56 g and from the point of view of the content in total dry substance, 9.90 %, which shows the superior quality of fruits and their pretability to their turning to profit also through industrialization.

Galben superior sort had the lowest acidity value (1.25) and the highest percentage of eatable part (87.58 %) being the most suited for industrialization.

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TABLES AND FIGURES

Table 1

Physical characteristics of the pepper and tomatoes cultivars analyzed

No. crt.	Cultivar	Average weight (g)	Average specific weight (g/cm³)	Shape index (î/d)
1	Amis	73.97	0.45	1.98
2	Belladonna F1	110.63	0.47	1.10
3	Yellow yellow	101.27	0.52	1.26
4	Hungarian	128.48	0.50	0.96
5	Galben superior	123.76	0.55	1.12
6	Red Kinght F1	169.56	0.46	1.10
7	Rio Grande	110.3	1.03	1.35
8	Kecskemeti	74.61	0.75	1.24
9	Coral	154.75	0.95	097
10	Benfica	164.53	0.92	0.92

Table 2

Chemical composition of the pepper cultivars analyzed

No. crt.	Cultivar	Water %	Total d.s. %	Soluble d.s.%	Mineral Subst. %	Titrable Acidity ml NaOH n/100 g	Ascorbic Acid mg/100g s.p.
1	Amis	93.58	6.42	6.15	0.43	1.40	184.60
2	Belladonna F1	93.79	6.21	5.50	0.44	1.50	177.70
3	Yellow yellow	93.43	6.57	5.20	0.46	1.31	232.84
4	Hungarian	93.79	6.21	5.87	0.42	1.37	188.49
5	Galben superior	93.70	6.30	5.90	0.41	1.25	234.08
6	Red Kinght F1	90.10	9.90	8.85	0.52	2.80	162.28
7	Rio Grande	95.12	4.88	4.30	0.36	3.50	110.88
8	Kecskemeti	95.49	4.51	4.32	0.35	3.60	144.14
9	Coral	95.41	4.39	4.21	0.29	3.37	206.97
10	Benfica	95.33	4.47	4.26	0.32	3.44	203.51

Table 3

Technological characteristics of the pepper cultivars analyzed

No. crt.	Cultivar	Pulp (%)	Uneatable part (%)	Pericarp thickness (mm)
1	Amis	82.86	17.14	4.50
2	Belladonna F1	86.34	13.66	5.50
3	Yellow yellow	82.11	17.89	5.00
4	Hungarian	81.11	18.89	5.00
5	Galben superior	87.58	12.42	5.50
6	Red Kinght F1	86.30	13.70	5.50

Table 4

Technological characteristics of the tomatoes sorts analyzed

No. crt.	Cultivar	Pulp (%)	Membrane (%)	Seeds %
1	Rio Grande	77.86	10.73	11.41
2	Keskemet	75.94	15.24	8.82
3	Coral	81.85	11.81	6.34
4	Benfica	79.99	11.68	8.33

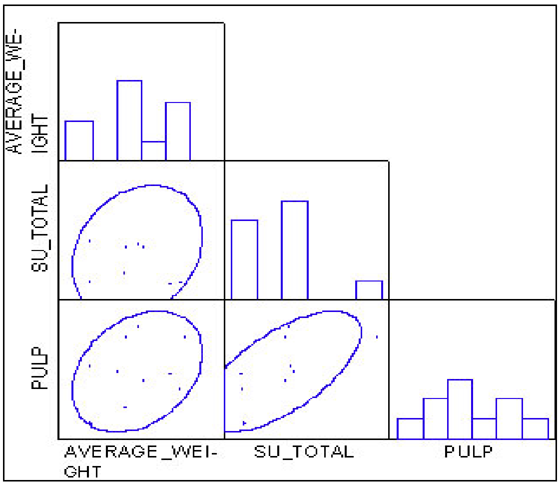

Fig.1. The graphical representation of the correlation between the average weight of the fruits, total dry substance and the percentage of pulp at the cultivars analyzed

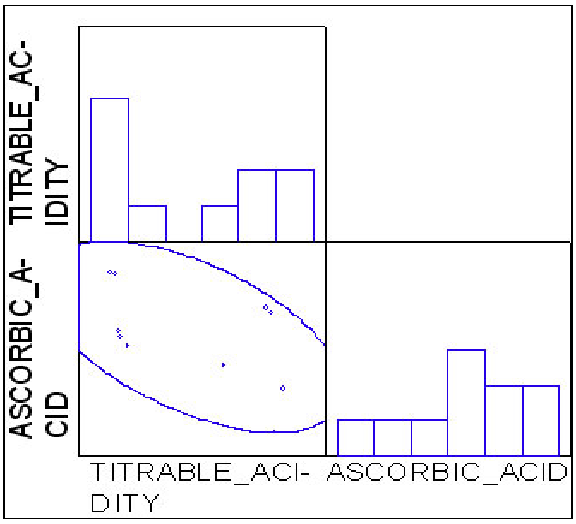

Fig.2 The graphical representation of the correlation between the titrable acidity and the content of ascorbic acid at the pepper and tomatoes cultivars analyzed

The creation of dill variety resistant to *Fusarium oxysporum*

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Keywords: resistance gene, interspecific cross

ABSTRACT

To clarify the contradictions between specialists on the isolation of seed varieties and different species was taken in study the cross compatibility between varieties and different species. Among these studies are included and the cross compatibility between (dill x fennel), (dill x caraway) because the experimental fields from ICDLF Vidra maintain the dill variety Comun de Vidra, and the fennel, the caraway and other umbelliferous herbs were in the collection of rare plants.

INTRODUCTION

During the research on the pollination compatibility between dill as mother plants (♀) and as father plants (♂): fennel (*Foeniculum vulgare*), coriander (*Coriandrum sativum*) or caraway (*Carum carvi*), has raised the idea of creating a dill cultivar (interspecific).

MATERIAL AND METHODS

It has been used as biological material: Comun de Vidra' dill variety as mother-plants and as father (♂) populations of fennel and caraway.

From the literature (Floria and Radu, 2001), is aware the diploid form of these species: *Anethum graveolens*-2n=22 chromosomes, *Coriandrum sativum*-2n=22 chromosomes, *Carum carvi*-2n=20 chromosomes, *Foeniculum vulgare*-2n=22 chromosomes.

The pollination method was used: through castration of mother plants from different stages: bud, first day of flowering, the second day after flowering and the third day after flowering.

The pollination was performed immediately after castration. It has worked only on inflorescences of the main umbel. The harvested stamens from father-plants were made one day before the pollination in sterile containers. These were kept from harvest to pollination, at room temperature, in dry conditions.

The experience has included three in three subdivided variant (table 1).

RESULTS AND DISCUSSION

The V_1 variant (*Anethum greveolens* x *Foeniculum vulgare*) showed a good compatibility and a very good pollination (table 2). The V_2 and V_3 variants showed a total incompatibility in all three phases of dill flower development since pollination.

These studies were conducted from 1987 to 1990.

Seeds were harvested on inflorescences. Was studied the descending plants phenotype, keeping for research the descendents after certain features with the fallowing important features: uniformity, resistance to pathogens, strength, etc.

These studies were performed compared with the "Comun de Vidra" dill variety. Incidentally, during this period was reported fusarium attack. In 1990 the descendents of the variant (*Anethum greveolens* x *Foeniculum vulgare*) at the third generation showed full resistance (100%) to *Fusarium* attack than the dill plants of the "Comun de Vidra" variety, which showed in the conservative selection a very low tolerance against fusarium leading to the elimination of 58% of seed plants. The dill seed crop was totally destroyed from production field.

For this reason, the seed of V_1 descendent variant was the basis in creating a resistant variety to *Fusarium*. Since 1990 was introduced in the improved selection the biological material of the V_1, after the following scheme:

I-st Year – choice field of elite plants (CA);

II-nd Year- study field of descendent elite plants (CSD)

and - the choice of elite plants from the most valuable descendents (AC).

From the repeated improving selection has been obtained a valuable line through fallowing features: plant uniformity, productivity, fusarium resistance, strength, intense flavor.

This line has been submitted for testing at ISTIS and in 2002, it was approved as a variety under the name "Stefan".

ŞTEFAN Description of variety (Dill):
The main features:
Vegetation period - 51 days
The leaves are green with yellow tinge, the anthocianic tint is present in seedlings stage (higher in low temperature conditions), at physiological maturity a small percentage of plants (<1%) has shades of purple.
- Average production for fresh consumption 10.8 t/ha (7.5 -12.8 t/ha)
Average seed-production
- The plant position is semiretrorse.
On the whole herb the rimy layer is middle
Good resistance to fusarium attack and high tolerance at pwdery mildew disease
Optimum density 70 000 pl/ha
Economic efficiency: 400kg/ha
- Quality production - total production to STAS classification is 92.0% (the plant length between 12-15 cm)
Zonation - can grow in all areas favorable for this species (field and protected areas)
Use – fresh consumption or used dried as a spice in cuisine and in pharmaceutical industry.

CONCLUSIONS

Stefan dill variety was created by repeated crossing between "Comun de Vidra" dill with a local population of fennel and selection for improvement in lines. It is characterized by productivity, resistance to *Fusarium* and powdery mildew disease, all intensely fragrant herbs.

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TABLES AND FIGURES

Table 1

Experimental variants

Variant	Hybryd combination	Development phase of the dill flower at pollination
V_1.	*Anethum greveolens* x *Foeniculum vulgare*	a. Bud
		b. First day of flowering
		c. Second day after flowering
V_2.	*Anethum greveolens* x *Coriandrum sativum*	a. Bud
		b. First day of flowering
		c. Second day after flowering
V_3.	*Anethum greveolens* x *Carum carvi*	a. Bud
		b. First day of flowering
		c. Second day after flowering

Table 2

The receptivity of the stigma dill to the pollen of the fennel

Variant	Hybrid combination	The development phase of the pollinated dill flower	The percentage of binding and development of the fruit (%)
V_1.	*Anethum greveolens* x *Foeniculum vulgare*	a. Bud	92
		b. First day after flowering	85
		c. The day after flowering	85
V_2.	*Anethum greveolens* x *Coriandrum sativum*	a. Bud	0
		b. First day after flowering	0
		c. The day after flowering	0
V_3.	*Anethum greveolens* x *Carum carvi*	a. Bud	0
		b. First day after flowering	0
		c. The day after flowering	0

Table 3

Some quantitative features of ŞTEFAN dill variety

Nr.crt	h	Nr.umb/pl.	Nr.us/up	Nr.crt	h	Nr.umb/pl.	Nr.us/up
1	83	3	35	**39**	92	4	48
2	101	4	57	**40**	100	4	52
3	98	3	57	**41**	100	4	55
4	82	3	32	**42**	100	4	55
5	98	4	32	**43**	100	3	42
6	95	4	58	**44**	102	3	33
7	102	4	29	**45**	102	3	35
8	105	4	61	**46**	102	4	60
9	99	4	47	**47**	105	4	67
10	93	4	55	**48**	105	4	43
11	100	4	56	**49**	105	4	30
12	105	3	43	**50**	107	4	48
13	71	3	40	**51**	110	3	35
14	98	4	56	**52**	110	5	62
15	105	4	65	**53**	87	3	49
16	92	3	62	**54**	103	4	59
17	92	4	44	**55**	71	3	47
18	102	3	47	**56**	80	3	39
19	99	4	41	**57**	80	4	45
20	102	3	40	**58**	88	4	46
21	97	5	63	**59**	90	3	63
22	90	4	65	**60**	100	4	67
23	105	4	43	**61**	92	4	67
24	92	4	37	**62**	92	4	52
25	83	3	50	**63**	87	3	46
26	83	3	52	**64**	100	3	55
27	83	3	53	**65**	82	5	55
28	85	4	67	**66**	110	4	68
29	87	2	40	**67**	103	4	47
30	88	4	43	**68**	110	3	46
31	92	3	51	**69**	112	5	62
32	92	5	60	**70**	92	4	43
33	92	5	42	**71**	85	2	41
34	94	3	56	**72**	72	3	47
35	96	4	56	**73**	100	4	36
36	98	5	66	**74**	84	4	41
37	98	4	58	**75**	94	4	59
38	98	4	53	**76**	100	4	81

h – The height of seed plant nr.umb/pl – umbells no./plant

nr. us/up – no. of secondary umbells/main umbels

Fig. 1 – ŞTEFAN dill variety– prebase field (Pb)

Fig. 2 – ŞTEFAN dill variety – field DE(Pb)

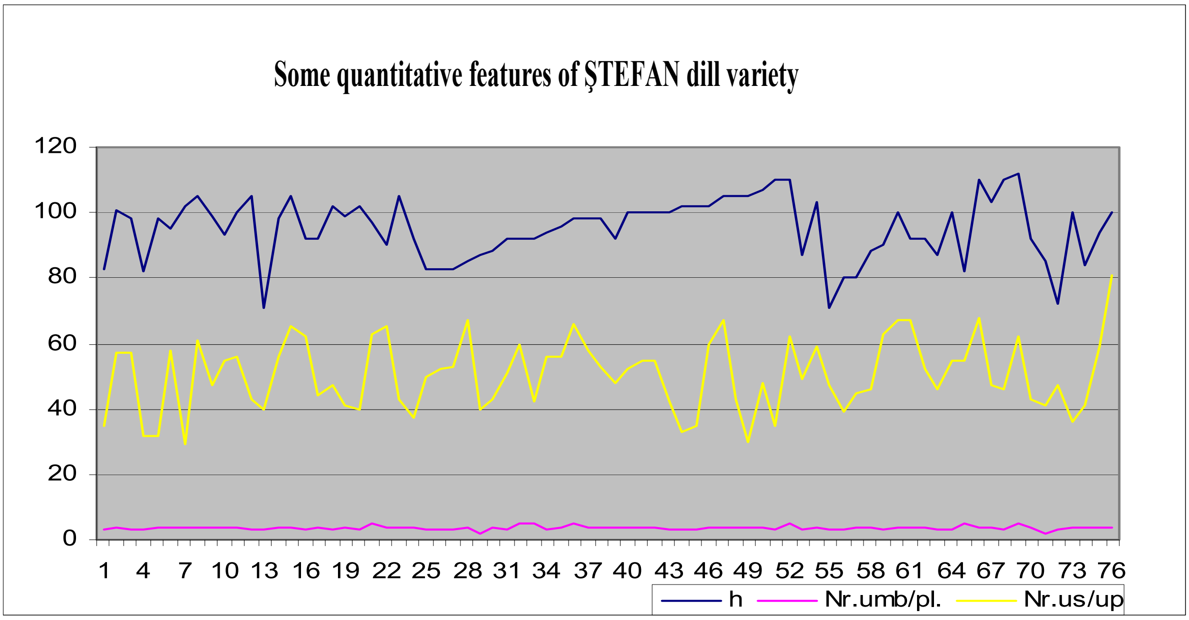

Fig. 3 – Some quantitative features of ŞTEFAN dill variety

Darsirius – new tomato variety for industrialization, obtained at SCDL Buzău

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Keywords: tomatoes, breeeding, segregation, genotype,

ABSTRACT

Disposing of a valuable germplasma base (over 200 genotypes), the breeders from S.C.D.L. Buzău tried to obtain tomato varieties in order to correspond to different usages (fresh consume, ketchup, juice, paste etc.). The researches made in order to obtain this variety started in 1996 and finished in 2006 with the homologation of a new tomato hybrid Siriana F_1 which has an undetermined growing used for fresh consume. Also, in 2006 there was homologated another tomato variety, called Kristin, with determined growing used for industrialization. In 2010, there was homologated Darsirius tomato variety with determined growing used for industrialization.

INTRODUCTION

Tomato breeding is a continuous process, where the researcher explores the genetic variability and selects the genotypes that own combinations of characters and characteristics in order to correspond to the nowadays necessities of the consumers.

Because of his multiple uses, the tomato occupies the 1st place in vegetable crops. The modern breeding directions for this species were oriented in order to obtain varieties and hybrids strict specialized according to the usage standards. Since Romania acceded to U.E., the quality standards to this species have increased. If, in the past, the homologations were been made with a generic applicability for fresh consume and industrialization, nowadays the claims have increased. Thus, nowadays homologations have a precise destination: tomatoes for fresh consume, tomatoes for industrialization (paste, juice, ketchup etc.).

MATERIALS AND METHODS

In order to correspond to the nowadays requirements both of the cultivators and consumers, starting 1996 the researches at the Breeding Laboratory from S.C.D.L. Buzău had intensified in order to obtain varieties and hybrids strict specialized.

The researches based on a great germplasma collection (over 200 genotypes) to which there were added the main characteristics and their genetic stability. The initial breeding material which composed the germplasma base derives from local populations, lines, varieties, hybrids from different geographic areas.

Among the genotypes from the collection field, there were confined and promoted in the work field 62 lines with determined growing (Sp). The promoting of the lines in the work field was made after the careful evaluation of the main characteristics, considering the genetic availability in the breeding process. The main objectives followed in the tomato breeding process for industrialization were the following:

– well defined genetic constitution (genetic stability);
– intensive fruits maturation that allows mechanized harvest;
– high content of dry substance;
– presence of the jointless gene which allows harvest without stalk;
– low acidity;
– appropriate pigmentation (pulp color);
– small number of seeds in fruit content.

The breeding method used was simple hybridizing between 2 advanced homozygote lines. After the hybridizing, in F_2 took place the segregation phenomenon; here appeared 3 distinct biotypes and a great number of intermediary phenotypes which were eliminated. The distinct lines obtained after the segregation were studied with the following names: L_{55}, L_{V6} and L_{31}. To these lines, there was applied the conservative selection scheme which is typical for this species. After applying the conservative selection scheme, L_{55} showed stability and genetic superiority comparative with the other lines studied, congregating the main characteristics followed in the amelioration process.

There was used the culture technology specific to the field tomato (Ciofu, 2003. During many years, there was studied the possibility of establishing a culture by seedling and direct seeding in field (table 1).

RESULTS AND DISCUSSION

After the intensive amelioration works made at S.C.D.L. Buzău, there was obtained Darsirius tomato variety used for industrialization. Among the main characteristics of this variety, we mention:

- Semi-early variety (100 – 120 days) used for industrialization;
- The plant has a determined growth (Sp) - plants height 50 – 60cm with 4 – 6 side shoots vigorous;
- The weight of the fruit surpass 80g;
- Immature fruits have uniform green color without cover, and presents the U.G. gene; at maturity the fruits are firm have dark red color with sheen (photo 1),
- The fruits have a small catch area without a ligneous tap inside the fruit (photo 2),
- The fruits do not strip off with a stalk and presents the jointless gene;
- The fruit is resistant to splitting up and solar burn;
- Fruits maturity is uniform, over 80% at the first harvest lend to mechanized harvest (photo 3);
- The pulp has a dark red color and has a great content of dry substance (over 6%);
- the fruit contains a small number of seeds, less than 80 seeds/fruit (photo 4) and a low titrable acidity (less than 0,370%) being recommended for industrialization;
- mean yield is over 2,5kg/plant (table 2);
- the keeping period surpasses 10 days (photo 5);
- The variety presents resistance or tolerance to the tomato specific diseases and nematode, because of these qualities it can be cultivated also in ecological system.
- Applying modern technologies of fertirigation and foliar fertilization leads to the significant yield increase for this variety.

CONCLUSIONS

After the amelioration works made at S.C.D.L. Buzău it can strongly affirm that the proposed objectives were accomplished by the homologation of the tomato variety with determined growing (Sp) – **Darsirius** and also by obtaining a great number of valuable lines (over 30) which are in an advanced breeding stage.

During the breeding works, the experimental field had been visited by many cultivators which followed the evolution of the variety and received seed at a bidding price. Nowadays, the cultivators manifest a great interest to this new homologated variety.

The line L_{44} was entered and proposed for homologation in 2009, but nowadays, it is in the second testing year at I.S.T.I.S.

Some of the lines obtained will be proposed for homologation, and some others are used like valuable genitors in order to obtain F_1 hybrids.

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TABLES AND PHOTOS

Table 1

Phonological data for Darsirius variety 2010

Type of culture	seeding	emergence	planting	flower	Consume maturity	no. of days
Seedling	24 III	10 IV	05 V	04 VI	02 VIII	105 – 115
Direct seeding	15 IV	02 V	–	21 VI	25 VIII	115 - 125

Table 2

Testing the yield potential of tomatoes for industrialization in the main national centers for vegetables (2009)

No.	Variety	Locality *						Media		STAS from total**	Early yield from total***
		Tc.	Ov.	Cl.	Cf.	Tu.	Tg.	t/ha	%	%	%
1	Rio Grande M_t	52,2	22,9	44,2	68,3	9,8	37,5	39,2	100	77,2	5,4
2	Darsirius	41,8	29,2	50,3	82,0	20,4	40,3	44,0	112,2	86,9	21,2

* Locality: Tc. = Tecuci; Ov. = Ovidiu; Cl. = Călăraşi; Cf. = Calafat; Tu. = Turda; Tg = Târgovişte;
DL 5% = 8,8t/ha 22,5%
DL 1% = 13,8t/ha 35,3%
DL 0,1%= 23,5 t/ha 60%

** Fruits with weight over 33g;
*** Yield obtained until 31 July – south area
10 August – other areas

Photo 1. To the maturity, the fruits have a dark red color with shine and they are firm.

Photo 2. The pulp of the fruit has a dark red color with a small catch area (0,8mm)

Photo 3. The fruits are not harvested with stalk (presents the jointless gene) and have a intensive maturation (over 80% at first crop)

Photo 4. The fruits presents 3 locular cavity and a reduced number of seeds (less than 80 seeds/fruit)

Photo 5. Mean yield surpasses 2,5kg/plant and the fruit is resistant to spliting

Frankliniella occidentalis Pergande species monitorization from tomatoes crop of protected spaces with the help of blue sticky traps

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Keywords: controlling, physico-mechanical methods, californian thrips

ABSTRACT

A modality more used in unpolluted controlling pests, was the usage of blue adhesive traps and it was a physico-mechanical controlling of thysanoptera pests, especially of californian thrips (*Frankliniella occidentalis* Pergande) from protected spaces of tomatoes crops from Agricultural Society Agro-Dor., Dorobanti locality, Arad district. Identification of thrips species directly on the trap is very difficult. Some species can be identified in this way including californian thrips, *Frankliniella occidentalis* Pergande. Blue sticky traps attract a large number of adults and can be used directly in controlling or monitoring this pest population. After the investigations made it was observed that the biggest number of species was collected on trap no. 3 at the second reading, and the smallest species registered on trap no. 1 at the third reading. In tomatoes crop, on blue traps registered in average 36.25 species/cm^2 at the first reading, 73.25 species/cm^2 at the second reading, and the third reading collected in average 21.18 species/cm^2. After realizing observations the conclusion concerning *Frankliniella occidentalis* Pergande species number collected on blue adhesive traps oscillated between 27 436 species/trap and 49 196 species/trap.

INTRODUCTION

A method used in thysanoptera pest controlling and monitorization from tomatoes crop of protected spaces was the physico-mechanical method of controlling using blue adhesive traps.

To find in time the thrips it were used sticky plates of light-blue colour, possible the most attractive and specific for those insects.

Among species which could identify in that way was the californian thrips, *Frankliniella occidentalis* Pergande.

Investigations about that domain abroad were made by: Andus and Trdan, (2005) in Serbia; Vernon and Gillespie, (1995) in Canada; Pearsall and Myers, (2001) in Canada; Lewis, (1959) in England; Kirk, (1984a, 1984b) in Australia; Brodsgaard, (1989) in Danmark; Gillespie and Vernon, (1990); Schmidt and Frey, (1995); Raymond, (2009) in S.U.A.; Teulon and Penman, (1992) in New Zealand; Gencsoylu, (2007) in Turkey; Demirel and Yildrum, (2005, 2008) in Turkey; Subramanian, (2009) in Kenya; Dabaj, (2010) in Libya, etc.

In our country investigations about that domain abroad were made by: Maier and colab., (1961); Raicu and Mihailescu, (1982); Baicu and Săvescu, (1986); Roşca and colab., (2001), etc.

MATERIAL AND METHODES

Blue traps were placed in tomatoes crop of cucumbers (fig. 1.) at a distance of 25 cm face to the plant, 75 cm distance among plants; it were placed two traps at 100 ml.

To monitorize the pests were used the following materials: adhesive traps of blue and yellow colour type Csalomon (fig. 2.), 10 db SZINb, MTA, Budapest etc.

The traps replaced with the others new at every 7 days.

After replacing traps those were transported in the labor to number and select them and also to interpret the data. Insect's selection realized through each trap division in a rectangle with four quadrants.

Every trap was a rectangle with a length 19 cm and a width 16 cm, the surface of that kind of rectangle was 304 cm^2. In every quadrant delimited a surface of 1cm^2, the surface taken accidentally with species of thrips catched on the sticky surface. Insects numbering from delimited surface realized with a loupe.

RESULTS AND DISCUSSIONS

In tomatoes crop, with the help of blue traps, at Ist reading, the species number/cm^2 oscilated from an average of 22,5 species/cm^2 to 54,0 species/cm^2 (table 1.).

At the first reading the biggest number of species captured was on trap no. 4 on blue traps at seven days of placing sticky plates in cucumbers greenhouses and the smallest number was on trap no. 3 (fig. 3.).

At the second reading made in 24 June 2008, at 7 days face to the first reading, the moment in which replaced both blue sticky traps and the yellow ones.

At the second reading on blue traps the number of californian thrips species/cm^2 was between 171 species/cm^2 on trap no. 1 and 418 species/cm^2 on trap no. 3, that means an average of 42,75 species/cm^2 at an average of 104,5 species/cm^2 (table 2.).

In fig. 4. is presented the number of species/cm^2 captured with the help of blue sticky traps, IInd reading; the biggest number registered on trap no. 3, and the smallest number on trap no. 1.

The last reading was peformed on 1st July 2008, also at an interval of a week face to the second reading.

At the third reading the collected species number was 7,50 species/cm^2 in average on trap no. 1, on trap no. 2 collected 8,75 species/cm^2, on trap no. 3 collected 35,75 species/cm^2 in average, and on trap no. 4 collected 32,75 species/cm^2 in average (table 3.).

Figure 5 shows the higgest number of species/cm^2 collected on trap no. 3, and that means 143 species/cm^2, and the smallest number of species/cm^2 collected on trap no. 1, a number of 30 species.

From table 4 it determined that in the tomatoes crop, on blue traps registered an average of 36,25 de species/cm^2 at the first reading, 73,25 species/cm^2 at the second reading, and at the third one collected 21,18 species/cm^2 in average.

On blue traps of tomatoes crop, 2008, the biggest number of species collected at the second reading, on trap no. 3 (104,5 species/cm^2), and the smallest number of species collected at the third reading on trap no. 1 (7,50 species/cm^2) (fig. 6.).

From table 5. it observed the biggest number of species collected on trap no. 3 (49 196 species/trap), and the smallest number of species collected on trap no. 1 (27 436 species/trap).

From fig. 7. it determined the biggest number of species collected on trap no. 3 at the second reading, and the smallest number registered on trap no. 1 at the third reading.

CONCLUSIONS

In tomatoes crop, with the help of blue traps, Ist reading, the monitorized species number/cm^2 oscillated from an average of 22,5 species/cm^2 to 54,0 species/cm^2.

At the second reading on blue traps the species number of californian thrips/cm^2 was between 171 species/cm^2 on trap no. 1 and 418 species/cm^2 on trap no. 3, so an average of 42,75 species/cm^2 at an average of 104,5 species/cm^2.

At the third reading the collected species number was 7,50 species/cm^2 in average on trap no. 1, on trap no. 2 collected 8,75 species/cm^2, on trap no. 3 collected 35,75 species/cm^2 in average, and on trap no. 4 collected 32,75 species/cm^2 in average.

On blue traps from the tomatoes crop, 2008, the higgest number of collected species at the second reading, on trap no. 3 (104,5 species/cm^2), and the smallest number of species collected at the third reading on trap no. 1 (7,50 species/cm^2).

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TABLES AND FIGURES

Table 1

Frankliniella occidentalis **monitorization from tomatoes crop with the help of blue sticky traps, I^st^ reading, 17.06.2008**

Trap no. 1		Trap no. 2		Trap no. 3		Trap no. 4	
no. species/cm^2				no. species/cm^2			
R_1	71	R_1	19	R_1	34	R_1	75
R_2	60	R_2	35	R_2	28	R_2	81
R_3	13	R_3	37	R_3	14	R_3	27
R_4	16	R_4	23	R_4	14	R_4	33
Total	160	Total	114	Total	90	Total	216
Average	40,0	Average	28,5	Average	22,5	Average	54,0

Table 2

Frankliniella occidentalis **monitorization from the tomatoes crop with the help of blue sticky traps, II^nd^ reading, 24.06.2008**

Trap no. 1		Trap no. 2		Trap no. 3		Trap no. 4	
no. species/cm^2				no. species/cm^2			
R_1	69	R_1	85	R_1	164	R_1	92
R_2	57	R_2	108	R_2	122	R_2	117
R_3	17	R_3	52	R_3	61	R_3	36
R_4	28	R_4	64	R_4	71	R_4	29
Total	171	Total	309	Total	418	Total	274
Average	42,75	Average	77,25	Average	104,5	Average	68,5

Table 3

Frankliniella occidentalis **monitorization from the tomatoes crop with the help of blue sticky traps, III^rd^ reading, 01.07.2008**

Trap no. 1		Trap no. 2		Trap no. 3		Trap no. 4	
no. species/cm^2				no. species/cm^2			
R_1	5	R_1	13	R_1	25	R_1	41
R_2	10	R_2	13	R_2	30	R_2	22
R_3	8	R_3	4	R_3	36	R_3	39
R_4	7	R_4	5	R_4	52	R_4	29
Total	30	Total	35	Total	143	Total	131
Average	7,50	Average	8,75	Average	35,75	Average	32,75

Table 4

Frankliniella occidentalis **monitorization from the tomatoes crop with the help of blue sticky traps, 2008**

Traps	nr. exemplare/cm^2		
	I^st^ reading	II^nd^ reading	III^rd^ reading
Trap no. 1	40,00	42,75	7,50
Trap no. 2	28,50	77,25	8,75
Trap no. 3	22,5	104,5	35,75
Trap no. 4	54,00	68,5	32,75
Average	36,25	73,25	21,18

Table 5

Frankliniella occidentalis **number on blue trap surface at the three readings, 2008**

Traps	Readings			Total species./trap
	I	II	III	
Trap no. 1	12 160	12 996	2 280	27 436
Trap no. 2	8 664	23 484	2 660	34 808
Trap no. 3	6 840	31 768	10 868	49 476
Trap no. 4	16 416	20 824	9 956	47 196

Fig. 1. Colored traps placing in tomatoes greenhouse
from Agricultural Society Agro.-Dor., Dorobanţi

Fig.2 Blue trap of Csalomon type, 10 db SZINb
used for thysanoptera controlling pests of protected spaces

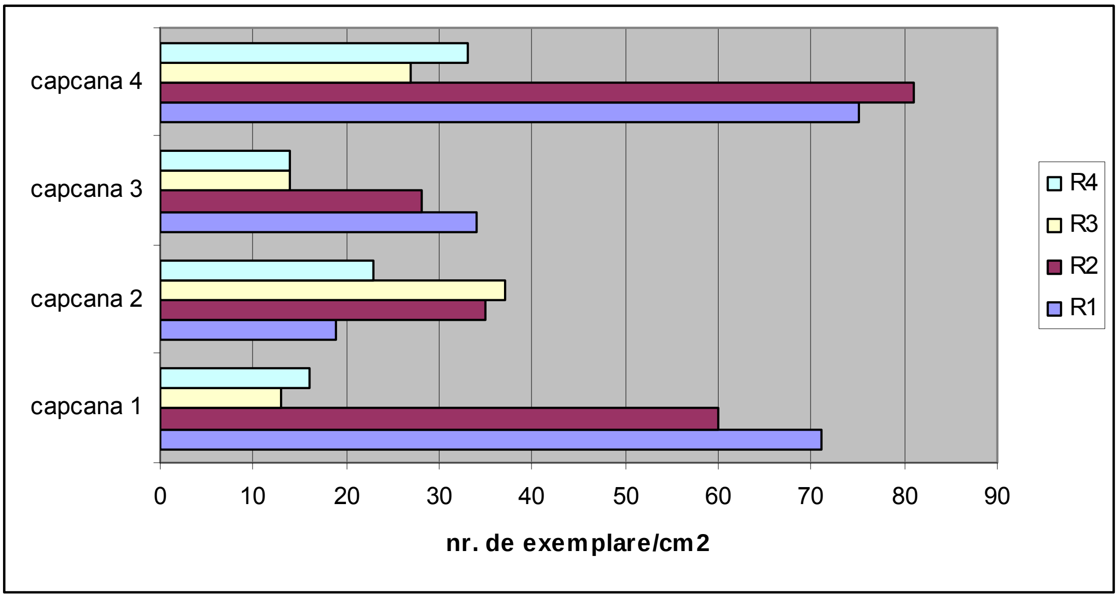

Fig. 3. *Frankliniella occidentalis* species number/cm^2, blue traps, tomatoes, Ist reading, Dorobanţi, 2008

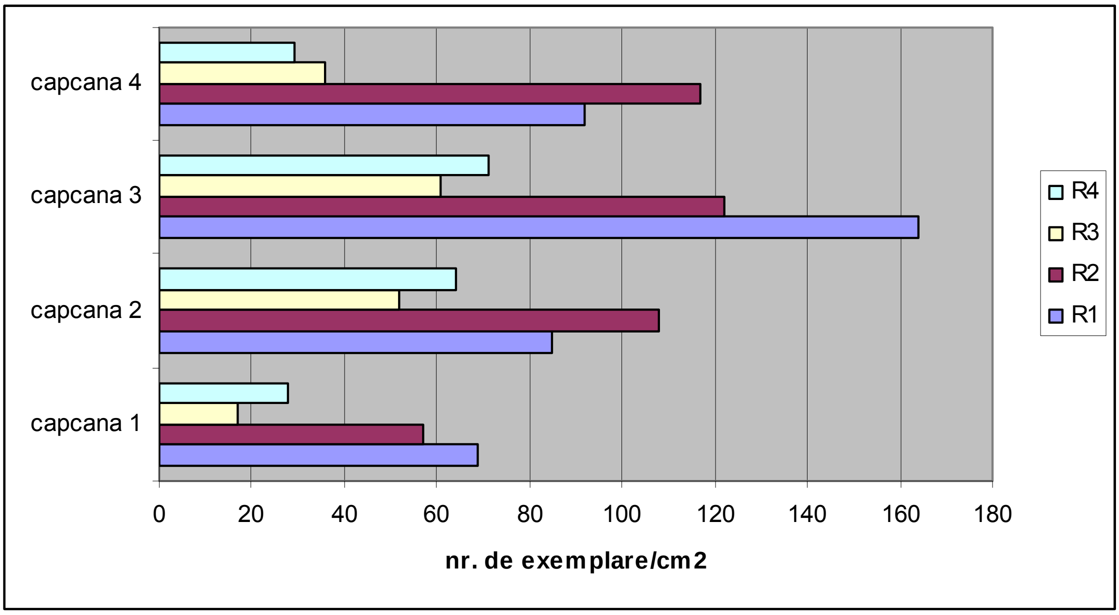

Fig. 4. *Frankliniella occidentalis* species number/cm^2, blue traps, tomatoes, IInd reading, Dorobanţi, 2008

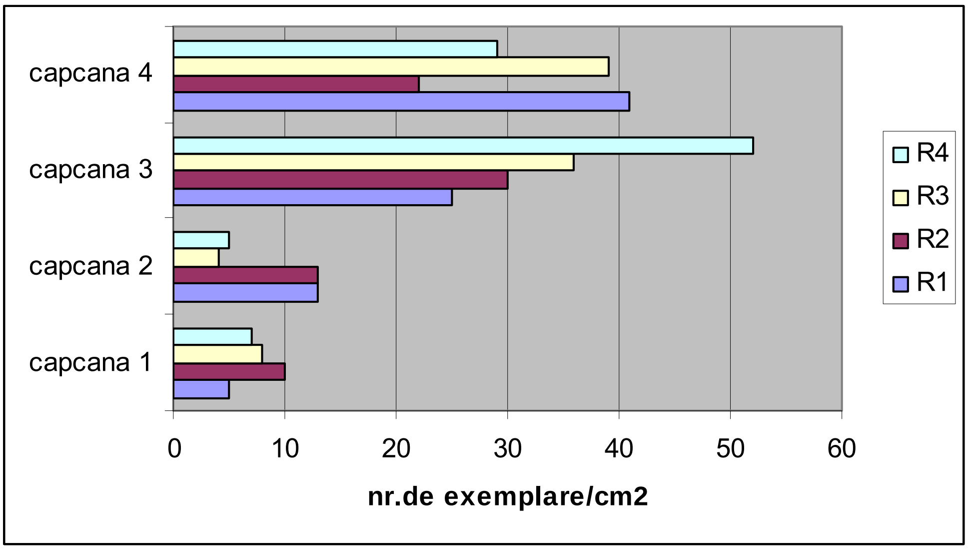

Fig. 5. *Frankliniella occidentalis* species number/cm^2, blue traps, tomatoes, IIIrd reading, Dorobanţi, 2008

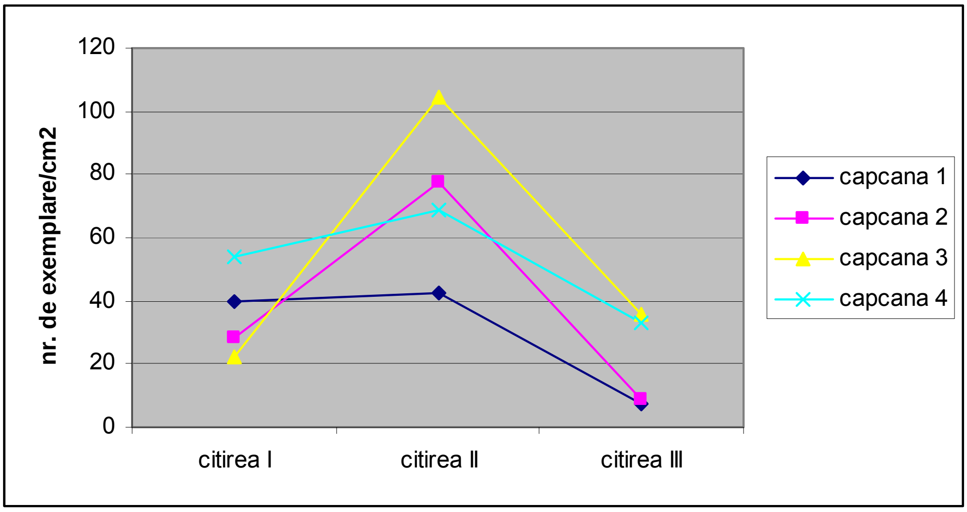

Fig. 6. *Frankliniella occidentalis* number variation at all three readings, tomatoes, blue traps, 2008

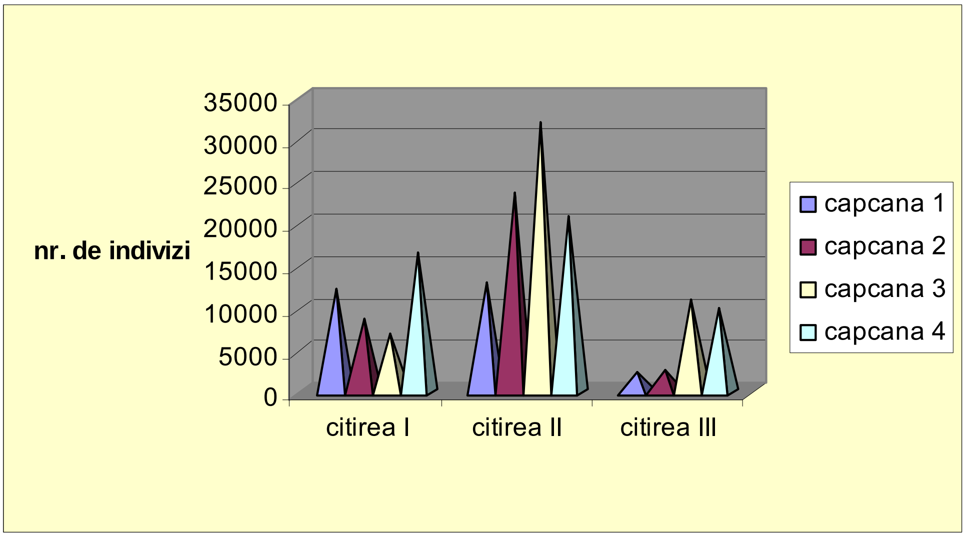

Fig. 7. Total *Frankliniella occidentalis* species number collected on blue trap surface, tomatoes, 2008

The attack produced by Frankliniella *occidentalis* Pergante on tomatoes crops, IInd cycle, from protected spaces

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Keywords: californian thrips, economical stage of damage, density

ABSTRACT

Cultures from greenhouses, which runs from midsummer until the coming cold season, is an optimal environment for the development of californian thrips, *Frankliniella occidentalis* Pergande. On the attack of the californian thrips, *Frankliniella occidentalis* Pergande, we can say that this insect is one of the most common and important species that affects the quantity and quality of cucumber production in protected areas and are necessary effective measures to controlling it. Damages produced by californian thrips (*Frankliniella occidentalis* Pergande) depended by plant development degree in the attack moment and insects density. *Frankliniella occidentalis* Pergande was active biological vector for tomatoes mosaic virus which bore to losses of 50-90% from the production in European Union countries and notwerely. That virus delivered in greenhouses, at the vegetables, especially to tomatoes, causing important economical losses. The manifestation of that disease was different in function on plant that it attacks. The economical step of damage was of 1-2 adults or larva on plant. In the tomatoes crop, IInd cycle, the pests populations density was 8,16 insects/ flower in average, that means the economical step of damage of that insects was beat. Attacked and untreated cultures may be compromised, so it is very important to know which is the number of individuals *Frankliniella occidentalis* Pergande on plants, in order to apply effective treatments, which reduce pest population.

INTRODUCTION

Wolverine pest, *Frankliniella occidentalis* Pergante, attacked over 500 species of plants from 50 botanical families, from cultivated and montaneous flora (Georgescu, 2006), the others authors said that *Frankliniella occidentalis* Pergante attacked 209 species of plants that appartain to 62 families, and Roman, (2005), affirmed that californian thrips had cca 240-244 host plants, both in spontaneous flora and in cultivated species.

After investigations made in international and national plane resulted that the thrips were major pests of cultivated vegetables on protected spaces because they easily dispersed, they could cover in a short time big surfaces of a greenhouse, producing great damages. Thus, it was necessary know the pests density, the best moment of treatments applying, also the most efficient insecticides.

Insects' presence on plants easily identified through manifestations of leaves decoloration depression – going under – stuck tissues.

At short time after introducing that new vector in our country, at greenhouses tomatoes crop appeared strong infections with TSWV.

The whitish splashes, brownish ulterior that the thrips its determined to flowers and fruits after feeding process, and giving TSWV (Tomato Spotted Wilt Virus) that brought tipical necrosis, all those aspects brought to economical value decreasing of greenhouses products.

The adults and larva stuck and drunk the cellular jus from the attacked leaves and flowers. After that attack, appeared the following manifestations: the leaves necrosis and its embossing, the stages drainage of increasing, the petals depreciation the pollen and anther destruction, the flowers abortion, etc. (Georgescu, 2006).

The attack could be sometimes followed by adherent translucent secretions to substrata on which developed in a secondary way the fumarine. (Teodorescu and colab., 2003).

Investigations concerning in that domain in abroad were made by: Allen and Broadbent, (1986); Daughtrey and colab., (1995, 1997), Ghidiu, Hitchner and Funderburk, (2006); Zhang and colab., (2007) in S.U.A.; Papadaki, Harizanova and Dagnon, (2008) in Bulgaria; Houston and David, (2008) in Georgia; Lotos, Efthimiou, Chatzivassiliou, Dimou and Katis, (2009) in Greece, etc.

In Romania, investigations in that domain were made by: Vasiliu-Oromulu (1993, 2004); Szabo and Vasiliu-Oromulu, (1998), Vasiliu-Oromulu, Barbuceanu and Ion, (2009); Vasiliu-Oromulu, Barbuceanu, (2010); etc.

MATERIAL AND METHODS

To performing investigations of the attack produced by thysanoptera in the year 2007, the experimental field was placed to Agricultural Society, Agro-Dor., from Dorobanţi locality, Arad district.

The experiences concerning the attack produced by thrips were realized in 3 repetitions and every repetition with a number of 20 plants in tomatoes case. (fig.1.).

To study thysanoptera populations from the point of vue of distribution way on attacked organs and its way of attack, it was the following stages: the entomologic material collecting, tisanoptera preserving and preparation, the larvar and adult stages determination, statistical dressing of data.

To collecting, preparation, preserving and determination of collected material were used the following materials: microscopes, binocular loupe, simple loupe, lamellae, blades, preparation needles, pincers, paper envelopes, rules, glass baguette, fixation solutions, chloroform, acetone, ethyl alcohol 70%, ether, diluted acetic acid 50%, distilled alcohol, Swann liquid, xilol, Canada balsam, etc.

For populations' thrips analysis, from tomatoes crop, it applied the beating method that presented species to analyze.

The entomologic material beat in carrier bags from flowers of tomatoes both to plant apex, middle part and of its base (fig. 2.).

RESULTS AND DISCUSSIONS

In the protected spaces appeared and multiplied new pests among which the californian thrips was emphasized (*Frankliniella occidentalis* Pergante).

The tomatoes crops, like the others crops from protected spaces were invaded by that new and dangerous pest, the californian thrips which quickly extended producing great damages.

In greenhouse climate the great number of vegetable species croped on surface unity, the high humidity atmosphere, the big temperatures during the summer time also the aeration deficient of spaces, constituted important factors that determined the multiplication and apparition of some pests, which affected both the decreasing of vegetables quantity and its quality.

In the year 2007, in tomatoes crop, the IInd cycle, investigations concerning *Frankliniella occidentalis* Pergante populations density emphasized that the high number of species/ flower on the experimental field variants before the treatment oscillated between 6 and 12. The average number of insects oscillated between 7,33 and 9 species.

From the analyzed data of table 1, resultted that in the year 2007, in the tomatoes crop, IInd cycle, registered a density of 8,16 insects/flower, that means the economical step of damage of that insect was beat.

The smallest number of *Frankliniella occidentalis* Pergante species identified on variants number 3, 5 and 6, repetitions I and III.

The biggest number of californian thrips species identified on the variants with number 1 and 2, in 3rd repetition, 2nd repetition and the variant number 5 in the second repetition.

CONCLUSIONS

In the year 2007 the economical step of damage in californian thrips (*Frankliniella occidentalis* Pergante) case in the tomatoes crop of protected spaces was over (1 – 2 adults/ flower).

In tomatoes crop, II^{nd} cycle, 2007, the populations density was 8,16 insects/ flower in average.

The most reduced number of adults/ flower was 6,00, and the highest number of adults/flower was 12,00.

The most reduced average density was 7,33, and the highest one was 9,00.

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TABLE AND FIGURES

Table 1

***Frankliniella occidentalis* Pergante density populations collected from the tomatoes greenhouses, II[nd] cycle of crop, before the treatment at Agricultural Society Agro.-Dor, Dorobanţi**

Collecting date	Repetition	Number of adults/ flower					
		V_1	V_2	V_3	V_4	V_5	V_6
14.09.2007	R I	9	10	9	7	6	6
	R II	8	7	7	7	12	9
	R III	10	8	6	9	8	9
	Average	9,00	8,33	7,33	7,66	8,66	8,00
							Σ=8,16

Fig. 1. Tomatoes greenhouses, II[nd] cycle of crop, Agricultural Society Agro.-Dor., Dorobanţi locality, Arad district

Fig. 2. Samples collecting for investigations concerning thysanoptera attack from the tomatoes crop, II^{nd} cycle

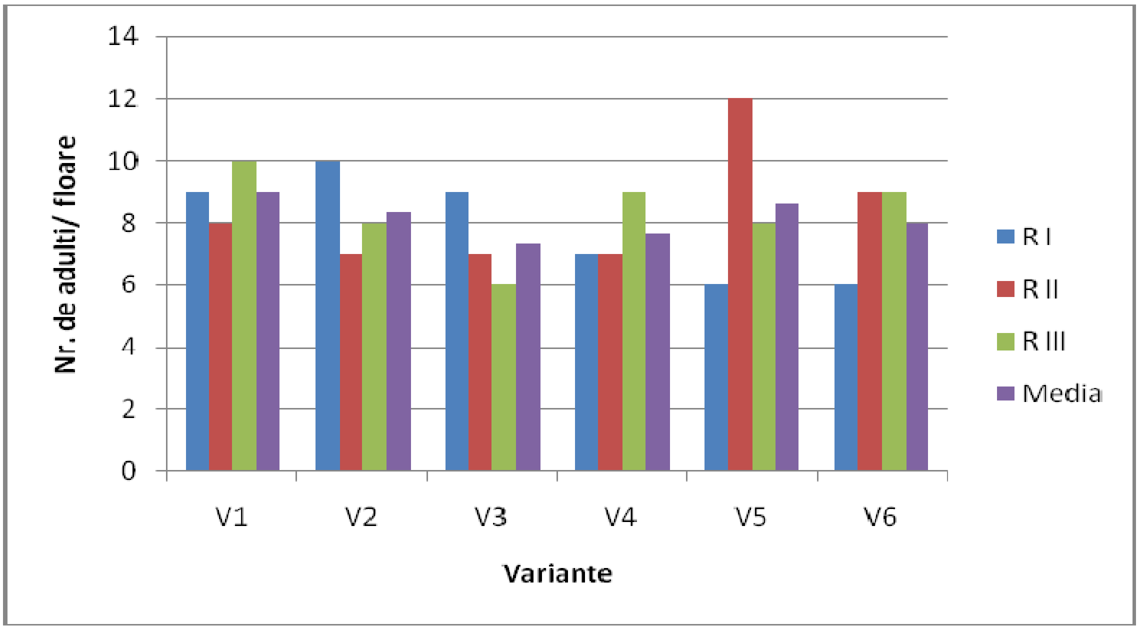

Fig. 3. Number of thysanoptera species/flower which were pests in the tomatoes crop, II^{nd} cycle

ORNAMENTAL PLANT

Effect of the nutrition and inflorescences development stage at harvest on the quality conservation of the gerbera's flowers

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Keywords: azote, potassium, diameter, vase-life, temperature, cultivar

ABSTRACT

Gerbera's flowers, although they are very beautiful, live for a short time after harvest; that's why many consumers avoid them. We made some researches with a view to diminish this inconvenience and to establish why the cut gerbera flowers live for such a short period of time and to find the solution to enlarge their life. This paper presents some aspects of the quality conservation of gerbera's flowers during preservation. It was distinguished the mineral nutrition effect with azote and potassium on the inflorescences quality evolution of the gerbera during preservation; it was ascertain that the greatest values of vase life were registered to flowers grown from cultures with a soil content of 33 mg N/100g sol and 40 mg K/100 g. It was also established the optimum development phase for flowers harvest, for cultivar with simple, thick and semi thick inflorescences, as to maintain the quality longer. For this, five cultivars of gerbera were examined: three with simple blossom (Armand, Symphonie and Fabiola) and two with thick blossom (Yellow Moor and Richard). After our experiments, we arrived to the conclusion that the optimum moment for gerbera harvest is the F II, corresponding to simple and semi thick inflorescences cultivars, with phase which presents 2-3 rows of open tubular flowers, and to thick inflorescences cultivars, when 2/3 of the ligulae flowers are stretched.

INTRODUCTION

Gerbera has a great decoration value, due to petals' elegance and smoothness, their way of sizing in blossom, colours' variety and the contrast made by disc's color and petals regarding simple and semi-double blossom types. There are few flowers which can be compared with the pureness and splendour of the gerbera in bouquet or in especial floral arrangement, alone, one colour or more (fig. 1), or in combination with other species of flowers, which completes through smoothness and elegance.

Gerbera presents the advantage of the possibility to grow during all the year, but has a great disadvantage: in a short time after harvest, the inflorescences fade and the stems break and therefore many flowers admires choose other flower species.

Knowing the influence of the nutrition system on the preservation of the cut flowers is really important both for obtaining a great flowers production, superior from the point of view of the quality and for the extension of the flower quality maintenance duration at beneficiary.

Researches made by Holley (1963) and Lancaster (1976) underline that mineral nutrition barely influences life's duration of the cut flowers. Conversely, a lot of authors sustain the fact that a high level nutrition, especially with azote, at the end of the crop, has a negative influence on the quality maintaining duration (Nell and all., 1989; Hell & Hendricks, 1994; Noordergraaf, 1995; Druege, 2001).

Through our researches, referring to this matter, we tried to see the influence of the sol content in azote and potassium on gerbera's behaviour during preservation, in water, at the circumambience temperature.

The stage of the flower's development at harvest influences their content in reserve substances and therefore it represents an important factor which determines life's duration after harvest (Burzo, 2005). Flowers are harvested, generally, at the earliest stage that assures their better quality growing and complete blooming at the consumer. It is preferable, depending on species, to harvest flowers at the stage of bud, because the buds are easy handled and more resistant to some unfavourable environment factors, such as high temperatures and ethylene (Barder and Hanan, 1972; Maxie and all., 1973; Nichols, 1968). Although some flowers species, as gerbera, don't bloom or fade if they are harvested too early. The stem bending of gerbera is more frequent at flowers which are harvested before maturity (Meeteren, 1978; Wilberg, 1983). Nowak and Rudnicki (1990) recommend gerbera flower harvest at the phase in which the exterior flower row shows pollen.

Due to the fact that subject literature didn't find references regarding optimum stage of harvest of the thick blossom, we managed the experiences with gerbera varieties, both simple and thick blossom in order to find the appropriate time of harvest.

MATERIALS AND METHODS

To evidence the nutrition effect on the gerbera flower quality maintenance during preservation, we made several experiments with the Red Marleen (fig. 2) gerbera flower, harvested in two periods of the year, with different milieu conditions in preservation space:

- 1^{st}-15^{th} May period, with temperature = 18-20^0C and RU = 55-65%;
- 20th-30th June period, with temperature = 28-30^0C and RU = 40-55%.

The factors observed are the potassium and the azotes, with four levels of their medium content in sol, maintained during vegetation. The experimental variant resulted from the combination of the four level azote (8; 14; 24 and 33 mg N-NO3) and of the four levels of potassium (9; 17; 25 and 40 mg K/10g sol) were 16.

The flower harvest was done at optimum moment. The experience organization was made after about two hours from the harvest; stems were cut to 35 cm and put into water. For each variant were used ten flowers.

During preservation, determinations on evolution of the inflorescence's diameter and their quality were made daily; changing water and refresh the section at the stem base was also one of our daily preoccupations.

The duration of the vase life was considered finished when the fading inflorescence and stem breaking appeared.

In order to evidence the influence of the inflorescence open phase at harvest moment on the evolution of the flower's quality and the duration of its maintenance, five cultivars of gerbera were examined: three with simple inflorescence (Armand, Symphonie and Fabiola) and two with thick inflorescence (Yellow Moor and Richard) – proceed from 2nd year culture (fig. 3) – in two periods, April and June, when the flower production arrived to a maximum level, two years consecutively.

The determined factors in the experiment organizing were: the cultivar, with five graduates and the open phase of the inflorescence, with three graduates (F I – the younger stadium of development, F II – an intermediary stage and F III – the more advanced stadium of development), resulting fifteen combinations cultivar x open phase. For each open phase of a cultivar, in an experimental stage, were used ten flowers.

After about an hour from the harvest, the stem flower was equalized at 35 cm and was put in water. Their preservation was made at temperature of 20-22^0C and the relative humidity of the air of 50-55%, in both experimental stages.

During preservation, like previous experiments, there were daily made the operations of changing water and refreshment the section at the stem base, removing each time about 0.5 cm from the stems.

There were made observations regarding the inflorescence diameter evolution, stem's position compared with vertical and the keeping ligulae flowers freshness.

The values presented in this paper represent the average of those four stages of experiments.

In order to make comparisons between all variants from each experience, the Duncan test was applied, and the values with different significance, with a probability of 5%, were noted with different letters.

RESULTS AND DISCUSSIONS

1. Regarding the nutrition system effect on the maintaining of the flower quality

The information provided in table 1 show that the inflorescence maximum diameter is influenced mainly by preservation temperature. Thus, at the temperature of 18-20^{0}C the medium values are higher with about 10 mm comparing with those realized at the temperature of 28-30^0 C, in the same conditions of nutrition.

There is evidence that both azotes and potassium influence significantly the flower maximum diameter in both stages of the experiment. The highest values are evident in the case of the variants with the highest content on these elements

The duration of living in water, presented in table 2, is also influenced by the preservation environment temperature. Thus, in the first stage of the experiments, at the temperature of 18-20^{0}C, the medium duration of flower's life is longer with 3-4 days comparative with the second stage, with temperature of 28-30^{0}C.

Regarding the influence of the soil content of azote and potassium on the vase life duration, there is an evidence that in the first experience stage, the level of the azote doesn't influence significantly the vase life, while, the potassium influences the vase life of gerbera flowers, its values increasing from K1 to K4 with 1,1 days.

In the second stage of the experiment, there is evidence a positive influence of the azote and potassium. The highest values of the flower vase life duration are recorded at N4 (33 mg/100 g soil), with significant differences (1 day) comparative with N1 (8 mg/100 g soil). The medium values of factor potassium increases also from K1 (9 mg/100g soil) to K4 (40 mg/ 100 g soil) with about 1 day, the differences being significantly That means that the soil element with a stronger influence on keeping of the gerbera flowers is the potassium, because at a higher level (40 mg/100g soil) the duration of the flower's quality maintenance extends with 1.1-1.3 days comparative with a lower level (9 mg/100 g soil).

The highest values of vase life duration were marked at gerbera flower proceeded from the variant with a soil content of 33 mg N/100 g soil and 40 mg K/ 100 g soil, in all the experiment periods.

2. Regarding the effect of the inflorescences development stage at harvest on the flower's quality maintenance

During keeping in water for six days, inflorescences diameter realizes higher augmentation at open phase F1, comparative with phases F II and F III at all cultivars, but the values aren't to be taken in consideration neither to F I (1.2 mm at cultivar Yellow Moor and 7.8 mm at cultivar Symphonie). In the two other phases of inflorescences development, augmentations are bigger at cultivar Richard (where a high augmentation was also marked at phase F I). The lowest augmentations of the inflorescence diameter in all phases were marked at cultivar Yellow Moor (fig.4).

Regarding vase life, the obtained results at these five experimented cultivars show that the maintenance duration of flower's quality is influenced by both the inflorescence open phase and cultivar.

From dates presented in table 3, there is evidence that vase life's duration increases from phase F I to phase F II and has intermediary values at phase F III, to all cultivars, significant differences between these three phases' values being registered. Not taking in consideration the cultivar, the phases average are: for F I -11 days, for F II -13 days and for F III - 12 days.

From all cultivars, Armand evidences with the best duration of vase life(all three phases average is 13 days), and the last place is occupied by cultivar Richard (all three phases average is 9,6 days), which presents flower stem very sensible at breakage.

From these experiments we can get on to the conclusion that the optimum moment for gerbera harvest is phase F II, corresponding to simple and semi thick inflorescence with phase which presents 2-3 rows of open tubular flowers, and to thick inflorescences, when 2/3 of the ligulae flowers are stretched.

A correlation between the inflorescence disc diameter and vase life duration hasn't been established yet at none of the three cultivar with simple inflorescence.

CONCLUSIONS

The measure of gerbera's flowers, expressed in their maximum diameter, is influenced by azote and potassium content in soil, but especially by the preservation temperature. Values up to 10 mm higher at the temperature of 18-20^{0}C, according to temperatures of 28-30^{0}C were marked.

The nutrition system influences the maintenance duration of the flower's quality in water at the appropriate temperature, the potassium's influence on preserving the gerbera being more pronounced than the azote. The highest values of the vase life duration in the case of cultivar Red Marleen were marked at gerbera flowers from the variant with a content of azote in soil of 33 mg/100 g soil and potassium of 40 mg/100 g soil.

The optimum moment for gerbera's harvest is, for all inflorescence types, phase F II-which corresponds to simple or semi-thick inflorescences cultivars, with presence of 2-3 rows of tubular flowers in the centre of the open inflorescence, and at thick inflorescence cultivar when 2/3 of the ligulae flowers are stretched.

The duration of the vase life in the case of the optimum time of gerbera harvest (phase F II) is higher with 1-4 days comparing to phase F I (younger stadium of development) and with 0.5-1.3 days comparing with phase F III (an advanced development stadium), depending on cultivar.

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TABLES AND FIGURES

Table 1

The maximum diameter of the gerbera inflorescence according to azotes and potassium content in soil

(UM = mm)

Factor	*K1*	*K2*	*K3*	*K4*	*Average on factor N*
Phase I: 1st-15th May (T=18-20^{0}C, UR=55-65%)					
N1	113.3	113.5	113.6	113.8	113.6 B*
N2	113.4	113.4	113.8	114.2	113.7 B
N3	113.6	113.9	114.2	114.7	114.1 A
N4	113.8	114.4	115.4	115.6	114.8 A
Average on factor K	113.5 N*	113.8 M	114.3 M	114.5 M	
Phase II: 20th-30th June (T=28-30^{0}C, UR=40-55%)					
N1	103.2	103.6	103.2	103.9	103.5 B*
N2	103.4	103.8	103.9	104.7	104.0 AB
N3	103.5	104.2	104.1	104.8	104.2 AB
N4	103.8	104.8	104.9	105.3	104.7 A
Average on factor K	103.5 N*	104.1 M	104.0 M	104.7 M	

* In an experiment stage and letters group (A…B for factor N average and M…N for factor K average), the values marked with the same letter don't present any significantly differences at 5% level concerning Duncan test.

Table 2

Vase life duration of the gerbera flowers according to azotes and potassium content in soil

(UM = days)

Factor	**K1**	**K2**	**K3**	**K4**	**Average on factor N**
Stage I: 1st-15th May (T=18-20^{0}C, RU=55-65%)					
N1	11.1	10.8	11.4	11.6	11.2 A*
N2	11.0	11.0	11.3	11.4	11.2 A
N3	10.8	11.2	11.8	12.2	11.5 A
N4	10.2	11.8	12.0	12.4	11.6 A
Average on factor K	10.8 N*	11.2 MN	11.6 M	11.9 M	
Stage II: 20th-30th June (T=28-30^{0}C, RU=40-55%)					
N1	6.2	6.8	6.9	7.6	6.9 B*
N2	6.4	7.0	7.2	7.8	7.1 AB
N3	6.8	7.4	7.6	8.2	7.5 AB
N4	7.4	7.6	7.8	8.6	7.9 A
Average on factor K	6,7 N*	7.2 N	7.4 N	8.0 M	

*In an experiment stage and letters group (A…B for factor N average and M…N for factor K average), the values marked with the same letter don't present any significantly differences at 5% level concerning Duncan test.

Table 3

Influence of inflorescence development at harvest on flower's vase life duration of some cultivars of gerbera

Cultivar	Inflorescence open phase			Cultivar average
	F I	F II	F III	
Armand	12.5	13.8	12,8	13,03 A*
Symphonie	10.0	14.1	12.8	12.32 C
Fabiola	12.0	13.3	12.5	12,59 B
Yellow Moor	12.1	13.0	12.5	12.53 B
Richard	8.7	10.8	9.1	9,56 D
Phase average	11,06 O*	13.0 M	11.97	

* In an experiment stage and letters group (A…D for cultivar average and M…O for phase average), the values marked with the same letter don't present any significantly differences at 5% level, concerning Duncan test.

Fig. 1. Gerbera flower bouquet, multicolored

Fig. 2. Gerbera flower, cultivar Red Marleen

Fig. 3. Gerbera, cultura in the 2nd year

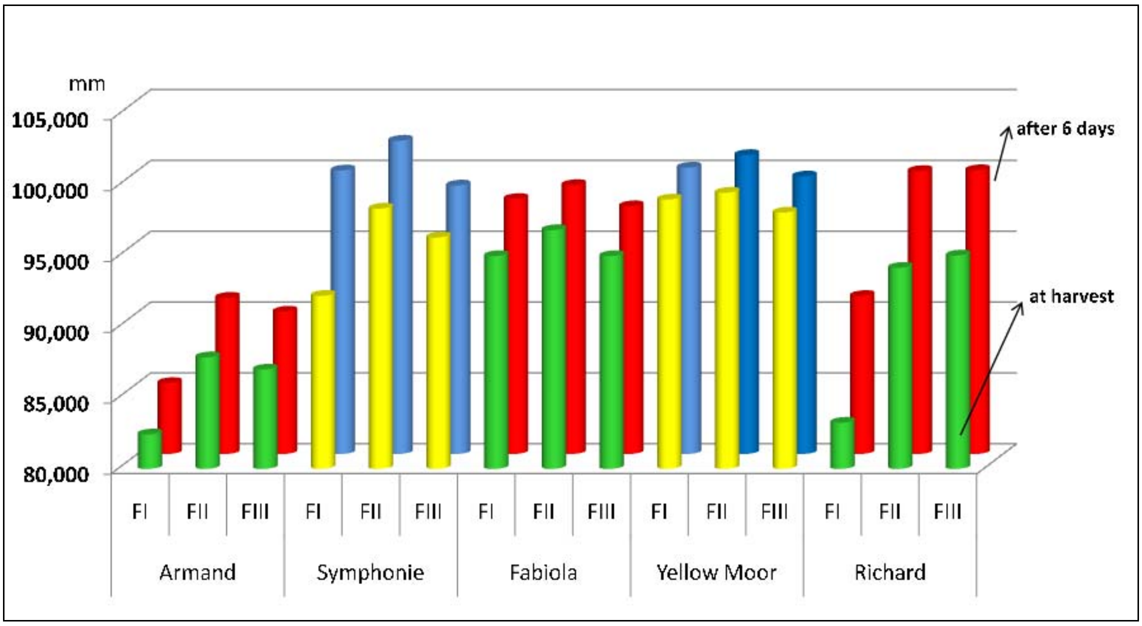

Fig. 4. The gerbera inflorescence diameter growth, harvested in different phases of development, during preservation in water

Researches concerning the behaviour of some superfreesia varieties in a private greenhouse from Timi’Hara

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Keywords: total length, stem’s length, flower group length, number of punks, first flower diameter

ABSTRACT

In this article there are presented the most important features of eight superfreesia varieties. The material for planting was bought from Holland and there were followed its behaviour in conditions of a private greenhouse from Timisoara. The special qualities of *Freesia* flowers make them very wanted. Nowadays there are cultivated over 80 varieties of *Freesia*, which are different concerning the type of flowers, their size and colour, intensity of their perfume, the number of flowers in the group, the vigor of the floral stem, the earliness period, the multiplication coefficient and resistance to diseases. In conditions of our country, there is very spread the culture by tuberobulbs, started in autumn-winter, with the blooming period in winter, mainly because these flowers are very appreciated in that period and also because in spring there cannot be assured the low temperatures needed for obtaining quality flowers. The varieties that were studied in this article are: Calvados, Dukaat, Orangina, Pimpernel, Pink Sun, Red River, Scarlet and White River. For the statistical interpretation of data we used variance analyze method, the control variant being the average value of the experiment. The results obtained show the best values concerning the total length of the plant, stem’s length, flower group length, number of punks and the diameter of the first flower were obtained in case of Pimpernel variety, followed by White River variety.

INTRODUCTION

The special qualities of *Freesia* flowers, is what makes them very wanted. Nowadays there are cultivated over 80 varieties of *Freesia*, which are different concerning the type of flowers, their size and colour, intensity of their perfume, the number of flowers in the group, the vigour of the floral stem, the earliness period, the multiplication coefficient and resistance to diseases (Bala, 2007; Toma, 2009).

Holland is the country with a large scale production of *Freesia* flowers and tuberobulbs in greenhouses. In 2000, the surface cultivated with *Freesia* in Holland was of 538 ha. Concerning the surfaces cultivated with *Freesia* in Europe, after Holland there are Germany with 65 ha, Italy with 35 ha, England with 25 ha, France with 20 ha, Poland with 18 ha and Romania with almost 10 ha (Bala, 2007).

In conditions of our country, there is very spread the culture through tuberobulbs started in autumn-winter, with the blooming period in winter, mainly because these flowers are very appreciated in that period and also because in spring there cannot be assured the low temperatures needed for obtaining quality flowers (Anton, 2007; Cantor, 2003; Șelaru, 2002).

MATERIAL AND METHOD

The biological material from this article is represented by eight new *Freesia* varieties cultivated in an individual solarium type greenhouse. The eight varieties are: Calvados, Dukaat, Orangina, Pimpernel, Pink Sun, Red River, Scarlet and White River.

The experiment was placed according to the randomized blocks method and the planting distance was 100 pieces/m². The number of experimental variants was three for each variety and for each experimental variety there were studied 10 plants, meaning 30 for each variety. The data were interpreted by using the statistical calculation method variance analyse, while the control variant was the average value of the varieties for each character.

The observed parameters were the total length of the plant, the floral stem’s length, the flower group length, the number of punks in the flower group and the diameter of the first flower.

RESULTS AND DISCUSSIONS

Concerning the total length of the plant, in table 1 it can be observed that Pimpernel variety was the most vigorous, with an average value of 109.87 cm, being very significant positive than the control, while Orangina variety registered an average value of 99.33 cm, being significant positive than the control variant (97.66 cm). Lower results were obtained from Calvados, Pink Sun and Scarlet varieties, which had values with very significant negative differences than the control variant.

The floral stem's length is represented by the difference between the total length of the plant and the length of the plant till the floral stem. In table 2 it can be observed that Pimpernel variety has an average length of 70.92 cm, being very significant positive than the control variety, while Calvados and Red River varieties had the smallest length (55.07 cm and 55.13 cm) and very significant negative differences than the control variant. The other varieties did not have significant differences than the control variant.

The flower group length varied sufficiently significant for all the varieties, so that White River variety had an average value of 11.73 cm, being very significant positive than the control, which had an average value of 10.98 cm. the same significance was registered for Calvados variety, which had an average flower group length of 11.63 cm. Lower results were obtained from Pimpernel (10.23 cm) and Scarlet (10.5 cm) varieties, both of them having distinct significant negative differences than the control variant (table 3).

Concerning the number of punks in the flower groups, this is one of main quality features of *Freesia* varieties because the larger the number, the best is the quality. The best results were obtained from the following varieties White River (14.03) and Dukaat (10.93), both of them being very significant positive than the control, while the rest of the varieties had lower values than the control variant (10.47) being very significant negative, respectively distinct significant negative (Scarlet variety) than the control (table 4).

The diameter of the first flower (table 5) has a great importance and it assures flowers quality when the delivery on the market is done with at least one open flower, this being possible just in case of those producers that have selling points and can harvest flowers in the moment of the asking on the market. When the transport of flowers on the market is done at large distances, the harvest is done in the punk stage and flowers' diameter is less important because flowers' opening at delivery will not be produced naturally, this being dependent on different factors, the most important being the light. The best results concerning this parameter were obtained from Calvados, Dukaat, Orangina, Pink Sun and White River varieties, which were very significant positive than the control, while the other varieties were very significant negative than it, having lower values.

CONCLUSIONS

According to the researches made on *Freesia* varieties, we can affirm that:

- concerning the total length of plants had the highest values in case of Pimpernel variety (109.87 cm);
- the floral stems' length had the highest values in case of Pimpernel variety (70.79 cm);
- the flower groups length had an average value of 11.73 cm in case of White River variety and of only 10.23 cm in case of Pimpernel variety;
- the variety that had the most punks was White River, with an average value of 14.03.

We recommend in culture the varieties that gave best results in this research, such as White River and Pimpernel, but also calvados and Orangina.

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TABLES

Table 1

The total length of plants (cm)

Variety	V1	V2	V3	Average	%	Difference	Significance
Calvados	95.2	93.5	94.4	94.37	96.63	-3.29	ooo
Dukaat	101	97.7	97.6	98.77	101.14	1.11	-
Orangina	99.2	99.6	99.2	99.33	101.72	1.68	x
Pimpernel	109.4	110.5	109.7	109.87	112.5	12.21	xxx
Pink Sun	94.7	93	93.8	93.83	96.08	-3.82	ooo
Red River	98.4	98.2	97	97.87	100.22	0.21	-
Scarlet	89	88.6	88.6	88.73	90.86	-8.92	ooo
White River	97.7	98.7	99	98.47	100.83	0.81	-
Average	98.08	97.48	97.41	97.66	100	0	-
sx	2.07	2.28	2.14	2.15			
s%	5.97	6.61	6.22	6.23			

DL5%= 1.45 DL1%=1.99 DL0.1%=2.74

Table 2

The floral stem's length (cm)

Variety	V1	V2	V3	Average	%	Difference	Significance
Calvados	56.1	54.1	55	55.07	92.23	-4.64	ooo
Dukaat	63.4	57.6	56.8	59.27	99.26	-0.44	-
Orangina	59.5	60.2	59.7	59.8	100.16	0.09	-
Pimpernel	71.7	71	70.2	70.97	118.86	11.26	xxx
Pink Sun	60.6	56.3	58.3	58.4	97.81	-1.31	-
Red River	54.5	54.9	56	55.13	92.34	-4.57	ooo
Scarlet	59.4	58.8	59.3	59.17	99.1	-0.54	-
White River	59.6	59.7	60.2	59.83	100.21	0.13	-
Average	60.6	59.08	59.44	59.71	100	0	
sx	1.85	1.87	1.67	1.75			
s%	8.65	8.96	7.95	8.29			

DL5%= 2.37 DL1%=3.27 DL0.1%=4.50

Table 3

The flower groups' length (cm)

Variety	V1	V2	V3	Average	%	Difference	Significance
Calvados	12	11.5	11.7	11.63	106.41	0.71	x
Dukaat	10.4	10.7	10.4	10.5	95.22	-0.53	o
Orangina	10.6	10.5	10.5	10.53	95.53	-0.49	-
Pimpernel	10.2	10.3	10.2	10.23	92.81	-0.79	oo
Pink Sun	10.5	10.9	11.9	11.1	100.67	0.07	-
Red River	11.3	11.4	11.9	11.53	104.59	0.51	-
Scarlet	10.7	10.4	10.4	10.5	95.22	-0.53	oo
White River	12.3	11.9	12	11.73	109.43	1.04	xxx
Average	11	10.95	11.13	10.98	100	0	-
sx	0.28	0.21	0.29	0.22			
s%	7.11	5.35	7.28	5.62			

DL5%= 0.52 DL1%=0.72 DL0.1%=0.99

Table 4

The number of punks in the flower group

Variety	V1	V2	V3	Average	%	Difference	Significance
Calvados	10	10	10	10	95.51	-0.47	ooo
Dukaat	10.9	11.2	10.7	10.93	104.43	0.46	xxx
Orangina	9.6	9.5	9.5	9.53	91.05	-0.94	ooo
Pimpernel	10	10	10	10	95.51	-0.47	ooo
Pink Sun	9.8	10	9.9	9.9	94.56	-0.57	ooo
Red River	9.1	9.2	9.6	9.3	88.83	-1.17	ooo
Scarlet	10.1	10	10	10.03	95.83	-0.44	oo
White River	14	14	14.1	14.03	134.03	3.56	xxx
Average	10.44	10.49	10.48	10.47	100	0	
sx	0.54	0.54	0.53	0.54			
s%	14.62	14.61	14.39	14.49			

DL5%= 0.24 DL1%=0.32 DL0.1%=0.45

Table 5

The diameter of the first flower (cm)

Variety	V1	V2	V3	Average	%	Difference	Significance
Calvados	7	7	7	7	105.26	0.35	xxx
Dukaat	7	7.2	7	7.07	106.27	0.42	xxx
Orangina	8	8	8	8	120.3	1.35	xxx
Pimpernel	6	6	6	6	90.23	-0.65	ooo
Pink Sun	7.2	6.8	7	7	105.26	0.35	xxx
Red River	5.1	5.2	5.1	5.13	77.19	-1.52	ooo
Scarlet	6	6	6	6	90.23	-0.65	ooo
White River	7	7	7	7	105.26	0.35	xxx
Average	6.66	6.65	6.64	6.65	100	0	
sx	0.32	0.31	0.32	0.31			
s%	13.59	13.13	13.43	13.36			

DL5%= 0.14 DL1%=0.20 DL0.1%=0.27

New genera in ornamental geophytes collection of UASVM Cluj-Napoca: Belamcanda

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Keywords: behaviour, perennials assortment, rhizome

ABSTRACT

Flower bulbs, also called ornamental geophytes, exhibit great diversity in their morphology, growth and developmental biology, and physiological responses to environmental factors. They contribute significantly to the global ornamental industry, and are utilized for commercial bulb and flower production, including outdoor and forced fresh-cut flowers and potted plants, and for landscaping, including private gardening (Benschop et al., 2010). Although ornamental geophytes belong to more than 800 different genera, the most important and dominate are the next 7 genera: *Tulipa, Lilium, Narcissus, Gladiolus, Hyacinthus, Crocus*, and *Iris*. Most of the traditional flower bulbs are cultivated in temperate-climate regions of the world (Bryan 1989, 2002). The goal of the research was to improve the assortment of ornamental geophytes at the University of Agricultural Sciences and Veterinary Medicine Cluj, floral collection, with new species which has special morphological characteristics and is easy to grow. In this case we introduced and studied the behaviour of new geophytes: *Belamcanda chinensis* (L.) DC. 'Freckle Face' and *Belamcanda ch.* 'Hello Yellow'.

INTRODUCTION

The root of *Belamcanda chinensis* (L.) DC. is known as the Chinese herb She-gan. Seeds of the plant were collected by Jesuit missionaries in China and sent to Europe by the 1730s. Linnaeus identified the plant as *Ixia chinensis*. It was cultivated in the botanical garden in Uppsala by 1748 and in English gardens by at least 1759. The plant was known in American gardens as early as 1825. It had become widely naturalized in the eastern United States by the late nineteenth century. Often listed in wildflower guides to the south-eastern United States, many people do not realize that it is an Asian introduction (http://www.one-garden.org/features/herbsinamerica.htm).

Belamcanda chinensis (Blackberry lily, Leopard flower, Leopard lily) has many synonyms as *Iris domestica, Belamcanda punctata*, *Gemmingia chinensis*, *Iris chinensis*, *Ixia chinensis*, *Morea chinensis*, *Pardanthus chinensis*. Blackberry lily is an ornamental plant it is belonging to the *Iridaceae* family. In 2005, based on molecular DNA sequence evidence, *Belamcanda chinensis*, the sole species in the genus *Belamcanda*, was transferred to the genus *Iris* and renamed *Iris domestica* (Goldblatt and Mabberley, 2005). This species is originated from China, Korea, Himalayas, and Southeast Asia, Japan.

Belamcanda chinensis 'Freckle Face' is a perennial plant it is grows 60-90 cm tall in full sun and is often found blanketing hill sides, the flowers is orange-red to burgundy speckles and bloom in summer to early autumn (fall).

Belamcanda chinensis 'Hello Yellow' is 30-45 cm height, with bright yellow flowers.

The erect central stalk is 50-80 cm tall and either branched or unbranched; it is glabrous, and pale green (http://www.illinoiswildflowers.info/weeds/plants/bb_lily.htm). This stalk terminates in a cyme or compound cyme of flowers. There are pairs of small linear-lanceolate bracts at each fork of the stalk; these bracts are slightly membranous and tend to wither away.

These leaves are often grouped together into the shape of a fan; they are green to grey-blue, linear in shape, glabrous, and glaucous like those of a gladiolus or iris (Table 1). Their margins are smooth, while their veins are parallel. The leaves are edible (Tanaka, 1976).

Cut stems and leaves down in fall cleanup. They can be used from mulch in winter, especially in colder areas. It is recommended to remove dead or dying leaves any time.

The flowers are hermaphrodite, typically orange spotted with red, consisting in 6 petals, although yellow-flowered varieties are in cultivation and also with blue, purple and pink flowers (Şelaru, 2007). The flower has only 3 stamens, while the flower of a lily has 6 stamens. The Blackberry Lily differs from other members of the Iris family in having 3 distinct stamens that are not petal-like in appearance, a style with a tripartite stigma, and an inferior ovary. The tepals are orange with purple dots and elliptic-oblong in shape, while the ovary is green, glabrous, and narrowly ovoid. Each cyme usually produces several flowers (Fig. 1). The blooming period occurs from mid - to late summer and lasts about 1-2 months (June-August) and gets the berries autumn. There is no noticeable floral scent.

Each flower is replaced by an oblongoid seed capsule, the 3 sides of this capsule become strongly recurved, revealing a mass of shiny black seeds that resembles a blackberry, gives the plant its common name, "blackberry lily." The seed pods open in the fall (Fig. 5). They are attractive in fresh or dried flower arrangements.

The root system consists of a thickened crown at the base of the plant, which has fibrous roots underneath; spreading rhizomes are also produced. Both the crown and rhizomes have an orange interior (Fig. 2). The plant is resistant till -10ºC (Dijk, 2002).

The dried rhizome has long been used in East Asia to treat throat troubles, asthma, swollen liver and spleen, malaria, and arrow poisoning. The leopard lily is a flowering perennial of Chinese origin and is locally used in Chinese villages for its medicinal values. The barriers are poisonous (Foster and Yue, 1992 and Russell, 1997). Recent pharmacological researches have shown that ethanol extracts lower blood pressure, and have experimental antifungal, antibacterial, and antiviral effects, and it is used against cancer cells (www.n-tv.de/wissen/koerpergeist/Hilfe-durch-Liliengewaechs-article369742.html).

The plant is propagated by seeds in early spring or rhizome division. Belamcandas are extremely vulnerable to early spring slug shredding.

Belamcanda is growing well in any type of moisture-retentive soils. This plant likes a lot of heat; best to site in a warm, protected spot in the maritime Northwest (Carter et al, 2007), but she can grown in partial shade. In the spring the plant rhizomes is planted about 3 cm deep and 10 cm deep in colder areas. Blooming time is in late summer (the flower lives only one day).

Recommended companions for Belamcandas: *Artemisia*, grasses, *Perovskia, Agapanthus, Helenium, Salpiglossis, Crocosmia*, dark-foliaged dahlias; it would be nice with *Hemerocallis* in similar color tones.

Good for fresh flower arrangements and the dried seed capsules are also great in arrangements.

MATERIALS AND METHODS

The subjects of the research were *Belamcanda chinensis* 'Freckle Face' and *Belamcanda chinensis* 'Hello Yellow' provided from RDA-Suwon, South Korea (Fig. 3 and 4). The seeds were sow in greenhouse at 21.09.2009 and risen in 20 days. The young plants were moved in a soil mixture consisting of garden soil, peat and sand (Fig. 5). Some observations and measurements were made in greenhouses concerning the high of plants, the diameter of leaves rosette and the number of leaves. The measurement was made on 10 plants in 3 repetitions. The statistical interpretations were made using the variance analysis method.

RESULTS AND DISSCUSIONS

The data obtained show (Table 2) that *B. chinensis* has an average of height of 43.3 cm, the diameter of leaves rosette was 21.5 cm and the number of leaves 12.4, while at *B. chinensis* "Hello Yellow" has a height plant only 38.6 cm, the diameter of leaves rosette 18.3 cm and the number of leaves 9.8.

Statistically interpretation shows in the table that *B. chinensis* 'Freckle Face' has a differences of 16.83 cm distinct significant positive, while *B. chinensis* "Hello Yellow" rich a negative difference of -16.83 cm comparing with the average of experience (control).

Analyzing the unilateral influence of diameter of leaves rosette on *Belamcanda* development (Table 4) we can notice that *B. chinensis* 'Freckle Face' achieved diameter of leaves rosette difference of +5.0 cm better than *B. chinensis* 'Hello Yellow', being distinct significant.

Regarding the unilateral influence of number of leaves on *Belamcanda* plants we can notice that again *B. chinensis* 'Freckle Face' has a higher number of leaves (+1.67) comparing with the control. *B. chinensis* "Hello Yellow", present a lower number of leaves with a negative difference (-1.67) comparing with the average of experience (Table 5).

Every stalk of *Belamcanda* has 3-5 branches that are the explanation why this species has so many flowers. The result from table 6 shows that *B. chinensis* 'Freckle Face'has a number of flower/stalk of 100.67, achieved a very significant difference comparing with the control. The second cultivar shows a lower number of flowers (35.0) with a negative difference.

CONCLUSIONS

This remarkable plant has the leaves of an iris (*Iris sp.*), the flowers of a lily (*Lilium sp.*), and a fruit that resembles a blackberry (*Rubus sp.*). There is nothing that quite resembles it. Based on the obtained results the following conclusions can be made:

1. *B. chinensis* 'Freckle Face' and *B. chinensis* "Hello Yellow" can be propagated by seeds or by division of rhizomes. Plants from seed will bloom in the first year.
2. The young plants can be planted in the field in first part of April. In late autumn the rhizome needs to be harvest and preserved at 5-8 ºC till spring.
3. *B. chinensis* 'Freckle Face'is more vigorous than *B. chinensis* 'Hello Yellow' cultivar with a difference of 16.83 cm.
4. Concerning the diameter of leaves rosette can conclude that the 'Hello Yellow' cultivar has a lower diameter than 'Freckle Face' cultivar.
5. The number of leaves is higher at 'Freckle Face' than 'Hello Yellow'.
6. The flowers/stalks are numerous at *Belamcanda chinensis* species than "Hello Yellow" cultivar with a difference of 32.83 flowers.

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TABLES AND FIGURES

Table 1

Belamcanda species and cultivars (Carter et al., 2007)

Species and cultivars	Height (cm)	Flower colour	Foliage	Comments
Belamcanda chinensis 'Freckle Face'	60-90	Orange-red to burgundy	Irislike, sword-shaped, rich green	Shining black seedheads, resembling clusters of blackberries
Belamcanda chinensis 'Hello Yellow'	30-45	Yellow, bright, unspotted	Broad, sword-shaped, rich green	Dwarf cultivar

Table 2

Observations concerning the morphological characters of Belamcandas

Crt. no.	Height of plants (cm)	Diameter of leaves rosette (cm)	Number of leaves
Belamcanda ch. 'Freckle Face'			
1	43.2	16	11
2	45	16	12
3	45	20	10
4	48	23	13
5	46	25	15
6	42	24	14
7	43	22.3	13
8	39.8	25.9	15
9	41.2	21	10
10	40.3	22	11
Average of repetitions	43.3	21.5	12.4
Belamcanda ch. "Hello Yellow"			
1	32	22	10
2	34	10	7
3	41	20	12
4	42	24	11
5	43	22	11
6	38	14	12
7	40	16	10
8	37	20	9
9	37	18	7
10	42	17	9
Average of repetitions	38.6	18.3	9.8

Table 3

The unilateral influence of height of plants on _Belamcanda_ development

Species/Cultivar	Height of plants		±D	Significance of difference
	cm	%	cm	
B. chinensis 'Freckle Face'	106.00	118.9	+16.83	**
B. chinensis 'Hello Yellow'	72.33	81.1	-16.83	00
Average of experience (control)	89.7	100.0	+0.00	-
DL (p 5%)			+7.38	
DL (p 1%)			+12.22	
DL (p 0,1%)			+22.87	

Table 4

The unilateral influence of diameter of leaves rosette on *Belamcanda* development

Species/Cultivar	Diameter of leaves rosette		±D cm	Significance of difference
	cm	%		
B. chinensis 'Freckle Face'	34.0	117.2	+5.00	**
B. chinensis 'Hello Yellow'	24.0	82.8	-5.00	00
Average of experience (control)	29.0	100.0	+0.00	-
DL (p 5%)			+1.97	
DL (p 1%)			+3.25	
DL (p 0,1%)			+6.09	

Table 5

The unilateral influence of number of leaves on *Belamcanda* plants

Species/Cultivar	Number of leaves		±D	Significance of difference
	no.	%	cm	
B. chinensis 'Freckle Face'	14.00	113.5	+1.67	*
B. chinensis 'Hello Yellow'	10.00	86.5	-1.67	0
Average of experience (control)	12.33	100.0	+0.00	-
DL (p 5%)			+1.31	
DL (p 1%)			+2.17	
DL (p 0,1%)			+4.06	

Table 6

The unilateral influence of number of flowers/stalk at *Belamcanda* plants

Species/Cultivar	Number of flowers/stem		±D cm	Significance of difference
	no.	%		
B. chinensis 'Freckle Face'	100.67	148.4	+32.82	***
B. chinensis 'Hello Yellow'	35.00	51.6	-32.83	000
Average of experience (control)	67.83	100.0	+0.00	-
DL (p 5%)			+0.66	
DL (p 1%)			+1.08	
DL (p 0,1%)			+2.03	

Fig. 1. Belamcanda flowers

Fig. 2. Belamcandas rhizome

Fig. 2. *Belamcanda ch.* 'Freckle Face' **Fig. 3**. *Belamcanda ch.* 'Hello Yellow'

Fig. 4. Belamcanda in pots

Fig. 5. Belamcanda fruits and seeds

Studies concerning the behaviour of new *Tulipa gesneriana* cultivars used in landscape design in Transylvania

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Keywords: morphological characters, cultivars, germplasm, bulb flowers

ABSTRACT

Tulips are among the most popular spring flowers of all time. *Tulipa* genus comprises about 150 bulbous species with showy flowers, in the family *Liliaceae* (www.efloras.org). There are now over 3,000 different registered varieties of cultivated tulips. A number of species and many hybrid cultivars are grown in gardens, used as pot plants or as fresh cut flowers. Most cultivars of tulip are derived from *Tulipa gesneriana* (www.wikipedia.org). The assortment in Romania concerning tulips is limited, to only a few cultivars were introduced until now. Nowadays, has been a grown interest among horticulturists for introducing new varieties into cultivation and landscape. Researching activity for diversification of *Tulipa gesneriana* germplasm by introducing of the new foreign cultivars has being the main goal of our researches at the Floricultural Department at the University of Agricultural Sciences and Veterinary Medicine Cluj-Napoca. In this scientific paper are presented the mains morpho-decorative characteristics of 12 new Tulips cultivars ('Alladin', 'Artist', 'Ballerina', 'Hollywood' 'Menton', 'Monsella', 'Queen of Night', 'Spring Green', 'Virosa', 'Pinocchio', 'Valentine', 'Shirley') that were introduced into our didactical collection using bulbs imported from the Netherlands. These where observed in our Transylvanian conditions and the following characteristics were recorded: flowering dates, colour of flowers, plant height, length of petals and width of petals. Dates obtained were statistical interpreted.

INTRODUCTION

By international agreement, tulips are classified into 15 divisions and tulip names are registered in the "Classified List and International Register of Tulip Names", published in the Netherlands by the Royal General Association of Bulb Growers. The 1996 edition lists some 3000 names for tulip species, garden cultivars, extinct cultivars and invalid names that are synonyms. The first 11 divisions include the garden tulips, all presumably derived from a single ancestor; the other four divisions are "botanical" tulips, which are wild tulip species and hybrids of them (www.floridata.com).

In our country, in the last period many new varieties of different floral plants are imported from Europe and United State. The request for novelties is very important in the field of ornamental horticulture. Several thousands of floral varieties are created each year in the words and we try to study in Transylvanian condition for can be quickly put in production and commercial use, for landscape and enrichment of Romanian floral trends (Cantor and Pop, 2008).

Tulips are easy to grow, they come in an incredible variety of colours, heights, and flower shapes, and some are even fragrant (Cantor et all, 2007).

The results obtained can be use also for students and doctoral thesis or are recommended for commercial production. The best varieties will be genitors in our breeding program for obtain new hybrids.

MATERIALS AND METHODS

The new ***Tulipa*** varieties, the subject of the research in our experimental field during 2009-2010 periods, were 12 Holland *Tulipa* varieties: 'Alladin', 'Ballerina', 'Menton, 'Queen of Night, 'Spring Green', 'Virosa', 'Pinocchio' (Fig. 1), 'Valentine (Fig. 2), 'Monsella', 'Hollywood', 'Artist' and 'Shirley'.

The bulbs were planted in the period of 20.10.2009. These where observed in our Transylvanian conditions and recorded for the following morpho-decorative characteristics:

flowering dates, colour of flowers, plant height, length of petals and width of petals. The varieties were compared with the average of experiment of the cultivars (Tab. 1).

The data were statistically analysed (Least Significant Difference - LSD test) to illustrate the significance of differences among studied variants.

RESULTS AND DISCUSSION

The observations and the measurements of main characters of *Tulipa* cultivars are presented in the next 5 tables. Analyzing those tables we can conclude the following:

Regarding the colour of flowers we can conclude that some cultivars are monocoloured ('Menton', 'Queen of Night') some of them are multicoloured with various stripped with different colours on petals ('Monsella', 'Pinocchio', 'Alladin', 'Shirley', 'Ballerina') or some flowers are doubles ('Monsella', 'Virosa') (Tab. 2).

It is a very important to know the flowering period of tulips for echelon the spring landscape design. The 'Hollywood' cultivar has a short blooming period (12 days) while 'Artist' cultivar has the longer blooming period (24 days). First start to bloom in 17 April 2010 - 'Spring Green' and the last was 'Artist' in 05 May 2010.

The height of tulips cultivars is very different. The value of average for this character is 39.45 cm. The most vigorous were 'Menton' and 'Shirley'; they have over 50 cm height, while variety 'Artist' is with less vigorous (23.56 cm). Concerning the plant height 'Menton' and 'Shirley' cultivars achieved a positive significance of difference (Tab. 3).

The petals length has between 6.20 cm ('Queen of Night') to 9.24 cm ('Alladin'). The value of average for this character is 7.39 cm. All the studied cultivars have an exceptional behaviour for garden design (Tab. 4).

The *Tulipa* cultivars present a great range of the petals forms, the petals width have between 2.88 cm ('Alladin') and 6.12 cm ('Shirley'). 'Menton', 'Monsella', 'Pinocchio and 'Shirley' cultivars have a positive significance and other cultivars have not significant differences (Tab. 5).

CONCLUSIONS

Analyzing the 12 new *Tulipa* cultivars in the collection field belonging to USAMV Cluj-Napoca, under Transylvanian conditions, we can conclude the following:

Most of them have a numerous flower types including singles, doubles, smooth to ruffled petal, various colour which may be stripped with different tints, very unique, beautifully sculptured recommended for spring landscape design planted in masses, in border or rockery and excellent commercial tulip ('Pinocchio', 'Monsella', 'Queen of Night', 'Virosa' etc.). They are very attractive, are very good qualities, very lovely and would blend beautifully or accent perennial garden and landscape.

Regarding the main characteristics of the cultivars under study there were found a large variability concerning the plant height, petals length and width. It is a very important to know the flowering period for echelon the spring landscape design.

They can be also use as cut flower for any occasions or make beautiful in the vase ('Menton', 'Shirley', 'Queen of Night', 'Alladin').

The most representative of *Tulipa* cultivars can be also use in our future-breeding program as parents for new hybridizing.

The *Tulipa* cultivars present a great range of the petals forms, the petals width have between 2.88 cm ('Alladin') and 6.12 cm ('Shirley'). 'Menton', 'Monsella', 'Pinocchio and 'Shirley' cultivars have a positive significance and other cultivars have not significant differences (Tab. 5).

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TABLES

Table1

Flowering dates of *Tulipa* culivars

Cultivars	Date to plant bulb	Rising period	Flowering dates			Blooming period (days)
			Start flowering	Maxim flowering	Ending flowering	
Alladin	20.10.2009	08.03.2010	01.05.2010	07.05.2010	21.05.2010	21
Ballerina	20.10.2009	12.03.2010	04.05.2010	10.05.2010	20.05.2010	17
Menton	20.10.2009	22.03.2010	31.04.2010	07.05.2010	17.05.2010	18
Queen of Night	20.10.2009	19.03.2010	02.05.2010	07.05.2010	17.05.2010	16
Spring Green	20.10.2009	14.03.2010	17.04.2010	24.04.2010	01.05.2010	14
Virosa	20.10.2009	12.03.2010	22.04.2010	28.04.2010	07.05.2010	16
Pinocchio	20.10.2009	12.03.2010	20.04.2010	26.04.2010	04.05.2010	15
Valentine	20.10.2009	14.03.2010	22.04.2010	27.04.2010	05.05.2010	14
Monsella	20.10.2009	13.03.2010	20.04.2010	27.04.2010	07.05.2010	18
Hollywood	20.10.2009	23.03.2010	04.05.2010	09.04.2010	15.05.2010	12
Artist	20.10.2009	08.03.2010	05.05.2010	11.05.2010	28.05.2010	24
Shirley	20.10.2009	04.04.2010	25.04.2010	01.05.2010	13.05.2010	18

Table 2

Observations of the flower colour of *Tulipa* cultivars

Cultivars	Colour
Alladin	Red with white border of petals, lilies type
Ballerina	Orange with median dark red-orange, lilies type
Menton	Pink
Queen of Night	Dark violet
Spring Green	White cream with green
Virosa	Red - cherry with cream border of petals, doubles type
Pinocchio	Red with white border, lilies type
Valentine	Dark move with light move border of petals
Monsella	Yellow with red narrow, doubles type
Hollywood	Very dark red with dark median
Artist	Pink with green
Shirley	White with violet border of petals

Table 3

Plant heights of *Tulipa* cultivars

Cultivars	Plant height		Differences	Significance
	Absolute (cm)	Relative (%)	(±cm)	of differences
Alladin	46.06	116.7	6.61	-
Ballerina	45.64	115.6	6.19	-
Menton	56.28	142.6	16.80	***
Queen of Night	49.80	126.2	10.30	**
Spring Green	45.48	115.2	6.03	-
Virosa	28.20	71.4	11.20	**
Pinocchio	28.00	70.9	-11.40	oo
Valentine	38.25	96.9	-1.20	-
Monsella	30.50	77.3	-8.95	o
Hollywood	27.25	69.0	-12.20	oo
Artist	23.56	59.7	-15.80	o o o
Shirley	54.48	138.0	15.03	***
Average	**39.45**	**100.0**		

LSD 5%= 7.45 LSD 1%= 9.97 LSD 0.1%= 13.05

Table 4

Length of the petals of the *Tulipa* cultivars

Cultivars	Flower length		Differences	Significance
	Absolute (cm)	Relative (%)	(±cm)	of differences
Alladin	9.24	125.0	1.85	***
Ballerina	8.68	117.4	1.29	*
Menton	9.16	123.9	1.77	**
Queen of Night	6.20	83.8	-1.19	o o
Spring Green	6.60	89.3	-0.79	-
Virosa	7.40	100.1	0.01	-
Pinocchio	8.00	108.2	0.61	-
Valentine	6.40	86.6	-0.99	-
Monsella	6.88	93.0	-0.51	-
Hollywood	6.33	85.6	-1.06	o
Artist	6.80	92.0	- 0.59	-
Shirley	7.08	95.8	- 0.31	-
Average	**7.39**	**100.0**		

LSD 5%= 1.02 LSD 1%= 1.38 LSD 0.1%= 1.85

Table 5

Width of the petals of the *Tulipa* cultivars

Cultivars	Width of petals		Differences	Significance
	Absolute (cm)	Relative (%)	(±cm)	of differences
Alladin	2.88	65.7	-1.50	o o o
Ballerina	3.76	85.8	-0.62	o
Menton	5.84	133.3	-1.46	***
Queen of Night	3.32	75.7	-1.06	o o o
Spring Green	3.84	87.6	-0.54	o
Virosa	4.56	104.1	0.18	-
Pinocchio	3.55	81.0	0.83	**
Valentine	4.55	103.8	0.17	-
Monsella	6.00	136.9	1.62	***
Hollywood	4.80	109.5	0.42	-
Artist	3.40	77.6	-0.98	o o o
Shirley	6.12	139.7	1.74	***
Average	**4.38**	**100.0**		

LSD 5%= 0.54 LSD 1%= 0.72 LSD 0.1%= 0.95


Fig. 1. Pinocchio


Fig. 2. Valentine

The influence of explants type and culture media during the initiation phase of *Acer platanoides* L.

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Keywords: *Acer platanoides* ‚Globosum’*, Acer platanoides* ‚Crimson King’, *in vitro* culture, explants

ABSTRACT

Taking into account the economic importance of *Acer* species and their frequent use in landscape architecture, both nationally and internationally, it is necessary to develop an *in vitro* biotechnology research to propagate some of the most popular and requested *Acer* varieties. The study presents data on the partial results of *in vitro* initiation for two varieties of *Acer platanoides*: 'Globosum' and 'Crimson King'. During the initiation phase, *Acer platanoides* 'Globosum' showed the best initiation percentage, using the next nutrient composition: MS macroelements, MS microelements, MS vitamins, auxins/citokinine 0,2:1 mg/l, while *Acer platanoides* 'Crimson King' variety recorded the best results on the nutrient medium with a different composition: MS macroelements, MS microelements, LF vitamins and auxins/citokinine 0,4:1,2 mg/l.

INTRODUCTION

'Globosum' and 'Crimson King' varieties belong to *Acer platanoides* species and are easy to propagate by seeds, buds and mostly by cuttings and grafting. Due to their reduce bud regeneration capacity, grafting and propagation by cuttings are hard to perform and as a result, is used the *in vitro* propagation technique.

MATERIALS AND METHOD

For the initial phase of *in vitro* culture, explants were taken from cuttings harvested in a single phonological moment, respectively the dormant phase (November), from the stock-plants.

Harvesting of shoots was carried out following the protocol requirements of the *in vitro* initiation phase. The two nutrient media V1 and V2, tested for the initiation phase had a different composition, in terms of vitamins and phytohormones (Table 1).

Before sharing the media in culture vessels, the pH of nutrient media was adjusted at 5.6-5.8.

Culture media distributed in vessels were sterilized by autoclaving, at 1,1 atmospheres, 120^0C, for 25 de min.

For the initiation phase, the experience has a total of 4 variants, with 3 repetitions each.

Variable factors were:

A - genotype with two graduations, A1 - variety 'Globosum'
A2 - variety 'Crimson King'

B - the nutrient medium, with two graduations, B1 and B2 (Table 2).

The ornamental varieties used were:

- '**Globosum**' - an ornamental tree by 5-6 m height, with globular canopy, round, flatted, with dense and compact branching. Its leaves are initially round, 5 lobed, dull lobes in turn lobate, all peaks acuminate. Leaf color is dark green, becoming golden in autumn (Posedaru, E.A., 2005) (Fig 1.);
- **'Crimson King**' - an ornamental variety with oval canopy, reaches by 15 m in height, with dark purple leaves during summer, very decorative (Fig.1).

Biological material was processed as followed (Fig.2):
- bending;
- microcutting at 2 - 2.5 cm;
- disinfection by washing with water and 2-3 drops of chlorine based disinfectant, followed by sterilization in 96% ethanol for 10 minutes and 6% calcium hypochlorite for 15 minutes;
- rinse in distilled water sterilized by autoclaving.

Explants, consisting in meristematic tissue with 2-3 leaflets were taken under the binocular in aseptic conditions in laminar air flow hood. The explants were maintained on nutrient media during the initiation phase of *in vitro* culture under laboratory conditions: 24° C ± 2ºC temperature, 14 hours photoperiodism and 3500 lux light intensity in the growing chamber.

RESULTS AND DISCUSSIONS

Results were recorded 30 days after *in vitro* culture initiation (Figure 3).

In the initiation phase of *in vitro* culture for the two ornamental maple varieties growth was influenced by two variable factors: nutrient medium composition and genotype.

Following the genotype influence on each nutrient medium we can note that explants from 'Globosum' variety grew faster than 'Crimson King' explants. The best growing percent of explants was obtained on the B1 nutrient medium by 'Globosum' variety with 93.33%, followed by 'Crimson King' with only 53.33% (Fig.4).

Following the culture media influence on explants' growth, we can observe that the B2 nutrient medium is not indicated for A1 genotype, explants showing a 66.66% growing percentage, while 'Crimson King' variety on the same nutrient medium presents the greatest value of 86.66% (Fig. 5).

CONCLUSIONS

We can conclude that the *Acer platanoides* varieties studied, 'Globosum' and 'King Crimson King' had a good behavior during the initiation of *in vitro* culture.

The observations and recorded data led to the following conclusions:

- 'Globosum' variety registered the best growing percentage on the nutrient medium with the next composition: MS macroelements, MS microelements, MS vitamins, citokinine/auxine 1:0,2 mg/l;
- 'Crimson King' variety recorded the best results on the nutrient medium with a different composition, such as: MS macroelements, MS microelements, LF vitamins and citokinine/auxine 1,2:0,4 mg/l;

This study presents only data obtained during the initiation phase. Because our goal is to establish the *in vitro* propagation biotechnology for these ornamental varieties, we will continue to perform research regarding the vitroplants behavior during the multiplication, rooting and acclimatization phases.

ACKNOWLEDGEMENTS

We are grateful to Pitesti University, to prof. univ. dr. Alexandru Teodorescu and asist. univ. drd. Magdalena Duta to make this study possible, for their guidance and great support.

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TABLES AND FIGURES

Table 1

Nutritive media composition tested during the initiation phase

Composition	V1	V2
Macroelements	MS	MS
Microelements	MS	MS
Vitamins	MS	LF
Agar (g/l)	7	7
Dextrose (g/l)	40	40
NaFeEDTA (mg/l)	32	32
Benzil aminopurină (BAP) (mg/l)	1,0	1,2
Indolil acetic acid (IAA) (mg/l)	0,2	-
Naftil acetic acid (NAA) (mg/l)	-	0,4

Legend: MS = Murashige-Skoog (1962), LF = Lee-Fossard (1977)
(Lee E.M.C., De Fossard R.A. 1977 and Murashige T., Skoog F. 1962**)**

Table 2

Experimental variants for *in vitro* initiation of cultures

Variants	Variable factors	
	Genotype	Nutritive medium
V1	A1	B1
V2	A1	B2
V3	A2	B1
V4	A2	B2

Fig 1. *Acer platanoides* 'Globosum' and 'Crimson King' stock plants

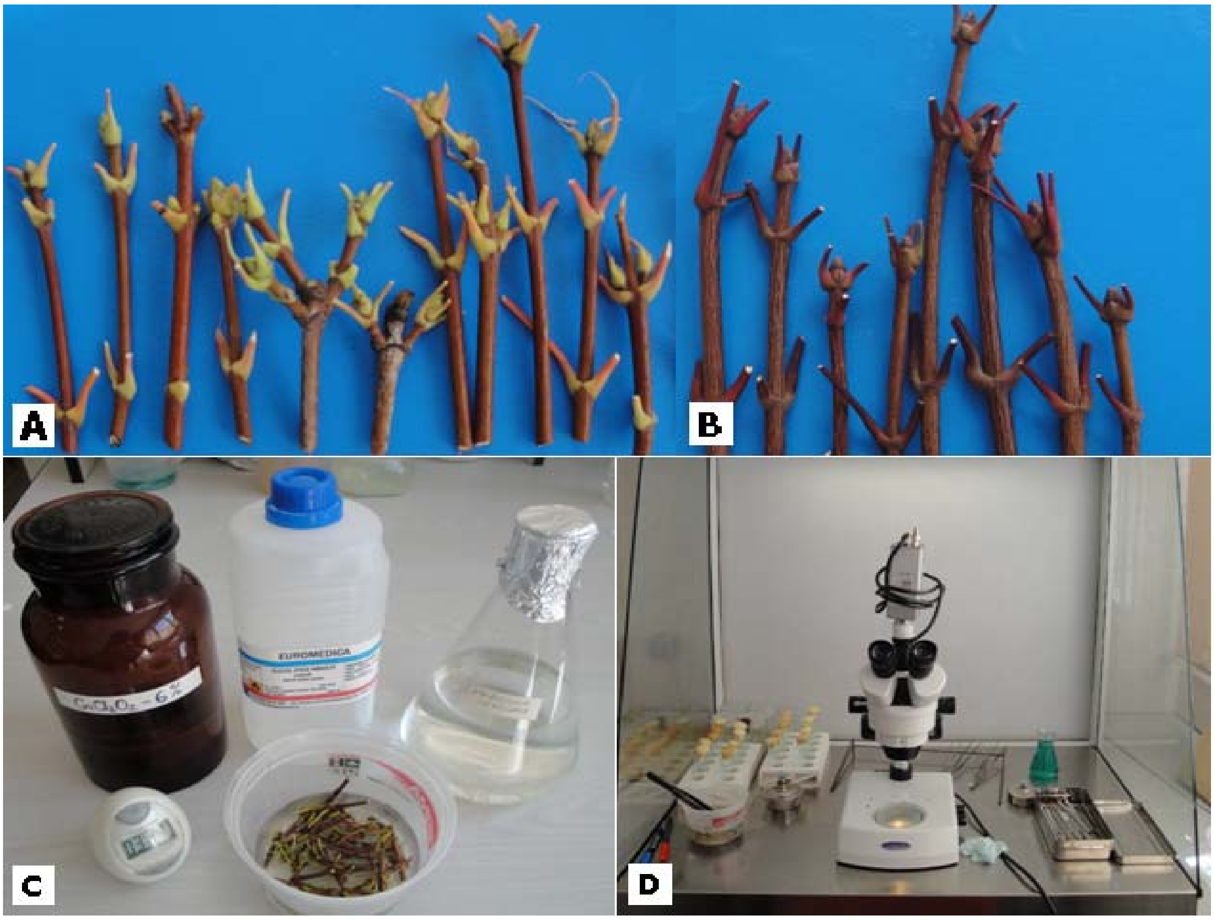

Fig 2. Initiation protocol: A. 'Globosum' cuttings; B. 'Crimson King' cuttings;
C. Disinfection; D. Explants' sampling

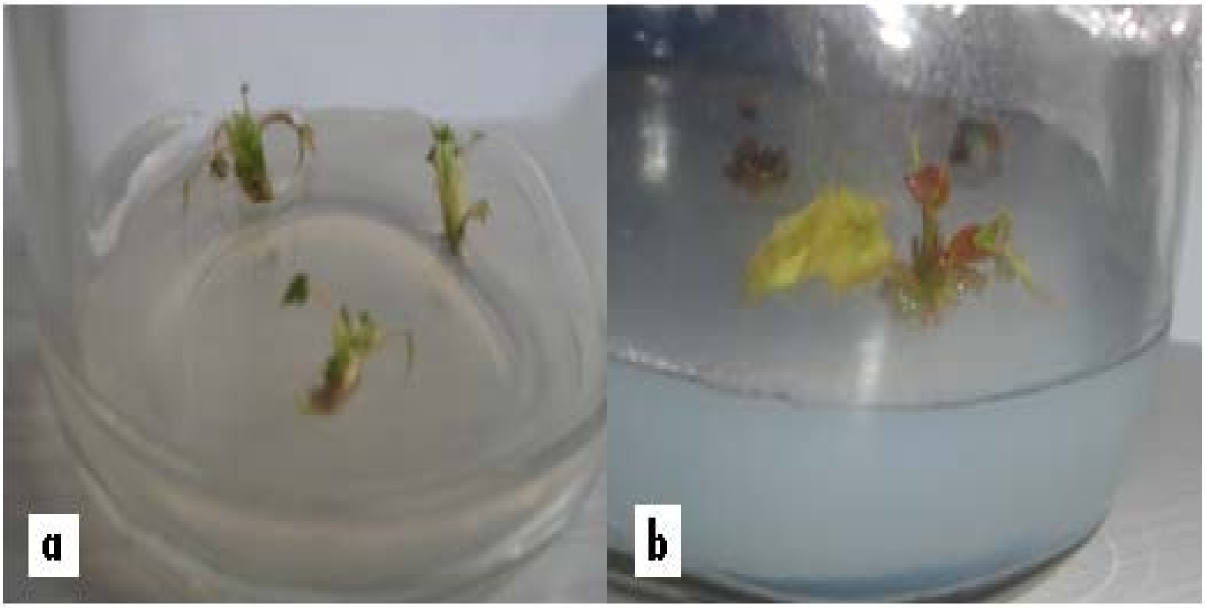

Fig 3. Explants' growing a) 'Globosum' (b) 'Crimson King'

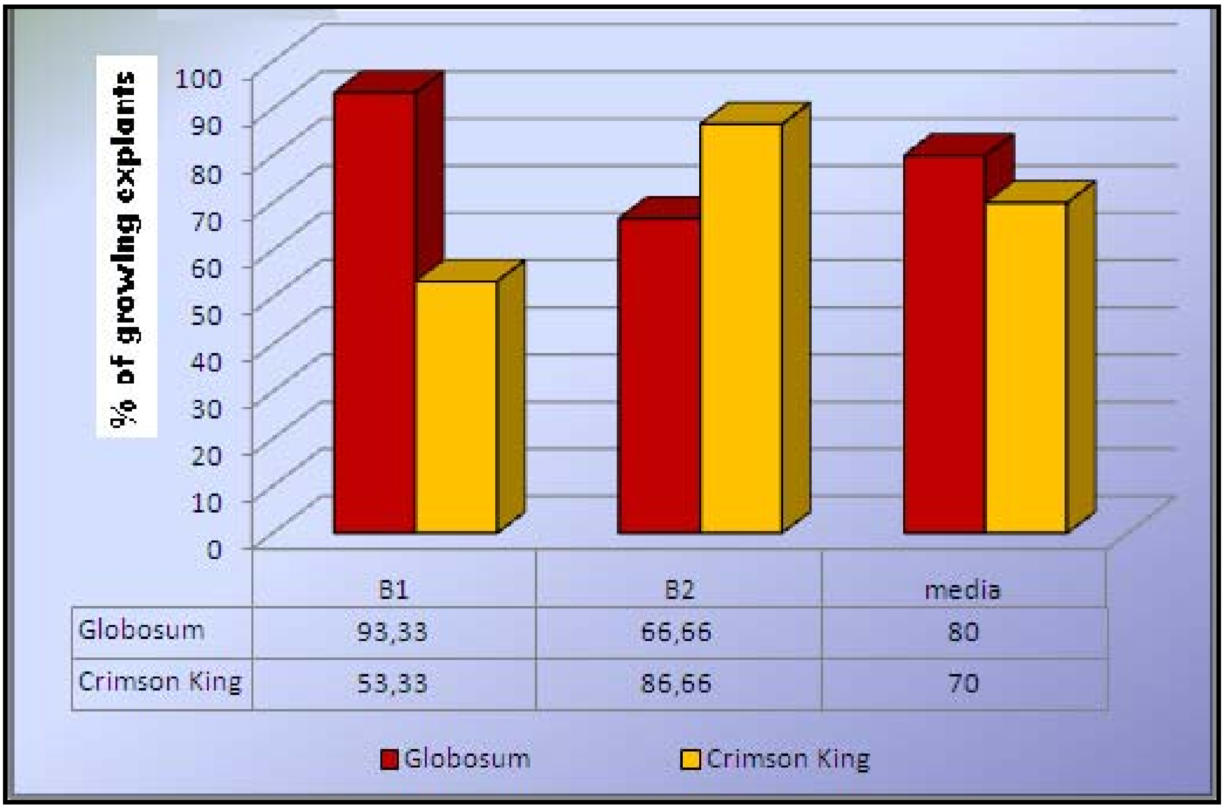

Fig 4. Explants' growing depending on genotype influence

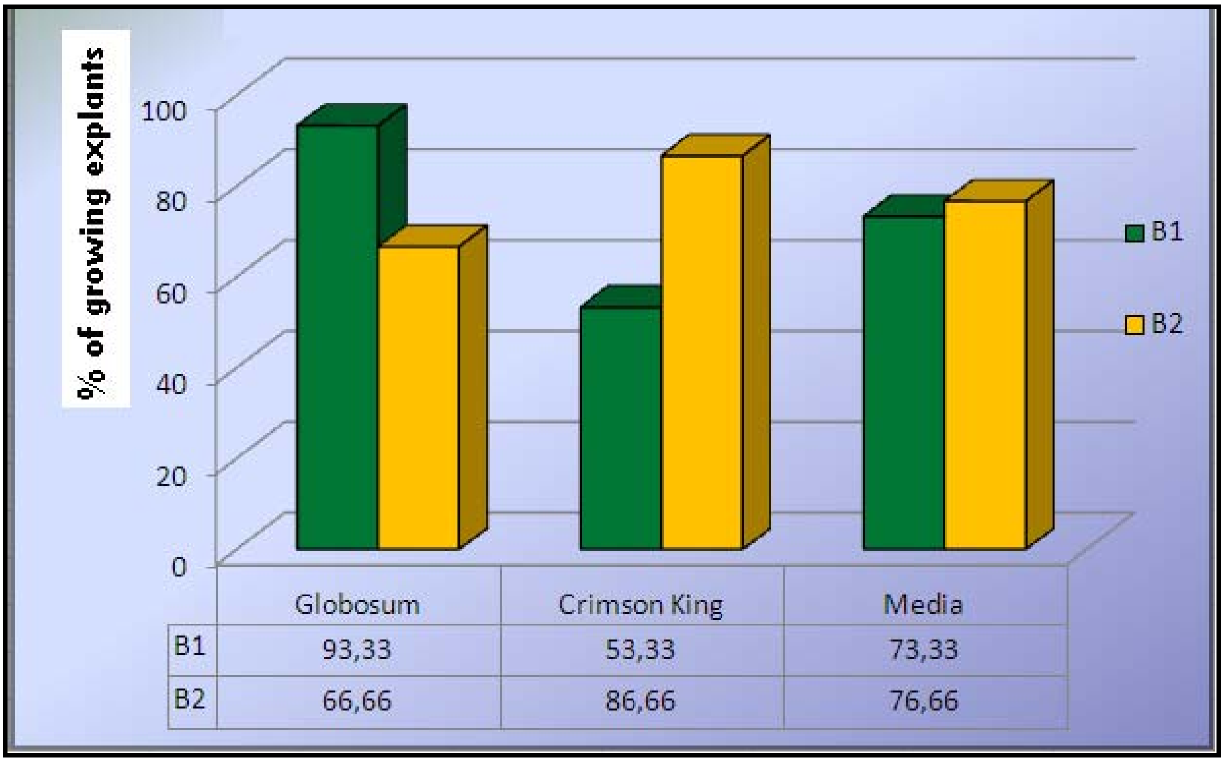

Fig 5. Explants' growing depending on nutritive medium

Rose propagation by cuttings

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Keywords: rooting, rose-propagation, vegetative propagation, Kings Ransom, Mr. Lincoln, Mónika, Peace, Queen Elisabeth, Don Juan, The Fairy

ABSTRACT

Roses are worldwide known for their beautiful blooms. Their propagation is an important question for the rose growers: Which method is the best? All methods have advantages and disadvantages. In our experiment we studied the rooting of seven rose cultivars: Kings Ransom (Hybrid Tea Rose), Mr. Lincoln (Hybrid Tea Rose), Monika (Hybrid Tea Rose), Peace (Hybrid Tea Rose), Queen Elisabeth (floribunda), Don Juan (climber) and The Fairy (ground cover). We chose these cultivars because they are well known and preferred by everyone. After we prepared the cuttings, we treated them with Incit 8 and Radistim hormone powder, and we used a check group. After five weeks they took roots. We measured their root length and root number. The results were variable by cultivars. We reached the best effects with Incit 8. The best rooting cultivar was the Kings Ransom. We propose that we choose another propagating method for the cultivar Peace, because it showed the worst rooting capacity.

INTRODUCTION

Roses are one of those plants, which are cultivated from very long time. These flowers are the most noble and beautiful flowers in the world. In China, in the imperial gardens these flowers were present 5000 years ago. Only since the 16th century they were brought from Asia to Europe. In those times the Hybrid Teas were beloved, and the Bengali roses were precious (Wolfgang, 1998).

The most outstanding pioneer of the Hungarian rose improvement by breeding Geschwind Rudolf a keeper of the forest was Korponai. At the end of 16th century many new cultivars were generated, about 700, and his ennobling work was known world wile. Especially with the *Rosa setigera* has got new, incomparable results. His literary work has a great value. The most important of his creation is a German book, entitled: „*Die Hybridisation und Sämlingszught der Rosen*”. In this book the author is treating the growing of the seedlings and about the ennobling (Wagner, 2002).

The roses can be propagated in generative or vegetative ways. In the case of generative propagation we understand the fling of the seeds. The vegetative propagation can be realized by rooting (cuttings, layer), inoculation, and propagation by division and micro-propagations.

The propagation by cuttings has advantages and disadvantages. An advantage is that in this way the genetic and phenotypic attributes can be preserved, because there is no stock, what could have impact on nobility. However, they do not need stock removing, which is an extra work occurs in case of multiplied roses. The cuttings can be produced simple and fast even at home. One disadvantage is that some cultivars are sensible on frost and the soil.

The aim of our experiment was to find the answer for the question: which cultivars are able to be propagated by cuttings, which cultivars have the best rooting aptitudes.

MATERIALS AND METHODS

In our experience we analyzed the rooting vigour and the flower purchase of seven noble rose cultivar.

The choosing criterions of the seven cultivar were:

- to be characteristic for bigger groups, like Hybrid Tea Roses, floribundas, climbers and ground covers

- to be popular cultivars
- to have different flower colours in the group
- to be liked and preferred
- to have more flowering waves (min. 2)

Monika – Hybrid Tea Rose, Mr. Lincoln – Hybrid Tea Rose, Queen Elisabeth- floribunda, The Fairy- ground cover, parc rose, Peace – Hybrid Tea Rose, Kings Ransom- Hybrid Tea Rose, Don Juan- climber.

On 4th July we picked the plant parts necessary for the cuttings. For propagation with cuttings we needed 2-3 joint legs. From the collected legs we cut the lower leaf, we kept the other two, because those are conducting the assimilation and affect the rooting.

We treated the cuttings with Incit 8 and Radistim rooting hormones. Apart from these we used a control group; where we didn't use anything. We placed the cuttings in the propagating medium, in Perlit.

The boxes were placed in a greenhouse, with an automatic humidifier system, which ensured the optimal conditions for the rooting. After four weeks, on 3th August we potted the rooted plants. Before the planting, we measured the length of the roots and we counted them.

The potted plants were left in the greenhouse, bathing the frequency of humidifying.

The results of different cultivars were evaluated with the double factor ANOVA program.

The statistical evaluation was effectuated by the Past program. Fort the statistic evaluation of the basic data, we used the logarithm with a decimal basis, reducing the dispersion.

We talk about significant differences between the stock and the improved combination if:

The value of *p*	Level of the significant difference	Significant difference that can be conformed
p<0,05	* the difference is significant	95%
p<0,01	** the significant difference is high	99%
p<0,001	*** the significant difference is too high	99,99%

RESULTS AND DISCUSSION

The roses showed differences between cultivars and treating.

In case of The Fairy cultivar the Incit 8 rooting hormone influenced the length of the roots. The treating with the Incit 8 shows a too high significant difference (***p<0,001), facing to the control (p= 0,000129) and the treating with Radistim (p= 0, 0,00108) in consideration of the length of roots (Fig. 1.).

For the Don Juan cultivar the results were almost identical for all three categories. In this case the Radistim rooting hormone was more efficient like the Incit 8, but there isn't significant difference between the examined groups (Fig. 2.).

Examining the Kings Ransom cultivar, we remarked significant difference (*p<0,05; p= 0.05) to the Incit 8 in front of Radistim (Fig. 3.). The media of the roots length in the control group was only 1,72 cm, this was lower than from the group treated with Incit 8 (3,3 cm) and Radistim (2,5 cm). Considering the number of the roots Incit 8 this showed the best results (5,7 pieces), the group treated with Radistim has a lower number of roots (2,4 pieces), than the control (2,8 pieces). Between the group treated with Radistim and Incit 8 there is significant difference (p<0,05) (Fig. 3.).

In the case of Peace cultivar the results of the control group shows significant differences referring to the length and the number of roots.

The Incit 8 rooting hormone resulted again a high number of roots (*p<0,05; p=0,0405), correlated to the Radistim, and a too high significant difference for the control group (***$\boldsymbol{p}$<0,001; p= 0,000189) (Fig. 4.). In the case of the media length of the roots the Radistim (**$\boldsymbol{p}$<0,01; p=0183) and the Incit 8 (**$\boldsymbol{p}$<0,01; p=00214) (Fig. 4.).

The measurements data of Queen Elisabeth floribunda referring to the number of the roots we find almost the same results, so there are no significant differences. Contrary, the treatment with Incit 8 shows significant differences against the controll (**$\boldsymbol{p}$<0,01; p=0,0047) and the Radistim (*$\boldsymbol{p}$<0,05; p=0,0306) as far as the length of roots (Fig. 5.).

In case of Mr. Lincoln cultivar the Radistim showed a too high significant difference referring to the number of roots (***$\boldsymbol{p}$<0,001; p= 0,000149) and to the length of roots (***$\boldsymbol{p}$<0,001; p= 0,000340) contrarily to control. We have got the best results using the Incit 8 rooting hormone, which influenced again the number of roots (Fig. 6.).

The treated cuttings with rooting hormone don't showed significant difference toward up the untreated cuttings in case of Mónika Hybrid Tea rose. There is no significant difference neither in the media length of roots, nor in the number of roots (Fig. 7.).

If we compared the length of roots, the The Fairy cultivar showed the highest media length (9,6 cm), followed by Don Juan (7,4 cm), Mr. Lincoln (7 cm), Queen Elisabeth (5,8 cm), Kings Ransom(2,8 cm), Mónika (2,8 cm), and Peace (2,45 cm), (Fig. 8.).

Studying the media number of roots the order of cultivars is changing. So the order is the following: Mr. Lincoln (19,3 pieces), Queen Elisabeth (9,3 pieces), Don Juan (7,4 pieces), Mónika (6,8 pieces), The Fairy (6,4 pieces), Kings Ransom (5,7 pieces), Peace (5,1 pieces), (Fig. 9).

CONCLUSIONS

Resuming the data above, we can establish that the cultivars reacts in different ways to the rooting hormones. The best results were obtained using the Incit 8 hormone.

Our experiment is demonstrating that we can't denominate cultivar groups, which are rooting better. For example we can't say that the Hybrid Tea cultivars are better rooting, than the climber cultivars, because the media of the results referring to the rooting is differing, inside a variety group.

So there is the question, what is more efficient in case of the propagation: if the cuttings have long roots or the number of the roots is higher? In planting it is better if the cuttings have a higher number of roots, and these are shorter. In case of the planting of the longer roots the appearance of lesions are higher and this is affecting the development of the plants.

With this viewpoint from the selected cultivars the Mr. Lincoln, Queen Elisabeth and Don Juan cultivar correspond to propagation by cuttings. For these cultivars the media of data referring to the number and the length of roots are suitable.

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FIGURES

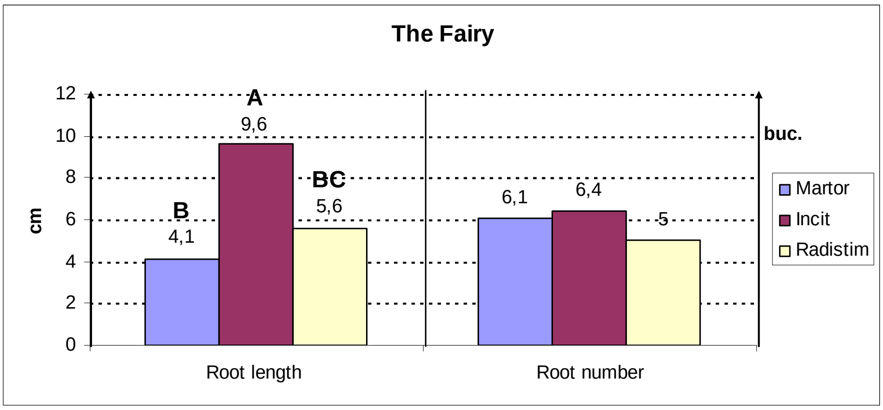

Fig. 1. Media of the length and number of roots for The Fairy cultivar

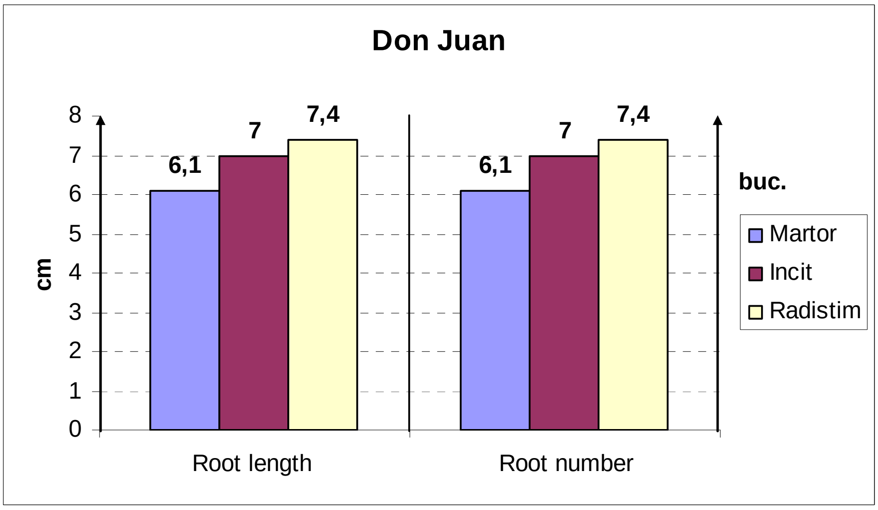

Fig. 2. Media of the length and number of roots for Don Juan cultivar

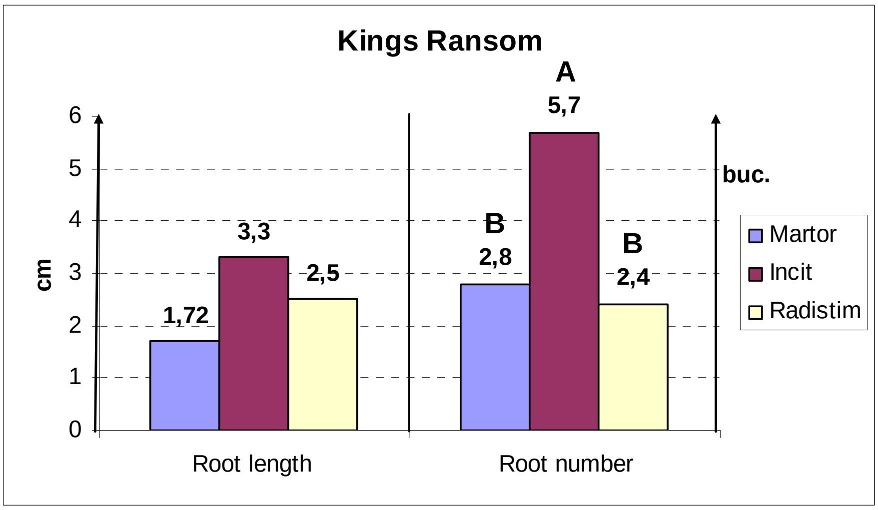

Fig. 3. Media of the length and number of roots for Kings Ransom cultivar

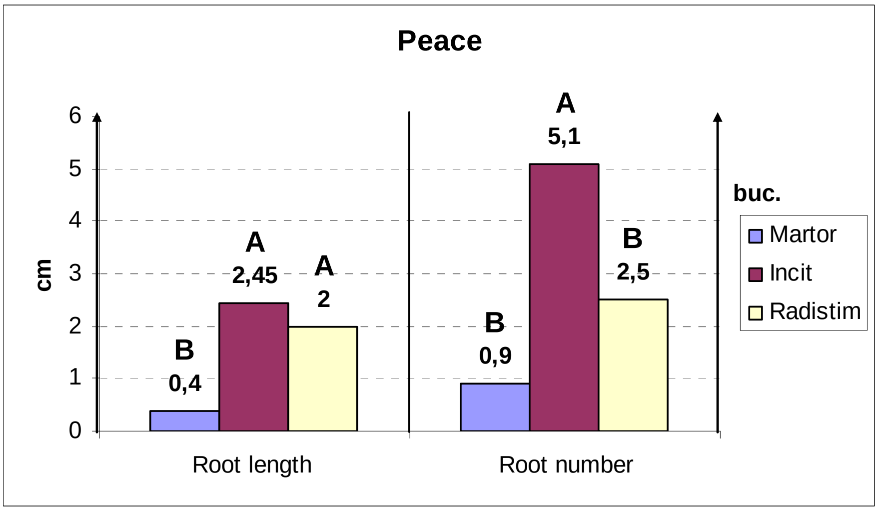

Fig. 4. Media of the length and number of roots for Peace cultivar

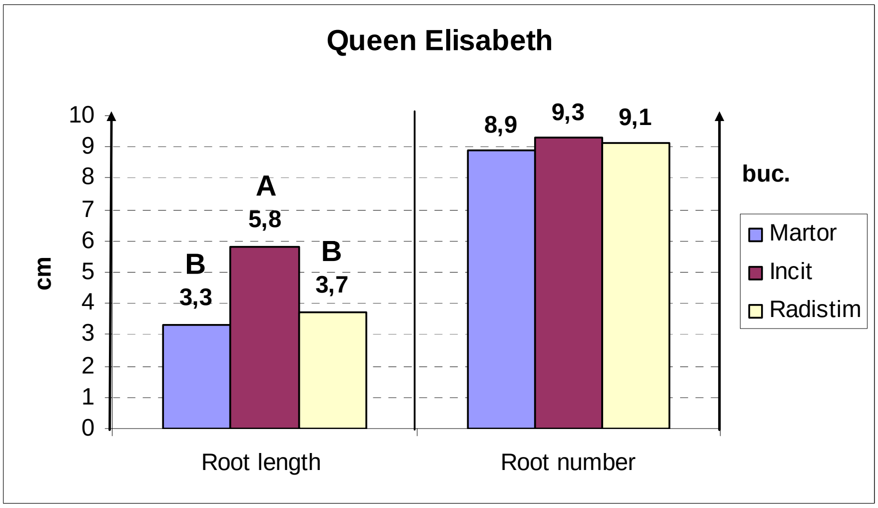

Fig. 5. Media of length and number of roots for Queen Elisabeth cultivar

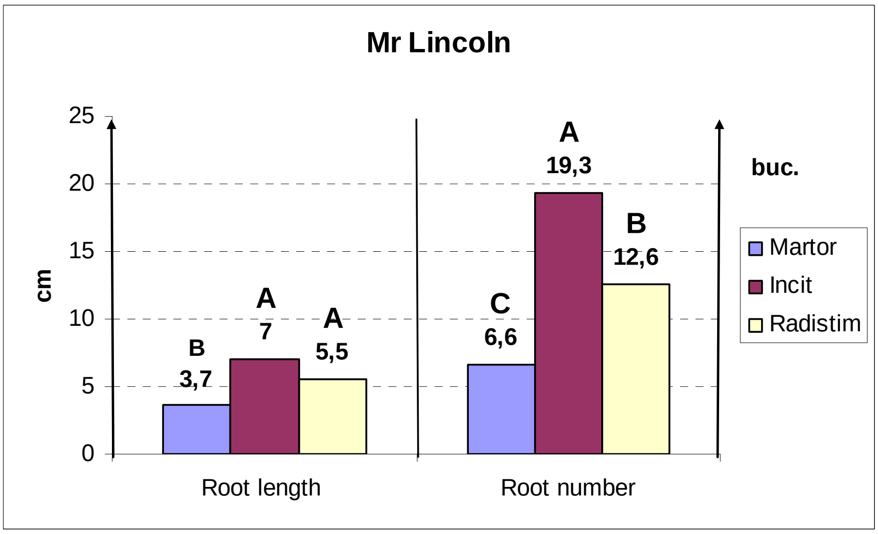

Fig. 6. Media of length and number of roots for Mr Lincoln cultivar

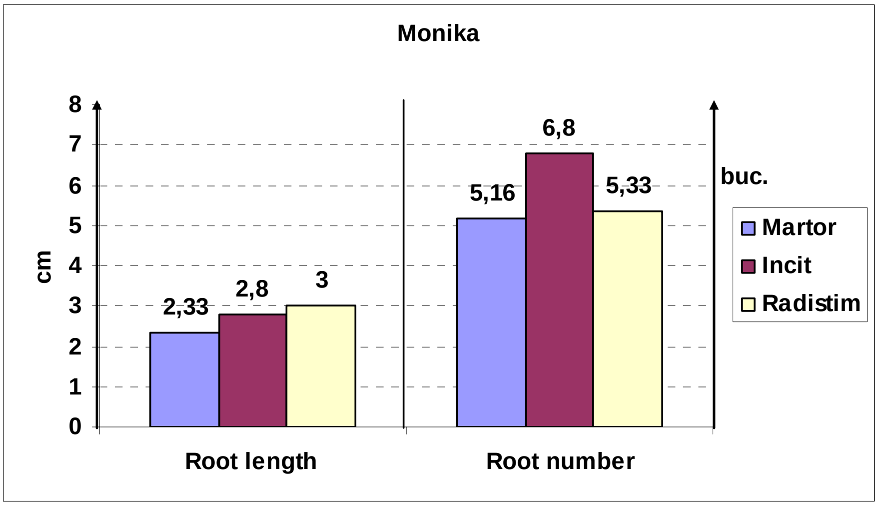

Fig. 7. Media of length and number of roots for Mónika cultivar

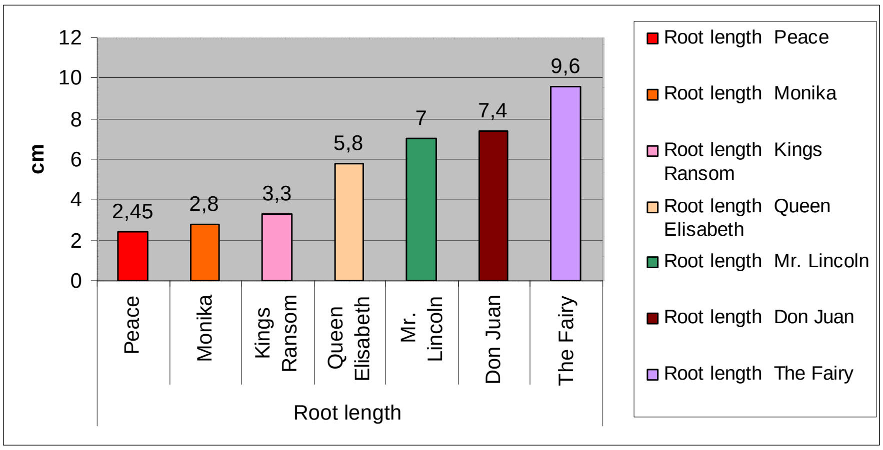

Fig. 8. Media of the length of roots for the examined rose cultivars

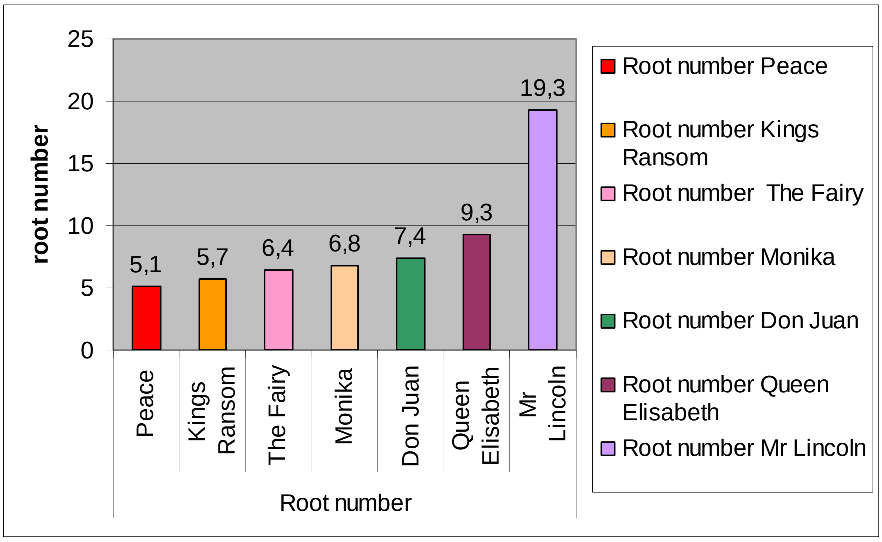

Fig. 9 Media of the number of roots for the examined rose cultivars

Aspects concerning some methods for the propagation of *Hippeastrum hybridum* bulbs

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Keywords: chip, twin scales, notch.

ABSTRACT

One of the major problems of Hippeastrum is the large amount of labour involved in its production. In our country there are two common methods for the propagation of the Hippeastrum- seeds and offset bulblets (bulbils).

Study on various methods for the propagation of Hippeastrum was conducted in the greenhouse of Horticulture Faculty USMV Bucharest using Roma hybrid, with very decorative flowers but with very low propagation coefficient.

Using propagating of Roma bulbs by notching, from chips and twin scales were developed more bulblets from one bulb, depending the methods.

INTRODUCTION

The *Hippeastrum hybridum* is a bulb with a promising economic future. Nevertheless this branch of horticulture is not steady and a large number of growers abandoned it mainly because of the large amount of labor involved in its production.

Because of the large variation in characteristics of the flowers, plant shape, time of flowering and others, the propagation by seeds it usually used for the development of new cultivars.

Only cultivars that produce at least three offset bulblets are suitable for propagation by offsets division.

In most cases the propagation is done by method known as twin scaling (Luyten, 1926, Heaton, 1934, Rees, 1985, Ephrath et al, 2001, Read, 2004).

This method is the most widely used propagation technique by commercial breeders and growers.

Chipping is also used for building up stocks of new cultivar from small initial quantities (Read, 2004).

Notching or basal cutting is used by Indian and South African breeders in addition to, or as an alternative to twin scaling.

Research undertaken in India in the late 1970s by Gupta and Kher, found notching to be quick, safe, effective and reliable (Gupta and Kher, 1987).

This was the reasons to test methods for a fast reliable technique for the propagation of Hippeastrum bulbs.

MATERIALS AND METHODS

Hippeastrum mother bulbs (*Hippeastrum hybridum* cv. *Roma*) of similar size (22 cm circumference) were cut for propagation using seven methods (Table 1).

Before chipping (for treatment 1 – 6) was removed the bulb's neck, the roots, cutting as possible to the basal plate and taking care not to damage the basal plate. T

he dividing of the bulbs into segments (chips) was done in such a way that which segment contained a portion of the mother bulb's basal plate.

For preparing twin scale starting from the outside, carefully peeled away the 2 outer most scales from one of the segments (chips).

Using a sharp blade was made vertical cut through the basal plate separating the 2 scale from the rest of the segment. It is essential that both scales remained attached to the basal plate.

All chips and twin scales (treatment 1 – 6) where treated for 30 minute with a systemic fungicide and then were placed into polyethylene bags containing dampened perlite. After shaking, the bags were inflated and placed upright in the heating propagator allowing spaced between the bags.

The propagator was covered with dark blanket to ensure no light penetrated.

The temperature was maintained at the level of 27 – 29 ^{o}C, up to 12 weeks.

For notching technique (treatment 7), the roots where cut back to about 2,5 cm from the basal plate and all leaves were removed by cutting level with the neck of the bulb.

Then were made 4 cuts through the basal plate up to two-thirds of the length of the bulb, so that the segments remained attached at the top.

The bulbs were planted in a large pot using peat from the market. All bulblets developed from chips, twin scales and notching bulb were planted in small pots.

RESULTS AND DISCUSSION

Increasing number of segments into which the bulb was cut into resulted in a larger number of bulblets (Table 2).

The proportion of the number of the bulblets developed to the number of sections into which the bulb was divided was defined as a propagation coefficient.

This coefficient was larger than one unit in cases where the bulb were cut into un-separated segments (chips) and smaller than one in cases where the bulbs where cut into segments and separated into twin scales.

When the bulbs were cut into segments (chips) each segment produces at least one bulblet (Table 3).

The average number of bulblets yielded from each mother bulb increased as the number of sections into which it was cut.

However these bulblets were smaller than those that resulted where the mother bulb was divided into fever section.

These results explained by a smaller quantity of available nutrients in the twin scaled and segments in the case increase in the number of sections. Presented results confirmed those obtained by Ephrath et al (2001) with Red Lion cultivar.

The least treatment, represented by notching method, where were made four cuts through the basal plate up to two-thirds of the length of the bulb so that remained attached at the top, around mother bulb developed 5 bulblets.

CONCLUSIONS

Increasing the number of segments (sections) into which the bulb is cut into, results in a larger number of bulblets.

The propagation coefficient (the proportion of the number of bulblet developed to the number of segments in to which the bulb was divided) had different valued depends the methods.

This was larger than one unit in cases where the bulb was cut into un-separated segments (chips) and smaller than one where the bulbs were cut into segments and separated into twin scale.

Notching method with four cuts through basal plate up to two-thirds of the length of the bulbs so that the segments remained attached at the top, developed at least one bulblet from each notch.

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TABLES

Table 1

Description of the cutting methods used in the propagation and the number of segments for each procedure

Treatment	Description of procedure	Number of segments
1	Cut into halves	2 segments (chips)
2	Cut into quarters	4 segments
3	Cut into eights	8 segments
4	Cut into twelfths	12 segments
5	Cut into eights and separation	32 twin scales
6	Cut into twelfths and separation	48 twin scales
7	4 notches	4 segments attached at the top

Table 2

Average number of bulblets derived from one mother bulb in various cutting methods

Treatment	Cutting method	Number of developed bulblets from a bulb
1	2 segments	2.2
2	4 segments	4.2
3	8 segments	8.3
4	12 segments	12.6
5	32 twin scales	27.2
6	48 twin scales	33.4
7	4 notches	5.0

Table 3

The effect of the various cutting methods on the propagation coefficient

Treatment	Cutting method	Propagation coefficient
1	2 segments	1.10
2	4 segments	1.05
3	8 segments	1.04
4	12 segments	1.05
5	32 twin scales	0.85
6	48 twin scales	0.69
7	4 notches	1.25

Contribution to knowledge the volatile oil from *Hippeastrum* flowers

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Keywords: *Hyppeastrum,* volatile oil, floral scent, perfume.

ABSTRACT

***Hippeastrum* flowers generally had no scent. Only a small number of cultivars as Dancing Queen have a weak scent. In the volatile oil of this cultivar was determined a great quantity of eucalyptol (23.67), linalool (4.92%), farnesene (4.26%), octanol (5.06%) and diphenylethylbenzoate (3.41%). The main classes of substances identified in the perfume of this cultivar were: terpenes (38.55%), esters (9.76%), alcohols (6.23%), hydrocarbures (1.42%) and aldehydes (0,55%).**

INTRODUCTION

Hippeastrum is a flower bulb, native to tropical and subtropical regions of Central and South America. The flowers of the most species of this genus have no volatile substances, respectively perfume, but their beauty and splendour compensate this drawback. Some species as *H. fragrantissimum* and hybrids have a strong perfume. Boatman et al (1997) determined 49 aliphatic, sulphur compounds and terpenes.

Our study was focused on the chemical compounds from the volatile oil of a scented *Hippeastrum* cultivar.

MATERIALS AND METHODS

The investigations were carried out with *Hippeastrum* flowers *"Dancing Queen"* cv. from the greenhouse of USAMV Bucharest.

Volatile substances were extracted from flowers by hydrodistilation, using for this purpose a device type Singer Nikerson and their capture was made in hexane.

Separation of components was performed by an AGILENT gas chromatograph, with a masspectrometric detector, with quadrupol. It was used a capillary column type DB5 having a length 30 m and diameter of 0,25 mm, helium as carried gas. The initial temperature of the oven was 50 ^{o}C, isothermal 4 minutes and increased to 280 ^{o}C, with a gradient 4 ^{o}C/ minute.

The identification of substances was made by NIST library, to confirm exact positions of the peaks in chromatogram were used the Kovats retention index and a series of n-alkanes as references.

RESULTS AND DISCUSSIONS

The chromatogram of volatile substances extracted from *Hippeastrum* flowers, Dancing Queen cultivar is presented in figure 1. Where identified 21 substances and their concentration is presented in table 1.

From the total identified components the greatest amount was represented by the terpenes and from these, eucalyptol, a bicycle monoterpen, represented 23.67% from the total identified compounds. It was also identified linalool, an acyclic monotype, (4.92%), α-foreseen an acyclic sesquiterpene (4.26%) as well a phenolic compounds phenylethylbenzoate (3.43%) and an alcohol: octanol (5.06%).

Less than 2% from the total substances of the *Hippeastrum* volatile oil was recorded in the case of the next compounds:

Terpenes: eucalyptol, cymene, cis-ocimene, linalool oxide, terpinolene, dihydrocarveole, estragol and α-terpineole with a content of 38.55% from the total identified compounds.

Alcohols: octanol, hexanol, butyloctanol with a content of 6.23% from the total identified components.

Esters: diphenylethyl benzoate, benzyl benzoate, 2,4-dimethyl heptane, 2,4-dimethyl heptene, dimethyl nonane, methyl undecane, 2,6,11-trimethyl dodecane, methyl tetradecane, 2,6,10-trimethyl tetradecane with the content of 9.76% from the total identified component.

Aldehydes are represented by the heptanal with a content of 0.55% from the total.

Hydrocarbures represented by undecane with a content of 1.42% from the total.

CONCLUSIONS

Hippeastrum flowers cv. *Dancing Queen*, had a low content of volatile oil; this was the reason for using the hexane as capture.

In their perfume was determined a greater quantity of eucalyptol (23.67%), linalool (4.92%), -farnesene (4.26%), octanol (5.06%) and phenylethylbenzoate (3.43%).

The main classes of substances identified in the volatile oil of *Hippeastrum* flowers cv. *Dancing Queen* was: terpenes (38.55%), esters (9.76%), alcohols (6.23%), hydrocarbures (1.42%) and aldehydes (0.55%).

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TABLE AND FIGURE

Table 1

The main components from volatile oil of *Hippeastrum flowers*

No	Substance	Retention time	% from total
1	2,4-Dimethylheptane	8,15	1,40
2	2,4-Dimethylheptene	9,52	1,26
3	Hexanol	10,40	1,26
4	Heptanal	11,69	0,55
5	2-Pentilfurane	15,72	1,66
6	Dimethylnonane	16,78	0,65
7	Cimene	17,34	0,68
8	Eucalyptol	17,68	23,67
9	cis-Ocimene	18,45	0,45
10	Octanol	19,47	5,06
11	Linalooloxide	19,67	1,90
12	Terpinolene	20,22	0,68
13	Linalool	20,96	4,92
14	Undecan	21,15	1,42
15	Dihydrocarveole	21,40	0,64
16	α -Terpineole	25,51	0,75
17	Estragol	25,88	0,60
18	Methylundecane	29,82	0,58
19	Butyloctanol	31,04	1,09
20	2,6,11-Trimethyldodecane	31,96	0,64
21	Methyltetradecane	38,64	0,41
22	α-Farnesene	38,97	4,26
23	2,6,10-Trimethyltetradecane	39,81	0,71
24	Benzylbenzoate	44,09	0,68
25	Phenylethylbenzoate	45,31	3,43

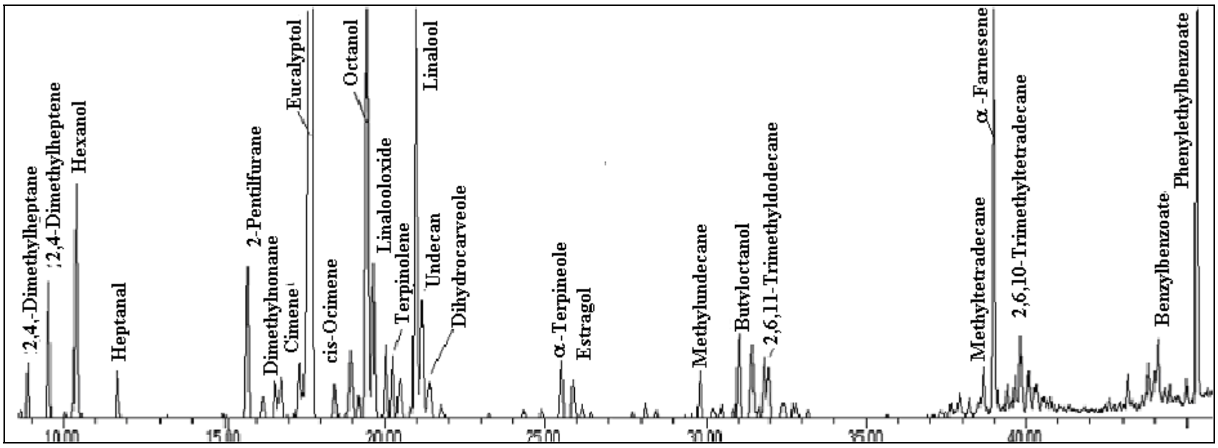

Fig. 1. The chromatogram of volatile oil extracted from *Hippeastrum* cv. Dancing Queen

Berberis thunbergii 'Atropurpurea Nana' comportment in containerized culture

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Keywords: slow-release fertilizer Osmocote Plus, leaves compost, rates of fertilizer.

ABSTRACT
The research had the study target of cultivar's comportment in containerized culture, in dependence of three growth media: V_1 - mould, leaves compost, peat, sand, 2:2:2:1; V_2 - peat, leaves compost, sod soil, sand, 1:1:1:0,5; V_3 - peat, leaves compost, sand, 1:0.8: 0.2 and, the influence of the Osmocote Plus slow-release fertilizer in 4 kg/m^3 and 5 kg/m^3 rates of administration. The best results of annual growth have been obtained at the V_1 with 4 kg/m^3 rate of fertilizer.

INTRODUCTION

From the agronomic point of view the culture substrate is a mixture of organic compounds alone or in combination with mineral components, specifically tested for growing plants, usually in containers, especially for woody plants.

For this reason, the species grown in pots and containers, such as woody plant, where gradually in the technology culture, the soil was replaced with substrates, mostly organic materials. Culture substrates can provide aeration to the root system and a balanced amount of water and nutrients (Florescu, 1999).

Plant culture in the container is a technology of a major need for both horticulture and, the economy as a whole Republic of Moldova. In this article we proposed the study comportment of *Berberis thunbergii* 'Atropurpurea Nana' containerized plant on different substrates, under the administration of slow-release fertilizer Osmocote Plus.

Berberis thunbergii 'Atropurpurea Nana' is a most popular Japanese Barberry selection. This low, dense plant grows and reaches the height from 0,5 to 0,6 m and the diameter between 0,5-1,0 m. The reddish purple superb foliage colour is best when the plant is grown in full sun until dark-red or dark red-brown. Yellow flowers blooms on May. Fruits berries, red-bright, glossy. It grows well on any soil, from relatively weak acid to alkaline, and is frost resistant. It lends itself well to trimming. The plant was raised by Van Eyck in Boskoop, Holand, in 1942. Unfortunately, it has been sold under the name 'Little Gem', 'Little Beauty', 'Little Favorite' and 'Crimson Pygmy'. It is an excellent landscape plant and can be used for a multitude of purposes (Dirr, 2005).

MATERIAL AND METHODS

The researches on the territory of the Botanical Garden (Institute) of ASM, Chisinau, during the growing seasons 2006-2007 were performed. In our study as a biological material the cultivar *Berberis thunbergii* 'Atropurpurea Nana' served.

Following the growing media were established: V_1 - mould, leaves compost, peat, sand, in proportions of 2:2:2:1, V_2 - peat, leaf soil, sod soil, sand in the proportion 1:1:1:0.5; V_3 - peat, leaves compost, sand 1:0,8:0,2 proportion. Components that are part of the substrate have been thoroughly mixed, the peat previously was moistened for not to leave on the substrate surface during watering.

Biological material aged 3 years were transplanted from containers of 2 litres in containers of 5 litres. Before transplanting, the plants, with the entire container they were kept for 20-30 minutes in a volume of weak solution of $KMnO_4$. The root system was shaped.

In mixture tested recipes, the variant of solid fertilization with slow-release fertilizer under the trade name of Osmocote Plus of 5-6 months longevity of action (the substrate temperature ≈ 21^o C) was applied.

The chemical composition of this fertilizer is as follows: NPK 15+9+9 (+3 Mg); 15% N - (7,1% NO_3; 7,9% NH_4); 9% P_2O_5 (4.0% P); 7,1% P_2O_5 (3,1% P); 9% K_2O (7,5% K); 3,0% MgO (1,8% Mg); 1,5% MgO (0,9% Mg); 0,02% B; 0,047% Cu; 0,40% Fe; 0,06% Mn; 0,020% Mo; 0,015% Zn. For determining the effectiveness of applying the rate of administration of solid slow-release fertilizer were tested rates of 4 and 5 kg/m3 kg/m^3 per substrate for both periods of experimentation and research. Fertilization rates with control variant were compared.

The variants were placed by 20 units, according to the method of subdivided parcels. Registration containerized plants and the aerial parts of biometric measurements were made at the time for the moment of planting in containers and were concluded at the end of the second cycle of vegetation. To achieve the objectives proposed, measurements and determinations were made on average increase plant growth container on various substrates. The growth increase of the aerial part of plants in containers was determined through measurements, also the difference between plant height grown throughout the period of vegetation and their initial of the plant. Based on these measurements were calculated growth parameters of aerial part and the influence of fertilizer given to these rhythms (Ceapoiu, 1960, Dospehov, 1985).

RESULTS AND DISCUSSION

The results obtained in plant growth and development of *Berberis thunbergii* 'Atropurpurea Nana' was statistically processed and is presented in table 1. Statistical analysis of results showed that the cultivar studied ornamental plants differed at all levels of statistical assurance. In the years of study the higher efficiencies of growth containerized plants under the administration of fertilizer experimented, compared with control, unfertilized were established.

In the case of plants grown on the culture substrate V_1 was revealed that the final height of the highest value was found in the standard administration of 4 kg/m^3, recording the final value of the average height of 28,5 cm in first year culture and 39.0 cm in the second year of cultivation (table 1); the same phenomenon was noted for plants grown in substrate culture V_2, recorded an average final height of 27,4 cm in the first year of cultivation and 36,6 cm in the second (table 1). In the case of plants grown on the culture substrate V_3 best outcome for growth at the end of two growing seasons were recorded in containerized plants under fertilization administration of 5 kg/m^3, recorded values of 26,4 cm in 2006 and 34,3 cm in 2007 (table 1).

Table 1 gives an overview of annual growth, depending on the substrate of culture, rates application of fertilizer with slow-release action in two seasons of vegetation,

Wining those plants grown in substrate of culture V_1 fertilized with Osmocote Plus in the rate of 4 kg/m^3 recorded the largest increases. At *Berberis thunbergii* 'Atropurpurea Nana' the differentiation of annual growth in the experiments was determined by the used substrate and, the rate of fertilization thus, the plants grown on the substrate of culture V_1 showed a higher annual average growth (6,2 cm unfertilized version, 10,5 cm and 10,2 cm by 4 kg/m^3 in 2007), than in V_2, V_3 in both seasons of vegetation.

CONCLUSIONS

At the cultivar *Berberis thunbergii* 'Atropurpurea Nana' the maximum annual increase occurred in plants grown on the substrate of culture V_1 consisting of mould, leaves compost, peat, sand, in proportions of 2:2:2:1, on the base of administration the rate of 4 kg/m^3 of Osmocote slow-release fertilizer. After the administration of Osmocote fertilizer, the value of annual growth of containerized plants is much higher, compared with the plants that received no fertilizer, resulting in a significant difference in annual growth indices between fertilized and unfertilized plants.

Annual growth of *Berberis thunbergii* 'Atropurpurea Nana' cultivar showed higher values in the second year of culture, this phenomenon being explained by the fact that in the first year of cultivation, the plants were transplanted to the container, therefore, had a period of the so-called physiological stress because of injuring the root system during its transplanting.

Plant growth and development in container conditions depends on rate of fertilizer administration and biological temperament (rhythm) of plant growth, identifying to be an inverse correlation between plant growth and the rate of fertilizer administration.

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TABLE

Table 1

Tags *Berberis thunbergii* 'Atropurpurea Nana' cultivar growth in terms of container

Variant substrate	Control			4 kg/m^3			5 kg/m^3		
	Initial height, cm	Annual growth, cm	Final height, cm	Initial height, cm	Annual growth, cm	Final height, cm	Initial height, cm	Annual growth, cm	Final height, cm
Year of vegetation 2006									
V_1	18,4 ± 0,60	5,7 ± 0,50	24,1 ± 0,71	18,7 ± 0,71	9,8 ± 0,36	28,5 ± 0,91	18,8 ± 0,59	9,3 ± 0,47	28,1 ± 0,69
V_2	18,2 ± 0,61	5,5 ± 0,43	23,7 ± 0,68	18,8 ± 0,64	8,6 ± 0,5	27,4 ± 0,65	19,1 ± 0,66	8,1 ± 0,38	27,2 ± 0,61
V_3	18,5 ± 0,44	4,5 ± 0,35	23 ± 0,65	18,9 ± 0,52	6,5 ± 0,41	25,4 ± 0,80	19 ± 0,58	7,4 ± 0,45	26,4 ± 0,83
Year of vegetation 2007									
V_1	-	6,2 ± 0,42	30,3 ± 0,80	-	10,5 ± 0,5	39,0 ± 0,99	-	10,2 ± 0,51	38,3 ± 0,63
V_2	-	6,0 ± 0,37	29,7 ± 0,72	-	9,2 ± 0,47	36,6 ± 0,96	-	8,9 ± 0,53	36,1 ± 0,87
V_3	-	5,1 ± 0,31	28,1 ± 0,61	-	7,3 ± 0,37	32,7 ± 0,93	-	7,9 ± 0,43	34,3 ± 0,87

Variants of fertilizer management (column group heading for 2006 table above Control / 4 kg/m^3 / 5 kg/m^3).

LANDSCAPE ARCHITECTURE

An investigation into the effects of climate change on historic gardens in the UK

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Keywords: heritage gardens, climate change

ABSTRACT

This study was conducted to establish the financial implications of the impacts of climate change on English heritage gardens and to assess how prepared the gardens are for the predicted changes. It was also the intention to establish what the industry experts thought were the main climate change threats to their gardens. The research was carried out with the use of a questionnaire, distributed throughout the United Kingdom, to heritage gardens of various sizes and from different eras. On their return the questionnaires were analysed into geographical areas to establish location patterns. It was also intended to assess how many of the gardens would be in danger of losing their historic character through the effects of the changes predicted. The results indicate that the heritage gardens in the UK believe that it is too early to speculate on the changes that may or may not happen, and that there is insufficient information available to plan for the future. Southern England appears to be more pro-active than other locations within the study, but they are predicted to suffer the largest impacts.

INTRODUCTION

It is important to understand that there is a difference between climate change and the weather. England's climate is made up from the general pattern of temperature, rainfall, snowfall, sunshine and wind that happens in different parts of the country throughout the months of the year. Whereas weather describes the temperature, rainfall, sunshine and wind that happens on a daily basis (www.naturalengland.org.uk).

'Climate change looks at the long term changes in average weather' (ibid).

What is climate change? Climate change is defined by the British Broadcasting Corporation (BBC) with the following paragraph:

"The climate of the earth is always changing. In the past it has altered as a result of natural causes. Nowadays, however, the term climate change is generally used when referring to changes in our climate which have been identified since the early part of the 1900s. The changes we've seen over recent years and those which are predicted over the next 80 years are thought to be mainly as a result of human behaviour rather than to natural changes in the atmosphere".

In 1997 the United Kingdom Climate Impacts Programme (UKCIP) was set up to establish scientifically, what the likely impacts of climate change would be (www.ukcip.org.uk, 2009). The main predictions from UKCIP are as follows:

- A mean temperature rise of between 2 to 5%.
- A threefold rise in days above 27 degrees centigrade.
- 5 to 10 days a year above 40 degrees centigrade.
- Longer growing seasons.
- 20% increase in winter rainfall.
- 20% decrease in summer rainfall.
- Fluctuations between drought and heavy rainfall in short periods of time.
- Increases in the likelihood of strong winds

The predictions are uncertain, but the evidence is becoming more apparent.

Several reports have been commissioned by high profile organisations, such as English Heritage, the National Trust and The Royal Horticultural Society, into the likely effects of climate change on gardens.

In April 2002 there were 1491 parks and gardens on the register of parks and gardens with special Historic interest in the United Kingdom; by April 2007 this figure had risen to 1590 (English Heritage 2007). Awareness of the predicted effects of climate change has made the author consider whether these historic properties will be able to survive, in their current form, with the forecasted global climate change scenarios.

AIMS

Therefore the aim of this report is to research gardens of historic value and try to establish the following:

- The financial implications of climate change on the maintenance of gardens promoted for their historic planting schemes.
- If these gardens can maintain their importance with the threat of survival to their planting schemes.
- Whether the owners/supervisors of such gardens are preparing for change. If so how?
- Is it advisable to invest more of the available funds into gardens that do not base their reputation solely on their historic planting schemes?
- To establish what percentage of these historic gardens could be at serious risk of closure due to the effects of climate change.

Predictions

It is predicted that due to climate change the average temperature in Britain will increase by 1 to 5 degrees Celsius over the next century giving us hotter drier summers and milder, wetter winters (Wilson, 2007).

The predicted higher summer temperatures will cause the soil to lose some of its water holding capacity (Donnellan, 1998). As a consequence, the variety of plant species which can be grown will change, some of the more traditional garden plants will disappear and more exotic plants will replace them. This could lead to many native plants fighting for survival. It must also be considered that as climate change is to some degree speculative, that native plants may adapt to the changing soil conditions and actually become stronger plants (English Heritage, 2008).

Flooding

Donnellan (1998) states that sea levels are currently rising at a rate of 1 to 2 mm each year; this is caused by the melting of the polar ice caps. It is predicted that this will continue to rise and forecasted to reach between 20 and 50 cm by the year 2050. This expected increase will place many British coastal gardens under the threat of recurrent flooding. There is also a risk from river flooding as a result of the increased winter rainfall (see plate 1). Inland gardens are also at risk from the excess water produced from heavy rain bursts, which cause run off. This will be more probable following a summer of drought where the ground has become compact (English Heritage, 2008).

Water Logging

Water logging in gardens prevents oxygen from reaching the roots of plants in a sufficient quantity. It also prevents carbon dioxide from dispersing away (RHS, 2009). These two factors can make it impossible for a plant to survive. This is a problem during summer months when the plants are actively growing. Winter water logging has less detrimental effects because most plants are dormant.

Summer Droughts

Evaporation will be significantly faster with the increased summer temperatures. This will cause plants to suffer repeated attacks of drought stress. As with the increase in temperatures some plants could adapt to the changes (English Heritage, 2008).

Wind

Strong winds are one of the big threats from climate change. The damage which could be caused to mature native trees that take years to replace is enormous (See plate 2).

Pests and Diseases

The higher temperatures will result in many pests completing their breeding cycle more quickly enabling more cycles in a season. With milder autumns, the breeding season will continue for longer. Pests that this will benefit include aphids and spider mites (National Trust, 2002). The change will also attract new pests from warmer climates.

The increase in pest numbers will also increase the transmission of virus diseases. The rise in outdoor temperatures may allow pests and diseases currently associated with the warmth of a glass house to move outdoors (Ibid).

Reduction in Visitor Numbers

The longer summers could actually see an increase in visitor numbers, but the promotion of the reduction of carbon footprints, and the suggestions from Lord Turner, the chairman of the committee on climate change that holiday flights should be rationed (www.telegraph.co.uk, 2009) could see a decrease in foreign visitors, if other countries take the same stance.

Economics

In a report entitled 'Gardening in the Global Greenhouse', Summary, (2002), p11, Richard Bisgrove and Paul Hadley stated that historically important gardens are maintained as cultural assets

"To perpetuate significant layouts, period styles, plant collections and the accumulation of past owners influences. In such gardens, maintaining their character and current combinations of species will require special attention and will become increasingly difficult and expensive, if not unsustainable."

This is substantiated in a case study carried out by Lorraine Hudson (2003) of Metroeconomica Ltd, who using the United Kingdom Climate impacts Programme (UKCIP) costing methods calculated that the climate change induced costs of maintaining all the lawns at National Trust Gardens would be between £550,000 and £2.7 million depending on the emissions scenario.

Both of the above reports concluded that the financial implications associated with the increased maintenance work caused by climate change could see many historic gardens proving to be uneconomical to sustain.

Tourism

The income from the tourist trade has a direct impact on the ability to provide the funding for the extra maintenance costs which are highlighted above. In a report produced by the Centre for Economics and Business Research (2007), for English Heritage, the attendance for heritage sites in the UK was studied. It was recorded that just over 10 million visits to gardens including those with a heritage dimension were made in 2002/2003. Bisgrove and Hadley (2002) also looked at the impact on tourism, concluding that the effects are unknown, warmer weather could bring more visitors but the pressure to reduce our carbon footprints could have an effect on overseas visitors.

Professional Concern

Cassar (2005) in the report 'Climate Change and the Historic Environment' investigated the impact of climate change specifically on heritage gardens. The results showed that the main concerns of the professional relating to climate change were wind, temperature, the changes in plant physiology and distribution, pests, diseases and rainfall. It was also concluded from the report that the key issues for concern, which could be controlled, included the public's awareness of the effects of climate change on the historic environment.

Plants

The effects of climate change on individual plants can be forecasted fairly accurately, because it is known what conditions plants require to thrive. Bisgrove and Hadley (2002) say that plants will behave differently if grown with other species because they will compete for survival. It is anticipated, by Bisgrove and Hadley that the issues for the main groups of plants under normal conditions are as follows:

Trees

Trees will be affected by the anticipated drought conditions, and the expected high winds which will dominate the winters which could be responsible for the uplifting of many trees. The main problem for trees in a heritage garden is summarised in the following quote made at a University of Surrey conference,

"For the National Trust, maintaining trees that provide the detail and determine the layout, character and significance of historic gardens and parkland, in a climate different from the one in which they were developed will be a particular challenge" (Calnan, 2005).

Shrubs

The wind damage which could affect trees could also have an impact on shrubs; the uprooting of trees could leave shade requirements at a level that some shrubs may find unacceptable (Bisgrove and Hadley, 2002).

Perennials

Perennials will be troubled by the lack of water in the summer (Ibid). Gardens will have to adapt to drought tolerant planting and consider plant species with care.

Annuals

Annuals are expected to struggle with milder winters. The milder winter weather could affect the stratification process of some species. If germination occurs at all, the hot dry summers will be an obstacle many will not survive (RHS, 1999).

Bulbs

Bulb development is controlled by the seasonal weather changes, in the colder months bulbs generate root systems ready to support the plant through spring, spring has advanced by 2 to 6 days per decade and autumn has been delayed by two days per decade (Bisgrove and Hadley, 2002) the dormant period, in which the lifeline roots are produced is shorter, some may adapt but could produce weaker plants which could flower earlier.

The replacement planting will have to be more tolerant to the drought conditions that are expected. This could lead to the planting of more exotic species. This was discussed at workshops held by the University of Central London, where concern was shown that exotic planting could produce a monoculture of future schemes (Cassar, 2005).

Financial Implications

The effects of climate change on heritage gardens could prove to be catastrophic to the economics of running such an attraction. The cost of replacing the many plants, which will not tolerate the changes, could cost thousands of pounds, water conservation will have to be a priority in any future plans, and maintenance time will increase with the lengthening of the growing season.

The report by Bisgrove and Hadley (2002) promotes the need to save and support as many gardens as possible, whereas Cassar promotes to concentrate efforts and direct funds into the most viable gardens. Both promote a point of view that will create controversy and does not necessarily take the heritage importance into account.

The reports and studies previously carried out fail to suggest how many gardens will survive the impact of Climate Change. With very little being written on the financial implications of the expected changes the reports studied were re-read to try to establish why this subject had been neglected.

In the case of Hudson (2003) it is stated:

"It is not feasible within the context of this case study to cost all the impacts of climate change; therefore it focuses only on the costs of lawn management" (p2).

Bisgrove and Hadley (2002) state that:

"*It is impossible, in a study of this scope, to deal in detail with the costs of climate change in each and every type of garden and for each type of garden operation. However the costs associated with managing the impacts of climate change on gardens falls into six broad categories:*

- *Plant Growth*
- *Plant Failures*
- *Pest, diseases and weed problems*
- *Reducing negative impacts*
- *Insuring for damage*
- *Managing negative impacts*"

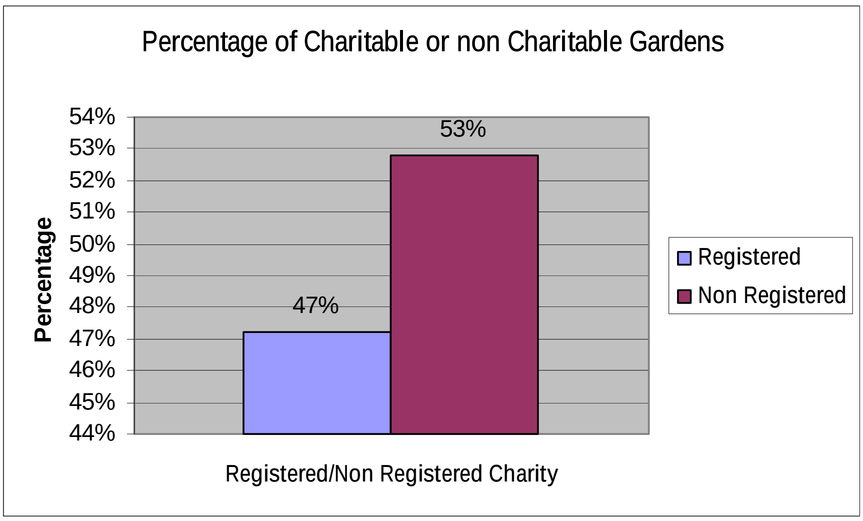
METHODOLOGY

The author used two different methods of data collection. The first was secondary data, collated via the literature review. This section analysed previous work carried out in the field of climate change within the heritage garden environment and provided the basis for the primary data which was conducted with the help of a questionnaire; questions included:

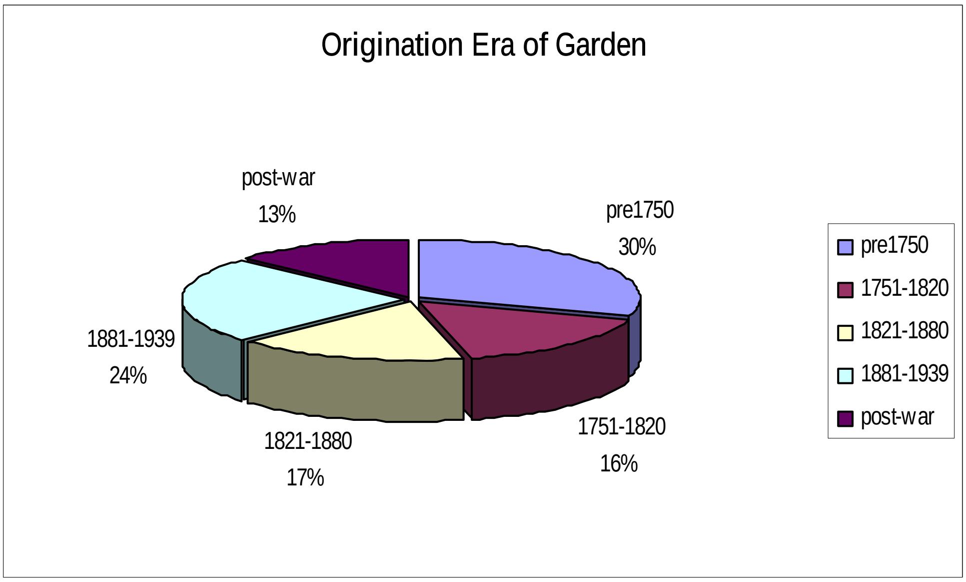
I. Has the garden got charitable status?
II. What era does the garden originate from?
III. What is the approximate size of the garden?
IV. Does the garden hold a national collection, and if so what are the plants?
V. How many visitors' doe the garden attract per year?
VI. How many members of staff are employed? Full time, part-time and volunteers
VII. Does the garden have a management plan?
VIII. Does the garden have a plan to manage climate change?
IX. Reasons for not having a plan to manage climate change
X. What area of the garden do you believe will be affected by climate change?

RESULTS

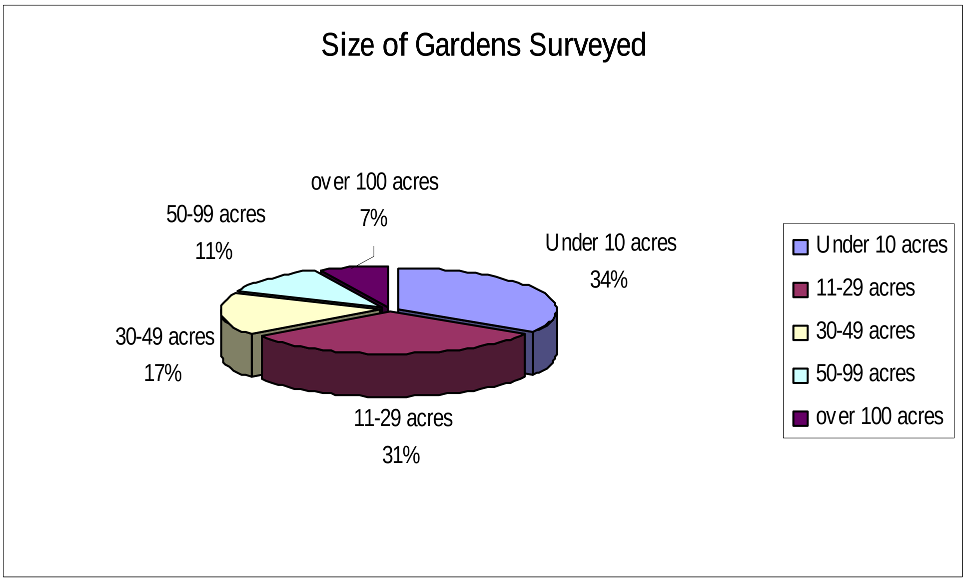
I. Gardens with charitable status



II. Origins of the gardens



III. Approximate sizes of gardens



IV. Gardens holding National Collections

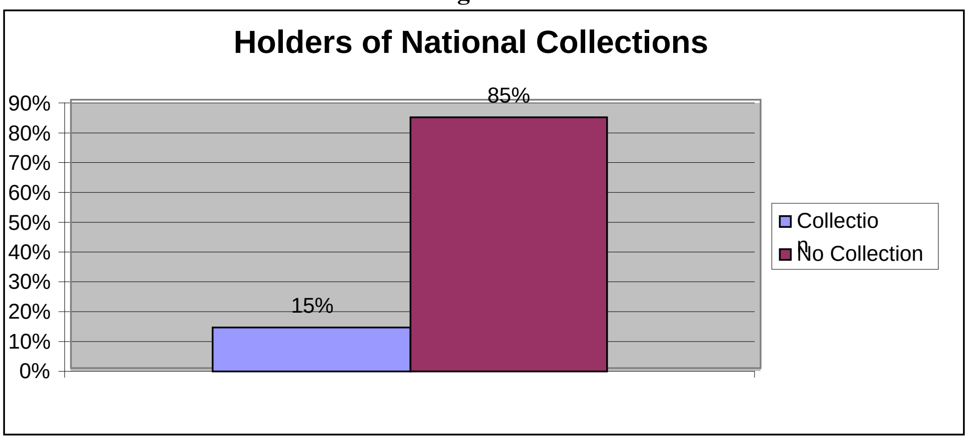
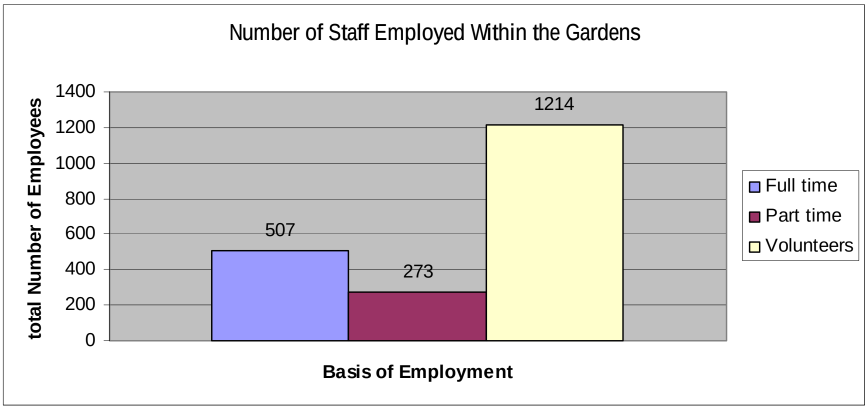


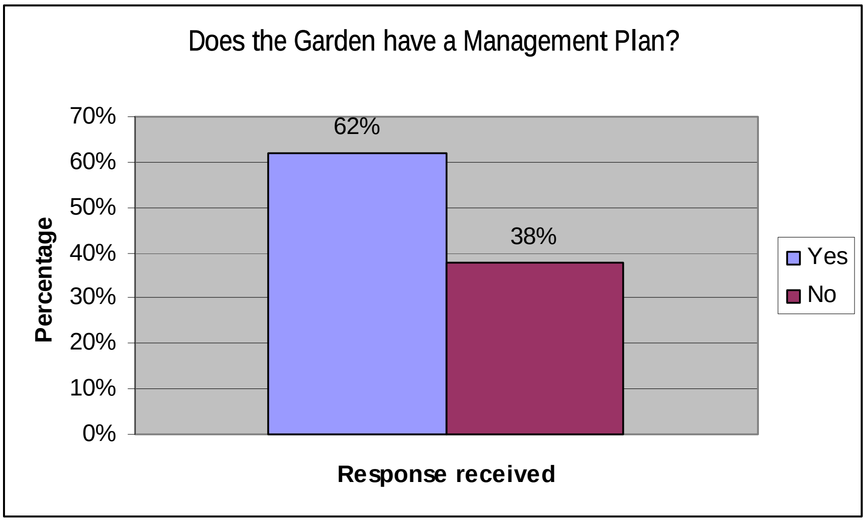
Table 1. Visitors to gardens

	Highest	Lowest	Average
2006 Visitor Numbers	600,000	400	35,000
2006 Admission Charge	£14.00	Free	£3.50
2007 Visitor Numbers	650,000	400	40,000
2007 Admission Charge	£15.00	Free	£3.50

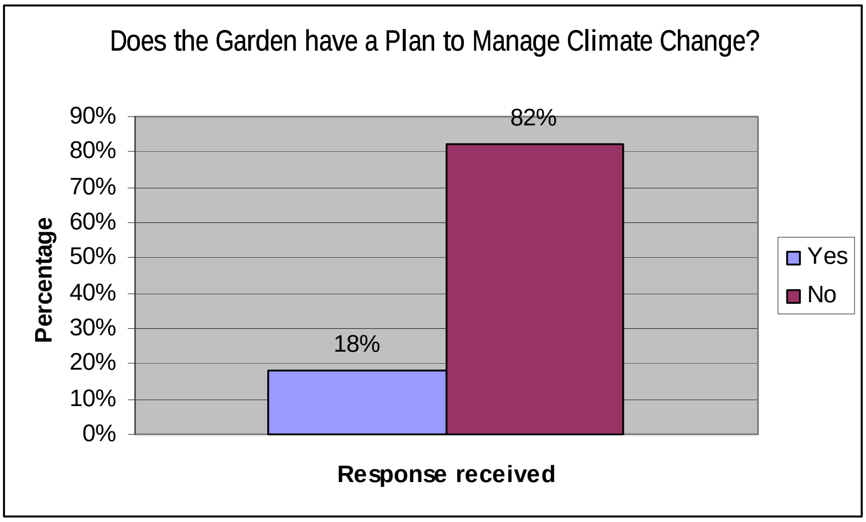
V. Numbers of staff employed in the gardens



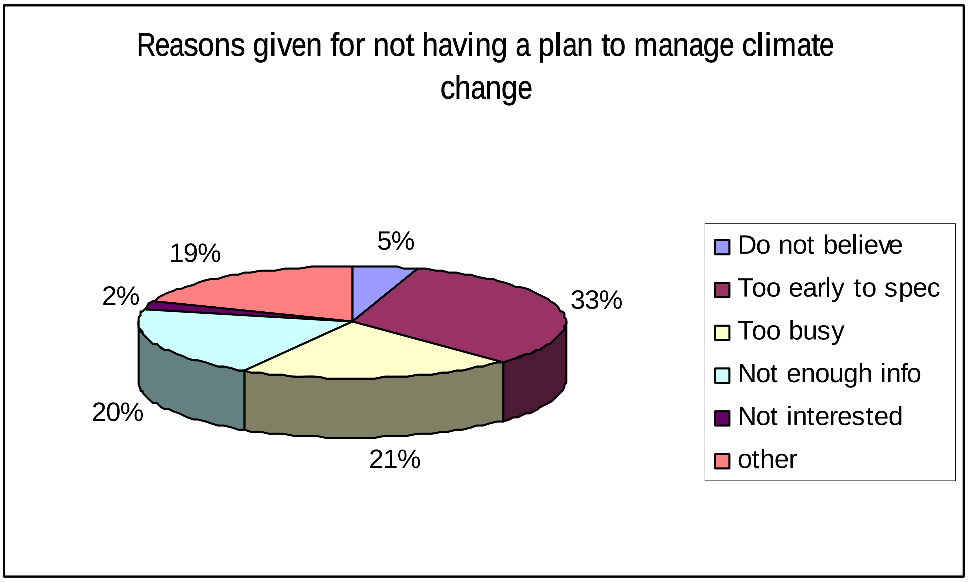
VI. Gardens with a management plan



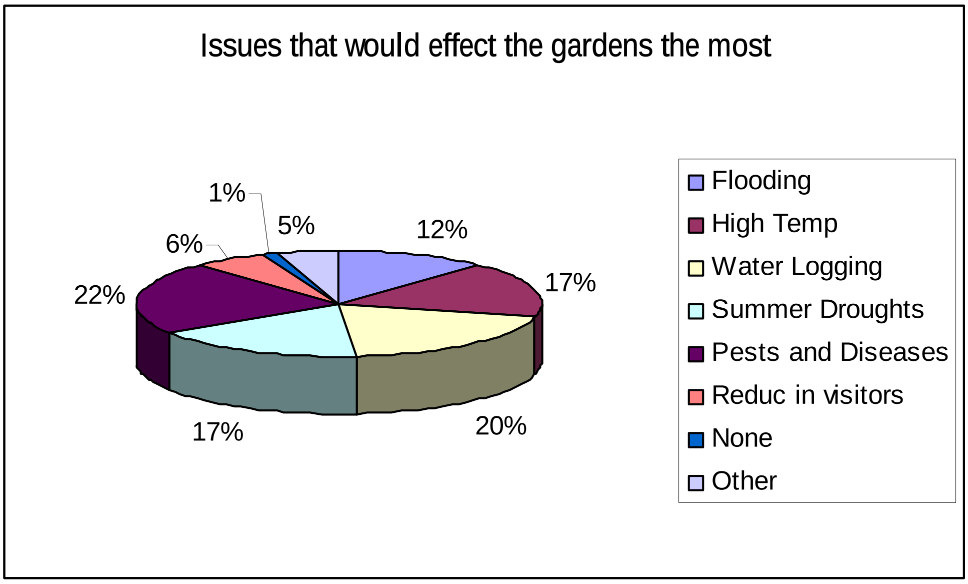
VII. Gardens with a management plan for climate change



VIII. Reasons for not having a plan to manage climate change



IX. Possible effects of climate change



CONCLUSIONS

The number of responses received show that climate change is an issue that provokes a reaction. Unfortunately the results also show that the owners and supervisors of the heritage gardens are not prepared for the climate change impacts that are predicted. The main reasons being given for not preparing is that it is too early to speculate on the impacts and that the gardens are too busy to plan.

In 2004, five years ago, Cassar conducted the research for 'Climate Change and the Historic Environment' it showed that the main issues of concern shown by the experts then, were the same concerns that this report has shown, pests and diseases, higher temperatures and flooding. Yet only 18% of gardens are planning for the inevitable changes that will be needed.

17 of the gardens that claimed to have a plan for climate change belonged to charities or trusts whilst 9 did not. These figures are closer together than the author would have predicted, incorrectly assuming that due to English Heritage and National Trust being leading

names in climate change research, and being involved in the commissioning of many of the leading reports into climate change including those by Bisgrove and Hadley (2002) and Hudson (2003), that their gardens would be recipients of some of the most up to date information available.

The two eras noted as being high risk due to their planting schemes are the pre1750s and 1881 to 1939. The respondents for the pre 1750s totalled 53 out of this number only 7 had a plan to manage climate change. Out of these 7, 5 were in Southern England. In the group 1881 to 1939 there were 43 respondents and only 12 had plans. From the 12, 9 were in Southern England. Using these figures as a guide, the best possibility of any topiary gardens or Gertrude Jeykll gardens surviving are if they are in Southern England.

The climate change scenarios forecasted by the UKCIP show that Southern England would be the area that would have to adapt to the most severe changes, the results show that Southern England do appear to be the most pro-active. With the highest number of heritage gardens and the highest proportion of the national collections this has to be a positive indication that climate change is beginning to be considered a threat in this location.

The results show that historic gardens across the remainder of the UK do not appear to be planning for the future in a pro-active way and that the situation will remain the same until the predicted forecasts become a more frequent occurrence. Until this happens the gardens will continue to deal with the impacts of climate change as they happen, which for some of the plant species could prove to be too late. Unfortunately this implies that the characteristics that typify the historic values of these gardens could disappear.

In Northern England none of the gardens had a climate change plan, but they did see the highest percentage increase, 15%, in visitor numbers from 2006 to 2007, more than double the national average at 6.6%. These two factors could prove to be the largest threats to the Northern gardens. The wear and tear of increased visitor numbers on very wet grounds of the winter months and the compaction of ground in the dry summer months will increase maintenance and increase the costs of running each garden. Thirteen national collections are held by four gardens in Northern England, none of these four gardens has a plan to manage climate change, but all four did have a management plan.

It was also obvious that the gardens relied heavily on volunteers to maintain the gardens. The National Trust has over 4,200 working in their gardens and estates in the UK (National Trust, 2005). In a report entitled ‘The restoration and maintenance of historic gardens’ Ballard (2004), it is claimed that the majority of the volunteers are not trained gardeners, and that the trained staff required to identify the impacts of climate change and to adjust maintenance routines accordingly could be in short supply.

In Cassar’s report Climate Change and the Historic Environment research was carried out using a questionnaire. The questions were phrased in a way were the respondents gave their thoughts on the predicted effects of climate change as great concern, some concern or no/or little concern. The results show that effect with the largest amount of concern was flooding first closely followed by temperature, rainfall and then pests and diseases. In this current research the order changed to pest and diseases followed by flooding, rainfall (lack of) and then temperature. These discrepancies could be caused by the selection of participants. The research in this study was directed at head gardeners and estate managers while Cassar aimed her research at a different target level, including the head of environmental practices at the National Trust and a chief scientist at English Heritage. Due to the target respondents being from different backgrounds the results are difficult to compare.

The research did not answer all the aims that were set at the start of the project. The literature review revealed why financial studies have not been undertaken; these facts unfortunately prevented the author from answering many of the aims set. The research did prove to be a partial success in the fact that it was established how much preparation was being done to prepare the gardens are for the predicted changes. It was also established which locations appear to be the most pro-active and have the support of the larger charities.

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Contributions to the development of a database data recorder used in the management plan required for landscape arrangements

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Keywords: mapping, dendrometric measurements, diagnosis, sustainable management.

ABSTRACT

This study aims to identify all dendrometric, cartographic and phytopathological elements required in data registration forms (Form of Registration and Census Data Sheet). All the information is centralized in special tables and it is necessary to identify the vegetation health and all of the elements that succour to the proper development of the dendrologic material, as a main element in the landscaping compositions. Also, in these centralizations are registered features of the arranged space (fencing, proximities etc), forming a complete "portrait" of the actual state of the arrangement, allowing the echeloning and urgency of the interventions for optimum development and maintenance of the arranged space. The ultimate goal of these efforts is to facilitate the establishment of a General Management Plan of the Landscaping Arrangement to provide the space perenniality, based on the timely and efficient intervention of the works, allowing the arrangement to function properly. Following the successive overlapping of the intervention plans regarding the surfaces that were mapped distinctly from the landscaping arrangements, follows a General Plan of the Arrangements Management with different areas of maintenance based on the frequency of interventions practiced in those areas.

INTRODUCTION

Arrangement Management, as a part of landscaping management, is represented by all the organizational, technical and financial measures that ensure the proper development of the landscaping arrangement, a good maintenance and exploitation of the green spaces, resulting in their perenniality in the context of overall socio-economic and sustainable development.

The purpose and main objective of a rational management is based on defending, conserving, restoring but also the recovery and rehabilitation of the green heritage, improving the quality of public green spaces in order to enhance the standard of living in urban areas.

The motivation of this study resides in the pursuit of another important objective of arrangement management which is leading the evolution of the landscaping assemblies in order to satisfy the needs and expectations of the inhabitants and to protect and improve the environment, leading to a sustainable development of the assemblies.

These desiderates can be maintained only through a better organization of the permanent maintenance works practiced in the managed area under a Sustainable Management Plan.

Arrangement Management is based on the acknowledgement on the green inheritance and on the technical and organizational methods of long term maintenance. It is impossible to manage something we have no knowledge about. Therefore, arrangement management operates based on the principle on globalization and continuity of the works that are specific to green spaces, meaning that they are based on a sustainable management of the designed landscape. These concepts (globalization and continuity) are integrated into a system that must operate from the founding of the arrangement and continue throughout the exploitation of the landscape arrangement.

Regarding the long term management, an important facet is represented by controlling the landscape evolution and planning interventions for correction and restoration given by the changes that appear by introducing new functions (composition alterations) and the volumetric changes of the vegetation (with the passing of the years). Generating lines of the landscape composition need to be maintained, and, in case of restoring, the tendencies of altering the atmosphere of the space need to be controlled.

Arrangement management includes: general maintenance (based on the upkeep of the constitutive elements) and planning interventions. Management activities should be based on:

1. **Knowledge instruments;**
2. **Intervention instruments and**
3. **Actions to inform the population.**

Knowledge instruments are necessary in order to achieve a long term management policy and include specific data collections that provide a real "picture" of the green heritage of a landscape arrangement. Collecting this data also reflects the degree of knowledge regarding the specific aspects of the environment.

Instruments of intervention refer themselves to the technical endowment regarding the management of the works.

Actions to inform the population include social surveys and special studies in order to determine the actions that need to be taken as a result to the management interventions over the green surfaces. The information recorded needs to posses' three characteristics: credibility, objectivity and regular updates.

MATERIALS AND METHODS

Various interactions of the detrimental factors with the urban landscape (pollution with carbon dioxide, sulphur dioxide, heavy metals etc.) sometimes cause harmful alterations. The urban space is diversified and complex and it is submitted to a global analysis that should not be connected to the subjective perception.

Different aggressions that may lead to deteriorations of the urban green space must be reported in time and this can only be achieved through regular monitoring completed by recording the results in **Special File Records**. The longer we process the living material the transformation of the landscape is inevitable in terms of the evolution of plant physiology. The management plan of landscape arrangement should include data regarding the possible transformations foreseen to take place in a period of time. In order to obtain this, it is imperative to acknowledge the vegetative material that is being worked with, both in terms of decoration and evolutionary perspective.

The study case on which observations and concrete recordings could be made is represented by C.E.T Park from Constanta. The general composition of the park is similar to the free style. The compositional element that dominates the park is the water course with the two spirals. In the East side, along the vicinity with the railway, there are two curved surfaces covered with thick vegetation (A5 and A8 areas). These surfaces have both an ecological and functional role along with an aesthetic one, ensuring a phonic and visual barrier. The southern micro relief is accessible through a secondary alley which ascends behind the waterfall and finally descends through a massive of *Robina pseudoacacia* towards the lawn. There are two open surfaces made of fine grass, the widest being The Future Lawn (A1 area) and the second wide surface has an elongated shape divided in two by the main alley (Central Lawns A6 and A7).

The vegetation is planted entirely new, replacing a former orchard of apricot trees. The vegetation is adapted to the environment conditions specific to the Romanian Seaside and most of the species are compatible with the industrial areas. In the outlying areas, especially near the railway (A5 and A8), there are several species of trees and shrubs that serve as protection curtains. The vegetation includes: eight species of leafy trees, three species of resinous trees, five species of leafy shrubs and one species of resinous shrubs.

In the southern part of the park a piscine shaped as a logarithmic spiral is placed. The water springs from the centre of the spiral and seeps along, continuing its course through the channel that leads out of the piscine. It flows further to the Future Lawn where takes the shape of an Archimedes spiral and the water flows smoothly towards its centre. In the centre of the spiral works a vertical jet of water. Another source of water of the first spiral is the waterfall which flows over the curved surface adjoined to the piscine.

Playgrounds destined for children are placed near the Future Lawn (A3 and A4) surrounded by a luxuriant vegetation. Basketball courts, mini-football, ping-pong and a space destined for dogs are located in the southern extremity of the park (A10 and A11), separate from the areas destined for social interactions. In the park there are two lawns (A6 and A7) dedicated for relaxation and games (badminton etc.). There is also an area with canopies (A9) accommodating tables for static games (chess, backgammon) destined for elder people but not exclusively. The rollerblading and roller-skating area (A2) lies south of the Future Lawn. This area was created by excavating the ground in order to provide a slope surface used as skateboarding ramp that is partially covered with grass.

Alternative energy production facilities are located in relation to the emblematic element, in the privileged points, in order to be observed by the visitors. Wind micro-turbines are located in the curved areas, photovoltaic panels in the sunny areas, near the spirals and the solar mirror in the centre of the main crossroad of the park. These contribute to the illuminating system during the night and the hydraulic mechanisms.

The vision of sustainable development (on a long-term base) represents a reflection on the regenerating process of nature, stressing the importance of t biodiversity and the use of the renewable resources in the energetic field. During the past decades, excessive consumption of the exhaustible resources has caused damaging effects to the environment as well as to mankind. In this context, the park concept is closely related to the problems of the present and reveals new perspectives towards the future, in line with the principles of sustainable development. The concept is materialized through several compositional elements including water, vegetation and the installations used for producing alternative energies that play a major role. Also, cultural events can also be organized as well as social, educational or sportive. Thus, the relationship of the locals with their living environment will be able to be substantially improved from an ecologic and social perspective.

The arrangement management plan will be able to be applied without causing damaging effects to the environment or to the inhabitants by a zoning that will lead to the development a Differentiated Management Plan. That implies a lot zoning of the park, from a spatial point of view, in 11 distinct areas (lots). On the plans below we can observe a classification of the lots by the intensity of the maintenance works and another classification, based on the management priority, which depends on the extent on which the respective space is frequented by visitors.

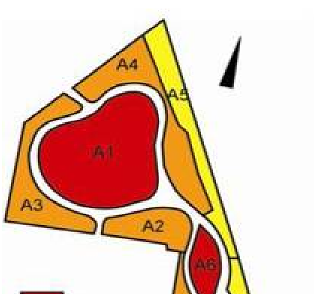

Fig. 1. Zoning according to the intensity of the managed landscape

Fig. 2. Zoning according to the importance of the managed landscape

RESULTS AND DISCUSSIONS

Long term management implies the coordination of the aspects regarding differentiated maintenance of the areas with a distinctive character, an important aspect of which the administrative team of the green space should take into account. This requires an inventory of the woody vegetation during a long time period. The main instrument of knowledge and data collection is the **census or the inventory**, including information regarding data mapping, photometry, dendrometry. The inventory sheet should include: date surveys, area code, type of green space (square, line, cemetery, park), land marks, surface mapping features, accessibility, overall (conservation / maintenance, lawns status, the number and type of floral decorations, the number and species of trees in hedges, the number and tree species in alignments, surface and type of pavements, the presence or the absence of an irrigation system, type and number of specific furniture and equipment). All these data are taken from the field and filled in tables specific to each distinct area. For the case in study, we presented a single Census Data Sheet of one of the most important areas of the park. These very accurate data correlated with zoning plans resulted from the intensity and frequency of the landscaping management give an overview of the entire management.

As a result to the superposition of the previous two plans we have a classification of the lots that indicates the management level of the lots. For example, area A5, from the vicinity of the railroad, will benefit of a minimum level of maintenance while areas such as A1 and A7 will be maintained at a maximum level.

CENSUS DATA SHEET Area A1- Park CET	Prepared by	Signature

Date	22-02-2010	Surface Code	A1	Cadastral marks	
Type of green space	Urban square		Surface	3500 square meters	

Delimiting elements (D.E.) – Type and orientation							
Without D.E	D.E. Wood	D.E. Metal	D.E Mineral	D.E. Plastic	D.E. Textile	D.E Organic	Other D.E
X							

Accessibility		
Inaccessible	Limited accessibility	Accessible
		X

General condition							
Conservation				Maintenance			
Very poor	Poor	Good	Very good	Very poor	Poor	Good	Very good

Elements contained							
Lawns	Floral decoration (number and type)	Hedge (specie and linear meters)	Trees (number and specie)		Shrubs (number and specie)		Liana
			Leafy	Resinous	Leafy	Resinous	
Yes	-	-	10 x *Robinia pseudoacacia* 6 x *Quercus cerris*	5 x *Pinus sylvestris*	-	-	-

Roads with trees (NO)		
Number and specie	Distance on and between the lines	Length (L.M)

Other elements contained				
Pavements (type and surface)	Irrigations (present / absent)	Furniture and equipments (type and number)	Lightings (type and numbers)	Underground networks (type and number)
Natural stone and gravel	Present	-benches and wooden/metal baskets -photovoltaic panels (5)	High metal illuminating	-

Observations	The lawn is crossed by a channel in the form of a spiral and from its center runs a vertical jet of water

Fig. 3.

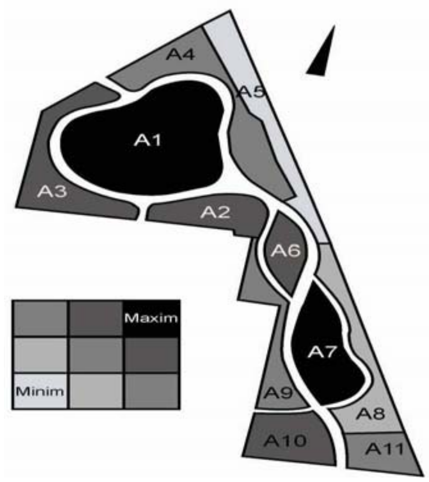

Fig. 4. Hierarchy of the lot management according to intensity and priority

CONCLUSIONS

Inventory sheets along the census and zoning plans and differential management plans, offer a complete image of the complex works of maintenance and all of the elements of the landscape arrangement. They can offer solutions that should be considered on a short, medium or long term. Given the complexity of the components of the park taken for the case study, it was considered necessary to draft a maintenance plan on a very short term (one year) and on a short term (four years).

General maintenance activities (valid all year): maintain general cleanliness (collection and disposal of the waste in the park); suppression of dry, broken or dangerous branches; collection of fallen branches on the ground; maintaining the cleanliness of the water and basin gutters; supplementation of the watering rate of the irrigation systems, if necessary, depending on the moistening levels of the soil; monitoring and annual evaluation of the woody vegetation; application of herbicides on the natural slabs and gravel paths, in case of invasive herbaceous species; application of phytosanitary treatments with minimum environmental impact, only if necessary; evaluation of the furniture state and the water parts (replacement/reparation if necessary); ensuring security, protection and systematic observations, with penalties for offenders.

Maintenance plan (four years)	**2010**	**2011**	**2012**	**2013**	**2014**
Maintenance cutting of the trees		**X**		**X**	
Forming cuttings of the leafy trees and shrubs		**X**		**X**	
Assessment of the curvy surface erosion, if necessary			**X**		**X**
Checking of the entire irrigation system			**X**		
Assessment of the soil state		**X**			**X**
Checking of the entire illuminating system			**X**		
Checking the operation status of alternative energy sources		**X**			**X**
Repairs and replacements the park furniture		**X**		**X**	
Alleys repairs (replacement of the stone slabs, etc)			**X**		**X**

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An historical survey and environmental rehabilitation of Dumbrăvioara Castle Garden (Romania)

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Keywords: Transylvanian castle parks, Teleki, monument protection, landscape design.

ABSTRACT

Our aim of research is the evaluation of Dumbrăvioara Castle Park, assessing both its actual stage as well as drafting its revitalization plan. The dynamical changes of the park have been studied with the help of military maps, which turned out to be more precise than any other map. Topographical measurements were carried out during the survey, accompanied by a conclusion regarding the present state of the park. 439 reference points were used on the investigated site. The geodesic assessments, together with the present state of the park, contain the most important restoration and revitalization dates. The article ends with a conclusion and references about the investigation.

INTRODUCTION

Garden researches in Transylvania have no comparable tradition in other similar sciences. This applies to Transylvanian garden art too, which was highly neglected compared to other countries. There is also a deficiency in studies regarding park investigation and restoration both in botanical and dendrological sense.

In this study the notion of 'historical garden' was adopted from the Charter of Florence, which comes to complete the Charter of Venice. Their role is to control the rules of modern international protection of primarily important monuments, stating that "historical gardens belong to the creation of buildings and they form a common value with buildings in historic or artistic terms. Therefore, they can be considered as historical monuments." (*Charter of Florence*, see Román 2002: 26).

After the First World War historical gardens in Transylvania lost their historical importance. This importance diminished much more after the Second World War, due to the horrors of war and destructions of the local people. On top of that, the intentional destructive policy of the communist regime destroyed the remains of these monuments together with the castle buildings. Wherever the castle remained, its garden-size was significantly reduced, and their condition deteriorated. Nowadays it is depressing that there are no efforts to evaluate the overall situation of castle gardens, which nevertheless constitute an important part of Transylvanian cultural heritage. As a result, whatsoever protection of these monuments remains questionable.

HISTORY OF DUMBRĂVIOARA CASTLE GARDEN

Dumbrăvioara is a village with several streets, situated on Mureş river bank, 18 kilometres north from Târgu-Mureş. Originally it was a royal property and later the owners were of the most famous families of the time, such as Szechenyi, King Sigismund, Erdélyi of Somberek, Dénes Bánffy and Count Teleki. The Count Teleki family, the owner and the builder of the present castle, called himself Teleki of Sec at the beginning of the 17^{th} century. The Teleki family of Sec had an important role both in the history and society of Transylvania of that time, establishing a well-known library and also making important geographical discoveries worldwide. Their castles, built in the eastern part of Transylvania, were fortresses in the noblest sense of the word. They protected themselves both physically and spiritually, in supporting their national identity and cultural heritage.

Two main stages can be distinguished in the history of the castle building.

1. The stage of the building construction with the ground floor, built by Count Samuel Teleki of Sec (1739-1822), Chancellor of Transylvania, the founder of the Teleki Library in Târgu-Mureş. The building bears the influence of Târgu-Mureş Artistic Centre. It consists of two parts, with a length of 60 metres each, vertically extended to the road. The northern wing is older, its cornerstone was placed in 1769 and a housing estate was built (Fig. 1).

2. Count Samu Teleki (1845-1916), the Chancellor's grandson, started to build the upper part, the two-storied building. He was a famous traveller and researcher in Africa (the discoverer of Lake Rudolf and Lake Stefanie). This building in the middle, parallel to the road, has an attic and it connects the two older buildings. The three buildings altogether form a "U" and bear all the characteristics of baroque castle gardens; there is also a "Court d`honneur" (circular courtyard), as the castle's basic plan shows (Fig.2).

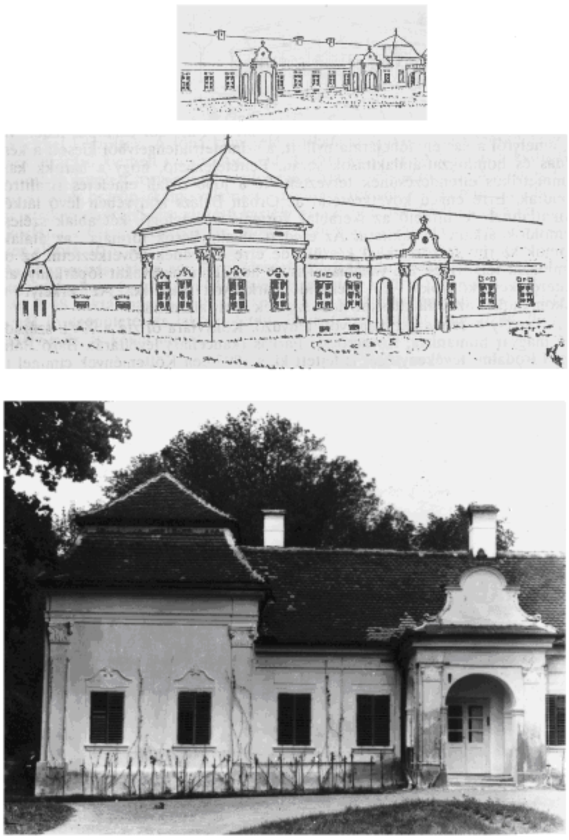

Fig. 1. The northern wing of the building

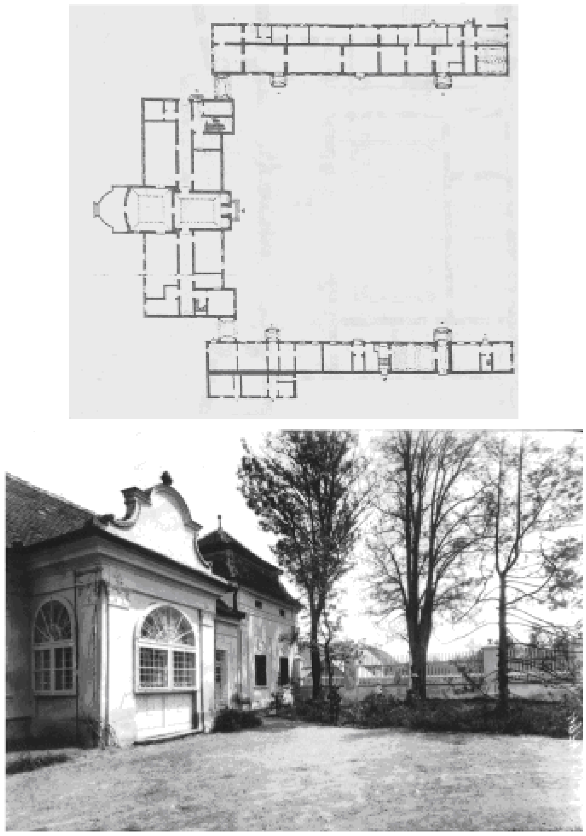

Fig. 2. The "U"-shaped building system

Only a short description is given about the garden: "Behind the castle, up to Mureş River there was a lake and enough space for the landlord's horses for training and riding shows. The castle, with a modest exterior, was surrounded by a dendrological landscape garden and a fir forest" (Keresztes 1995, Fig. 3).

Hilda Horváth also reminds of "the shadow of the big oak in front of the castle" (Keresztes 1995) as the favourite resting place of the family. The castle also has a burial vault, including a large hall and the funeral chapel of the Teleki family. The decorated sarcophagus of Samuel Teleki and other family members are to be found here, covered with stone slabs placed on the floor. The front side of the tomb was built in the same baroque style (Fig. 4).

Fig. 3. The park **Fig. 4.** Teleki's tomb

It is worth mentioning that contemporary descriptions should be treated with a certain reservation; the names of places used in some cases are not exact and may be interpreted wrongly. The same remark is valid for the old sculptures and representations. Military maps may be regarded as the most authentic contemporary documents. The evolution of the castle and its park, their size and garden style in Dumbrăvioara can be best supported by analyzing the measurements of Transylvanian military maps.

According to the First Military Metrics Map (I Military Josefinische Aufnahne, 1769-1773), Dumbrăvioara is a village with 38 houses, fields on both sides of the road, similarly to the 18^{th} century Transylvanian prevalent style. At this time, a larger building is already situated in the north-west part of the village, which is supposedly the north wing of the castle compound, a construction shown even during military measurements. There is no park or garden to be observed near the building, which is probably due to simultaneity of the construction and drawing the maps (Fig. 5).

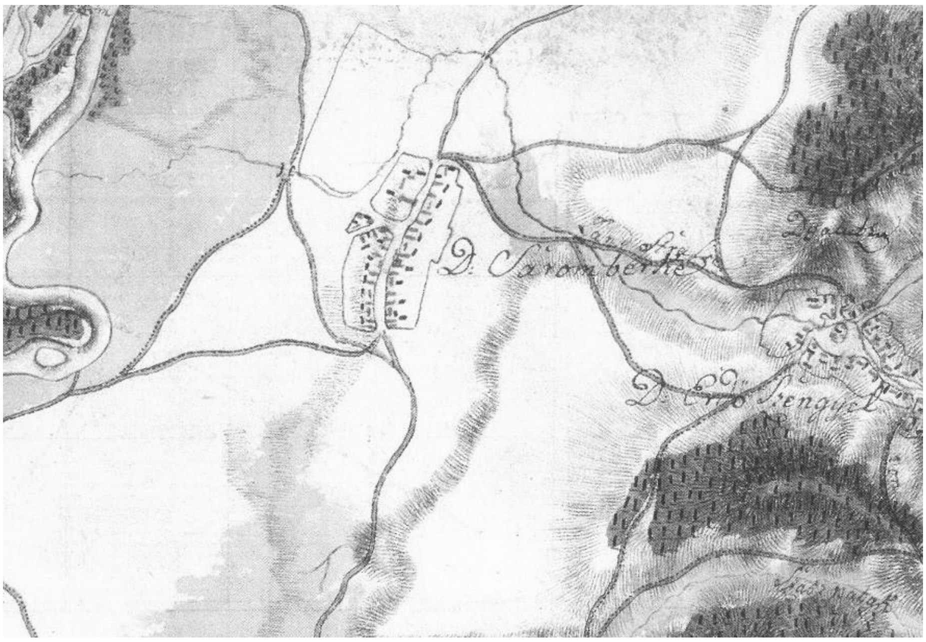

Fig. 5. The first military map of Dumbrăvioara

The third military measurements (1869–1874, Map Archives – History of Wars) inform us about the presence of the castle's ground floor wing; however, there is no trace of the middle wing built by Samu Teleki.

A garden can be distinguished behind the castle, which lies close to Mureş River flowing at 1500m from the castle. Two channels were built in the middle of the site, parallel to the road. It is estimated that this landscape garden belonging to the castle was about 60ha. Four lakes, somewhat symmetrical, can be seen on both sides of the path leading to the backside of the park. Compared to the first military measurements, the village enlarged its territory in the past 100 years, and it ran south first (Fig.6).

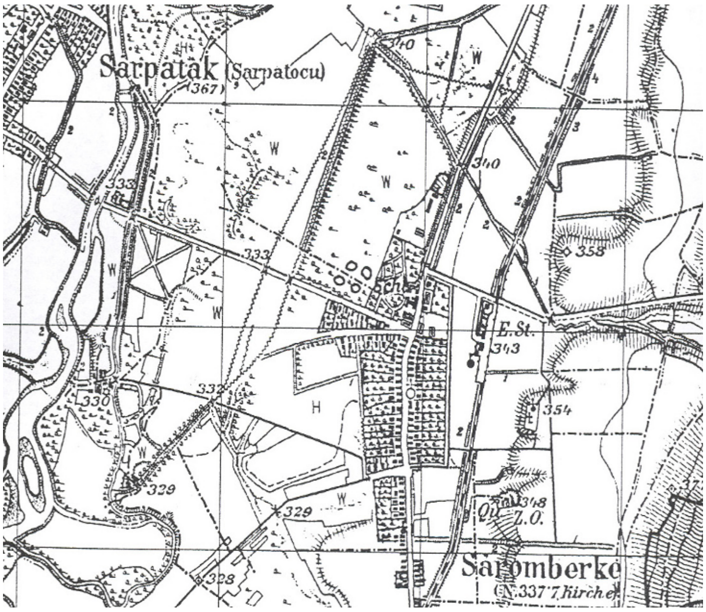

Fig. 6. The third military map of Dumbrăvioara

THE GEODESIC STUDY OF DUMBRĂVIOARA CASTLE GARDEN

The geodesic study presented below was conducted in July 2004, in digital form, scaled 1:1000 (Fig.7).

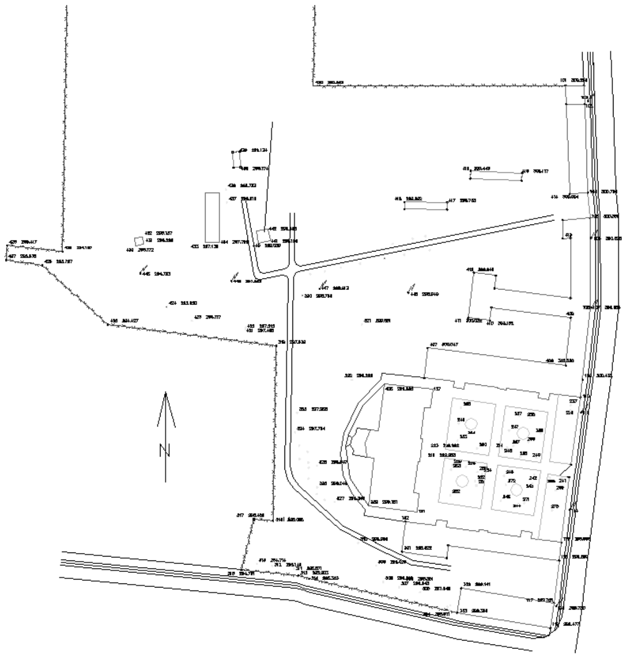

Fig. 7. Geodesic assessment

During these measurements, 439 specific points were recorded on the analyzed territory. The geodesic study contains data of the characteristic heights of the territory, its boundaries, the buildings on site, outbuildings, roads, pedestrian roads, outdoor constructions, objects of art, trees with trunk diameter larger than 10cm and other characteristic data about the respective garden. It is remarkable that the assessed garden is only a part of the original old garden and it belongs to Dumbrăvioara Agricultural School. The larger part of the old dendrological park, especially the area located outside the school fence, is under agricultural use and its property is unelucidated. This area also contains the remains of the old lakes. The evaluation of the garden's state and its value was carried out using the basic geodesic map. Specific dates about the assessed objects were set on the evaluation sheets, considering the possible protection of the historic monuments, the landscape, the image of the territory and the garden's dendrological importance. The primary task is to protect the landscape values to be found here in both botanical and architectural terms.

THE CURRENT STATE OF THE GARDEN

On assessing this Dumbrăvioara heritage, Peter Goodchild's four basic criteria was taken into account, who is a founding member of the Advisory Committee of English Heritage Garden History. These criteria are as presented below (Goodchild 2003):

1. the historical value of the garden and buildings
2. the style of the garden and buildings
3. the state of the garden and buildings
4. its geographical context

Thus Dumbrăvioara garden is divided into two by the main building, and these are independent from each other; the front garden (instead of the former "court d'honneur") on the eastern part of the road and the garden on the west side, located near Mureş River bank. In accordance with these findings, our surveys were completed separately for both gardens, but the most important elements are presented on a measurement sheet of the garden architecture which corresponds to the garden area scale of 1:1000 (Fig. 8).

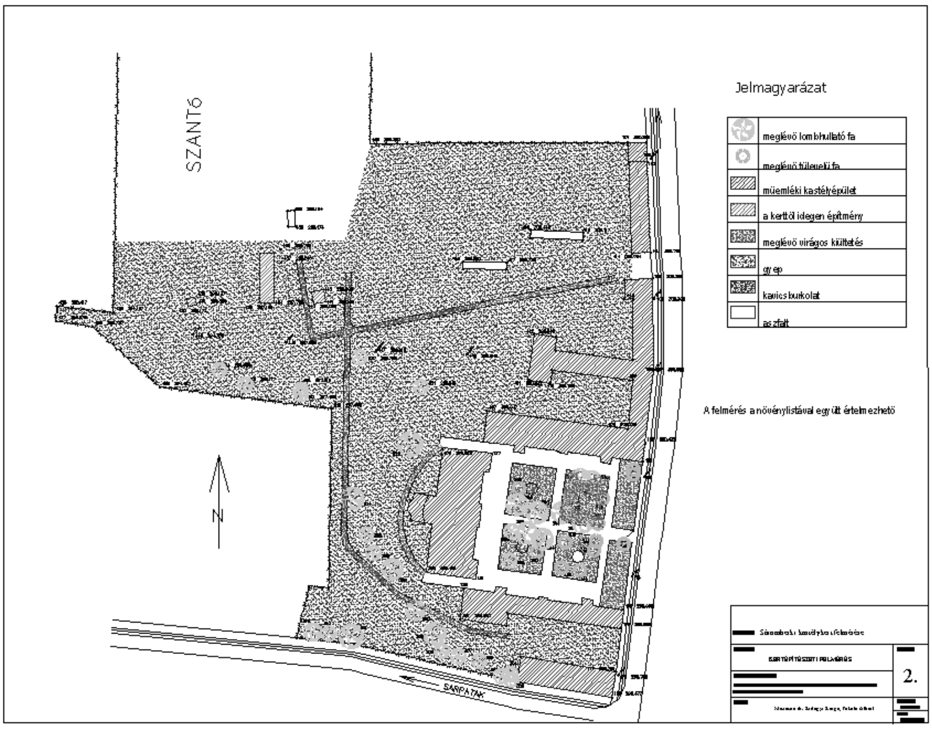

Fig. 8. The vegetation assessment plan

The circumference of the front garden is 228m and 3241m². The front garden is disturbed to a great extent and highly accessed by school staff and pupils. However, this garden is separated from the main road by wired fence, which is built on the remains of the old stone fence, and it does not match the character of the historic monument.

Outside the fence, between the road and the pavement, a green patch of 80cm in width can be observed, as well as an open ditch line crown of 150cm wide for water evacuation.
The tree vegetation consists of 38 individuals with trunk diameter greater than 10 cm. The proportion of the active area is 51.12% of the entire front garden, whereas the canopy cover is 40%. The division of the front garden is geometrical; there are four rectangular shapes, each of 330m². There is a pond made of concrete formed in the middle part of each of the four rectangular shapes, as Figure 9 illustrates. During the evaluation there was no water in any of them.

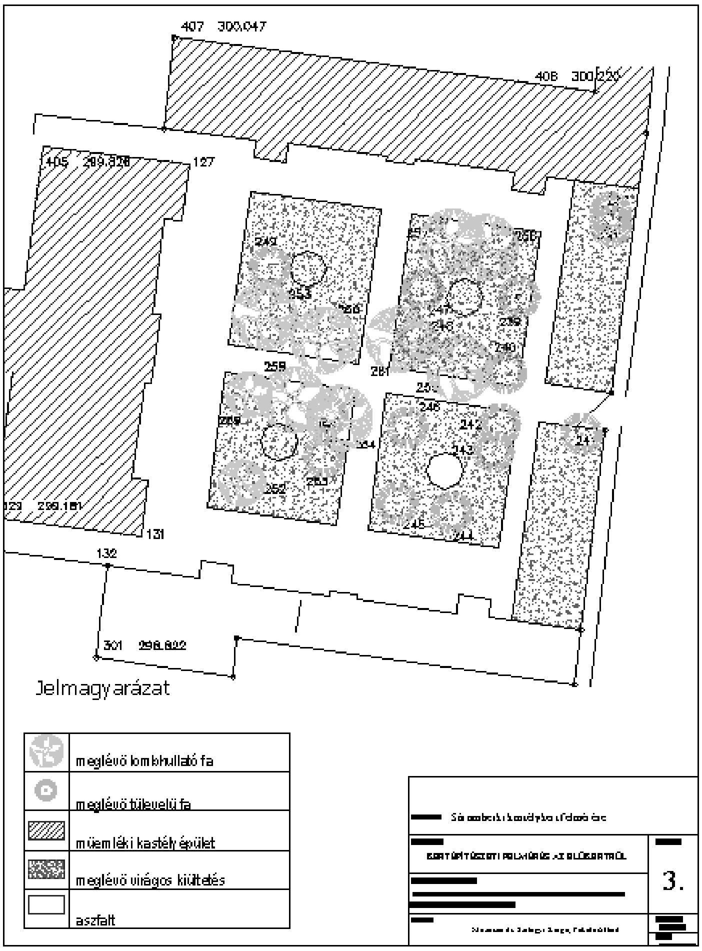

Fig. 9. The front garden

Although the front garden attempts historising from an architectural point of view, this is questionable from several points, as discussed below:

- the Baroque arrangement is not supported by the historical events, as we could not identify any similar arrangement in the representation of plans, neither in the engravings, nor in the pictures or descriptions during the research.
- the proportions of the plan and the various sizes suggest a Renaissance style rather than a Baroque one, as there is nothing built in the Baroque period around the castle, bearing characteristics of Baroque or Neobaroque style. Some evidence of the Baroque style may be observed on the decorative plants (*Buxus sempervirens* and *Ligustrum ovalifolium*) surrounding the rows. However, plant individuals (trees) appear in these rows, which are not at all typical for the Baroque, such as perennial plants (spruce -

Picea abies) or a couple of fruit trees (walnut tree - *Juglans regia* or apple tree - *Malus spp*., etc.). Two oak individuals planted at regular distances (*Quercus petreae* "columnaris") are the only acceptable species in terms of style in this part of the garden, located parallel to the central wing of the building.

Layers built in geometrical forms, floor types do not contain specific forms of floor flowers, grass or other type of embroidery, due to the high vegetation. Their function is not appropriate either in terms of plant material, or in composition. Artificial elements used in the garden (fences, benches, ponds, areas for paths and asphalt) are not in harmony with the material they were created from, or with the building. The current state of the front garden is neglected and it may be regarded as deserted. The feeling of ineffability is enhanced by the neglected state of the flora and the deplorable state of the buildings. The character of the former dendrological park can be hardly recognized, except for some plants. The garden area decreased significantly, as it is equivalent to the current institution limits of the Agricultural School. After having identified the park borders, the garden area is about 26,852m². It is difficult to identify the current northern border on the surface of the ground. A part of the southern road is closed by a barbed-wire fence hanging on a few rusty metal posts.

In the rear garden we identified some improvised outbuildings, which do not fit into the environment and largely destroyed both the image and the atmosphere of the garden. The condition of the current roads is also neglected, full of potholes and weeds, providing the first the link between a former stable, now a garage for tractors and a learning ramp, and a lateral entry from the main road. All the buildings and gardens are imbued with the "black communist" atmosphere of the 1970s and 1980s. We were unable to trace any sign of the garden composition in the back garden.

Although the dendrological garden represented an invaluable biological value in the past, there is hardly anything left of it by now. Its value can only be associated with the historically important figures or families; on the other hand, it represents the environment of a building which can be considered an historical monument.

Currently, from an aesthetic point of view, which is a rather broad concept and a relatively subjective category, the garden cannot be regarded as having an aesthetic value. This is due to the direct consequence of the collectivization following the Second World War.

Unfortunately it cannot be classified as fitting into any category of the traditional garden styles, as only some isolated plant individuals remained after the devastation, with less significant dendrological value.

Given its present educational role of the building, a beautifully maintained garden would be beneficial both in terms of social use and cultural recreation. However, as the garden is in such a neglected state, its use is minimal.

The area is in a poor physical condition and, as described above, it has lost its importance as a garden. Its present state unfortunately does not favour its declaration as an historical site, as nobody would consider, for instance, that the ruins of a medieval fortress should be protected only because it has been preserved in ruins. Sadly, the relationship between physical condition and historical importance cannot be defined so clearly. This is true to a marked degree in case of Dumbrăvioara Castle Garden, where the larger part of the garden was entirely destroyed, and the remaining part could not ensure the preservation of its historical value and local character. There is a wider regional framework of which Dumbrăvioara Castle Garden was part of, similarly to other castle gardens, such as those in Glodeni, Voivodeni, Apalina, Gorneşti, Gurghiu, Ernei, Brâncoveneşti, Sângeorgiu de Mureş, as well as Periş, Păingeni, Păcureni, Ceuaş, Sângeru de Pădure, or Căluşeri. These formed and still form an ecological - economic system together with the gardens and the properties of manor houses. The garden of Dumbrăvioara is an historical place and because it represents the values of noble life of humanism tradition, it can be considered an historical monument, and it's saving and preserving must be of public interest.

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The effect of designed green spaces on the Transylvanian landscape

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Keywords: historic gardens, royal gardens, cemetery gardens, Bonţida castle garden.

ABSTRACT

The purpose of this article is to present the effect of various gardens (peasant, castle, monastery and cemetery) on the evolution and forming structure of the Transylvanian landscape, along with the historical changes. The influence of the listed green spaces was decisive on landscape structure and design. The garden research in Transylvania does not have comparable traditions to other similar sciences. This is especially valid for Transylvanian garden art, which is highly neglected compared to other countries. Park investigation is also inexistent and neither can we talk about restoration either in botanical or dendrological sense.

INTRODUCTION

An historical retrospective

The great renaissance of the 15th century in Transylvania first could be identified on religious paintings containing a natural background. Around the Saviour and Saints, natural background was painted very realistically by painters, so naturally that they placed biblical scenes in central and northern European locations; instead of palm trees they painted gardens specific to these landscapes (see Figures 1 and 2):

Fig. 1. Biblical landscape

Fig. 10. Biblical landscape

If we survey the shrine paintings of this century, we can observe old vineyards and orchards where the scenes have gardens in the background.

Wall paintings represent simple gardens in the Middle Ages with hedges, apple trees, dandelion surrounded by grass, indicating that these gardens were rather neglected. Gardening in this period was characterized by wildness between the trees, as it was considered that this would not influence substantially its function.

Transylvania needed no foreigners to create garden art in this period, as its traditions can already be found in the 16th century. Green space design was not carried out based on a model; instead, it was developed according to the characteristics of the relief and depending on the climate conditions.

Peasant gardens

Peasant gardens or kitchen gardens are already certified in documents from the 13th century. In general, the main plant cultures were garlic, red onion, chilli, poppy and herbs to which therapeutic effects were attributed. People in this area learned gardening and planting from monks, who were the first growers. Details were recorded about scented and perfumed herbs even in the legends of the heathen period.

Our predecessors cured themselves with herbs, to which magical forces were attributed and they even prepared balms; we can say that in the Christian period they secretly brought sacrifices with these plants to their gods (e.g. the legend of Balvanyos fortress), thus it is possible that they grew these plants in their gardens.

However, the new gardening needed some order in the garden, especially straight lines and arithmetic rules. This element was inserted into the Transylvanian gardening as a first artistic requirement, and the person who developed this most elementary knowledge must have observed the disorder and mess. Thus, the need for fruit trees and vineyards to be ordered quickly installed throughout the region.

Beside the arithmetic punctuality of the line, gardening also had another requirement, namely the recognition of formal and chromatic beauty. This was in contrast with the ancient gardening, where the main objective was only harvest quantity.

The gardening art in Transylvania had a further requirement, the cult of the plants, which appeared later than the animal cult but it was more persistent.

The royal gardens

We can find evidence about the sequences of the royal gardens near castles, fortresses and common houses only from the 16th century. On the lower hills of the villages, massive buildings were built and protected by strong walls, but gardens were also created outside the walls. Decorative gardens existed only in royal cities and castles. King Matthias Corvinus was the first who introduced luxury, which took effect in decorative gardens and parks as well. The character of the gardens was determined mainly by the Italian style, followed by the French style (Figure 3-4) and later by the English style (Figure5).

The French style

The French style park in Gorneşti was developed in 1792 by András Mayerhoff by the orders of Count József Teleki. The garden was created independently of the castle and it greatly differs from other gardens in Transylvania.

The Bonţida French park style dates from the period after 1750, conducted by Johann Erras by the orders of Count Dénes Bánffy. At the west side of the castle one can distinguish four lines of linden trees starting from a bridge, almost one thousand feet in length. The outside of the castle was ornamented by hunting men and artificial caves.

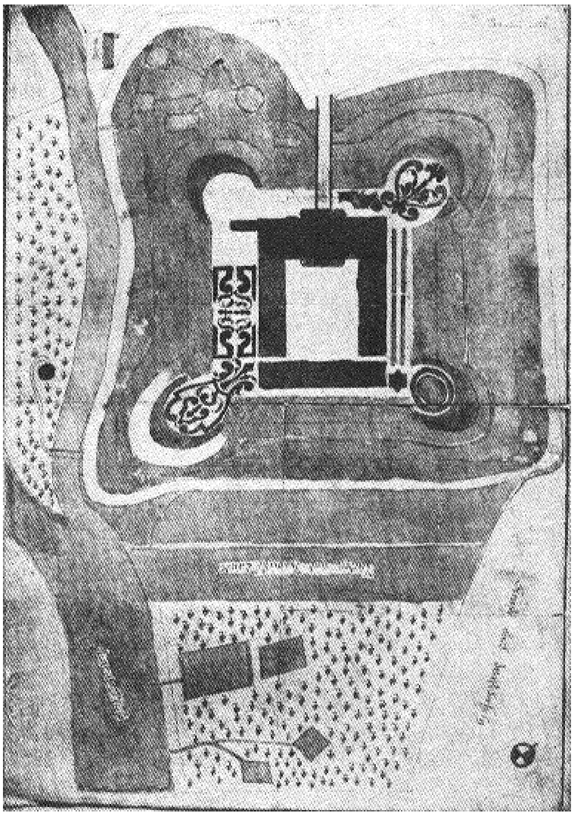

Fig. 3. French park-style in Gorneşti, József Bíró's work

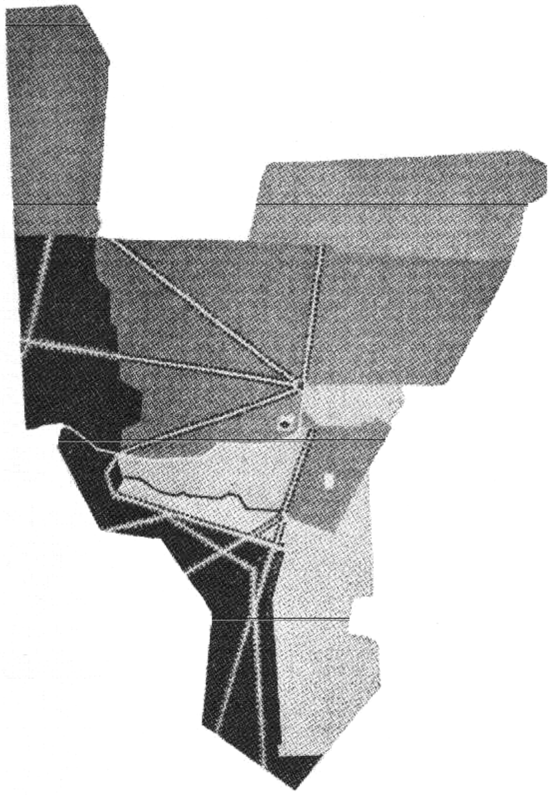

Fig. 4. French park-style in Bonţida, József Bíró's work

The English style

Later on the English style became dominant in gardens, which had a major importance, as people began to plant new trees from abroad – locust-trees, Canadian poplars, American whip trees and other species –, which appeared in the gardens of the aristocracy for the first time.

We could say that the English style gardening was an attempt to afforest places without trees, where local trees could not root easily.

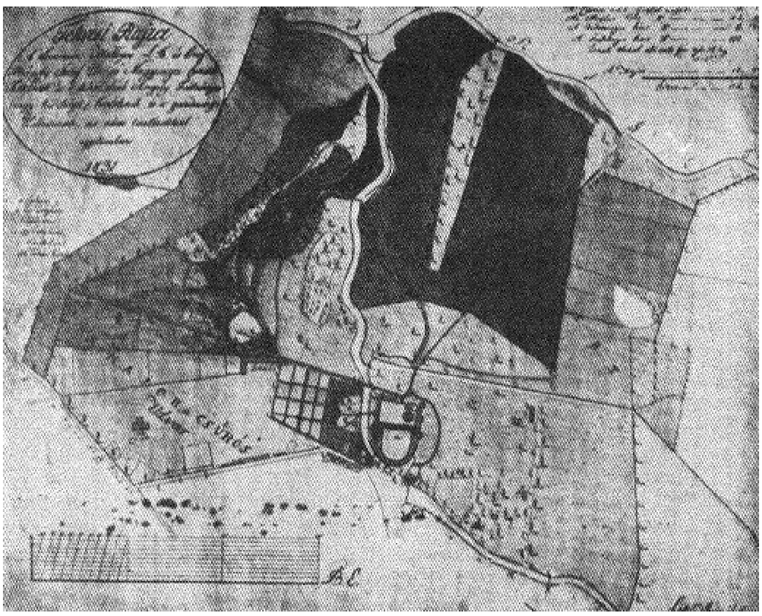

Fig. 5. English park, Bonţida Castle

However, these garden styles were transformed throughout Transylvania later. For example, the garden of Bonţida was transformed by count József Bánffy, who followed the plans designed by János László in 1831. He ordered the cutting of three-fourths of the interior of the three boulevards, and he surrounded the castle by crooked roads, bushes and artificial disparate layers and flowers. The detailed plan listed the requisites of the park, according to which an old fishing house, memorials, a church of loneliness, a pan church, fountains, flag hermitage, botanical gardens, a fruit dryer, a place for beekeeping, an obelisk and a sun-dial would have ornamented the garden (Figures 6 and 7).

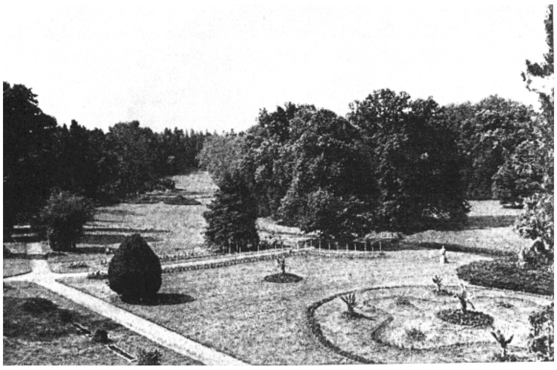

Fig. 6. Part of Bonţida Castle park

Fig. 7. The park from the interior courtyard of Bonţida castle

The Gorneşti French park form was transformed by József Teleki, Jr. into an English park as at the beginning of the last century (see Figure 8), and this is what Rohbock etched later (see Figure 9).

Fig. 8. The English style park of Gorneşti

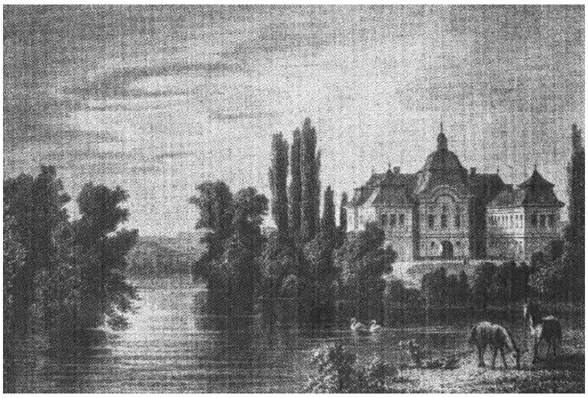

Fig. 9. Part of Gorneşti Castle park, etching by L. Rohbock

Monastery gardens

Small gardens near monasteries, estates with medicinal plants will be transformed later into flower gardens with roses. Let us remember that roses and lilies were considered medicinal plants in medieval gardens. Then these gardens will be known as gardens of herbs in spite of the aforementioned changes and their transformation to botanical gardens (see Figure 10).

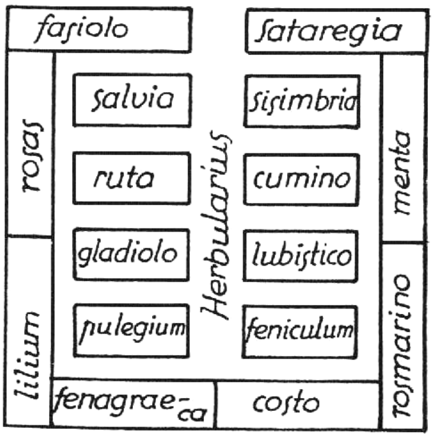

Fig. 10. Garden of herbs

A similar arrangement can be observed in the garden of St. Gallen Monastery, where we can observe a huge garden, which is extended on both sides of the building (Figure 11).

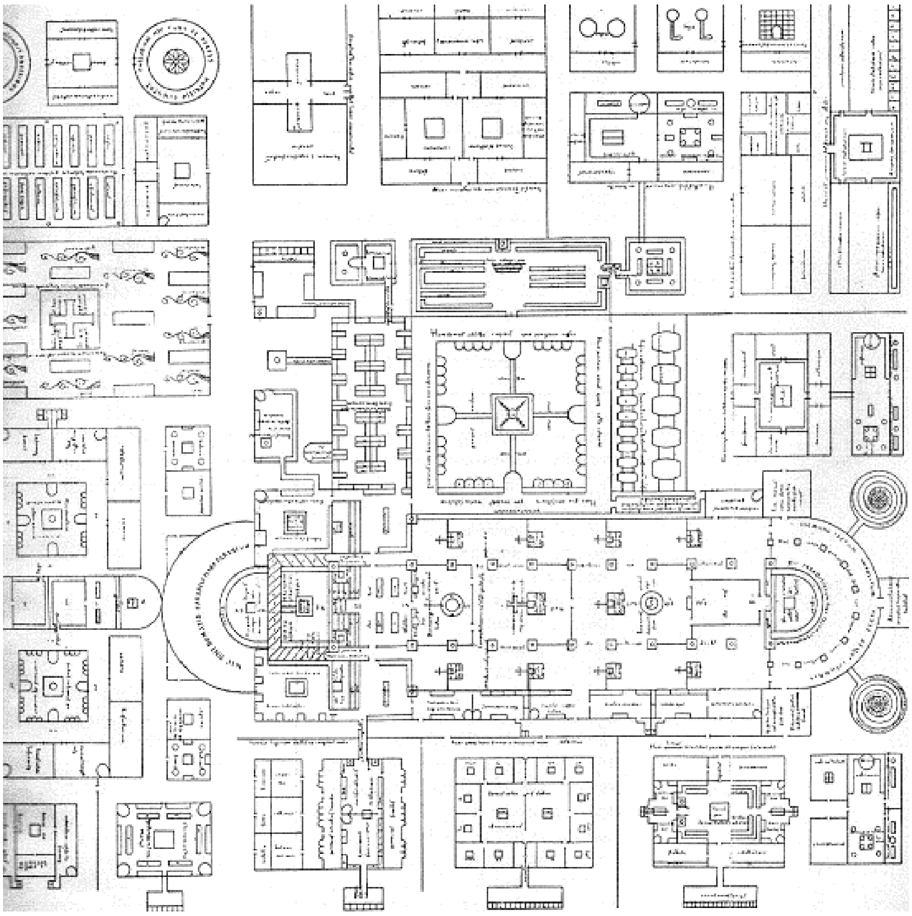

Fig. 11. The plan of St. Gallen Monastery

In the garden of the centre-court we can see a linear system of four rays in a square; at the intersection of the four lines there is a small circle, in which we can see the inscription of the *Savina a Juniper* species. The small square which occupies the centre of the court is actually the juniper; the main courtyard of the plan is in fact the first court-garden in Central Europe (see Figure 12).

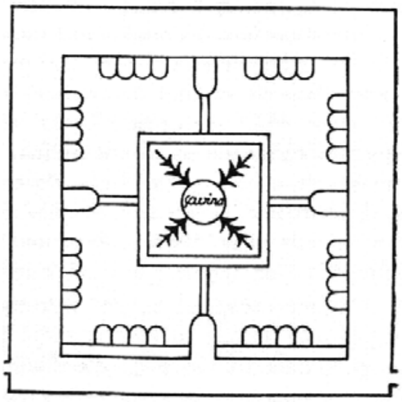

Fig. 12. The main court of St. Gallen Monastery

A square similar to the central circles can be seen in the courtyard of each house and it is clear everywhere that the same thing symbolizes the tables of the lawn, trees, probably groups of fruit trees, which received the status of decorative plants in the meantime.

These above-mentioned monastery plans suggest as an artistic system of gardens composed of vegetable gardens, herbs and orchards. The monks of St. Gallen had obtained the above plan to be a model for construction; however it was applied only partially, due to the peculiarities of the local landscape. This landscape divergence resulted in a great variation of the Central European monasteries in spite of the similar plans (see Figure 13).

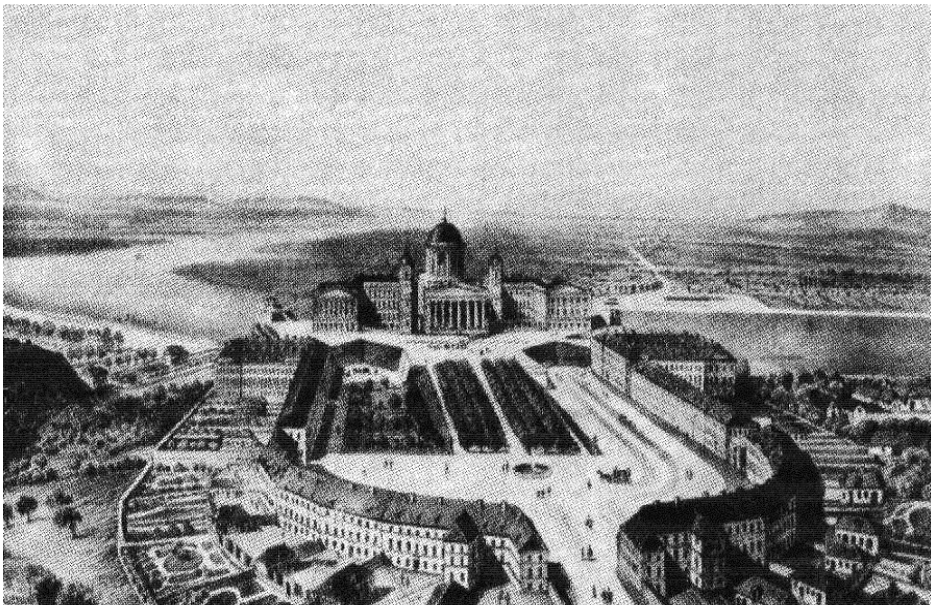

Fig. 13. The plan of Esztergom Cathedral and Chapel

CEMETERY GARDENS

In some distinct parts of the monastery gardens we can observe the cemetery from the early Middle Ages. They were similar with today's cemeteries with lined knolls; trees and a decorated place in the middle (see Figure 14).

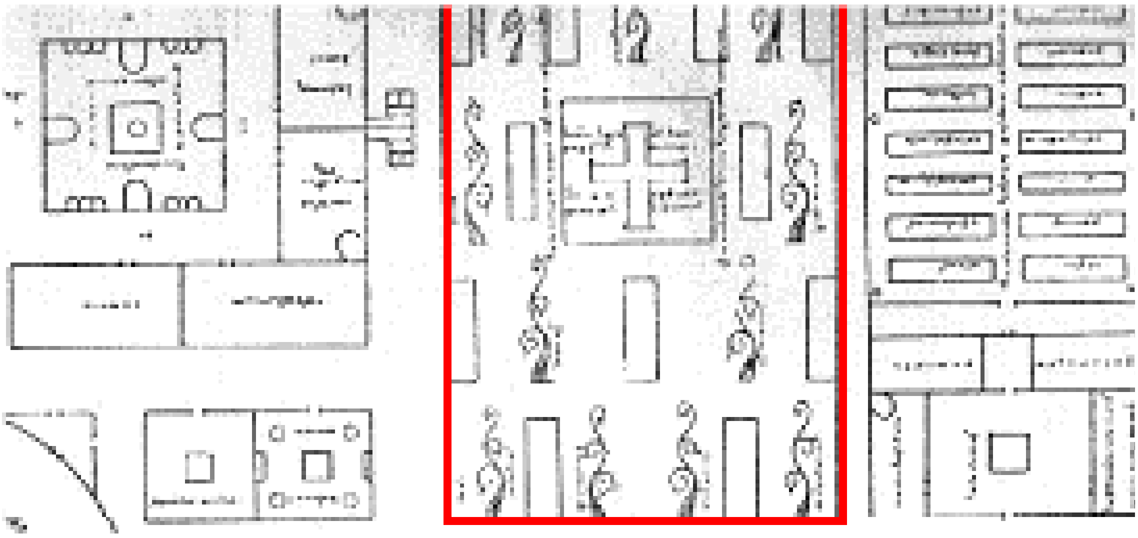

Fig. 14. The garden-cemetery of St. Gallen Monastery

In the past centuries people tried to bury their neighbours near churches, if it was possible even under the church. The upper class actually often built churches only for this reason. Later, for health reasons, they moved the graves outside the city walls. The period of outside and systematic cemeteries arrived in Transylvania in the 18th century, but at first they were very rudimentary, surrounded only by hedges or trees, in some cases only by a simple groove. In the Middle Ages fruit trees were planted in cemeteries and the area was covered in grass all over, which was nevertheless taken care of regularly. This is the reason why these cemeteries were called gardens of the past centuries (see Figure 15).

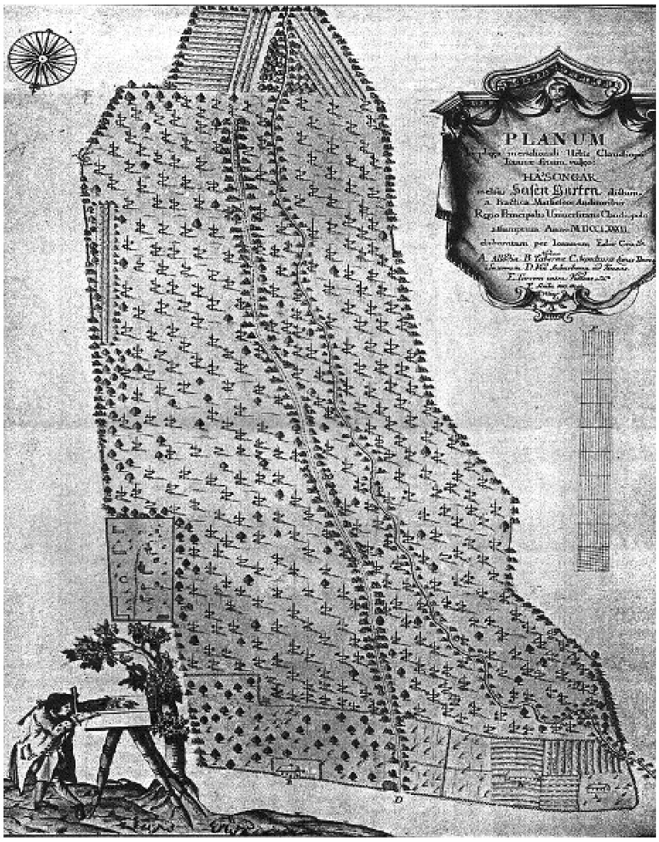

Fig. 15. Házsongárd cemetery in the past, Cluj-Napoca

The Házsongárd cemetery (at present the central cemetery of Cluj-Napoca, Romania) was a vineyard located in the southern part of Cluj-Napoca city, and it was investigated by employees and students of the University of Cluj, under the leadership of János Eder in 1782. The great part of the map is full of "Vitis", whereas in the middle part an orchard can be observed banked by a stream on one side. Ornamental plants replaced the fruit trees and flowers.

Only when the notions of decorative gardens and crop-providing gardens began to be distinguished from each other, did people start thinking that cemetery gardens should be converted into ornamental gardens. The first cemetery of this type is Házsongárd of Cluj, where the art of gardening competes with sculpture art (Figure 16).

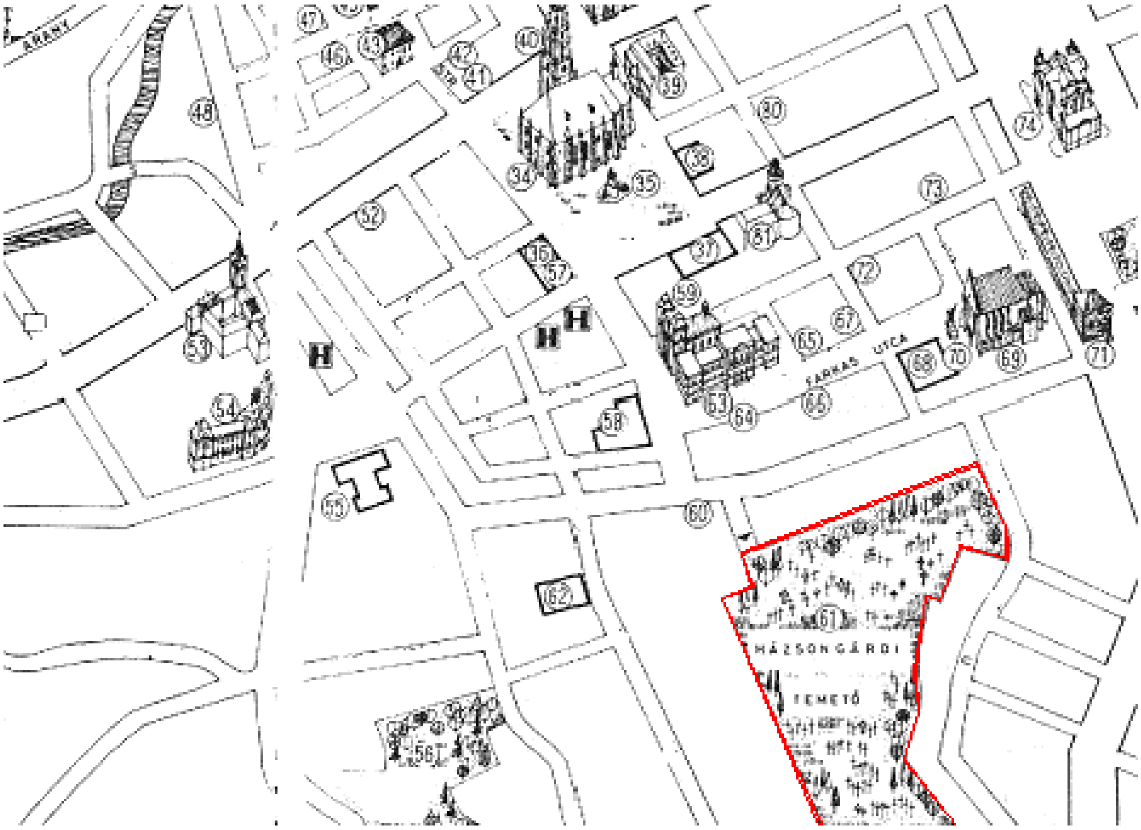

Fig. 16. Házsongárd cemetery garden

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Trends in 20th Century Landscape Architecture – from Art Deco to Cubism

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Keywords: landscape architecture, art deco, cubism, garden

ABSTRACT

Art Deco style was born in France around 1920 and its implications in landscape architecture were important. The Véra brothers were the exponents of this style in garden making and theory. The tendency they developed was aiming at renewing the art of gardens in a geometric manner which is radical and equivocal. Their compositions were reigned by geometry, also planting. They used colour and perspective effects and the design reveals clarity and simplicity. Their most famous and important work was the garden for the Noailles family in Paris. Art Deco style was named after the International Exposition of Modern Industrial and Decorative Arts in Paris, 1925, when also the Cubism style in terms of landscape architecture arise with the Garden of water and light designed by Gabriel Guevrekian. His style was also dominated by geometry, he used colour in the same manner, but what he brought was the movement in his composition. The art deco gardens where more static, and lacked this fourth dimension of Cubism theories, time and movement. Then Guevrekian designed the garden for the Villa Noailles in Hyères, this major work in the history of landscape architecture which influenced landscapers all over the world.

INTRODUCTION

Art Deco and Cubism are two art styles from the first half of the 20th century. Art deco was born in France around 1920 and named as it is now after the International Exposition of Modern Industrial and Decorative Arts in Paris, 1925. The main exponents in terms of landscape architecture were the brothers André and Paul Véra, designers of many French gardens.

Cubism was developed after Art Deco style, also in France, and was important for landscape architecture too. The first work in this domain was made by the architect Gabriel Guevrekian who later designed The garden of the Villa Noailles in Hyeres, France, masterpiece and landmark for landscape architecture history.

STATE OF THE ART

Art Deco in landscape architecture - the Modernist garden in France - The Véra Brothers

Around 1920 in France, landscape architecture moves away from the Impressionist tendency after Monet and Gertrude Jekyll and the Neoclassicism promoted by Achille Duchêne and developed by Jean-Claude Nicolas Forestier which had been defining it starting with the beginning of the 20th century, as the French develop a taste for geometry, not the Classical kind but a sort of geometry which favours stylising and the use of pure colours, in line with the fashion of the time. This type of geometry was regarded by some as Cubism; however, it hardly exceeded the graphisms of planimetric composition, failing to render the depth of the concepts belonging to the promoters of this movement (Le Dantec, 2002). The Véra brothers, André (1881-1971) and Paul (1882-1957) (Imbert, 1993) developed this tendency which falls in the category of decorative arts. André, described by Michel Baridon as "*le Coco Chanel de l'art des jardins*" (Baridon, 1998), and his brother Paul are seen as „the first French Modernists" (Wilson, 2003) in landscape architecture, aiming at renewing the art of gardens in a geometric manner which is radical and equivocal, somehow in the line of Le Notre; their entire composition, including plants (mainly shorn green hedges and vegetal carpets) pay tribute to geometry. Their style is rigorous, sober, devoid of experimental flourish and exotic fantasies (the Véra brothers favour them too, just as Achille Duchêne and Jean-Claude Nicolas Forestier, indigenous species), the lines of their compositions are of great clarity and simplicity, and the colours they use channel a strong dynamic force (Baridon, 1998). The Véra brothers received artistic education, Andre turning towards landscape architecture and architecture criticism and Paul towards decorative arts (stained- glass, upholstery, furniture), painting and the creation of gardens. Owing to their education and permanent contact with artists of the time, they followed the movement in fashion, therefore their affiliation to Art Deco - as it will be named from 1925, after the *Exposition Internationale des Arts Décoratifs et Industriels Modernes* (International Exposition of Modern Industrial and Decorative Arts) - the sovereign artistic movement during the 30s in France. In 1912, Andre Véra published in "*Le Nouveau Jardin"* (resumed after the first world war in 1920 as „*Le Jardin"*), a manifesto on landscape architecture theory, illustrated with the engravings of his brother, in which he displays and comments upon a series of garden models, all of them representative for what I will term further as Art Deco. The Véra brothers justify this choice by three interdependent factors:

- Changes in daily life (including in garden use) triggered by technological progress (electricity, vehicles, sports...)
- Evolution of taste and mentality as a result of the above mentioned changes.
- Active fidelity (that is rejecting the pastiche) in the French *genius"* (Le Nôtre) (Le Dantec, 2002).

Art Deco and Cubism in landscape architecture

This fidelity towards the Classical aspects of the art of parks and gardens, representative for France, testifies to the preservation of the national tradition, principle emphasized in *Le Nouveau Jardin.* It is precisely this aspect which makes the difference between the Cubist experimental search of Picasso, Braque and Juan Gris and the style promoted by the Véra brothers, under the same title of Cubism, however, only at decorative level (Le Dantec, 2002). The essential element which separates the works of the Véra brothers form Cubism is the third dimension, movement, highlighted by the artist Marcel Duchamp in 1912 in the painting *Nu descendant un escalier no. 2* (Figure 1). However, movement can be in a way rendered by time induced transformation of landscape, or by the ever changing aspect of plants season by season (bloom, autumn foliage colour, fall of foliage in the winter at plants which are not evergreen etc). In gardens and parks time makes up for this movement that the Cubists try to convey through the bidimensional character of their works.

The influence of plastic arts in landscape architecture - Art Deco and Cubism

The works of the Véra brothers are another example illustrating the significant influence of visual arts in the French landscape architecture of the 20th century. They used paintings as models for designing their gardens. Taking into account their preference for Cubism, as well as the fact that the majority of Cubist works are still lives, it comes as a paradox that the Véra brothers had such models for their gardens, so lively in the nature displayed. This paradox is doubled by the fact that the landscaper works in a real environment, while the painter works upon an representation of space (Baridon, 1998). Later on, the famous Brazilian landscape architect Roberto Burle Marx too was to use paintings as starting point in designing public parks and private gardens.

Like Monet in his gardens at Giverny, the Véra brothers made use of colours in landscape architecture based on their knowledge of artistic theories of colours. Monet used colours like an Impressionist painter, while the Véra brothers followed the new Cubist movement and later Art Deco. In "*Le Nouveau Jardin"* Andre Véra explains the theory of colours, primary and secondary, warm and cool, and advises us to use plain shades of colours that are large monochromatic patches in works of landscape architecture either public or private. He suggests we choose warm dominant colours for plat bands, since these are bright and lively, and thus refresh and stimulate us; cool hues are suitable for vegetation rooms where a cool and shaded atmosphere is desired; for small areas, he suggests we use warm monochromatic plat bands in order to create a sense of satisfaction and happiness; he also recommends juxtaposing plants in complementary colours, but in large patches, not isolated. (Véra, 1910)

The Art Deco Garden- The Noailles Garden in Paris

The Véra brothers' most radical work of landscape architecture is the garden of the palace belonging to the viscount Charles de Noailles, in Paris (Wilson, 2003) (Figures 2, 3) at which they collaborated unofficially with Jean-Charles Moreux in 1924. In the composition of this 500 square metre garden, the ground floors' geometry is obviously Avangardistic, moving away completely from the harmonious traditional geometry of the Classical 17th century pattern (Le Dantec, 2002). The bidimensional aspect of the garden is a precise indication that it was designed starting from a work of art, a drawing.

The Cubist Garden- Guevrekian

Creation as a consequence of *Le Nouveau Jardin* was delayed due to the First World War, until the *Exposition Internationale des Arts Décoratifs et Industriels Modernes* from 1925, which acted to a great extent as display cabinet for the ideas of the Véra brothers, but also for those of architect Gabriel Guevrekian (1900-1970) (Fleming et al., 1999) who transformed profoundly the history of landscape architecture by designing, for this event, the first genuine Cubist garden. Framed by a triangle and having this geometric figure as starting point also used as leitmotif, the Garden of Water and Light (Figure 4) is his first work of landscape architecture. From Cubism, he borrows the geometrisation and pure colours, leaving out the third dimension, time, thus falling into the category of Avant-Garde and not Neoclassical and Nationalist decorative Cubism.

This garden and especially the one destined to the Noailles familiy in Hyères, France (Figure 5) will become major points of reference to young landscapers worldwide in the 30s and also nowadays is an important landmark in landscape architecture history. And yet this garden is a tribute to Cubism and its innovative role; however, it did not transform much the art of parks and gardens (Baridon, 1998).

Plants in the Modernist garden

The Modernist gardens are not fully valued due to the unknown species of plants, especially those of Guevrekian. When the Noailles garden at Hyères was restored, many of the species of plants initially used precisely for this reason were replaced (Leenhardt, 1994).

French Modernism - return to Classicism

The Modernist movement in France was mainly a return to Classicism, a renewed Classicism with no clear cut separation from the past. The Modernist landscape architecture of the Véra brothers and Guevrekian can be seen as manifesto of the art of traditional French parks and gardens. These specialists did not start writing on a white page but took as starting point the rich history of French landscape architecture (Baridon, 1998).

International Exposition of Modern Industrial and Decorative Arts in Paris, 1925 – between Neoclassicism and Modernism

Now going back to the International Exposition of Modern Industrial and Decorative Arts in Paris, 1925, we can state that this was above all an energy stimulus to urbanism and architecture on one hand, and landscape architecture on the other, to France and the other attending countries. In the context of this exhibition of vitality, the two tendencies between which the French society oscillated at the beginning of the century, with direct implications in landscape architecture, were clearly separated. We are talking here about traditionalism opaque to social transformation triggered by the First World War, including the Neoclassicism of Duchêne and his followers, and Modernism induced by the society's democratisation where, in areas such as urbanism, architecture and landscape architecture, the emphasis dwells on industrialisation. This last aspect has significant effects on the practice of landscape architecture as well. Specialists who favour this tendency take equal interest in housing for the masses, therefore including public parks and gardens, as well as residential areas for the rich, with individual properties which sometimes have gardens.

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FIGURES

Fig. 1. *Nu descendant un escalier no.2*, Marcel Duchamp 1912, Museum of art, Philadelphia
After: http://lyc58-romain-rolland.ac-dijon.fr/Pedago/HDA/SanRomano.htm

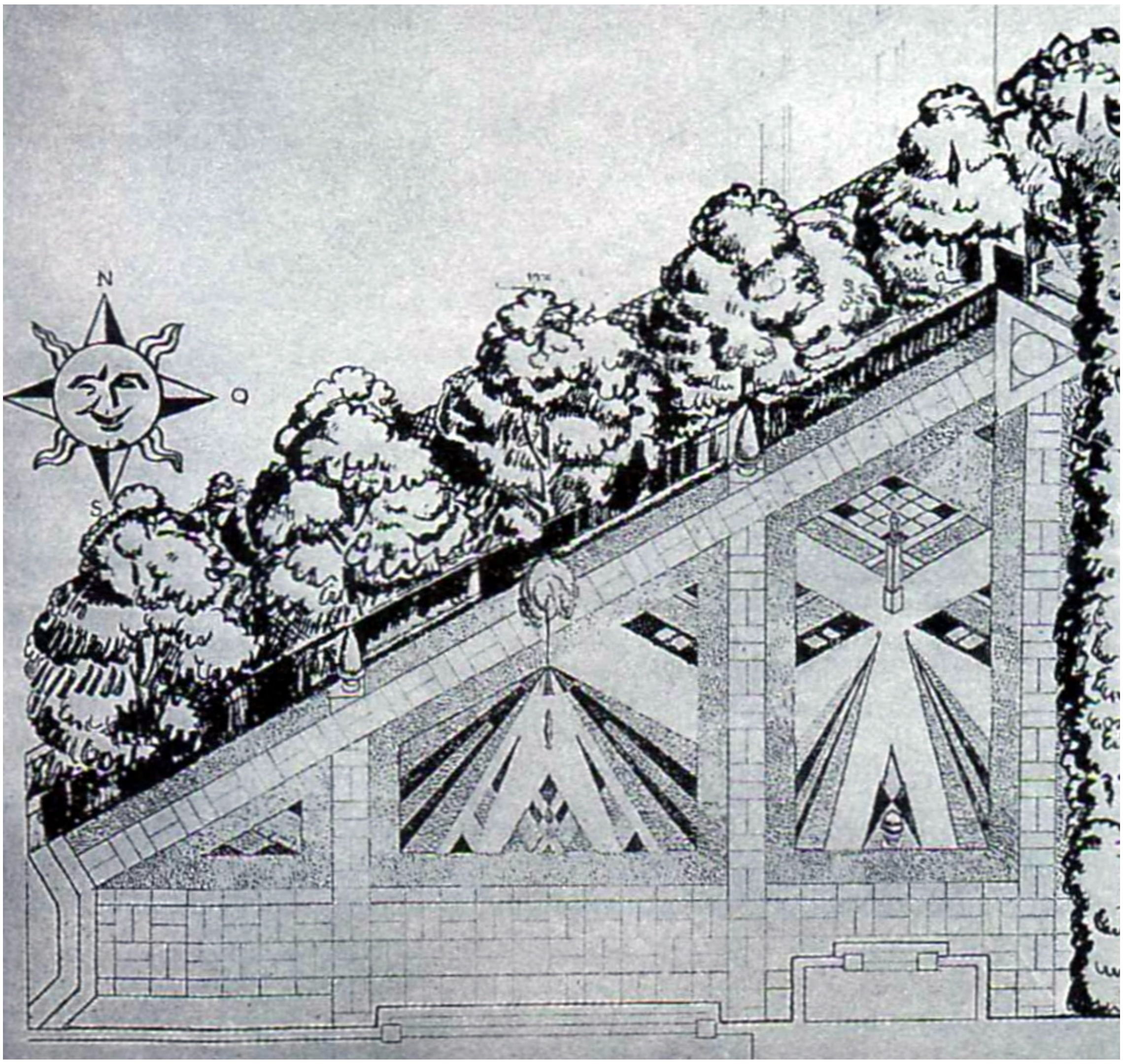

Fig. 2. Noailles garden, Paris – Plan, after Le Dantec, 2002

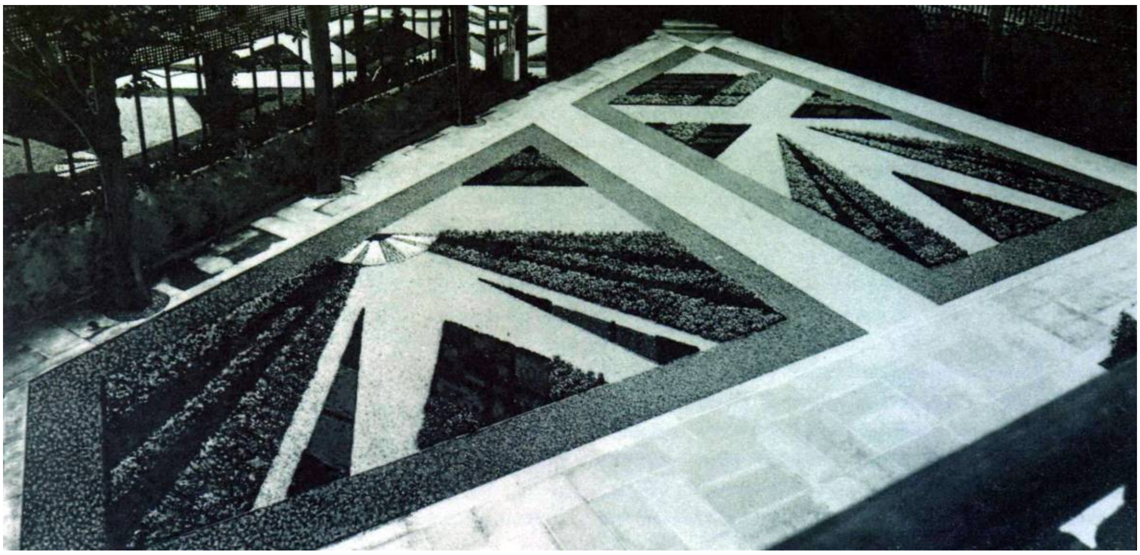

Fig. 3. Noailles garden, Paris – perspective. After Le Dantec, 2002

Fig. 4. Garden of water and light by Gabriel Guverekian - plan. After Le Dantec, 2002

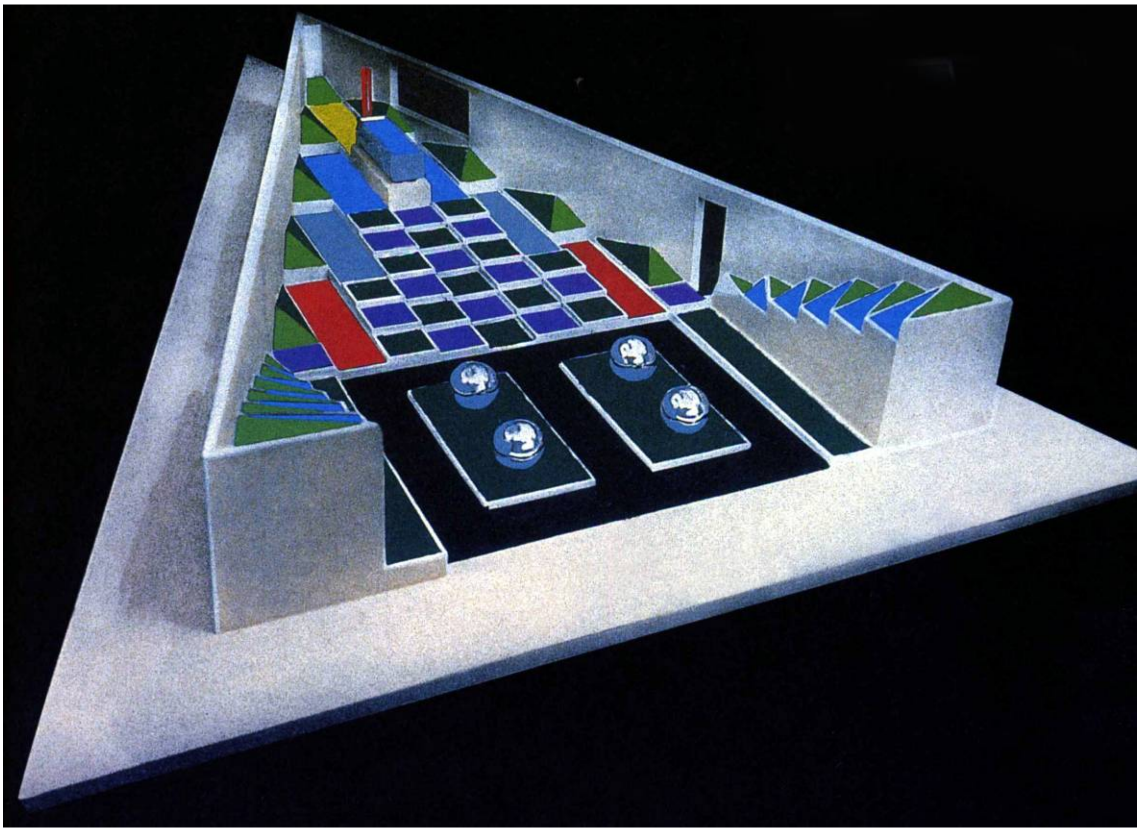

Fig. 5. Garden for Villa Noailles, Hyères by Gabriel Guverekian - model. After Campbell, 2006

Trends in 20th Century Landscape Architecture – Impressionism

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Keywords: landscape architecture, impressionism, garden

ABSTRACT

Impressionism is an art style born in France at the end of the 19th century and an important exponent, the painter Claude Monet created his own garden at Giverny, near Paris in order to paint it. He worked at his garden since 1883 until he past away in 1926 and this garden became a laboratory for plant combinations and gardening also, not only for painting. He used the art of colours in his garden as in his paintings. He chose simple and autochthonous plants, native and simple flowers. He started from a traditional garden and he preserved its principles, thus creating the first vernacular garden in the world. It became very popular, a model for gardens first in France then worldwide and also in public parks and gardens. It influenced a lot the British landscaper Gertrude Jekyll, the main exponent of the Arts and Crafts style in gardens who was very prolific at the beginning of the 20th century.

INTRODUCTION

Impressionism is an art style born in France at the end of the 19th century. Its main principle is to work with the effect of light on an object rather than to paint the exact presentation of the form. Between the most famous exponents in painting, Claude Monet was very interested also in gardens and he designed his own in Giverny, near Paris, and worked at it till the end of his days. These gardens became a model for landscape architecture, a world landmark in this domain.

STATE OF THE ART

The Impressionist garden – Monet' s garden at Giverny.

The painter Claude Monet (1840-1926) (Baridon, 1998) lived at Giverny since 1883 until he passed away in 1926. He started working at the garden in 1890 and kept on doing so for the rest of his life, driven by the pleasure of both gardening and painting, thus turning the place into what is deemed to be a genuine creative laboratory in the field of landscape architecture. So great is the influence of Monet's garden that at the beginning of the 20th century, it features in the works of the famous British landscaper Gertrude Jekyll (Le Dantec, 1996; Pizzoni, 1999; Wilson, 2003; Stuart, 2004), the primary figure of the *arts and craft* trend in garden art, but also across the century to the present day, in urban public parks, for instance the Citröen Park in Paris, in Gilles Clément's *Garden in Motion* (Clément, 1991; Cortesi, 2000; Clément and Jones, 2006; Panţu, 2009), a „more experimental approach, bearing the influence of ecology and that of a certain contemporary plastic search, sensitive to the „spontaneous artistic" creations" (Le Dantec, 2002).

Monet's garden comprises two opposing and at the same time complementary areas (figure 1): the flower garden in front of the house, which he calls the *Clos* Normand (Murray and O'Connor, 1989; von Schaewen et al, 2008) (*clos* – typical medieval garden closed by walls), of approximately 1 hectare, and the water garden, influenced by the Japanese style, on the other part of the street, on a land he purchases later on (http://giverny.org).

Although the flower garden has a compositional structure that is symmetric, rigorous and in fact pre-existent (it is the former orchard pierced axially by an alley pointing north-south towards the house, alley which Monet preserves together with the two yews on each side, and to which he adds platbands of flowers) (Figure 3), the way in which the Impressionist painter organizes the variety of floral species is utterly free, the compositional structure serving only as frame. On each side of the alley there are two lawns where Monet replaces fruit trees by flower trees, cherry trees and Japanese apple trees; the lawns are continued at the west along the alley with long platbands of flowers mostly monochromatic, and at the east with smaller east- west oriented platbands of flowers. However, the variety of species, colours and various heights of flowers, floods this geometry which cannot be deciphered but during winter, from the floor of the house. He creates exquisite volumes through massifs of flowers of different colours and heights. In this garden, the artist pursued a variety of well managed perspectives, and even by placing various species in certain areas, highlighted effects of perspective: in the western area he planted species with warm colours which ripen at sunset, whereas for the eastern area he chose species in cool and pastel hues (Figure 2, 4). Monet continually added new species of plants in this mix, mainly perennial plants with simple flowers, but also seasonal plants, so the ground is always covered with flowers and left as little visible as possible (Le Dantec, 2002).

Judging by the vegetal composition of the garden at Giverny, we can state that Monet's landscape architectural style falls into the category of the natural style, especially 18th century English environmental style, and that of the French *alphandisme*, as Jean Pierre Le Dantec named it, and could be regarded as neo-natural.

The first vernacular garden

Monet creates the garden at Giverny starting from a traditional popular garden with orchard, that is an utilitarian garden; he preserves its spatial composition and part of the wood vegetation thus not altering its structure. He transforms it to fall into the same pattern of traditional popular countryside garden with flowerbeds in front of the house and orchard. For that reason, we can say that Monet's garden at Giverny is the first example of vernacular garden. Monet introduces the traditional garden pattern into the cultural area, so we can speak of a refining and development of the traditional garden pattern in terms of aesthetics.

The influence of fine arts in landscape architecture- Impressionism

The composition of the water garden is utterly free and evincive of the Japanese influence (Figure 5), fashionable at that time in Western Europe, among painters but also architects and landscapers. Monet will paint the Japanese bridge no less than forty five times (http://giverny.org).

The gardens at Giverny are therefore the work of a plastic artist who is very careful about the effects of colour he explores and uses here. We can even refer to this style in landscape architecture as Impressionism. The influence of the visual arts on the 20th century landscape architecture is significant, across France and worldwide, and this is only one of many examples.

The elitist and popular culture in landscape democratization

Monet's garden is visited by people who write about it and thus render it famous which makes it a model first for the gardens in France, then for those worldwide, and in this way influences also landscape works destined to the public. We can therefore say that through his garden, Monet introduces the popular to the elitist culture, at the beginning of the 20th century. The Impressionist painter starts from a popular garden which he transforms, yet preserving its popular pattern, so as to reach the level of educated creation, thus turning it into a model for several generations of landscapers. In the previous centuries, the landscape was elitist – starting with the 17th century it becomes courtly (Elias, 1985). It wasn't until the end of the 19th century that landscape lost this elitist nature and starts to undergo a process of democratization, and that is when the public park emerged. During the 20th century this process of democratization is fully completed, and the public park is thus destined to the entire society, not only to the elites. This is when Monet introduces his model of popular garden, at first in the elitist garden, the model being thus further disseminated at first to private gardens destined only to the elites, and only later to parks and public places, that is the democratized landscape.

Preference for native and popular plants

Another aspect worth taken into consideration when discussing Monet's work at the garden at Giverny is the preference for popular and native plants. Up until then the gardeners and landscapers would pick out mainly exotic plants with the most spectacular aspect, so fashionable in the age of Alphand. Monet chose plants used in the traditional, vernacular garden, especially those with plain flowers. Other important French landscapers, contemporary to the Impressionist painter, shared this choice too, as Achile Duchêne (1866-1947) (Baridon, 1998) and Jean-Claude Nicolas Forestier (1861-1930) (Baridon, 1998; Fleming et al., 1999). However, the penchant for native plants is not characteristic to France, as it exists in other European countries as well (Negruzzi, 1867).

Another aspect worth mentioning when talking about Monet's work at the garden at Giverny is that the painter started to move away from exotic plants, so fashionable until then, especially during the time of Alphand.

CONCLUSIONS

Monet's gardens in Giverny influences are very important in the landscape architecture history. They were a model first for French private gardens, than for gardens in the whole world and also for public parks. In the beginning of 20th century, the famous British landscape architect Gertrude Jekyll (Le Dantec, 1996; Pizzoni, 1999; Wilson, 2003; Stuart, 2004) was visibly inspired by this gardens in the multitude of her works. In our days, one can observe aspects of Monet's gardens in Gilles Clément's Garden in Motion from Citröen Park in Paris (Clément, 1991; Cortesi, 2000; Clément and Jones, 2006; Panţu, 2009).

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FIGURES

Fig.1. Giverny gardens plan, after http://giverny.org

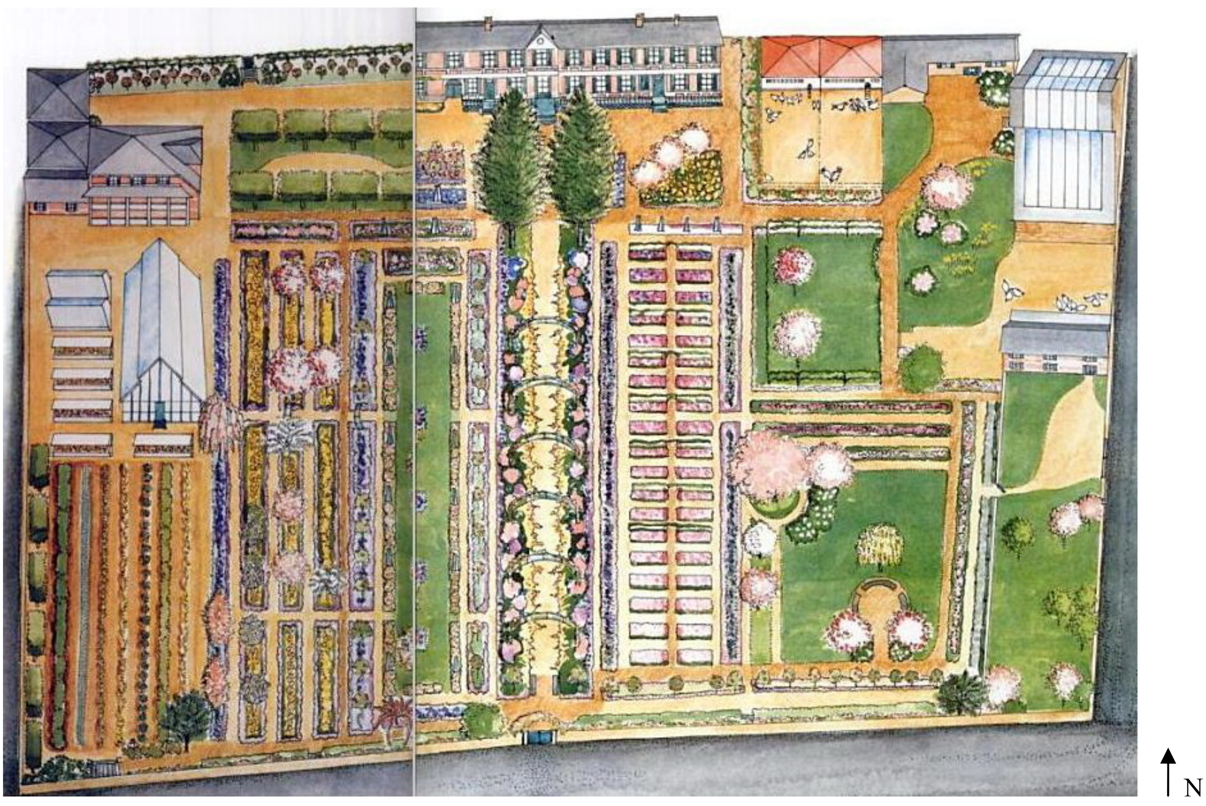

Fig.2. The Clos Normand plan, after Murray, 1989

Fig.3. North-south alley from the Clos Normand flower garden, 2010

Fig.4. Eastern platbands with cold colour flowers from the Clos Normand, may 2001

Fig.5. The water garden, 2010

Windows in time on Loire Valley

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Keywords: cultural landscape, pastiche, historical approach.

ABSTRACT

Loire Valley is one of the well-known areas for the French cultural landscape and for the French historical gardens in particular. The Loire Valley, between Sully-sur-Loire and Chalonnes, is a *UNESCO World Heritage* since 2000, and Sully-sur-Loire is part of *Zone Zico* and of *Natura 2000* protected natural sites. In April 2010 we had the opportunity to participate to an international competition with an exciting theme: *Jardins à la française* at Huardière Domain, Sully-sur-Loire, France. This contest aimed to stimulate the students' creativity and to involve them in a large scale international project, in order to form a multi-cultural team. The students' aim was to reconcile their own vision on one part with the owner desire and the restrictions imposed by the site as a part of *UNESCO World Heritage*, of *Nature 2000* protected sites and of *Zone Zico* on the other. To answer to all these goals was a great challenge that will be presented in detail.

INTRODUCTION

In 2000, the Loire Valley was declared a *UNESCO World Heritage*, thanks to its outstanding cultural landscape that illustrates the ideals of the Renaissance and the Age of the Enlightenment thought and design. *Jardins à la française* or *French classical gardens*, created in the 17th century by André Le Nôtre, are historical monuments and an important part of the French heritage. These gardens are well-known for their symmetry, optic illusion, fountains, water channels, artefacts and the ability to handle the vegetation and to use it in large compositions. Gardens are a privileged part of the French cultural landscape from Middle Age up to modern times.

The international competition *Jardins à la français* was initiated for the students in landscape architecture from all over the world. Universities from Canada, France, Germany, Bulgaria, Holland, Hungary, New Zeeland, Russia and U.S.A. were some of the competitors. In this contest were involved the Landscape Architecture Departments of three Romanian universities: "Ion Mincu" University of Architecture and Urbanism in Bucharest and the Universities of Agronomical Sciences and Veterinary Medicine in Cluj-Napoca and in Bucharest. Three of the Romanian projects, one of each of these universities, were nominated. Landscape Architecture Department in Bucharest University of Agronomical Sciences and Veterinary Medicine contribution in this contest consists in 6 idea-projects. One of them was nominated and then was awarded with the first prise.

The theme was extremely difficult because of the complexity and the incompatibility of some requirements. *Jardins à la française* are relevant for the 17th century. Huardière Domain has been coagulated starting with the middle of the 19th century in the middle of a beautiful natural area: Loire Valley itself and a large forest which will be declared natural protected area. These areas are in the centre of landscape architects' concerns starting with the 20th century. All these seem to be pieces of a very complicated puzzle. We have to find the rule of the game. How to put together five centuries of French culture and the new ecological approach?

MATERIALS AND METHODS

All the elements related with this subject had to be thoroughly studied: the impressive context of Loire Valley, the history of the place, the cultural landscape of Loire and of Orléans County, the natural protected areas of this county, the legislative restrictions related with natural and historical protected areas etc.

1. We have studied the **literature** related with French history, art and culture, with French cultural landscape, with protected areas (archaeological, architectural and natural). The history, the personalities and all important events related with Orléans, with Sully-sur Loire and with Huardière Domain were studied too.
2. **Legislative restrictions** related with natural and historical protected areas were studied. On Huardière Domain is a protected forest, part of *Forêt d'Orléans*, an archeological site and a little graceful mansion of 19th century with its own garden. *Musée du Patrimoine*, Palais de Chaillot, Paris, France (architecture, gardens and design) is relevant for the importance given to the national patrimony and the force of the legislation concerning the French patrimony. Gardens are considered an important part of it.
3. A **field study** was strongly required. In March 2010 I have the opportunity to visit Huardière Domain just after a storm which putted down a lot of trees of the protected forest (Fig. 1.) and I drew the following conclusions:

Fig. 1. Huardière Domaine in March 2010

3.a. The <u>soil</u> of Huardière Domain, situated in the Loire meadow, is sandy. That can be seen on the roots of the fallen trees after the storm.

3.b. The <u>groundwater level</u> is very up. Some puddles can be seen on the actual field of the future garden (Fig. 2.). This is the reason to maintain and to extend the network of drainage channels. Also, the configuration of the fallen trees' roots proves the up level of groundwater.

3.c. The <u>vegetation</u> of the domain is natural on the borders of Loire Valley and in the protected forest and planted in the courtyard and in the garden of the 19th century. *Pseudotsuga menziesii* trees of the garden have spread in the natural forest, but they are not adapted with the sandy soil of the domain and some of them have been uprooted. *Cedrus atlantica* trees, plated in the garden, are in a poor condition and some are already dead. Almost of the plants of the garden and of the courtyard are covered by lichens and fungus because of the humidity present in atmosphere and soil (Fig. 4.). The area intended to become garden is now an agricultural field. A beautiful alley with alignments of *Aesculus hipocastanum* and *Pseudotsuga menziesii*, planted alternatively, ensure the access to the mansion area, even on the axis (Fig. 5. and Fig. 6.).

Fig. 2. Huardière Domaine in March 2010

Fig. 3. Puddles on the actual field of the future garden

3.e. Visually, the mansion has no intimacy, especially during in the night, when the lights are on. It can be seen from a great distance from the road, but not from the entrance, because of the alley flanked by old trees (*Aesculus hipocastanum* and *Pseudotsuga menziesii* planted alternatively) (Fig. 6).

3.d. The volumetric appearance of the domain is divided in two: one is important and impressive by the presence of the forest and the garden and another is flat and open (the agricultural field). The domain has no volumetric coherence (Fig. 3.).

Fig. 4. Hibiscus syriacus in the formal garden of Huardière mansion

Fig. 5. The mansion and the alley flanked by old trees

Fig. 6. Panorama of Huardière Domain

Fig. 7. Huardière Domain on Google Earth

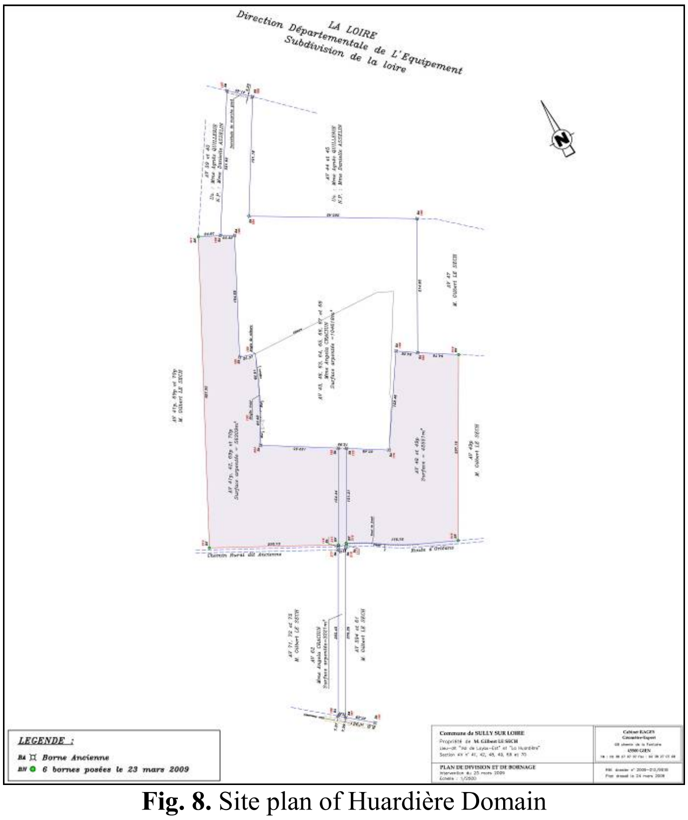

Fig. 8. Site plan of Huardière Domain

The area intended to become garden is marked with gray.

3.f. The proportions and the dimensions of the area intended to become garden in relation with the surroundings (the agricultural fields, the Loire Valley, the main road and Sully-sur Loire) was a very important point too. This was the moment when we decided to approach the entire assembly, not only the area imposed in the theme of the competition.

3.g. The field study was very important for the right perception of the space and of the relation between the components of Huardière Domain - the constructed heritage, the forest, the actual garden and the area for the future garden (Fig. 6. and Fig. 7).

RESULTS AND DISCUSSION

We wanted to understand the reasons of declaring the Loire Valley as a *UNESCO World Heritage* and to reveal its character among others. Loire Valley consists in a lot of settlements, landscapes ("natural" or cultural) and monuments (historic, artistic, architectonic, gardens) of a great interest for scholars and tourists all over the world. Huardière is not a great château with a long history, but a little graceful mansion of 19th century situated on the borders of Loire, at 3 km**.** of Sully-sur-Loire. It has a short history, connected with Andre Malraux who used to live here for a while. We had to find something new, unique and exciting in this context. On the other side we were very impressed by the bright appearance of the mansion projected on the dark background of the forest, by the graceful and delicate neoclassical architecture in contrast with the wilderness of nature. The study of French historical gardens was strongly required. All the details are important in solving the difficult problem of integrating the new gardens in the cultural and ecological context of Huardière Domain.

Fig. 9. Huardière mansion

Concept

In the process of looking for the concept, we selected some notions related with the theme, the mansion, the site etc. like: symbol, art, citation, history, happiness, events, creativity. Step by step, we realized that everything could not come down to only one idea. A series of schemes were born, and we strived to assemble them all together, unable to abandon any of them. Besides, this place, with a huge potential, must be arranged as a prolongation of its symbolic inheritance… by its conservation, valorisation and enrichment. Our project should not damage the wonderful vegetal frame on the site and its natural equilibrium. Our thoughts have been materialized in four schemes:

1. We found four connected layers which define the first scheme: the way (the access alley), the chore (the manor), the nest (the forest) and the orbit (La Loire) **(**Fig. 10.).

2. The next scheme is a symbolical one: we represented the *movement* (activities like riding, archery, tennis etc. supposed to be held here), the *art* (festivals, concerts, lend-art etc.) and the *fusion* of them (the forest can be the place for both of them) with the primary three colours (red, blue and yellow). By mixing the three colours lights we obtain the *light* of the day, the brightness. It's a symbolic representation of our thoughts concerning the activities and their specific places, related with the mansion and the site (Fig. 11.).

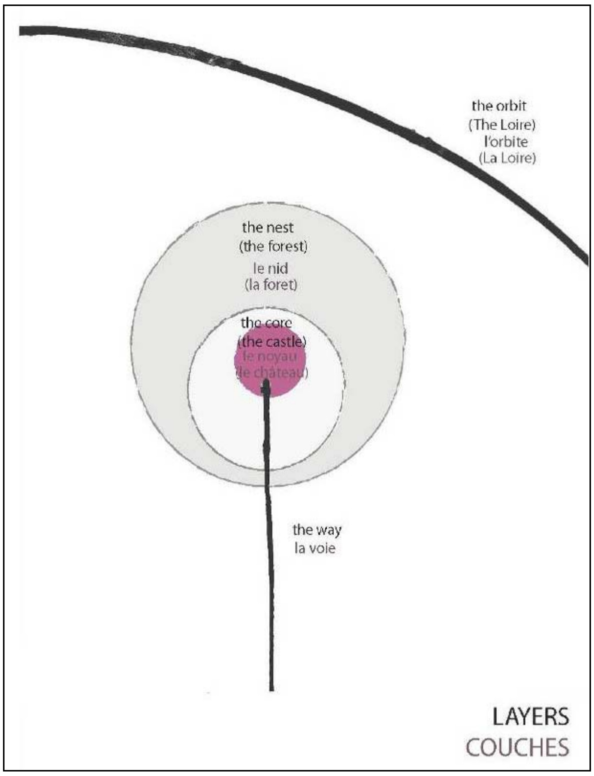

Fig. 10. The first scheme – Layers

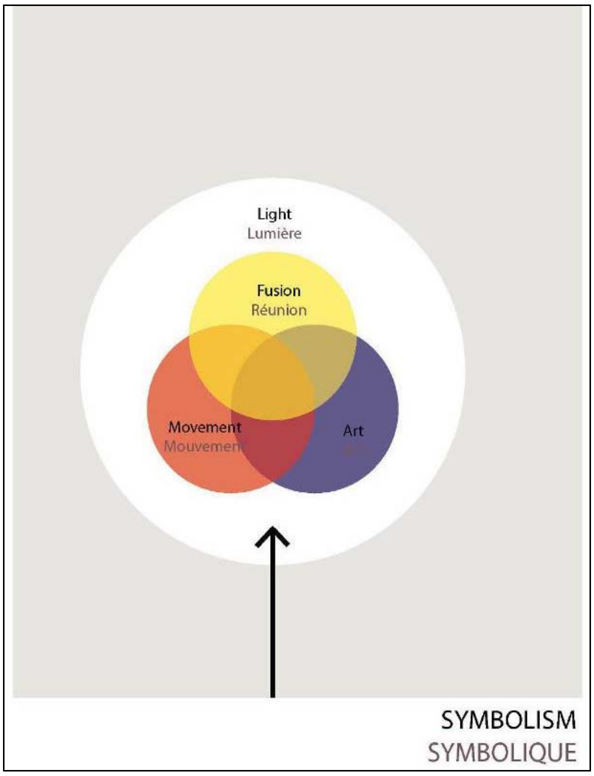

Fig. 11. The second scheme – Symbolism

3. The third scheme is more detailed. We took the commitment that our project should bring homage to the French Garden by creating an incursion in its history. We wanted to avoid a facile *pastiche* and we proposed an elevate approach of cultural quotation: the ages of French historical gardens are represented by emblematic gardens, from Bois Richeux to Villandry and Versailles (Fig. 12.).

4. Our desire to avoid the *pastiche* was an important motivation in our approach. The composition follows a time travel, starting from the primary, utilitarian view of the garden and meeting the spiritual view of the romantic era, which aims to ennoble the human being. We imagined five *chambers*: chamber of the past, chamber of the present, chamber of the

future, a timeless chamber and a chamber beyond time (Fig. 13.). Imaginary windows make communicate these chambers. This was the way to the concept: *Windows in time*.

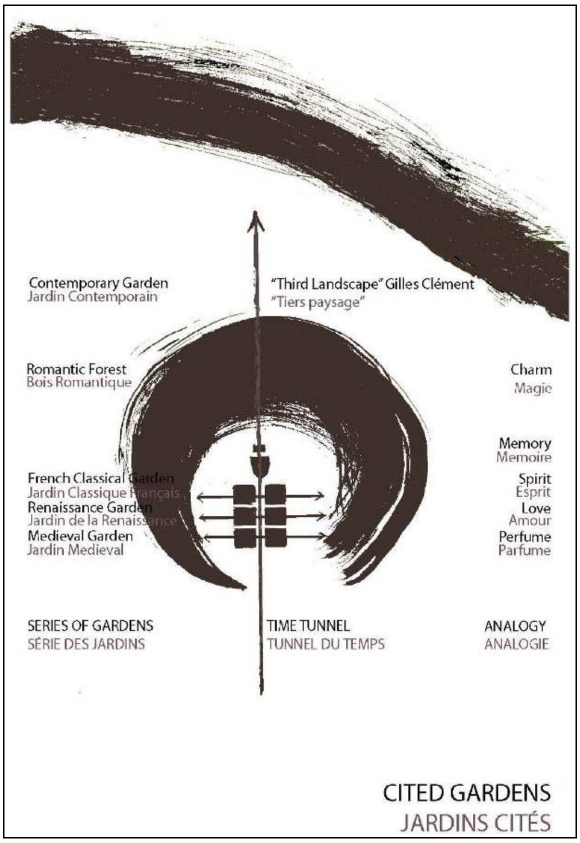

Fig. 12. The third scheme – Cited gardens

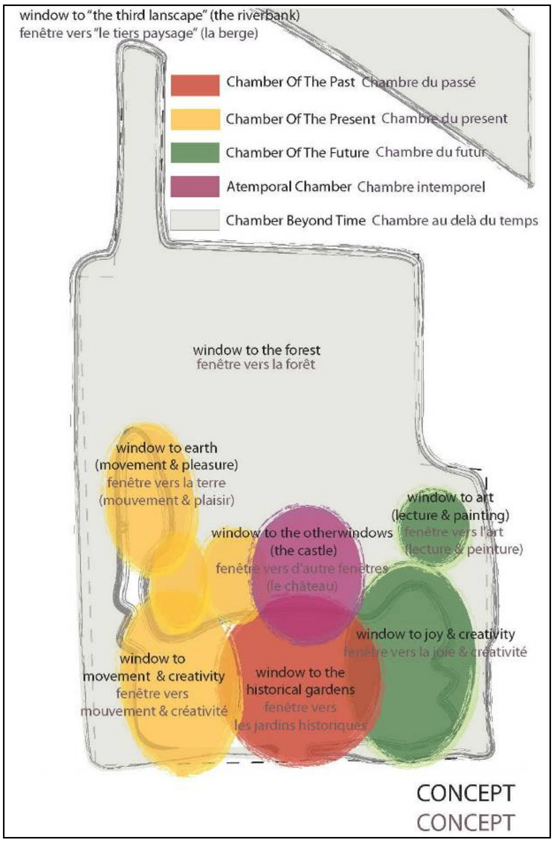

Fig. 13. The fourth scheme – Concept

Atmosphere

To make a garden *à la française* today, with all its implications – compositional, functional and spiritual – represents a challenge.

We have been conquered by the mansion, by the elegance and delicacy of its style, as well as the forest around it and by the entire natural frame, the Loire Valley. Everything radiates poetry and beauty, tranquility and equilibrium, and our duty was to bring something that should complete this environment, without corrupting anything. Few words synthesize the desired atmosphere: brightness, clearness, energy, harmony, inspiration, dream and freedom. They will characterize each area of the domain, not only the new garden (Fig. 14., Fig. 15., Fig. 16. and Fig. 17.).

Project

The location of the Huardière Domaine on the Loire Valley, at the Eastern end of the historical monuments cluster in the area, translates into a very rich landscape with a great potential for cultural tourism. The solution we suggest is a very ambitious one: to create a garden *à la française,* perfectly integrated in the free lines of the forest surrounding the Huardière domain. Hereby, the project aims to integrate a new space (the former agricultural fields) in the stylistics of the current domain, pursuing that the complex, on its whole, should keep a coherent image and functionality, defined by unity, diversity and harmony.

Fig. 14. The orchard

Fig. 15. With the carriage in the "time tunnel

Fig. 16. Events

Fig. 17. Walking in the forest

The castle's garden is harmoniously integrated into the new composition, and so is the forest, a *Natura 2000* protected natural site. The result is a unitary design making subtle connections between various cultural landscapes which are archetypal for the French cultural space. In the *Year of Biodiversity*, this project proposes the expansion of the forest – that has been thoroughly studied – to provide unity, as well as privacy to the whole. Expanding the forest is vital for the habitat of the animals, birds and insects too. We wanted Huardière to be a complex where the natural equilibrium will be preserved. We have surrounded the entire domain with a new body of forest, as a protective, magical girdle. We decided that it is very important to surround the entire domain with the species living in this forest. We only added some non-invasive species, to underline and make the best use of a certain area, to generate a certain atmosphere, to create intimacy.

The presence of Loire right next to the domain fascinated us even from the very beginning. This natural area, lacking any intervention, was dedicated to the concept of the *third landscape* of Gilles Clément.

The whole domain, not only the new gardens, is organized in several key moments, threading along the pivot of the composition:

Moment 1- Incursion into the history of the French gardens

A series of gardens, arranged along the central pivot, that gives a didactic illustration of the major stages in the history of the French garden: the Medieval Garden, the Renaissance Garden and the French Classical Garden.


Fig. 18. and **Fig. 19.** Garden of perfume or sensorial garden quotes the gardens of Bois Richeux, Maintenon


Fig. 20. and **Fig. 21**. Garden of Love quotes the Gardens of Villandry Castle


Fig. 22. and **Fig. 23.** Garden of Spirit quotes the Garden of Great Trianon, Versailles

Those stages are represented through *quotations from famous gardens of the French history*. In this sequence, the *time axis* is doubled by a *route of perceptions*:

– The Medieval Garden, a quotation from Bois Richeux Garden, Maintenon, flavorous and functionally oriented, is dedicated to the *Sensorial* and we named it *Garden of perfume*.

– The Renaissance garden, a quotation from the garden of Villandry Castle, where passion rises from the love of beauty, is the *garden of Love*.

– The French Classical Garden, a quotation from the garden of The Great Trianon in Versailles, is dominated by simplicity and elegance and bows before *Spirit*.

– The Garden in front of Huardière mansion, defined by geometrical lines, mixed with the Romantic style, is a space dedicated to *Memory*.

– The *Romantic Park*, inspired by the protected forest surrounding the castle. This has a double function: it limits the perimeter of the property and it harmoniously integrates the didactical gardens, carrying on the line of the forest.

Moment 2 - The Forest

– It is a magical forest, where history rests, generating a *space of meditation*. It can also host a wide series of events and it is a space for equitation;
– This natural landscape makes the transition from man's creation to the Creator's authoring.

Moment 3 - The Loire Valley

– The Loire and the wild vegetation on its bank is *a third landscape*, in Gilles Clément's definition**.** This is the moment that will bring a contemporary touch to the charming domain of the Huardière Castle.

While in the first part of this journey, that pursues the reconstruction of the history of French Garden, the promenade is organized in a geometrical manner, in the second part it will unfold on free trajectories, which either end directly on the grass of the lawn, or merge with the paths of the woods, heading for the Loire (Fig. 24., Fig. 25. and Fig. 26.).

The composition is defined by the pallet of the vegetation delicate colours, by fluid and soft lines, balancing the geometry of the central, didactic garden through the general feeling of poetry given by the extension of the forest through the suggestion of a romantic park (Fig. 27., Fig. 28. and Fig. 29.).

The functions imposed by the task are harmoniously integrated in the general composition:

– *Spaces dedicated to various events* (artistic, cultural and social): the lawns set on the left and on the right of the central axis.
– *Spaces dedicated to relaxation*: equitation and pool beside the guest house, forest walks and strolls alongside Loire.
– *Utilitarian spaces* opened to active relaxation: *jardin potager* and the *orchard*.
– *Private spaces*, meant for passive meditation and recreation: the *Andre Malraux Garden,* for painting and reading.

Particularity of this project is *the lighting*, derived from solar energy. The lighting units are independent and mobile, generating the possibility to create various moods, playful or sober, romantic or rigorous, suited for each and every event hosted by the complex.

Fig. 24. Romantic moment with a medieval vase and vegetation with purple flowers

Fig. 25. Romantic moment with a Renaissance vase from the Gardens of Villandry Castle and vegetation with pink flowers

Fig. 26. Romantic moment with a classical vase from the Garden of Great Trianon, Versailles and vegetation with white flowers

CONCLUSIONS

The new garden was conceived in a manner that makes possible to be built in several stages and each newly created area will have its distinct personality. The domain can be fully functional after the creation of the forest girdle in the first stage - the Romantic stage. The areas recalling the evolution of the French Garden will be realized in the second stage, enriching and completing the whole.

AKNOWLEDGEMENT

The authors are grateful to Angela Crăciun for the idea of launching and international project competition for the Landscape Architecture students and we hope that, together, we will realize a true and wonderful *jardin à la francaise,* in the unique atmosphere of the Huardière Domain! We also thank Mrs. Angela Crăciun for the wonderful opportunity to

dream *on the banks of Loire* and especially for her confidence in the creativity and enthusiasm of students.

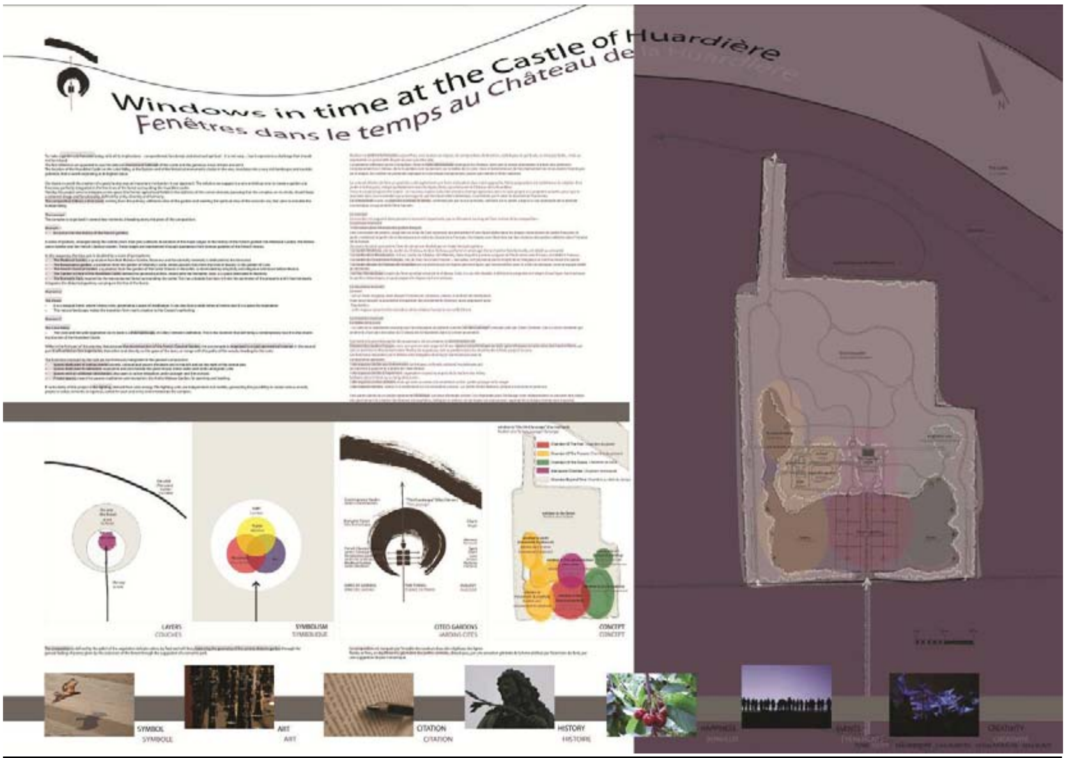

Fig. 27. The concept and the first sketch

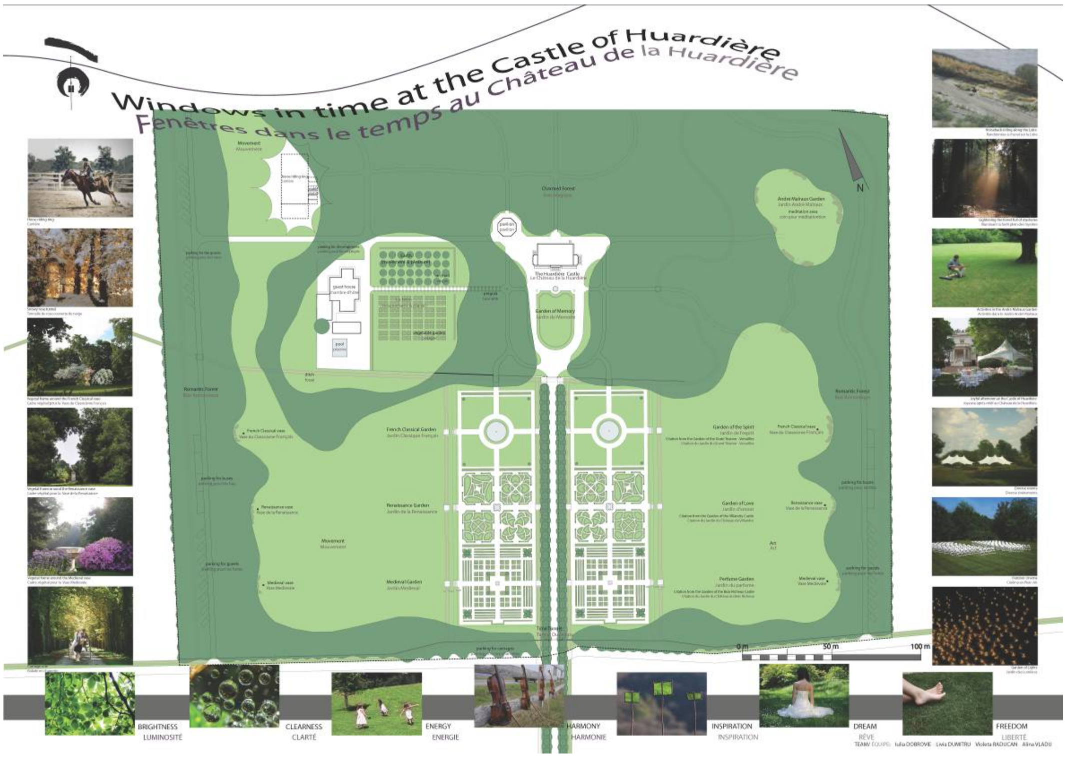

Fig. 28. The project

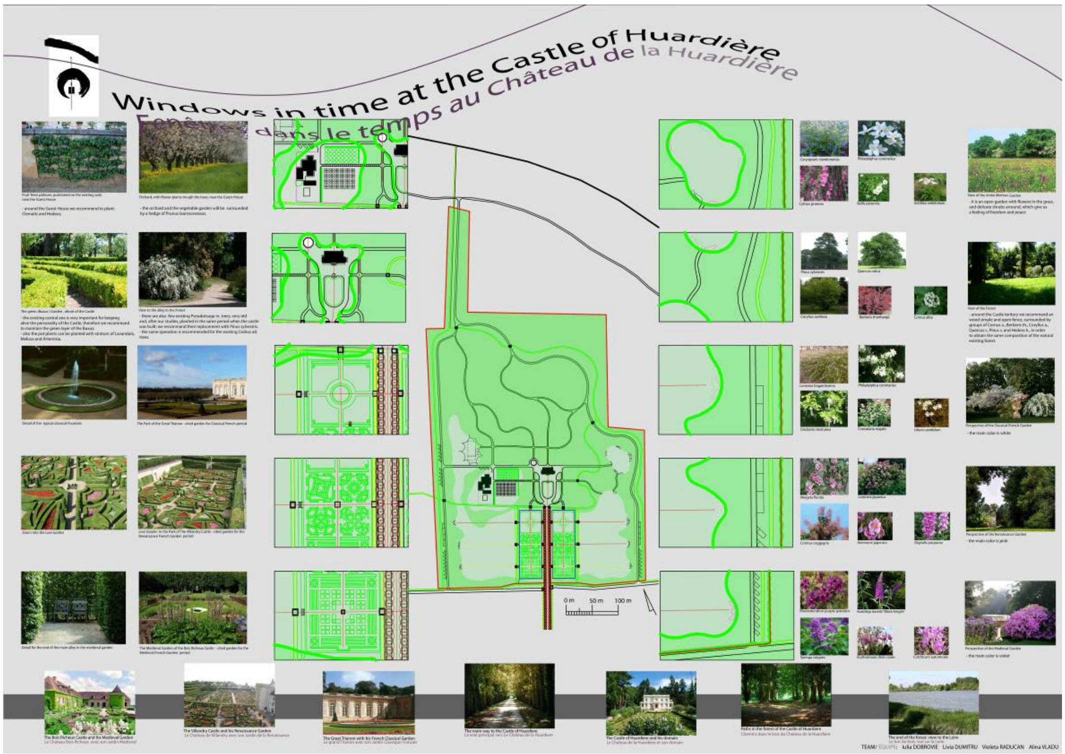

Fig. 29. Details concerning the vegetation

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SAFO - Société des amis de la Forêt d'Orléans

Conseil général du Loiret

Pays Forêt d'Orléans Val de Loire

ONF - Office National des Forêts

Comité départemental de Randonnée du Loiret

Ceramics in landscape arrangements

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Keywords: ceramics, garden, urban public green space

ABSTRACT

The current work studies the diverse forms of ceramic usage in urban landscaping, public and private green spaces. The study also (debates and) analyses the multitude of functional, esthetical and ambient aspects generated by using ceramics in the compositional-functional structure of urban landscape arrangements. Because of its multiple qualities, ceramics are used in the construction of architectural-functional endowments, as well as in the realization of objects with a decorative character.

INTRODUCTION

Ceramics have been known and used since ancient times by civilizations like: Asiro-chaldeens, Persians, Greek and Romanian, up to present times. Ceramics are realized of clay soils which are burned in high temperature ovens and so are obtained materials resistant to physical and mechanical forces, having a remarkable durability. In the garden art, ceramics have been used as pavement material, for decorative lining as enamelled blocks and also for bowls and other decorative objects.

The purpose of the present study is to point out the qualities of ceramics in the landscape designs, the variety of usage possibilities and esthetical aspects of the most diverse for their usage.

MATERIALS AND METHODS

The scientific development of ceramics technology let to the improvement of the natural qualities of the soil and clay, to the removal of certain fabrication difficulties, to the extension of choice, to the refining of some products in esthetical purposes. The specialized industry produces: blocks, materials for finishing and plies, resistance elements, materials for covering and sanitary equipment.

The raw materials for the ceramics industry are clays. They are natural soils combined in a certain proportion with water, after which they become plastic. The mass obtained can be modelled and it maintains its shape after drying. The products obtained by these means are burned ovens at high temperatures, and by burning they become non-deflecting and insoluble in water. Clays have these qualities because of their main component: kaolin. It can be found in a greater or smaller proportion in any soil. Some clays may contain up to 97% kaolin.

Ceramics are used on a wide scale in constructions: masonry, structure elements, and pavements, elements for roofs, linings and decorative objects. In public and private green space arrangements, ceramics are frequently used as elements which are part of the construction component, as enclosure or pavement elements and also as decorative objects.

The method applied in the present study is that of documentation about the usage of these materials in landscape designing and the esthetical valences offered by these materials in the public or private green space arrangements.

The study material consists of a selection of representative images for the importance of ceramics in landscape arrangements.

RESULTS AND DISCUSSIONS

The presence of ceramics in the arrangements of green spaces implies various aspects: utility, functional and esthetical. Therefore they can be used for:

- retaining walls (figure 1)

- pavement and alleys execution in public spaces and private gardens; a lot of these pavements, along the functional role, have a decorative role because of the spectacular shapes and colours (figures 2a, 2b, 2c, 2d, 2e)
- functional elements such as sitting places (figures 3a, 3b)
- enclosure elements (fences) where ceramics are used along with other materials such as metal or wood (figure 4)
- elements for decorative linings: pedestals, walls, columns
- decorative objects (bowls, fountains, statues etc.), realized exclusively out of ceramics (figures 5a, 5b)

Ceramics are frequently used in landscape compositions because they offer usage possibilities in the arrangements of public or private green spaces. The easiness of processing and adaption to numerous types of constructions and construction details, the durability and the esthetical qualities let to their usage in parks, gardens, urban public spaces regardless of the dimensions.

One of the important qualities of ceramics is that it permits the obtaining of the desired character in an arrangement, may it be classic or modern. Furthermore the association possibilities with other materials (glass, wood, concrete) are infinite, therefore assuring the materialization of any creative intercession in the landscape art.

The contribution of the present study is that of the documentation and selection of realizations in landscape arrangements which prove the importance of ceramics usage and suggests a greater usage for these materials in organizing green spaces.

CONCLUSIONS

- Ceramics are frequently used in urban landscaping, along with natural stone, concrete, wood, glass or metal.
- The variety of products based on clay and the easiness of their manufacture let to the usage of ceramics in landscaping for the most diverse purposes: functional, utility and esthetical.
- Ceramics have a great durability and a remarkable resistance to the physical and chemical factors of the surrounding environment.
- Ceramics can be used in any type of spatial and volumetric compositions regardless of the style and character in which they were conceived.

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FIGURES

Fig.1. Ceramics used for retaining walls

Fig.2a. Alleys paved with ceramics in private gardens

Fig.2b. Alleys paved with ceramics in private gardens

Fig.2c. Alleys paved with ceramics in private gardens

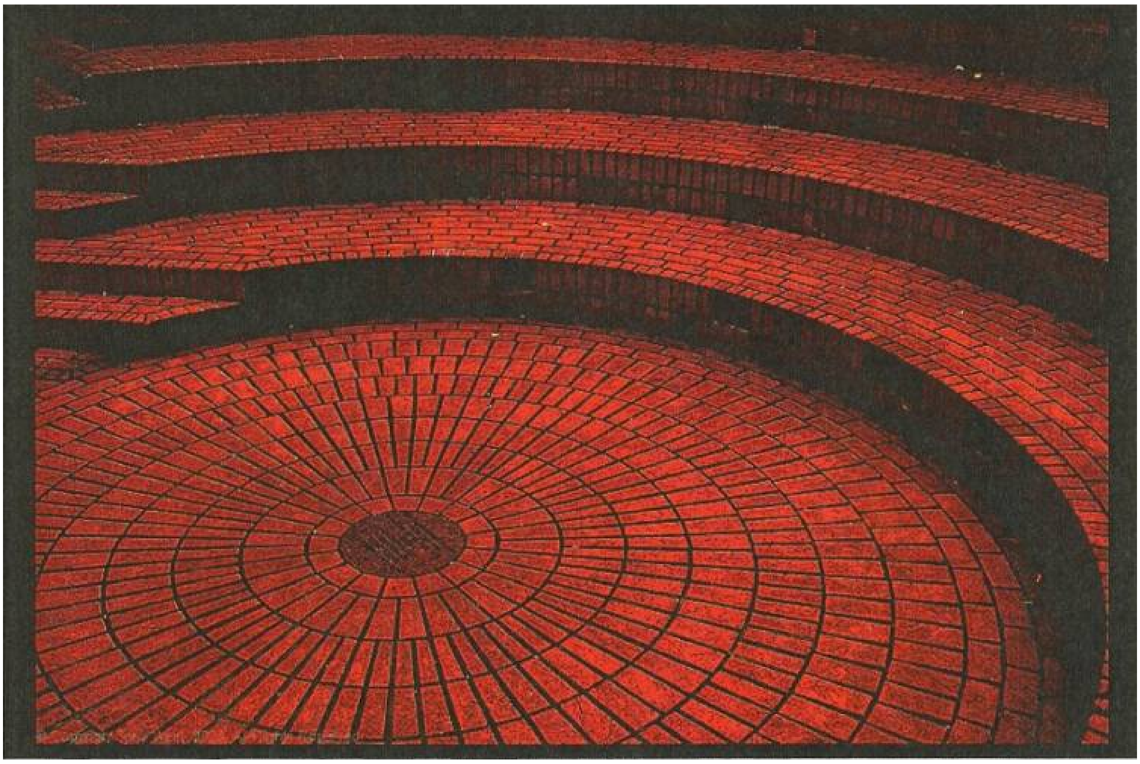

Fig.2d. Pavement made out of ceramics in public spaces

Fig.2e. Pavement made out of ceramics in public spaces


Fig.3a. Urban furniture – sitting place made of ceramics


Fig.3b. Urban furniture – sitting place plated with decorative ceramics

Fig. 4. Enclosure element made of ceramics and metal

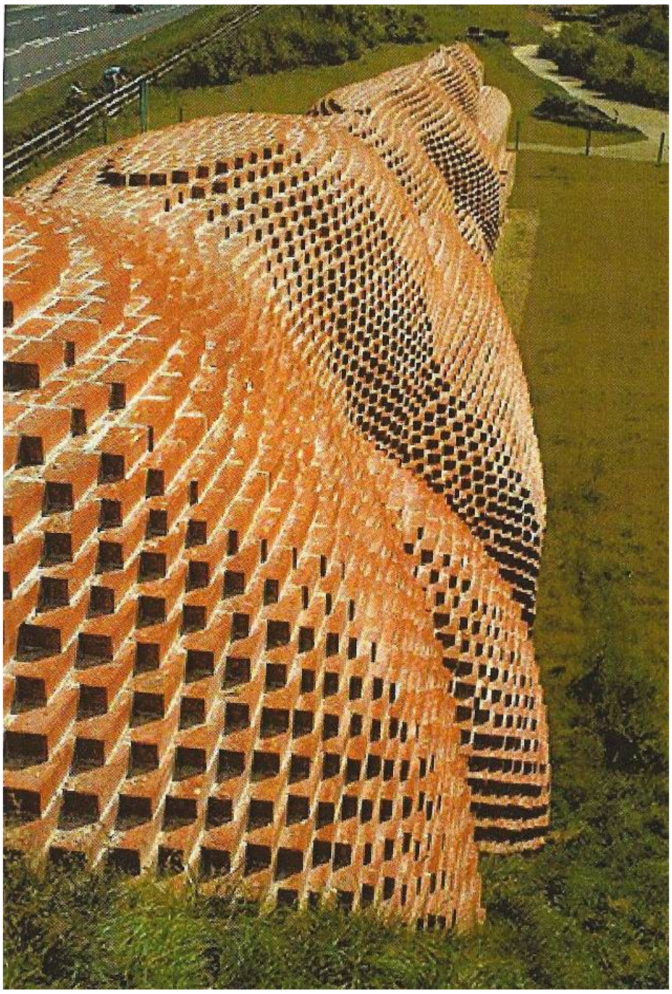

Fig.5a. Decorative objects made of ceramics

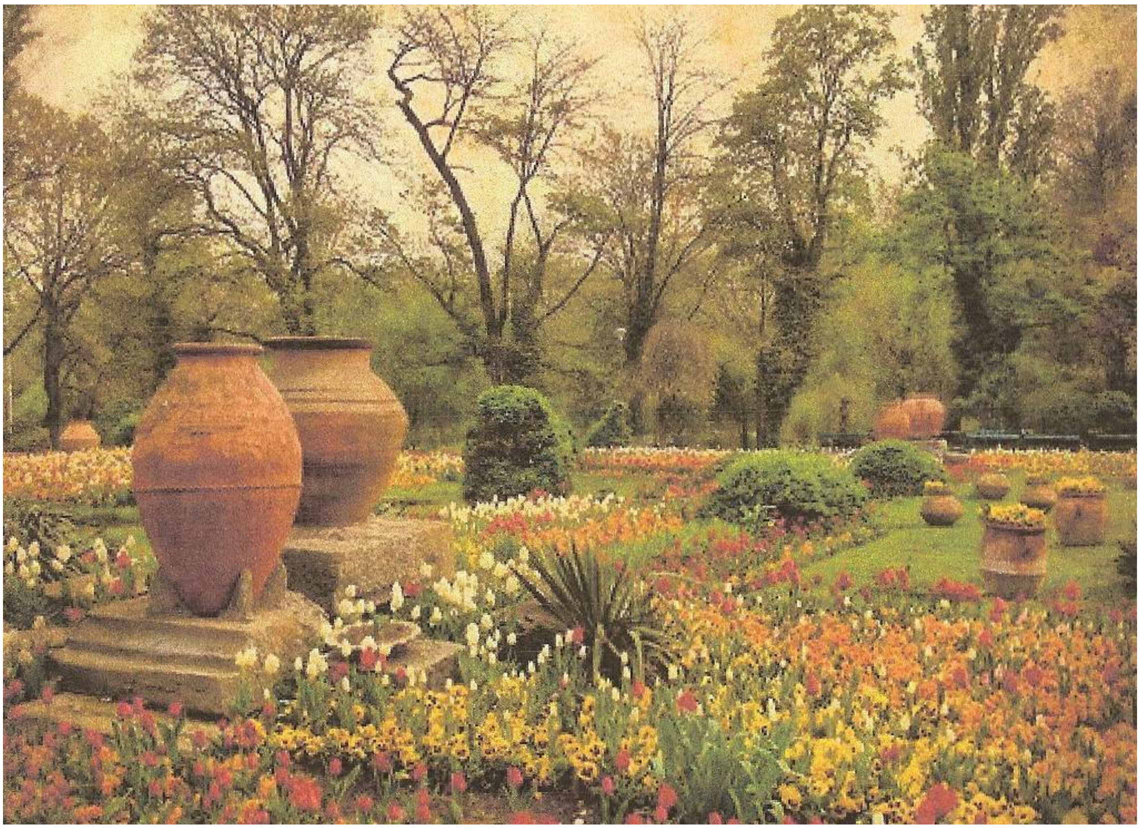

Fig.5b. Decorative objects made of ceramics

FRUIT GROWING&TECHNOLOGY

The behaviour of some black currant cultivars in Bucharest area

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Keywords: cultivars phenology, growth, fruiting, adaptability

ABSTRACT

In the last decades, the bush berry culture is more and more sustained and promoted due to their great content in minerals, vitamins and medicine substances. The market requires fresh and conditioned berry fruits as much as the consumers do. Nevertheless, we assist at a less culture land surfaces occupied with such berries, most of them in private gardens. The goal of the experiment is to evaluate some black currant cultivars adapting capacity to the south-east region of the country from the ehaviour al and agroproductivity point of view. Three black currant cultivars were studied: Abanos, Deea, Ronix and a selected Elite 124. In the Bucharest condition, the black currant fruits ripen in the first half of June. The earliest cultivars were Abanos and Ronix. The most vigorous cultivar was Abanos that realize the highest growth increase. Elite 124 performed the biggest fruits. The biggest productivity is obtained yet by the Deea cultivar next by Abanos (more than 1kg fruits/plant). Deea accumulated the higher content of vitamin C.

INTRODUCTION

Black currant (*Ribes nigrum* L.) is considered the longevity fruit. It is very appreciated for his nutritional and therapeutically value, more rich in vitamin C than most of the fruits, and represent also a very efficient and profitable culture with great potential for ecological conversion. In our country, the black currant culture is located especially in the submontane regions but the needs of spreading reclaim to cultivate black currant even in the south region. The present paper looks forward to establish the ehaviour of some valorous cultivars of black currant in the Bucharest area considering adapting capacity to the stress factors and agroproductivity as a stimulating argues for extending the culture. It is also important that the quality of the fruits to reply the fresh fruits market or food chain exigencies.

MATERIALS AND METHODS

The study was carried out in the experimental field of Pomiculture Department of Horticulture Faculty where in 2009 it was establish an experimental lot with black currant cultivars from ICDPP Maracineni.

The biological material was represented by three black currants: Abanos, Deea, Ronix and one selected Elite 124. The experiment was designed as randomized blocks with four repetitions and five plants per repetition. The distance between the rows is 2.5 m and between the plants in row is 1m, total density resulting is 4000 plant/ha. The soil was covered with agrotextil folium along the row of the plant. The experimental lot is equipped with a drip irrigation system.

To evaluate the growth and fruiting potential of plants and the phenology dynamic processes during 2009-2010, specific biometrics measurements and observation have been started. It was recorded the height and the thickness of the plants, the length of the stalks and growing shoots, the number of stalks/bush, number of shoots/stalk, the foliar surface for growing indicators calculation. In order to estimate the fruiting capacity we proceed to count the number of clusters at the stem and bush level, the diameter and weight of the berry, the number of berries in the cluster. It was also marked the uniformity of berries ripening in the cluster and on the entire plant. Biochemical composition of fruits was also done by specific methods.

RESULTS AND DISCUSSION

1. Phenology of the black currant cultivars

The monitoring of the ehaviour al phases namely dates and ongoing periods of vegetation and fructification concerned: bud opening, early flowering, late flowering and early fruit ripening, late ripening fruit, harvest date, intensive growth of shoots period. First begun to expand the buds cultivar Abanos in the middle of March and the latest was Ronix, with two days delay (Table 1). The flowering starts in the first decade of April, the Elite 124 being the latest, in April 8, 2010. The flowering length was different depending on cultivar; 15 days for Abanos, 16 days long for Deea and Ronix and 17 days for Elite 124. The fruits are ripening in the first half of June. The earliest cultivars were Abanos and Ronix, the ripped fruits was observed in 2010 on June, 10 and one year ago on June, 7 respectively June, 8. The last fruits were harvested from Deea and Elite 124 varieties. Fruit ripening on the plants lasted between 25 and 28 days. During the May and June it was registered the most intensive period of black currant shoots growth.

2. Growth and fruiting of the black currant cultivars

The largest increasing of growth in 2010 (11.95 respectively 11.5 mm) was remarked at Abanos and Deea cultivars (table 2). The thickness differences of the bush stalks were also statistically assured very significant. Ronix and Elite 124 were less vigorous than the other two black currant cultivars. Regarding the height of the bush (table 3), it seems that Elite 124 grew higher than Deea and Ronix, very close to Abanos increasing growth values. In end of July, 2010 excepting Ronix, all the variants exceed 1 m height. Foliar surface measurements indicate a bigger capacity of photosynthesis at Deea (8542.44 cm^2/plant) and a smaller one at Ronix and Elite 124. The average foliar surface/plant at Abanos cultivar was only 3564.23 cm^2 (table 4).

The highest number of fruiting stalks was recorded in 2010 by Abanos with an average number of 5,5 stalks/bush (table 5). The average clusters/stalk indicates Elite 124 the most fertile cultivars (16,5 clusters/stalk) but with the shortest clusters (9 cm). The same Elite 124 recorded in 2010 the biggest fruits with 11.23 mm diameter and 1.08 g/berry. Deea was the next cultivar in ranking with 1.01 g/fruit. Although the Elite 124 performed such well concerning the fruit size, the productivity overall was a medium one, with about 800 g/plant. The highest yield was registered by Deea (1,15 kg/bush) and Abanos with 1.03 kg/plant. The estimated production for the second year after planting is quite encouraging (over 4 t/ha) given to the cultural conditions.

3. Biochemical composition of the black currant cultivars

In the table 6, there are presented the main biochemical composition of the cultivars tested. The differences between the culture year were closer and do not disturb the differences between the cultivars regarding the substance, water and vitamin C accumulation. Thus, the highest value of total dry and soluble substance (27.57%/17.55%) was registered by Elite 124 and the highest content of vitamin C (252.58 mg/100 g) by the Deea black currant cultivar.

We consider that further researches are required in order to consolidate the experimental data obtained in the first two years of culture in the experimental area.

CONCLUSIONS

The black currant fruits ripen in the first half of June. The earliest cultivars were Abanos and Ronix. The most vigorous cultivar was Abanos that realize the highest growth increase. Elite 124 performed the biggest fruits. The biggest productivity is obtained yet by the Deea cultivar next by Abanos (more than 1kg fruits/plant). Deea accumulated the higher content of vitamin C.

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TABLES

Table 1
The main growth and development phenophases of some black currant cultivars in Bucharest area

Phenophase	Year	Variety			
		Abanos	Deea	Ronix	Elite 124
Bud opening	2009	17.03.	17.03.	18.03.	17.03.
	2010	15.03.	16.03.	17.03.	16.03.
Flowering start	2009	05.04.	06.04.	04.04.	07.04.
	2010	07.04.	09.04.	06.04.	08.04.
End of flowering	2009	20.04.	22.04.	19.04.	23.04.
	2010	22.04.	25.04.	22.04.	25.04.
Beginning of the fruit ripening	2009	08.06.	10.06.	07.06.	11.06.
	2010	10.06.	14.06.	10.06.	12.06.
End of the fruit ripening	2009	04.07.	06.07.	05.07.	08.07
	2010	06.07.	09.07.	08.07.	10.07.
Intensive growth of the shoots period	2009	05.05.-12.06.	09.05.-10.06.	06.05.-16.06.	08.05.-11.06.
	2010	07.05.-14.06.	12.05.-14.06.	09.05.-19.06.	07.05.-12.06.

Table 2

The ehavio of thickness growth of some black currant cultivars in vegetation time

Variety	The stalk diameter at 5 cm above								Thickness increasement (mm)	
	09.03. 2009	10.03. 2010	12.05. 2009	15.05. 2010	20.06. 2009	21.06. 2010	30.07. 2009	31.07. 2010	2009	2010
Abanos	3,75	13,52	4,81	19,50	7,56	23,40	10,38	25,47	6,63	11,95
Deea	4,38	12,85	5,38	17,20	7,88	21,32	10,63	24,35	6,25	11,5
Ronix	4,17	11,62	5,33	13,58	7,33	17,42	9,17	19,28	5,00	7,66
Elite 124	4,38	10,59	5,44	14,60	7,00	18,95	8,75	20,44	4,38	9,85

Table 3

The **ehavio of height growth of black currant cultivars in vegetation time**

Variety	Bush Height (cm)								Height growth increasement (mm)	
	09.03. 2009	10.03. 2010	12.05. 2009	15.05. 2010	20.06. 2009	21.06. 2010	30.07. 2009	31.07. 2010	2009	2010
Abanos	28,2	73,85	32,2	80,34	55,8	90,48	71,88	110,5	43,63	36,65
Deea	33,8	84,61	38,0	89,24	63,2	92,95	81,94	100,7	48,06	16,14
Ronix	33,0	71,05	37,0	74,36	58,5	85,94	70,67	97,85	37,67	26,8
Elite 124	31,2	70,14	33,1	75,23	50,6	89,02	66,25	109,3	35,00	39,16

Table 4

Foliar surface of some black currant cultivars cultivated in Bucharest area

Variety	Average number of shoots/stalk		Average number of leaves/stalk		Average foliar surface of leaf (cm^2)		Average foliar surface of plant (cm^2)	
	2009	2010	2009	2010	2009	2010	2009	2010
Abanos	6,00	8,00	9,85	10,95	45,00	47,60	2659,50	3564,23
Deea	3,00	10,00	14,75	17,20	68,80	74,28	3044,40	8542,44
Ronix	2,00	7,00	24,00	25,50	47,60	50,95	2284,80	7527,60
Elite 124	3,00	11,00	22,00	24,75	30,80	45,20	2032,80	7816,30
Average	3,50	7,50	17,65	19,11	48,05	50,20	2506,38	6862,64

Table 5

The main morpho-productive characteristics of some black currant cultivars in the Buchares area

Variety	Year	Number of bearing stalks	Number of clusters/stalk	The lenght of the cluster (©	Total number of clusters/stem	Cluster weight (g)	Number of berries/cluster	Size of the berry		Total yield/plant (g)	Estimated yield/ha (t)
								Diameter (mm)	Weight (g)		
Abanos	2009	4	10,5	6,9	42	8,12	11,6	8,3	0,7	341,04	1,36
	2010	5,5	12,6	10,2	69,3	14,85	16,5	9,2	0,9	1029,11	4,11
Deea	2009	4,5	13,5	7,2	60,75	7,49	10,7	7,6	0,7	455,02	1,82
	2010	5	15	9,5	75	15,45	15,3	8,95	1,01	1158,98	4,63
Ronix	2009	3,5	11	7,6	38,5	6,78	11,3	7,9	0,6	261,03	1,04
	2010	4,5	12,75	12,4	57,38	12,73	13,4	8,85	0,95	730,38	2,92
Elite 124	2009	2,5	14	4,8	35	4,56	5,7	9,2	0,8	159,60	0,63
	2010	3,5	16,5	9	57,75	13,82	12,8	11,23	1,08	798,34	3,19
Average	2009	3,63	12,25	6,63	44,06	6,74	9,83	8,25	0,7	304,17	1,21
	2010	4,63	14,21	10,28	64,86	14,21	14,5	9,56	0,99	929,2	3,71

Table 6

Biochemical composition of some black currant cultivars fruits

Variety	Year							
	2009				2010			
	Water (%)	Total dry substance (%)	Soluble dry substance (%)	Vitamin C (mg/100 g. p.p.)	Water (%)	Total dry substance (%)	Soluble dry substance (%)	Vitamin C (mg/100 g. p.p.)
Abanos	73,85	26,15	17,02	194,1	74,96	25,04	17,25	196,14
Deea	74,98	25,02	16,98	240,25	75,2	24,8	17,05	252,58
Ronix	74,05	25,95	16,05	219,85	74,97	25,03	16,5	222,05
Elite 124	72,14	27,86	17,23	185,91	72,43	27,57	17,55	188,91
Average	73,76	26,25	16,82	210,03	74,39	25,61	17,09	214,92

The behaviour of some high bush blueberry cultivars in Bucharest area

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Keywords: cultivars phenology, growth, production, potential

ABSTRACT

Because of the specific needs of high bush blueberry concerning the cultural conditions, it is very hard to extend the culture in other areas. In this study we aim to determine the cultivars adapting capacity to the south-east region of the country from the phenological and agroproductivity point of view. Six blueberry cultivars were studied: Augusta, Delicia and Simultan (Romanian cultivars); Bluecrop, Weymouth and Pemberton (American cultivars). In the Bucharest condition, the earliest ripening of the fruits was recorded by Weymouth and the latest by Augusta cultivar. The most vigorous cultivar was Pemberton that also realize the highest growth increase. Delicia and Bluecrop bear the largest fruits. The biggest yield is obtained by the native blueberry cultivars: Delicia, Augusta and Simultan who exceed 600g/plant in the second year. Simultan accumulated the higher content of vitamin C.

INTRODUCTION

The high bush blueberry (*Vaccinium corymbosum* L.) is a very much appreciated plant for his many potential uses of the fruits. The blueberry culture find good condition in areas where the soils have high content of organic matter, good permeability and low pH value (optimal is between 4.5 and 5.5). The needs of the plant refer also at the moderate and constant humidity; good expositions with plenty light but not overheat especially in the summer time. In Romania, these conditions are found on limited areas. That is why, for extending this culture on other places it is absolutely necessary to assure from the beginning the cultural conditions in respect with the plant needs. The issue is what blueberry varieties are much adapted to the south east conditions and how these environmental factors influence the agroproductivity and phenology of the cultivars in order to choose the right variety with the biggest potential.

MATERIALS AND METHODS

The experiment was conducted in the experimental field of Pomiculture Department of Horticulture Faculty where in 2009 it was establish an experimental lot with native and international blueberry cultivars.

The biological material was represented by six blueberry cultivars as fallows: Augusta, Simultan and Delicia – national cultivars and Weymouth, Bluecrop and Pemberton – international cultivars. The experiment was designed as randomized blocks with four repetitions and five plants per repetition. The distance between the rows is 2.5 m and between the plants in row is 1m, total density resulting is 4000 plant/ha. At the planting site it was added acid peat and the soil was covered with sawdust and agrotextil folium along the row of the plant. The experimental lot is equipped with a drip irrigation system.

To quantify the growth and fruiting of plants and the phenology dynamic processes were done a lot of observation and measurements such as biometrics dates regarding the height and the thickness of the plants, the foliar surface and number of fruiting/stalk, clusters/stem, diameter and weight of the berry. Biochemical composition of fruits refers at the water, total and soluble dry substance content and the C vitamin determination.

RESULTS AND DISCUSSION

1. Phenology of the blueberry cultivars

In order to surprise the differences between the blueberry cultivars concerning the phenological growth and development phases it were noted the dates of expanding buds, the start and the end of the bloom, the ripening period, the intense growth of shoots time. In the spring time, first of all was Weymouth cultivar that starts expanding the buds and the latest was Augusta cultivars (Table 1). The bloom starts at the end of April and beginning of May, with differences of no more than 3 days between the cultivars in 2010. The flowering length was different depending on cultivar; 15 days for Augusta till 29 days to Pemberton that finish the flowering time on May 30. The fruits are ripening at the end of June and first day of July. The earliest cultivar was Weymouth (2009, June 15 respectively 2010, June 27) and Augusta the latest (2009, July 30; 2010, July 29). During the May and June it was registered the most intensive period of blueberries shoots growth.

2. Growth and fruiting of the blueberry cultivars

The vigor of the blueberry cultivars was interpreted by taking into consideration the thickness and the height of the plants. Thus, it was observed that Pemberton and Delicia recorded the highest values of stem thickness (table 2) and also the largest increasing of growth (6.56 respectively 7.55 mm). The differences of thickness emphasize however insignificant statistic differences except the Pemberton cultivar. It was remarked also a bigger height of the Pemberton bush (89.45 cm) and an important growth increasing (22.5 mm) comparatively with Augusta cultivar that recorded only 65.85 cm in height and a 15.1 mm increasing growth (table 3).

Foliar surface measurements indicate a bigger capacity of photosynthesis at Pemberton and Bluecrop cultivars and a smaller one at Weymouth. The average foliar surface/plant vary between 1739 cm^2 and 3040 cm^2 depending on cultivar (table 4).

Regarding the number of bearing stems on the plant, the highest values were recorded in 2010 by Pemberton, Augusta and Simultan and the poorest Weymouth that remarks also by a bad productivity (table 5). The average clusters/stalk indicates Bluecrop and Simultan as the most fertile cultivars (15 clusters/stalk). The size of cultivars berries was different, influenced by genetically features and cultural condition. So, the biggest fruits were collected from Delicia (2.6 g/fruit) and Bluecrop (2.45 g/fruit) which of course registered the highest diameter of berries (16.89 mm and 15.85 mm). In the second year, all the national cultivars produced more than 600 g/plant (Augusta, Simultan and Delicia) comparatively with the other three international cultivars. From them, Bluecrop recorded the highest yield with 572 g/plant next by Pemberton with 364 g/plant.

3. Biochemical composition of the blueberry cultivars

Analyzing the values presented in the table 6, we distinguish the Simultan cultivar with the highest value of total dry substance (34.17%/39.17%) and also the highest content of vitamin C (14.95 mg/100 g). Closer values were observed at the soluble dry substance content where except Delicia and Bluecrop, all the rest of cultivars exceed 12 %.

In the future, we consider that it is absolutely necessary to continue the researches in order to confirm the stability of the agroproductivity features of the studied cultivars.

CONCLUSIONS

The earliest ripening of the fruits was recorded by Weymouth and the latest by Augusta cultivar. The most vigorous cultivar was Pemberton that also realize the highest growth increase. Delicia and Bluecrop bear the largest fruits. The biggest yield is obtained by the native blueberry cultivars: Delicia, Augusta and Simultan. Simultan accumulated the higher content of vitamin C.

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TABLES

Table 1

The main growth and development phenophases of some blueberry cultivars in Bucharest area

Phenophase	Year	Variety					
		Augusta	Simultan	Delicia	Weymouth	Bluecrop	Pemberton
Starting the bud opening	2009	27.03.	26.03.	26.03.	22.03.	26.03.	23.03.
	2010	29.03.	28.03	30.03	24.03	28.03	25.03
Bud opening	2009	22.04.	20.04.	18.04.	17.04.	19.04.	18.04.
	2010	25.04.	23.04	22.04	20.04.	21.04	22.04
Flowering start	2009	30.04.	27.04.	27.04.	24.04.	26.04.	28.04.
	2010	01.05.	29.04.	30.04.	28.04.	29.04	01.05.
End of flowering	2009	12.05.	08.05.	07.05.	03.05.	09.05.	09.05.
	2010	15.05.	18.05.	20.05.	23.05.	28.05.	30.05
Beginning of the fruit ripening	2009	25.06.	24.06.	20.06.	15.06.	21.06.	21.06.
	2010	29.06.	28.06.	01.07.	27.06.	30.06.	01.07.
End of the fruit ripening	2009	30.07.	10.07.	15.07.	01.07.	13.07.	07.07.
	2010	29.07.	27.07.	25.07.	18.07.	25.07.	20.07
Intensive growth of the shoots period	2009	15.05.-22.06.	19.05.-30.06.	16.05.-26.06.	18.05.-21.06.	21.05.-26.06.	18.05.-26.06.
	2010	17.05.-20.06.	20.05.-28.06.	14.05.-20.06.	19.05.-24.06.	18.05.-22.06.	20.05.-27.06.

Table 2

The dinamic of thickness growth of some blueberry cultivars in vegetation time

Variety	The stalk diameter at 5 cm above								Thickness increasement (mm)	
	09.03. 2009	10.03. 2010	12.05. 2009	15.05. 2010	20.06. 2009	21.06. 2010	30.07. 2009	31.07. 2010	2009	2010
Augusta	3,75	7,65	5,25	8,95	6,50	9,50	7,63	11,9	3,88	4,25
Simultan	4,13	7,58	5,50	8,94	6,81	9,23	7,56	9,92	3,44	2,34
Delicia	4,70	8,81	6,28	12,91	7,08	14,89	7,78	16,36	3,08	7,55
Weymouth	3,17	7,59	4,00	8,66	5,75	9,05	7,50	9,45	4,33	1,86
Bluecrop	5,48	7,98	6,56	8,85	7,35	9,47	7,93	10,58	2,46	2,6
Pemberton	5,43	9,42	7,79	11,58	8,86	13,98	9,36	15,98	3,93	6,56

Table 3

The dinamic of height growth of blueberry cultivars in vegetation time

Variety	Bush Height (cm)								Height growth increasement (mm)	
	09.03. 2009	10.03. 2010	12.05. 2009	15.05. 2010	20.06. 2009	21.06. 2010	30.07. 2009	31.07. 2010	2009	2010
Augusta	41,71	50,75	45,14	55,25	47	60,5	49,86	65,85	8,14	15,1
Simultan	38,38	52,99	41,5	58,75	46,5	65,87	52,63	70,59	14,25	17,6
Delicia	45,5	55,8	48,2	60,71	51,6	66,52	54,4	72,38	8,9	16,58
Weymouth	31,33	44,18	34,17	50,02	40,33	58,96	44,15	65,12	12,82	20,94
Bluecrop	47,73	65,3	50,47	69,21	57,87	75,62	63,27	85,2	15,53	19,9
Pemberton	48,25	66,95	53,13	71,45	60,5	80,64	65,75	89,45	17,5	22,5

Table 4

Foliar surface of some blueberry cultivars cultivated in Bucharest area

Variety	Average number of shoots/stalk		Average number of leaves/stalk		Average foliar surface of leaf (cm^2)		Average foliar surface of plant (cm^2)	
	2009	2010	2009	2010	2009	2010	2009	2010
Augusta	10	14	14,25	16,75	11,25	11,95	1603	2802
Simultan	10,75	13,5	13,75	15,25	11,1	12,25	1641	2522
Delicia	10,5	11,75	13,25	14,75	10,8	11,1	1503	1924
Weymouth	8,5	11,5	12,25	13,5	10,1	11,2	1052	1739
Bluecrop	10,25	14,75	14,5	15,25	11,4	12,5	1694	2812
Pemberton	12,25	13,75	15	16,75	11,8	13,2	2168	3040
Average	10,38	13,21	13,83	15,38	11,08	12,03	1610	2473

Table 5

The main morpho-productive characteristics of some blueberry cultivars in the Buchares area

Variety	Year	Number of bearing stalks	Number of clusters/stalk	The lenght of the cluster (cm)	Total number of clusters/plant	Cluster weight (g)	Number of berries/cluster	Size of the berry		Total yield/plant (g)	Estimated yield/ha (t)
								Diameter (mm)	Weight (g)		
Augusta	2009	1,60	6,00	60,0	9,60	20,50	10,00	15,5	2,00	196,80	0,79
	2010	3,20	10,0	8,30	26,56	23,62	11,75	15,54	2,01	627,35	2.50
Simultan	2009	1,40	11,0	6,00	15,40	15,3	9,25	14,5	1,60	235,62	0,94
	2010	3,10	15,0	9,40	29,14	21,15	10,90	14,75	1,94	616,31	2.46
Delicia	2009	1,60	10,0	5,50	16,00	24,25	9,50	16,5	2,50	388,00	1,55
	2010	2,80	14,0	8,20	22,96	28,21	10,85	16,89	2,60	647,70	2.59
Weymouth	2009	1,00	8,00	4,25	8,00	13,25	8,50	14,5	1,50	106,00	0,42
	2010	1,78	9,00	5,60	9,97	16,93	9,25	15,01	1,83	168,79	0,67
Bluecrop	2009	1,80	9,00	5,75	16,2	23,05	10,25	15,5	2,2	373,41	1,49
	2010	2,80	15,0	7,10	19,88	28,79	11,75	15,85	2,45	572,35	2,28
Pemberton	2009	1,10	7,00	4,50	7,70	13,25	7,50	15	1,70	102,03	0,41
	2010	3,20	14,0	6,20	19,84	18,38	8,75	15,35	2,10	364,66	1,45
Average	2009	1,42	8,5	5,33	12,15	18,27	9,17	15,25	1,92	233,64	0,93
	2010	2,81	12,83	7,47	21,39	22,85	10,54	15,57	2,16	499,52	1,99

Table 6

Biochemical composition of some blueberry cultivars fruits

Variety	Year							
	2009				2010			
	Water (%)	Total dry substance (%)	Soluble dry substance (%)	Vitamin C (mg/100 g. p.p.)	Water (%)	Total dry substance (%)	Soluble dry substance (%)	Vitamin C (mg/100 g. p.p.)
Augusta	70,49	29,51	11,58	6,02	73,61	26,39	12,45	5,79
Simultan	60,83	39,17	11,8	14,75	65,83	34,17	12,65	14,95
Delicia	79,54	20,46	9,06	9,87	83,21	16,79	9,25	9,27
Weymouth	65,5	34,5	11,98	8,02	68,98	31,02	12,75	7,49
Bluecrop	81,05	18,95	10,85	6,58	82,84	17,16	11,2	6,06
Pemberton	65,26	34,74	12,02	5,75	68,83	31,17	12,15	4,53
Average	**70,45**	**29,56**	**11,22**	**8,5**	**73,88**	**26,12**	**11,74**	**8,02**

Walnut selections susceptibility to *Xanthomonas arboricola* pv. *juglandis*. Preliminary results

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ABSTRACT

***Xanthomonas arboricola* pv. *juglandis* is the causal agent of walnut blight, one of the most important and widespread diseases of Persian (English) walnut (*Juglans regia* L.), causing severe damage to leaves, twigs, buds, petioles, rachides, male and female catkins, nutlets and kernels. It has been known since the end of 1800s, as this disease is present all over the world. It has been constantly causing damages in Romania for 70 years. Its appearance was first recorded in 1941 by Traian Săvulescu et al. in Sebeş. Currently, it is a permanent disease agent, and the damage depends substantially on the weather.**

The preventive defence against walnut blight includes the preparation and introduction of resistant varieties to the cultivation process. In order to select the breeding genotypes, we evaluated the susceptibility of a selected walnut population from Eastern Transylvania's in 2010. For the control we used the very susceptible 'Milotai intenzív' and the moderately susceptible 'Bonifác' cultivars.

Susceptibility was carried out based on the methods of Ozaktana et al. (2008) and Tsiantos et al. (2008) using 30 immature nuts from every selection and cultivar, collected in the first decade of July 2010. For the artificial infection a mixture of 2 *Xaj* strains was used, isolated from naturally infected walnut nuts from two different locations Budakeszi (Hungary) and Catalina (Romania). The sensitivity of the examined selection was realised on immature nuts using the frequency of infections and disease rate.

INTRODUCTION

Walnut is a well-represented species of the Romanian fruit-tree flora within the Banat, Transylvania and Oltenia region, ranging from the Danube River to the Mureş River. Local populations present a great genetic variability due to the seed reproduction used and to an intensive exchange of seminal material with Hungary, Austria and Serbia (Draganescu et al., 2006).

Juglans regia L. is very sensitive to a number of abiotic and biotic factors. Two of the most important abiotic factors are the autumn frost, sometimes leading to tree death, and the late spring frost, having an effect on stem form. The main biotic damage factor is fungi attacks. *Armillaria mellea, Phytophthora cinamomii* and *P. cambivora* are important diseases affecting the root system and walnut anthracnose, caused by *Gnomonia leptostyla,* results in summer leaf fall. Bacterial diseases are important too. *X. arboricola* pv. *juglandis* damages leaves and young shoots in humid and mild climate and after several rainy summers some trees might even die (Fernandez-Lopez and Pereira, 1997).

X. arboricola pv. *juglandis* is the causal agent of walnut blight, one of the most important diseases of Persian (English) walnut *(Juglans regia* L.). The disease has been known since the end of the 19th century and is widespread in walnut growing areas. It causes severe damage to leaves, twigs, buds, petioles, rachides, male and female catkins, nutlets and kernels, and it is considered a major cause of reduction in fruit yield and tree vigour (Belisario et al., 1999). The damage produced by this pathogen is favoured by wet springs, with high humidity.

It has been observed in Romania since 1941 as a permanent disease agent of walnut trees. The infection rate depends on the weather, which differs each year.

Studies of bacteria have been performed worldwide by Miller (1946), Mulerean (1982), Belisario (1995), Martins (1996), Gomes Pereira (1997), Ninot (1997), etc. Romanian studies on this disease were carried out by Alexandri, Gheorghiu, Manolescu,(1960 –1963) Blaja, Stoian (1964), Severin (1974), Tetileanu (1994).

This research presents the behaviour of 10 selected genotypes from Eastern Transylvania and two walnut cultivars from Hungary and their classifications according to the infection level caused by *X. arboricola* pv. *juglandis* on immature nuts in laboratory conditions.

MATHERIAL AND METHODS

The research on the susceptibility of the ten prospective elites and two cultivars to *X. arboricola* pv. *juglandis* was realised in laboratory conditions, at the Department of Pomology, Faculty of Horticultural Science, Corvinus University of Budapest.
The examined Transylvanian selection results from a research made in 2005 with the purpose to establish a suitable assortment for growing in Eastern Transylvania, from local varieties of walnut (Thiesz et al., 2007, 2009). For the control we used the very susceptible 'Milotai intenzív' and the moderately susceptible 'Bonifác' varieties within the Hungarian cultivars (Szentiványi, 2006).

The susceptibility was carried out based on the methods from Ozaktana et al. (2008) and Tsiantos et al. (2008) using 30 immature nuts from every individual, collected in the first decade of July 2010. For the artificial infection a mixture of 2 *Xaj* strains was used, isolated from naturally infected walnut nuts from two different locations Budakeszi (Hungary) and Catalina (Romania). Before infection of immature nuts isolates were either inoculated into intercellular of White Burley tobacco leaf tissue and were inoculated immature nuts for confirmation capability of them to induce hypersensitive tissue necrosis and also aggressiveness to produce disease symptom. The mixture of the two strains was used for the infection after the virulence test. These strains were preserved for short-term in 1% preservative fluid, while the long-term preservation was carried out at -18°C with lyophilisation.

Inoculation was carried out by infiltration of a suspension 10^8 cfu/ml of a previously selected virulent strain of *X.a.*pv.*juglandis*. Before the infection the fruit surface was disinfected with alcohol. Five inoculations of 20µl bacterial suspension were performed in exocarpium for each nut, thus the 20 nuts per selection and cultivar with 5 inoculations each were tested. Sterile Distilled water (SDW) was injected into the 10 immature nuts for every selection and cultivar as Control Negative treatment. After the infection the nuts were incubated in transparent plastic boxes for 7 days at a temperature of 26-28°C, with over 90% relative humidity. Temperature and RH% were monitored by a micro-sensor placed into one of the plastic boxes.

The disease severity was recorded on a scale from 0 to 4 (Fig.1), from the least to the most, based on the diameter and depth of necrosis reached on the 7th day:

0 - no symptoms;
1 - less than 2.0 mm, superficial and small spots on the inoculation point;
2 - blackening on the inoculation point of nut by 2.1 mm to 2.6 mm;
3 - blackening on the inoculation point of nut by 2.7 mm to 3.1 mm;
4 - blackening on the inoculation point of nut more than 3.2 mm;

Disease rate was calculated by the equation of Bertrand and Gottwald (1978):

$$DR = \frac{[(N1 \times 1) + (N2 \times 2) + \dots (Nt \times t)]}{N1 + N2 + Ni}$$

DR - the extent of disease of the nuts;
Nt - the scale of infection;
t - the proportion corresponding to each of the frequency;
Ni - number of nuts tested within the selection/breed;

Four groups were formed: **MR***(Moderately Resistant)*= <2; **MS***(Moderately Susceptible)* =2.1 – 2.6; **S***(Susceptible)*= 2.7 – 3.1; **HS***(High Susceptibility)*= 3.2<

RESULTS AND DISCUSSION

The infection of the selected individuals by *X. arboricola* pv. *juglandis* based on the disease rate, the calculated susceptibility categories are displayed in Fig. 2.

Based on their susceptibility results, the Eastern Transylvanian walnut selections have been categorised in 4 groups. A similar categorization of the control cultivars leads us to the conclusion that the resistance of the individuals is identical with the control cultivars.

The moderately susceptible 'Bonifác' control cultivars to walnut blight show similar sensitivity found at the 'SOM-120' and 'SOM-90' selections. Moderate resistance showed the 'SZEN-10' selection, which was resistant compared to the moderate susceptible control cultivar. The 'SOM-50', 'SAR-33', 'FFA-11', 'SOM-274', 'SOM-101' selections on examination proved to be susceptible. The 'OZSD-37' and 'ALB-22' selections behaved similarly, compared to the very susceptible 'Milotai intenzív' control cultivar.

The dendogram (Fig. 3) obtained from the susceptibility index separates the selections from certain groups of susceptibility; this resulted in more susceptible groups and less susceptible groups.

The infection of the selected individuals by *X. arboricola* pv. *juglandis* based on the frequency is displayed in Fig. 4. By analysing the infection dates of the nuts, it can be determined that the examined selections show high frequency of infection. Of the control cultivars, the 'Bonifác' has a significantly lower frequency value ($df = 11$, $F = 2.65$, $p = 0.003$). Statistically viewed, 'SAR-33', 'SOM-274', 'FFA-11', 'SOM-120' selections showed similar rates of frequency to the 'Bonifác' control cultivar.

CONCLUSIONS

The need of this study is also supported by the widely accepted view, that both the candidates and already grown cultivars must be evaluated regarding their susceptibility in order to mitigate the expected damages.

The results of the present study show four susceptibility categories (Fig. 5.) of the Eastern Transylvania selections and the control cultivars using the above-mentioned criteria; it can be determined, which individual's resistance is identical with the control cultivars.

Based on the results of this study, the extension of examinations in laboratory conditions is recommended, using artificial infections to appreciate the walnut cultivar sensitivity to *X. arboricola* pv. *juglandis.*

Our results are considered preliminary, so in order to classify the selections, we intend to continue the study in the forthcoming years, with a particular view to determine the resistance of the flowers, shoots and the nuts.

ACKNOWLEDGEMENT

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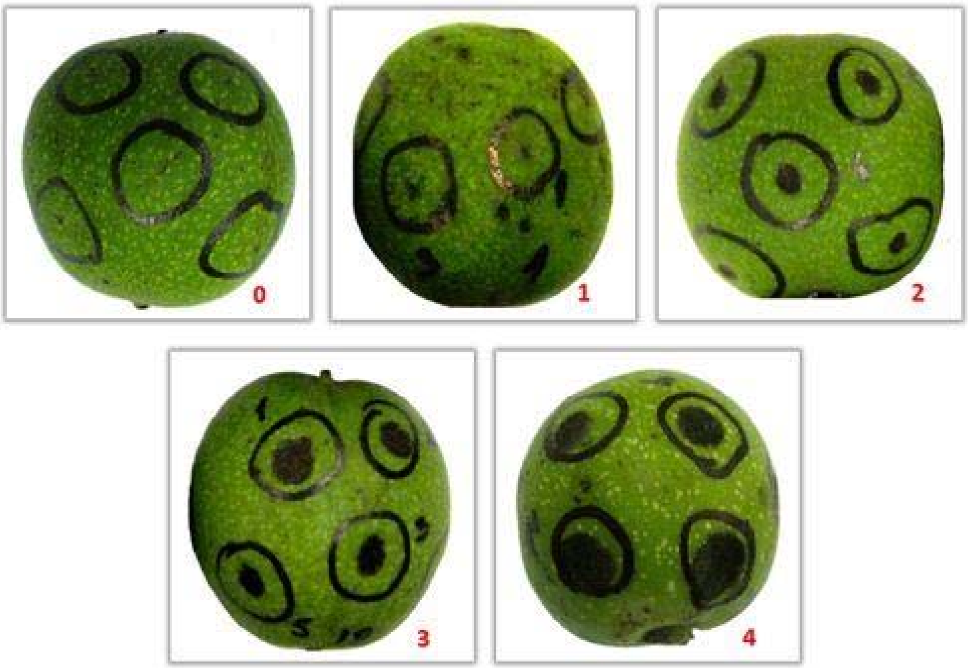
FIGURES



0 - no symptoms;

1 - less than 2.0 mm, superficial and small spots on the inoculation point;

2 - blackening on the inoculation point of nut by 2.1 mm to 2.6 mm;

3 - blackening on the inoculation point of nut by 2.7 mm to 3.1 mm;

4 - blackening on the inoculation point of nut more than 3.2 mm;

Fig. 1. Evaluation of susceptibility, scale (0-4)

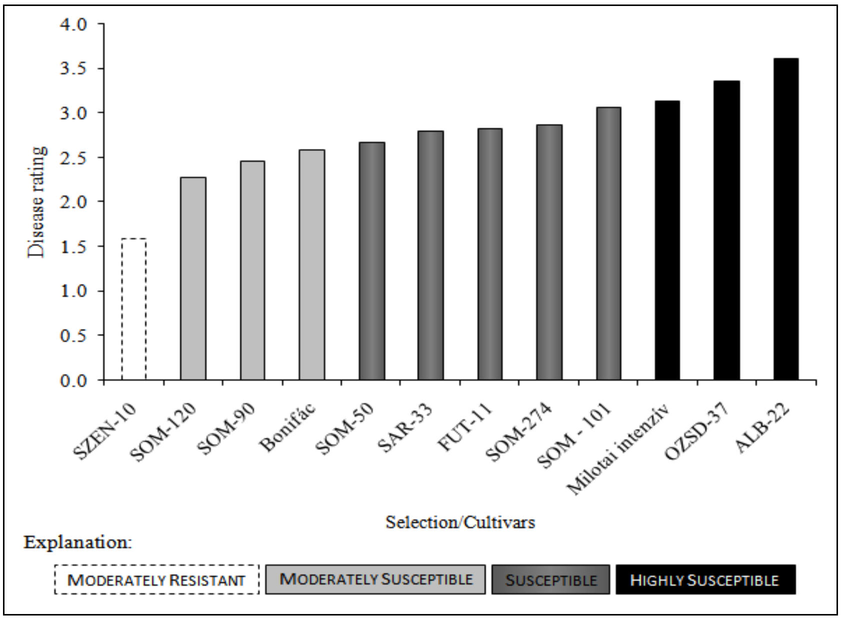


Fig. 2. Levels of infection in immature nuts after artificial infection by *Xanthomonas arboricola* pv. *juglandis* (2010)

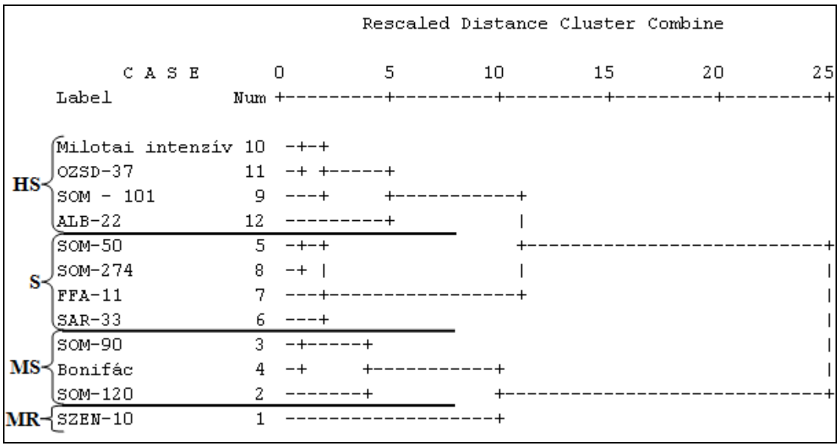


Fig. 3. Susceptibility index of infected immature nuts

MR = *Moderately Resistant;* MS = *Moderately Susceptible;* S = *Susceptible;* HS = *Highly Susceptible*

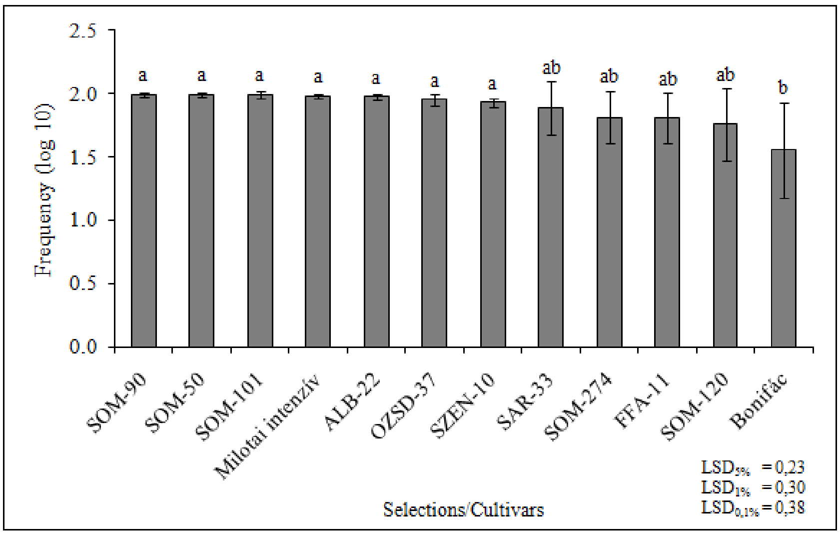


Fig. 4. Walnut blight infection in immature nuts after artificial infection (2010)

Different letters refer to $p < 0.05$ (ANOVA).

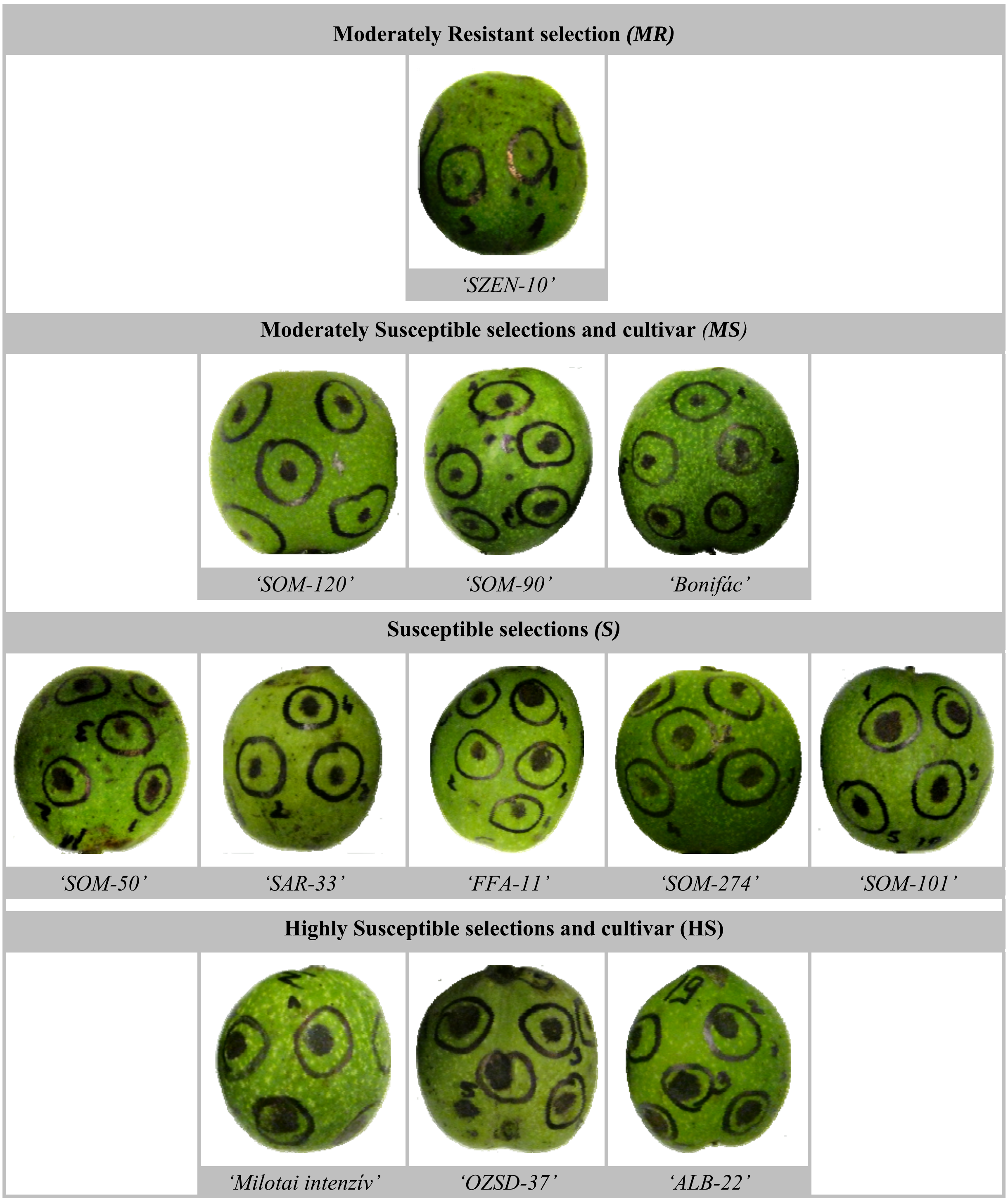


Fig. 5. Susceptibility of walnut selections and cultivars to the bacterial blight of walnut (*Xanthomonas arboricola* pv. *juglandis*) on immature nut test (2010)

Fruiting depending of the apple tree in the orchard on soil maintenance

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Keywords: apple; productivity; systems of maintenance; soil cultivation; mulching.

ABSTRACT

The article describes the apple trees productivity of some varieties - Mantuaner, Red Delicious, Jonathan, Star crimson, Gold spur, Idared, Spartan and Golden Delicious depending on systems of maintenance, soil cultivation and mulching.

INTRODUCTION

An important part of agro-technical measures, which is used in orchards, is the maintenance of ground systems. If the trees crown care, in terms of technology, is relatively satisfactorily adjusted to the requirements of the developing stage of fruit growing, then ground maintenance requires considerable further research efforts to streamline. Priority direction of improving the soil maintenance technology must be determined taking into consideration that weather conditions in Moldova have a clear tendency to manifest itself ever more extreme (long periods with high temperatures) during plant vegetation.

The above recital, justify the scientific circuit data obtained in research in IP and Applied Scientific Institute of Horticulture and Food Technologies.

This article includes data on fruiting apple depending on the different kinds of soil maintenance in apple orchards.

MATERIAL AND METHODS

Field experiences related to the maintenance of soil (nr.1 and 2) were installed in two apple plantations Household experimental ASP ”Vierul” in 1976.

Schemes 1 and 2 trials included the same version:

1. Black field (control);
2. Plants (vetch and oat mixture) for use as green manure. Over a period of times;
3. Green plants use as fertilizer. In each interval between the lines;
4. Artificial greening (mixture of herbs) over a range of rows;
5. Artificial greening in each interval between rows;
6. Artificial greening files on-line row of trees.

Exp. no. 3 mounted on tillage in 1977 in the apple plantations of the village Truşeni (Straseni district) included the following work in autumn (basic) soil:

1. Plowing at 18-20 cm depth with returning arable layer (control);
2. Plowing at 18 -20 cm depth without turning arable layer;
3. Milling 6-8 cm soil depth;
4. Grower with deep tillage at 6-8 cm;
5. Loosening soil depth 18-20 cm cultivator equipped with knives (feet) scarifies;
6. Soil disking at 6-8 cm depth.

Exp. no. 4 about mulch on the ground, mounted in the apple plantation farm household, Fructovi Donbas "(village Cosnita, Dubasari district) in 1987, included variants:

1. Blank - no mulch (control);
2. Covering of the strip of land near the line of the row of trees with vegetal mass;
3. Regular permutation of polyethylene film on the surface between rows of trees. Permutation is made towards an end of the row and back. In place a film is over 12 -16 days (depending on the frequency of atmospheric deposition);
4. Ground cover (from both sides of the row of trees) with polyethylene film. An edge of the films buried in soil throughout the period of use, and leave the other side surface is easily

fixed. Thus, each film is a wing that can be easy “open-closed” (permuted) in left and right. Periodicity permutation -12 -16 days;
5. Regular permutation around the tree stem of a shield, which is a polyethylene film fixed to a wooden frame. Periodicity permutation once in 12 -16 days;
6. Regular permutation around the tree stem of a shield, which is fixed vegetable meal a wooden frame. Periodicity of permutation: once in 12-16 days.

Soil was: ciornoziom normal, middle, on loamy clay (experience nr.1); ciornoziom leach ate, middle, on clay (experience nr. 2) ciornoziom normal medium sandy-clay on clay (experience no. 3) soil grassland alluvial black clay black clay (Experience 4).

Relatively right field landscape with a slight tilt (1-2º) south-east (experience nr.1 and 2), southwest (experience nr.3), right field (experience nr.4).

Orchards were established in 1973 (experience nr.2), 1974 (experience nr.1), 1975 (experience nr.3), 1985 (experience nr.4). Experiments were repeated three times each.

Apple varieties were studied:
- Mantuaner, Red Delicious and Jonathan grafted on M - 4 (for instance 1 and 3) -9 M (exp.3);
- Gold spur Star crimson and grafted onto wild apple forest (for instance, 2);
- Red Delicious, Spartan and Idared grafted on MM -106 (for instance, 4).

Planting distances: 5 x 4 m (for instance a), 4 x 4 m rootstock M-4 (for instance 3), 5 x 3 m (for instance, 4) 4 x 2 m for trees grafted on M-9 (exp.3) and those grafted on wild apple forest (for instance 2).

Experience no. 5 included the same six types of mulch and was mounted for testing in terms of household agricultural production, Nicolae Munteanu (c.Cojusna, Straseni district). Planting distances of trees were Idared variety: 5m x 3m (for trees grafted on MM-106) and 4m x 2m (for trees grafted on M-9). Soil - ciornoziom normal. Variants were tested from 2002 until 2007 in the apple orchard established in 1999.

Data collected were determined by the methods of work accepted for fruit plants.

RESULTS AND DISCUSSION

Fruiting apple maintenance depending on whether the apple orchard soil where the tree crown was flattened (experience nr.1) is quantitatively characterized in the table. Most harvest summary for the years 1978-1988 was obtained from varieties: Mantuaner-option three - 392 kg fruit/tree, which is 53 kg lighter than the version control (difference limit - 20.5 kg), Red Delicious - version four - 471 kg/tree, the difference was 26 kg, Jonathan-version control - 416 kg/tree (DL 0.95 to 49.2). The summary below was detected in fruit varieties: Mantuaner - version six, Red Delicious - version five, Jonathan - version six. The experience no.2 (plantation type apple varieties 'spur' apple grafted on wild forest planting distance 4 x 2 m, crown spherical) in the relevant index, or varieties performed as follows. Maximum: Star crimson - in version three, Gold spur - in version three.

Note that the experiences nr.1 and 2, employment land between rows of trees with vetch and oat mixture, as well as artificial greening throws back over a period is beneficial to trees fruit-bearing capacity.

The experience nr.3 (plantation of apple varieties grafted on M-4, planting distance - 4 x 4 m crown flattened) crop summary for the years 1978 to 1987, significant size, was obtained in options two and five. The minimum was detected in option six. If trees planted at distances 4 x 2 m variants of tillage occurred close analogy. Meaning that autumn tillage on the depth of 18-20 cm by plowing without returning arable layer and purification of the same depth ensures maximum fruit-bearing trees. Trees on which I served as rootstock planted -9 and 4 x 2 m distance were stronger in fertile variants were expected work topsoil (to depth of 6-8 cm). For example, soil cultivation and milling, as variants have contributed to the fruiting trees obtaining increases in the amount of 9.7%, 34.0% (Red Delicious and Jonathan) and 10.9% (Mantuaner).

Soil mulch acts in its own way on fruiting of the trees (experience nr. 4, plantation of apple varieties grafted on MM - 106, range 5 x 3 m planting, crown - naturally enhanced). Versions four, five and three, which expects mulch in the orchard soil by covering it with polyethylene film, but moves periodically from one position to another, ensure maximum fruiting trees. Trees react positively and at the sixth variant. The specifics of this experience, is that version control in the fruiting remains significantly behind the other variants studied. For example, the Golden Delicious variety in version four, fruit trees per year summary 1988 - 1991 reached 113 kg fruit/tree growth was 28 kg (DL $_{0.95}$ to 13.4 kg).

Experience no. 5 data obtained in the years from 2003 to 2007 production test confirms placement sequence variants studied data on crop summary, the experience nr.4 detected. For example, most fruit trees brief were observed variety I dared: grafted on MM-106 - the version of 4-138 kg/tree, grafted on M-9 - the version of 5 - 94 kg per tree.

CONCLUSIONS

For planting apple with flattened crowns (rootstock - M-4, planting distances of 5 x 4 m) and for planting apple varieties type, spur and crest of wave spherical (stock - wild apple forest, planting distances 4 x 2 m) are most suitable for application to soil maintenance systems, which provide employment between intervals with rows of trees and plants used as green manure artificial greening over an interval.

Mulch in orchard soil by covering with polyethylene film, which periodically allows a position to another, providing of apple trees high fruit-bearing, grafted on MM-106 and planted at distances of 5 x 3 m.

Apple trees grafted on M-4 (planting distances - 4 x 4 m with flattened crowns) more fruitful soil in plantations when processed by fall plowing deep 19 to 20 cm without turning arable layer. Trees grafted on M-9 (4 planting distances x 2 m, flattened crowns) more fruitful soil when in shallow fall plantings are working at depth of 6-8 cm, applying grower or milling machine.

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TABLE

Table 1

Depending on soil maintenance of fruiting apple orchard, kg fruit/tree.

Option	Experience no. 1 (Rootstock - M-4, planting distances - 5 x 4 m).			Exp. no. 2 (Rootstock – wild apple forest planting distances 4 x 2 m)		Exp. no. 3 (Rootstock - M-4, planting distances – 4 x 4 m			Exp. no. 4 (Rootstock -MM106, planting distances 5x3 m)		
	Crop summary for the years 1978-1988			Crop sum. 1977-1983		Crop summary for the years 1978-1987			Crop summary for the years 1988-1991		
	Mantuaner	Red Delicious	Jonathan	Star crimson	Gold spur	Mantuaner	Red Delici ous	Jona than	Ida red	Spar tan	Golden Delicious
Exp.1 and 2											
1	339	445	416	123	125						
2	331	436	409	113	127						
3	392	459	377	128	131						
4	370	471	396	120	111						
5	327	398	355	111	106						
6	317	417	345	104	108						
Exp.3											
1						210	329	283			
2						218	315	302			
3						205	279	265			
4						186	265	247			
5						222	301	299			
6						197	260	232			
Exp. 4											
1									81	75	85
2									78	80	88
3									91	83	94
4									109	103	113
5									98	95	100
6									101	88	99

Mathematical models, tables and nomograms concerning the pH variation with the concentration of the fertilizers solutions as foliar feeding: 2. sulfates of micronutrients. 2.3. $(NH_4)_2SO_4 \cdot FeSO_4 \cdot 6H_2O$

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Keywords: iron ammonium sulfate, pH of aqueous solutions, foliar fertilizers

ABSTRACT

The paper presents mathematical models, data table and nomogram that can be used in order to estimate the pH of the aqueous solution as related on the required concentration in $(NH_4)_2SO_4 \cdot FeSO_4 \cdot 6H_2O$. The laboratory researches have been carried out both for fresh solutions in current/common water (CW), with pH 7.18, and in distilled water (DW), for comparisons. The pH decreases with the increase of the concentration from 0 to 3 % $(NH_4)_2SO_4 \cdot FeSO_4 \cdot 6H_2O$ in both types of solutions (DW and CW), the solutions becoming more and more acid. The pH decreases from 7.18 to 3.74 (extremely acid) in CW and reaches 3.51 (extremely acid) in DW. The pH in DW solutions is smaller than in CW, but the differences diminish with the increase of the concentration. The mathematical models have been statistically validated and they give excellent fit to the analytic data.

INTRODUCTION

The iron chelates are very efficient fertilizers used as foliar feeding (Budoi, 2001, 2010), but $(NH_4)_2SO_4 \cdot FeSO_4 \cdot 6H_2O$ (Mohr's salt) and $FeSO_4 \cdot 7H_2O$, as aqueous solutions, are alternatives much cheaper.

The acidity of many sulfates can determine burnings on the leaves when the aqueous solutions are used as foliar feeding, so we need to know which is the pH value in order to neutralize the resulted acidity, if necessary (Budoi, 2009a).

The pH of $FeSO_4 \cdot 7H_2O$ aqueous is time dependent, decreasing more and more with time, which is a great disadvantage, because they have to be used as foliar feeding only as fresh solutions (Budoi, 2010).

MATERIALS AND METHODS

The aqueous solutions have been prepared from pure substance. The ferrous ammonium sulfate/sulphate hexahydrate has molecular formula $(NH_4)_2SO_4 \cdot FeSO_4 \cdot 6H_2O$ or $Fe(NH_4)_2(SO_4)_2 6H_2O$. The synonyms are: ferrous ammonium sulfate/sulphate 6-hydrate, ammonium ferrous sulfate/sulphate hexahydrate, ammonium iron (II) sulfate/sulphate hexahydrate, iron (II) ammonium sulfate/sulphate hexahydrate, Mohr's salt (Oxford University, 2009)). This compound has 14.24 % Fe, 16.35 % S and 7.14 % N ; the water solubility is slight and the density is 1.86 g cm^{-3}.

All iron (II) salts are reducing agents. In analytic chemistry, Mohr's salt is preferred over iron (II) sulfate for titration purposes as it is much less affected by oxygen in the air than iron (II) sulfate, solutions of which tend to oxidize to iron (III). The oxidation of solutions of iron (II) is very pH dependent, occurring much more readily at high pH. The ammonium ions make solutions of Mohr's salt slightly acidic, which prevents this oxidation from occurring (Wikipedia, 2009).

Two series of aqueous solutions have been prepared: in current/common water (CW), with pH 7.18 (almost neutral), and in distilled water (DW), as reference to be compared with at different concentrations. Theoretically, the distilled water has pH 7, but the measured pH was 5.18; the difference between the measured value and the theoretical value was explained in another paper (Budoi, 2009a).

The aqueous solutions had the following concentrations: 0, 0.1, 0.25, 0.5, 0.75, 1, 1.5 and 3% $(NH_4)_2SO_4{\cdot}FeSO_4{\cdot}6H_2O$. These ranges of concentrations cover the ranges of concentrations used in practice, which vary with species (Budoi, 2010). The volume of solution prepared for concentration case was 100 ml.

The pH of the aqueous solutions has been determined using a pH/ion-meter inoLab pH/ION 735, produced by WTW Germany – ISO 9001, with a SenTix Plus 41 electrode. The following buffer solutions have been used for pH-meter's calibration: TPL 4 – pH 4.01, TEP 7 – pH 7.0, TPL 10 – pH 10.0 (Budoi, 2010). The analyses have been done in fresh ferrous ammonium sulfate solutions.

The interpretation of the pH values has been done by the limits published by specialists (Pérez and Paz, 1999, cited by Jones Jr., 2003).

The mathematical models have been elaborated with Cohort Software and the nomograms and other graphs have been drawn with Microsoft Excel 2007 and Microsoft Word 2007. The best regression equations have been established and selected taking into account scientific criteria (Budoi, 2004).

RESULTS AND DISCUSSIONS

The analytic data tables and the nomograms can be used in practice in order to easily evaluate the pH of an aqueous solution at a desired $(NH_4)_2SO_4{\cdot}FeSO_4{\cdot}6H_2O$ concentration. If necessary, the interpolation method has to be used in order to find the corresponding pH. The practical use of a nomogram is simple and this has been explained in another paper (Budoi, 2009a). Unlike the use of data tables and the nomograms, which in many cases need interpolations, that means approximations, the mathematical models ghive exact values (Budoi, 2010).

Analytic data table and nomograms

The aqueous solutions of $(NH_4)_2SO_4{\cdot}FeSO_4{\cdot}6H_2O$ are acidic. The analytic data (Table 1) and the nomograms (Fig. 1) shows that the pH decreases with the increase of the concentration (C, %), the solution becoming more and more acidic; this happens in both types of solutions: distilled water solutions (DW) and common water solutions (CW).

The pH decreases fast at the small concentrations and slower and slower with the increase of the concentration. The higher the concentration is, the smaller the pH decreasing rate is and the smaller the acidification rate is. We have a decreasing curve which trends to become more and more linear with the increase of the concentration (Fig. 1).

The pH decreases from 7.18 (almost neutral) to 3.74 (extremely acid) with the increase of the concentration from 0 to 3 % in common/current water solutions (CW) and decreases from 5.18 to 3.51 (extremely acid) in distilled water solutions (DW).

At all concentrations, the pH of DW solutions is smaller than that of CW solutions, because the common water has some buffer capacity while the distilled water has not at all; the differences vary between 0.23-1.22 pH units and decreases with the increase of the concentration (Table 1 and Fig. 1).

The $(NH_4)_2SO_4{\cdot}FeSO_4{\cdot}6H_2O$ aqueous solutions used as foliar feeding need pH (acidity) correction at all concentrations, by adding a base, in order to prevent foliar burnings.

Mathematical models for pH calculation

The mathematical models established on the basis of the analytic data are valid only for the range of concentration (C) indicated for each model. Extrapolation on the right or on the left of this range is prohibited either because we exit the range of experimental data on which the model coefficients have been calculated, or because on very small concentration the model does not work according the analytic data, or because the model is not defined when C = 0.

For distilled water solutions, the inverse regression equation is the best model:

$$pH = 3.52 + 0.065/C$$

with $R^2 = 0.984^{***}$. This model is valid in the range of C between 0.039-3 %. The inverse function is not defined in 0, because division by 0 is not possible.

For common water solutions, the power regression equation is the best model:

$$pH = 4.1465 \cdot C^{-0.109}$$

with $R^2 = 0.993^{***}$. This model is valid in the range of C between 0.0065-3 %.

The excelent fit of the mathematical models to the analytic data (Fig. 2) is statistically shown by the very high R^2 values, but also by the very small differences betveen calculated pH values and the analytic pH, ≤ 0.04 pH units for DW and ≤ 0.06 pH units for CW solutions (Table 1).

Both inverse and power models have been statistically validated by the very significant correlation between the calculated pH and analytic pH ($R = 0.992^{***}$ for DW and $R = 0.996^{***}$ for CW) and by the fact that the points are disposed on or very close to the first bisecting line (Fig. 2).

The apparent specific acidifying power of $(NH_4)_2SO_4 \cdot FeSO_4 \cdot 6H_2O$ in aqueous solution, **ASAP**

This new chemical index was calculated with the following equation (Budoi, 2009a):

$$ASAP, \text{ pH units/1 \% concentration} = (pH_{ws} - pH_{H2O})/C$$

where:

pH_{ws} = pH of the aqueous/water solution at concentration C;

pH_{H2O} = pH of the distilled water (DW), the theoretic value 7, or pH of the common/current water (CW), from the case;

C = concentration of the solution, % $(NH_4)_2SO_4 \cdot FeSO_4 \cdot 6H_2O$.

In both DW and CW solutions, the ASAP is very high, as absolute values, at small concentrations and decreases with the increase of the concentration (Fig. 3): from -28.5 to -1.16 for DW solutions and from -18.1 to -1.16 for CW solutions. The ASAP in DW solutions is higher, as absolute values, than ASAP in CW solutions at each concentration (Fig. 3); the highest differences are at the smallest concentrations, which proves that the common water has a certain buffer capacity as compared with the distilled water, which has not at all. The differences decrease with the increase of the concentration; if C at > 1.5 %, they practically disappear.

CONCLUSIONS

The pH of $(NH_4)_2SO_4 \cdot FeSO_4 \cdot 6H_2O$ aqueous solutions decreases with the increase of the concentration (C, %), the solutions becoming more and more acidic; this happens in both types of solutions: distilled water solutions (DW) and common water solutions (CW). The pH decreases fast at the small concentrations and slower and slower with the increase of the concentration.

The pH decreases from 7.18 (almost neutral) to 3.74 (extremely acid) with the increase of the concentration from 0 to 3 % in common/current water solutions (CW) and decreases from 5.18 to 3.51 (extremely acid) in distilled water solutions (DW).

The Apparent Specific Acidifying Power of the $(NH_4)_2SO_4 \cdot FeSO_4 \cdot 6H_2O$ in Aqueous Solution, ASAP, is very high at small concentrations and decreases, as absolute values, with the increase of the concentration.

The $(NH_4)_2SO_4 \cdot FeSO_4 \cdot 6H_2O$ aqueous solutions used as foliar feeding need pH correction at all concentrations, by adding a base, in order to bring the pH in the slightly acid area (6.5-6.8) and to prevent foliar burnings.

Useful mathematical models, analytic data table and nomogram have been elaborated based on the analytic data; these can be used in practice in order to evaluate the pH of an aqueous solution of $(NH_4)_2SO_4 \cdot FeSO_4 \cdot 6H_2O$, at a desired concentration (C), necessary to be applied as foliar feeding for a given species. The mathematical models give always exact values, while the data tables and the nomograms can give in some cases approximate values, because of the interpolations needed.

All the established mathematical models give excelent fit to the analytic data and they have been statistically validated.

ACKNOWLEDGEMENTS

This paper is a tribute brought to the memory of Z. Borlan, the greatest and most original Romanian agrochemist ever.

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TABLE AND FIGURES

Table 1

Analytic data concerning the decrease of pH depending on the concentration (C, %) of distilled water solutions (DW) and common water solutions (CW), as compared with the calculated data using the mathematical models

Concentration, %	Measured pH (analytic data)		Differences (CW-DW)	Apparent Specific Acidifying Power (pH units/1 % concentration)		Calculated pH		Calculated pH - Measured pH	
						Inverse model	Power model	Inverse model	Power model
	Distilled water (DW)	Common water (CW)		Distilled water * (DW)	Common water (CW)	Distilled water (DW)	Common water (CW)	Distilled water (DW)	Common water (CW)
0	5.18	7.18	2.00						
0.0065							7.18		
0.039						5.19	5.91		
0.1	4.15	5.37	1.22	-28.50	-18.10	4.17	5.33	0.02	-0.04
0.25	3.82	4.91	1.03	-12.72	-9.32	3.78	4.82	-0.04	-0.03
0.5	3.68	4.50	0.77	-6.64	-5.46	3.65	4.47	-0.03	0.02
0.75	3.62	4.23	0.61	-4.51	-3.93	3.61	4.28	-0.01	0.05
1	3.58	4.10	0.52	-3.42	-3.08	3.59	4.15	0.00	0.05
1.5	3.54	3.96	0.42	-2.31	-2.15	3.56	3.97	0.02	0.01
3	3.51	3.74	0.23	-1.16	-1.15	3.54	3.68	0.03	-0.06

*Calculated related to pH 7, the theoretical value of distilled water

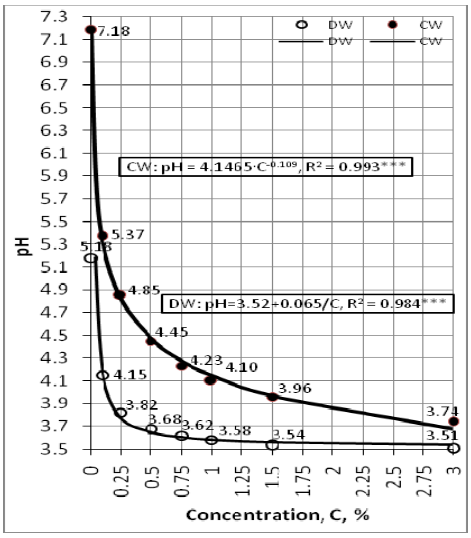
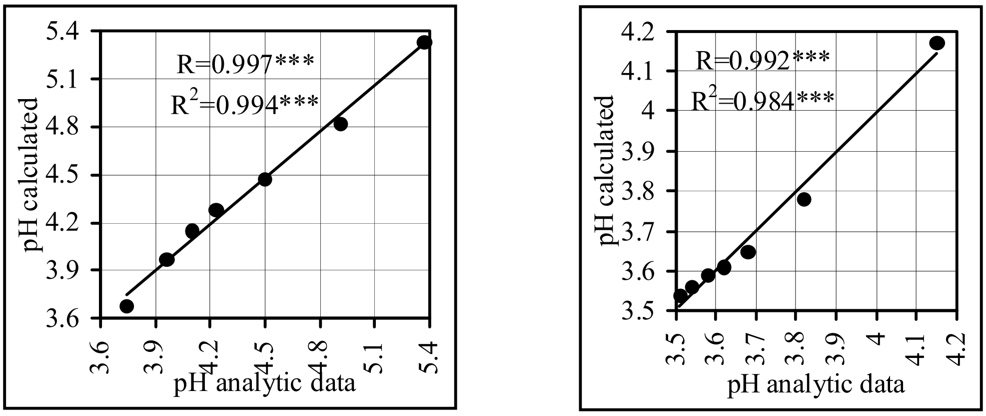


Fig. 1. Nomogram and inverse and power models for pH evaluation of $(NH_4)_2SO_4 \cdot FeSO_4 \cdot 6H_2O$ distilled water solutions (DW) and common water solutions (CW) (water pH: 7.18) depending on the concentration; excellent fit of the models' curves to the measured analytic data, very high R^2 values.



a) DW solutions b) CW solutions

Fig. 2. Statistical validation of the inverse model for DW solutions (a) and of the power model for CW solutions (b): very significant linear correlation between calculated and analytic pH; the points disposed on or very close to the first bisecting line

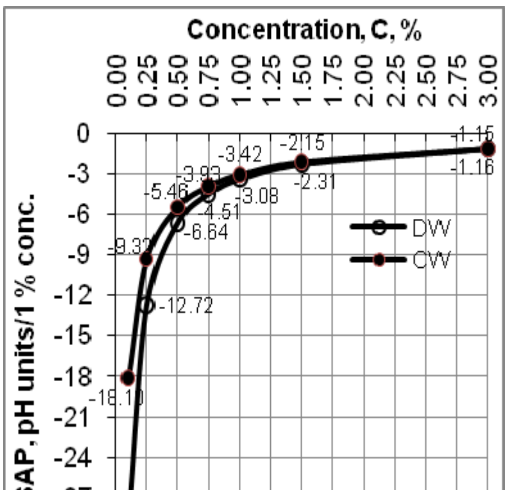


Fig. 3. The Apparent Specific Acidifying Power (ASAP) of $(NH_4)_2SO_4 \cdot FeSO_4 \cdot 6H_2O$ in DW and CW solutions (pH units/1 % concentration)

Mathematical models, tables and nomograms to settle the technically optimal rates (TOR) of N, P_2O_5 and K_2O in fruiting sweet cherry tree, *Cerasus avium*

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Keywords: nitrogen, phosphorous, potassium, macronutrients, fertilizers, maximum yield

ABSTRACT

The paper presents mathematical models and agrochemical tables and nomograms which serve in order to settle the Technically Optimal Rates (TOR) of N, P_2O_5 and K_2O in fruiting sweet cherry tree, on plan and terraced terrains, depending on the maximum expected yield, Y_m, and soil agrochemical indexes on 0-40 cm soil depth: IN (nitrogen index), P_{ALc} (mobile P), K_{AL} (mobile K). TOR allows obtaining the maximum yield in given conditions concerning the soil supply with the regarded nutrient and allowing a sustainable horticulture. The TOR system uses the same equations for nutrients action coefficients and soil nutrient supply as the Economically Optimal Rate (EOR) system. TOR has some advantages versus EOR. FERTEXPERT software, version 3, has been used in order to compute TOR. The practical agrochemical tables and nomograms allow the farmer to operatively settle TOR. The mathematical models have to be used when exact TOR values are needed. The agrochemical tables and nomograms will be accessed online, on a specific website.

INTRODUCTION

Some authors elaborated over the year's agrochemical tables and nomograms for sweet cherry tree for experimentally optimal rates, ExpOR (Borlan et al., 1982), and for economically optimal rates, EOR (Budoi et al., 1988, 2003; Budoi, 2001), but nobody for technically optimal rates, TOR. The advantages of TOR versus EOR have been presented in another paper (Budoi, 2007b).

MATERIALS AND METHODS

The TOR mathematical model has been derived (Budoi, 2007a, 2010) from the Mitscherlich-Bray-Black-Borlan response function (Borlan et al., 1984).

FERTEXPERT software, version 3 (Budoi, 2007, 2009), has been used in order to calculate the TOR. This version was specially developed for TOR calculations. The 1-st version of this software was elaborated in the framework of the author's PHD thesis (Budoi, 1997). FERTEXPERT uses the mathematical models presented in this paper for TOR, nutrient action coefficients, c_a, and soil nutrient supply, S_n.

The equations used to calculate c_a and S_n have the same coefficients as those used for the EOR of N, P, K (elaborated by Budoi et al., 1988).

Based on TOR calculated with FERTEXPERT, specific agrochemical tables and nomograms have been elaborated.

RESULTS AND DISCUSSIONS

The mathematical model used to calculate TOR is (Budoi, 2007a, 2010):

$$\text{TOR, kg N, } P_2O_5\text{, } K_2O\text{/ha} = [\log(2.3 \cdot c_a \cdot Y_m)]/c_a - S_n$$

where:

Y_m = maximum expected yield, kg/ha;

c_a = action coefficient of N, P, K;

S_n = soil nutrient supply, potentially available form, kg N, P_2O_5 or K_2O/ha.

For TOR, the following models have to be used in order to calculate c_a and S_n, the same as those for EOR (Budoi et al., 1988, 2003):

- for nitrogen:

$c_a = 0.011 + 18/Y_m$; $S_n = 60(1 - 10^{-0.5 \cdot IN}) + 0.003 \cdot Y_m$

- for phosphorous:

$c_a = 0.012 + 22/Y_m$; $S_n = 120(1 - 10^{-0.01 \cdot PAL}) + 0.0035 \cdot Y_m$

- for potassium:

$c_a = 0.0065 + 10/Y_m$; $S_n = 165(1 - 10^{-0.006 \cdot KAL}) + 0.004 \cdot Y_m$

where:

IN = soil nitrogen index, calculated with the model: $IN = H \cdot V_{Ah}/100$ (Borlan, 1982); H = humus content (%);V_{Ah} = degree of base saturation (%);

P_{ALc} = soil mobile P content, ppm P (extracted by Egner-Riehm-Domingo method), corrected with a pH depending factor (Borlan, 1982);

K_{AL} = soil mobile K content, ppm K (extracted by Egner-Riehm-Domingo method). IN, P_{ALc} and K_{AL} are the average values for the 0-40 cm soil layer.

TOR calculated with FERTEXPERT software, 3-rd version, have been used in order to elaborate the agrochemical tables and nomograms.

The calculated TOR of N, P_2O_5 and K_2O for different values of Y_m and soil agrochemical indexes (IN, P_{ALc} and K_{AL}) are presented in tables 1-3 and in nomograms from figures 1–3.

These tables and nomograms allow to easily estimate TOR; interpolations have to be done if Y_m, IN, P_{ALc}, K_{AL} are not exactly those from tables or nomograms; in these cases, the results are approximates (Budoi, 2009). The mathematical models have to be used in order to calculate TOR when exact values of the rates are desired and Y_m, IN, P_{ALc}, K_{AL} are not exactly those from these tables and nomograms.

The tables and nomograms have been used in order to build Web pages, which will be accessible through an online Decision Support System (DSS). The mathematical models will be used to develop the DSS in order to calculate TOR online.

CONCLUSIONS

The mathematical models and the agrochemical tables and nomograms are used in order to settle the technically optimal rates (TOR) of N, P_2O_5 and K_2O in fruiting sweet cherry tree on plan and terraced terrains, as function of the maximum expected yield, Y_m, and soil chemical indexes: IN, P_{ALc}, K_{AL}.

The agrochemical tables and nomograms can be used in practice by the farmers in order to operatively settle TOR; in some cases, the results are approximates because of the visual interpolations. The mathematical models have to be used when exact TOR values are needed.

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This paper is a tribute brought to the memory of Z. Borlan, the greatest and most original Romanian agrochemist ever.

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TABLES AND FIGURES

Table 1

Technically optimal rates (TOR) of N (kg/ha) in sweet cherry tree as function of the maximum expected yield (Y_m) and soil nitrogen index (IN)

(Computerized with FERTEXPERT v. 3, Budoi, 2007, 2009)

Y_m	IN								
(kg/ha)	*0.5*	*1.0*	*1.5*	*2.0*	*2.5*	*3.0*	*3.5*	*4.0*	*4.5*
2000	65	51	42	38	35	34	33	32	32
4000	100	85	77	73	70	68	68	67	67
6000	119	104	95	91	88	87	86	85	85
8000	130	115	106	102	99	98	97	96	96
10000	136	122	113	109	106	104	103	103	103
12000	140	126	117	113	110	108	108	107	107

Table 2

Technically optimal rates (TOR) of P_2O_5 (kg/ha) in sweet cherry tree as function of the maximum expected yield (Y_m) and soil mobile P content (P_{ALc})

(Computerized with FERTEXPERT v. 3, Budoi, 2007, 2009)

Y_m	ppm P												
(kg/ha)	*5*	*10*	*15*	*20*	*25*	*30*	*40*	*50*	*60*	*70*	*80*	*120*	*160*
2000	67	56	45	36	28	21	8						
4000	99	87	77	67	59	52	39	30	22	16	11		
6000	115	103	93	83	75	68	55	46	38	32	27	15	11
8000	124	112	102	92	84	77	64	55	47	41	36	24	20
10000	129	117	107	97	89	82	69	60	52	46	41	29	25
12000	131	119	109	100	92	84	72	62	54	48	43	32	27

Table 3

Technically optimal rates of K_2O (kg/ha) in sweet cherry tree as function of the maximum expected yield (Y_m) and soil mobile K content (K_{AL})

(Computerized with FERTEXPERT v. 3, Budoi, 2007, 2009)

Y_m	ppm K										
(kg/ha)	*40*	*60*	*80*	*100*	*120*	*140*	*160*	*180*	*200*	*240*	*300*
2000	71	48	31	18	8						
4000	127	104	86	73	63	56	50	45	42	38	34
6000	157	134	116	103	93	86	80	76	72	68	64
8000	175	153	135	122	112	104	99	94	91	87	83
10000	188	165	147	134	124	117	111	107	103	99	95
12000	196	173	156	143	133	125	119	115	111	107	104

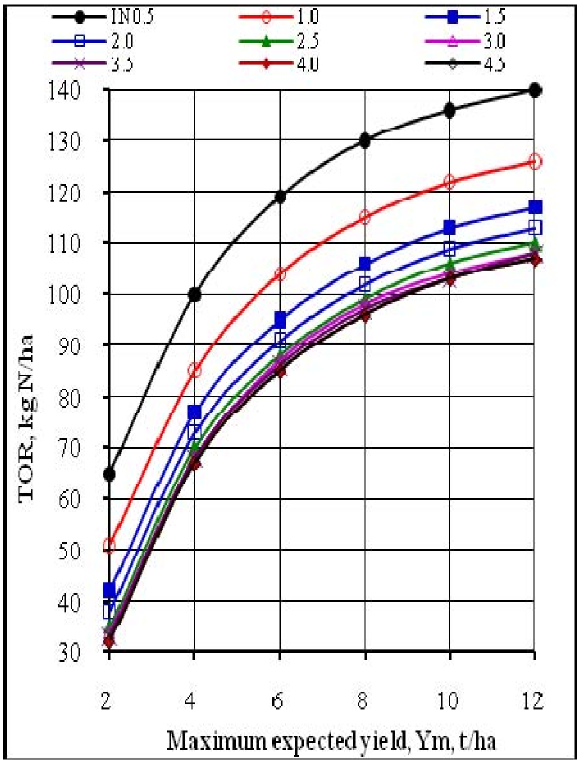

Fig. 1. Technically optimal rates (TOR) of N in sweet cherry tree as function of the maximum expected yield (Y_m) and soil nitrogen index (IN)

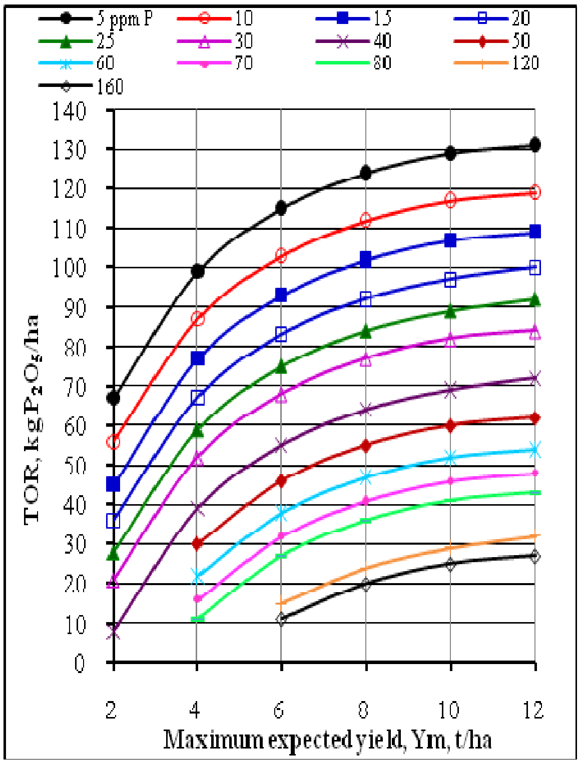

Fig. 2. Technically optimal rates (TOR) of P_2O_5 in sweet cherry tree as function of the maximum expected yield (Y_m) and soil mobile P content (P_{ALc}, ppm P)

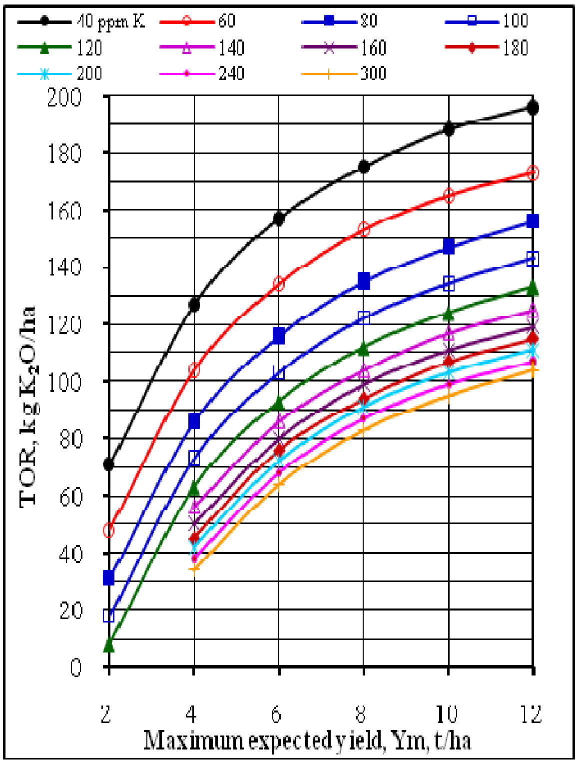

Fig. 3. Technically optimal rates (TOR) of K_2O in sweet cherry tree as function of the maximum expected yield (Y_m) and soil mobile K content (K_{AL}, ppm K)

Mathematical models, tables and nomograms to settle the technically optimal rates (TOR) of N, P_2O_5 and K_2O in fruiting sour cherry tree, *Cerasus vulgaris*

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Keywords: nitrogen, phosphorous, potassium, macronutrients, fertilizers, maximum yield

ABSTRACT

This paper presents the mathematical models, 3 agrochemical tables and 3 nomograms which can be used with the aim to calculate or evaluate the Technically Optimal Rates (TOR) of N, P_2O_5 and K_2O in fruiting sour cherry tree cultivated on plan field and terraced terrains. TOR is calculated/evaluated as function of the maximum expected yield, Y_m, and the relevant soil chemical properties (in 0-40 cm soil depth): nitrogen index: IN, mobile P: P_{ALc}, mobile K: K_{AL}. FERTEXPERT software (version 3) has been used for TOR calculations; the calculated results served to build the agrochemical tables and nomograms, useful tools for horticulturists in practice, for fertilization with N, P and K.

INTRODUCTION

The Technically Optimal Rates (TOR) present many advantages versus the Economically Optimal Rates (EOR) of macronutrients (Budoi, 2007b). The main purpose of this paper is to offer to the sour cherry-tree growers, for the first time, scientific tools to calculate or evaluate TOR.

MATERIALS AND METHODS

The TOR model was mathematically derived (Budoi, 2007a) from a modified Mitscherlich response function (Borlan et al., 1984). FERTEXPERT software version 3 (Budoi, 2007, 2009) was used in order to calculate TOR. The software use the mathematical models presented in this paper for TOR, soil nutrient supply, S_n, and action coefficients of the nutrients, c_a. The mathematical models used to calculate S_n and c_a have the same coefficients as those used for EOR (established by Budoi et al., 1988).

RESULTS AND DISCUSSIONS

The mathematical model for the Technically Optimal Rates (TOR) is (Budoi, 2007a, 2009, 2010a):

$$\text{TOR, kg N, } P_2O_5\text{, } K_2O\text{/ha} = [\log(2.3 \cdot c_a \cdot Y_m)]/c_a - S_n$$

where:

Y_m = maximum expected yield, kg/ha;

c_a = action coefficient of nitrogen, phosphorous and potassium;

S_n = soil nutrient supply, potentially available form, kg N, P_2O_5 or K_2O/ha.

The mathematical models that have to be used in order to calculate c_a and S_n for TOR, the same as those for EOR, are (Budoi et al., 1988, 2003):

- for nitrogen:

$$c_a = 0.0095 + 13/Y_m; \qquad S_n = 60(1 - 10^{-0.5 \cdot IN}) + 0.004 \cdot Y_m$$

- for phosphorous:

$$c_a = 0.0095 + 15/Y_m; \qquad S_n = 125(1 - 10^{-0.01 \cdot PAL}) + 0.005 \cdot Y_m$$

- for potassium:

$$c_a = 0.0055 + 9/Y_m; \qquad S_n = 160(1 - 10^{-0.006 \cdot KAL}) + 0.001 \cdot Y_m$$

where:

IN = soil nitrogen index (Borlan, 1982);

P_{ALc} = soil mobile P content (Budoi, 2010b), ppm P;

K_{AL} = soil mobile K content, ppm K.

IN, P_{ALc} and K_{AL} are the average values for the 0-40 cm soil layer.

The original data concerning the TOR have been calculated with FERTEXPERT software within the range of Ym: 1000-7000 kg/ha, IN: 0.5-4.5, P_{ALc}: 5-160 ppm P, K_{AL}: 40-300 ppm K, and they are presented in specific agrochemical tables and nomograms (Table 1-3, Fig. 1-3).

The mathematical models and the agrochemical tables and nomograms are scientific tools destined to the horticulturists in order to be used to calculate or evaluate TOR for practical purpose: fertilization.

Other useful discussions on the mathematical models and agrochemical tables and nomograms are presented in other papers (Budoi, 2009, Budoi, 2010b).

CONCLUSIONS

The mathematical models, the original agrochemical tables and nomograms presented in this paper are scientific tools destined for horticulturists in order to be used to calculate or evaluate Technically Optimal Rates (TOR) of N, P_2O_5 and K_2O for practical purpose: fertilization in fruiting sour cherry tree cultivated on plan field and terraced terrains.

TOR are calculated or evaluated as function of the maximum expected yield, Y_m, and the relevant soil chemical properties (in 0-40 cm soil depth): nitrogen index: IN; mobile P: P_{ALc}; mobile K: K_{AL}.

ACKNOWLEDGEMENTS

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TABLES AND FIGURES

Table 1

Technically optimal rates (TOR) of N (kg/ha) in sour cherry tree as function of the maximum expected yield (Y_m) and soil nitrogen index (IN)

(Computerized with FERTEXPERT v. 3, Budoi, 2007, 2009)

Y_m	IN								
(kg/ha)	*0.5*	*1.0*	*1.5*	*2.0*	*2.5*	*3.0*	*3.5*	*4.0*	*4.5*
1000	45	31	22	18	15	14	13	12	12
2000	82	67	59	54	52	50	49	49	49
3000	104	90	81	77	74	73	72	71	71
4000	120	105	97	92	89	88	87	86	86
5000	130	116	107	103	100	99	98	97	97
6000	138	124	115	111	108	107	106	105	105
7000	144	130	121	117	114	113	112	111	111

Table 2

Technically optimal rates (TOR) of P_2O_5 (kg/ha) in sour cherry tree as function of the maximum expected yield (Y_m) and soil mobile P content (P_{ALc})

(Computerized with FERTEXPERT v. 3, Budoi, 2007, 2009)

Y_m	ppm P												
(kg/ha)	*5*	*10*	*15*	*20*	*25*	*30*	*40*	*50*	*60*	*70*	*80*	*120*	*160*
1000	52	40	29	20	11	4							
2000	87	75	64	55	46	39	26	15	7	1			
3000	109	97	86	76	68	60	47	37	29	22	17	5	1
4000	123	111	100	91	82	75	62	52	43	37	32	20	15
5000	134	121	111	101	92	85	72	62	54	47	42	30	25
6000	141	129	118	109	100	92	80	69	61	55	50	38	33
7000	146	134	123	114	105	97	85	74	66	60	55	43	38

Table 3

Technically optimal rates of K_2O (kg/ha) in sour cherry tree as function of the maximum expected yield (Y_m) and soil mobile K content (K_{AL})

(Computerized with FERTEXPERT v. 3, Budoi, 2007, 2009)

Y_m	ppm K										
(kg/ha)	*40*	*60*	*80*	*100*	*120*	*140*	*160*	*180*	*200*	*240*	*300*
1000	36	13									
2000	96	74	57	44	34	27	21	17	14	10	6
3000	137	114	98	85	75	68	62	58	55	50	47
4000	167	145	128	115	105	98	92	88	85	80	77
5000	190	168	151	138	129	121	116	111	108	104	101
6000	209	187	170	157	148	140	135	130	127	123	120
7000	225	203	186	173	163	156	151	146	143	139	136

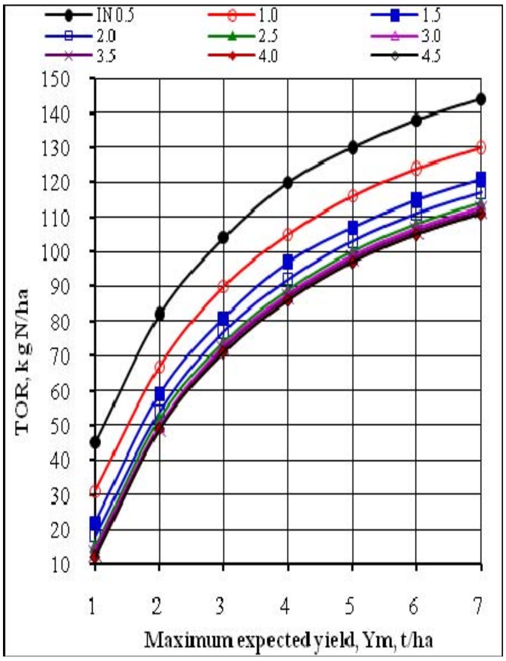

Fig. 1. Technically optimal rates (TOR) of N in sour cherry tree as function of the maximum expected yield (Y_m) and soil nitrogen index (IN)

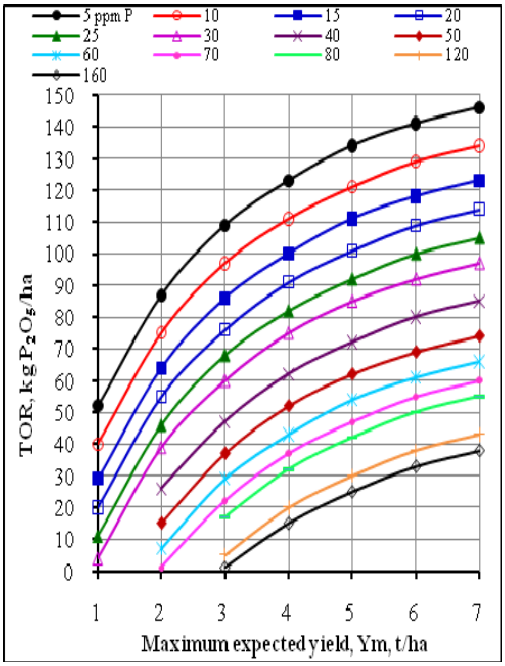

Fig. 2. Technically optimal rates (TOR) of P_2O_5 in sour cherry tree as function of the maximum expected yield (Y_m) and soil mobile P content (P_{ALc}, ppm P)

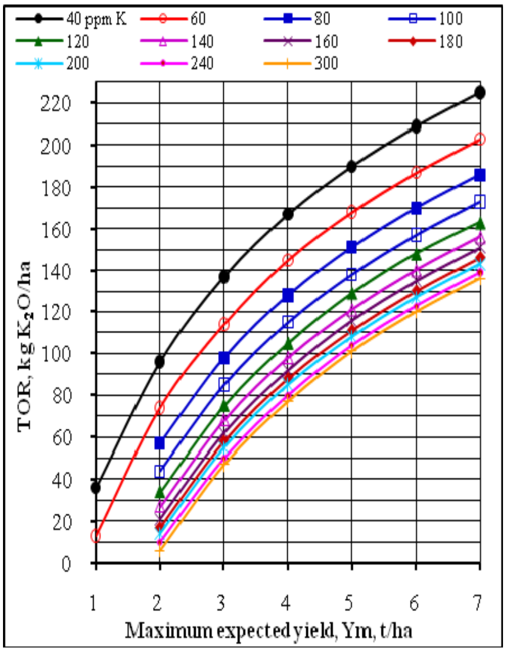

Fig. 3. Technically optimal rates (TOR) of K_2O in sour cherry tree as function of the maximum expected yield (Y_m) and soil mobile K content (K_{AL}, ppm K)

Electronic nose discriminate seven types apples, after maturity grade

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Key words*:* Multivariate statistics (PCA, DFA, SQC), maturity indices, climacteric stage

ABSTRACT

An electronic nose (E-nose) was used to classify apple samples based on their smell, depending on maturity grade. Seven varieties of apples from Romania, Golden, Starkrimson, Jonathan, Gala were from Reghin region and Pinova, Fuji, Golden, too, from Însurăței area, were used. All the samples were analyzed using the E-nose FOX 4000 with 18 metal oxide coated or uncoated sensors. The resulting E-nose intensities were analyzed by Principal Component Analysis (PCA), Discriminant Factor Analysis (DFA) and Statistical Quality Control (SQC), which resulted in grouping the used varieties of apples or in grouping the types of samples (peel, homogenate or diluted homogenate from the same apple). The obtained results indicated that E-nose could discriminate successfully among varieties of apples (% of variance >> 90; percentage of recognition ≈ 100 %) and can be helpful in optimum harvest period determination.

INTRODUCTION

Apples are the most widely consumed fruits in Romania. Romania is a leading producer of fresh fruits and vegetables, topping the 6th place among the biggest European producers of fruit, after France, Spain, Poland, Italy and Germany, which limits export opportunities in this country, according to a release of the Ministry of Agriculture, Forestry and Rural Development. Apple flavors and essences are food ingredients that emit a vast array of aromatic volatile gases, which contribute to the sensorial quality of foods in which they are incorporated. The headspace atmosphere of different flavors and essences are distinct both qualitatively and quantitatively (Marrazzo, 2005a)

Volatile (often aroma) compounds are traditionally analyzed by gas chromatography (GC), GC analysis with flame ionisation (FID), GC mass spectrometry (GC-MS), and GC olfactory (GCO) methods (Lebrun et al., 2008), which involve very expensive equipment, time and labour intensive steps, methods development, sample preparation, separation of specific volatile compounds using appropriate chromatographic columns, and chromathogram interpretation; but, a major challenge for the fruits and vegetables industry is to replace time-consuming laboratory analyses, used in process and control quality monitoring, with new application techniques that are fast, precise and accurate. E-nose technology represents a possible alternative to volatile measurement, at least in some applications (Lyukx, 2008; Peris, 2009). These are multi-sensor arrays designed to measure headspace volatiles. Each sensor type has a greater or lesser affinity for a particular chemical class or group of compounds. Using chemometric techniques and multivariate statistical analysis, it is possible to distinguish among groups of samples, and possibly identify individual sample components (Zoecklein, 2009).

Several studies have investigated the use of E-nose type sensors for apple quality evaluation. A non-destructive evaluation of apple maturity has been measured by means of E-nose by Pathange et al. (2006). Evaluation of the feasibility of detecting differences between volatile gases from intact apples and apple juice extracts from different cultivars using E-nose was studied by Marrazzo et al. (2005b). Xiaobo and Jiewen (2008) realized a comparative analysis of apple aroma by a tin-oxide gas sensor array device. Other researchers like Li and Heinemann (2007a) developed a multisensor data fusion model to integrate two volatile detection instruments (Enose and zNose) for apple defect detection, a new method throw which they could differentiate undamaged from deteriorated apples using Enose and zNose (2007b) and an ANN-integrated Enose and zNose system for apple quality evaluation (2007c).

The objective of this study was to develop a methodology for discriminating apples from two regions of Romania, regarding optimal harvesting period determination. In order to achieve this goal we focused our efforts on physic-chemical and sensory (instrumental) analysis. As far as the sensory approach is concerned, were elaborated "fingerprints" (↔ E-nose intensities) of the apples analyzed using an E-nose FOX 4000, that were further used for multivariate statistics analysis (PCA, DFA and SQC).

MATERIALS AND METHODS

1. *Experimental set-up*

Golden, Starkrimson, Jonathan and Gala varieties are the most cultivated in Romania, meanwhile Pinova and Fuji are varieties less cultivated by growers across the country.

Prior to testing, all the samples were kept at room air temperature (23°C) for about 12 hours to reach ambient air temperature.

Average samples from each of the analyzed varieties were made. Three types of samples were analyzed using an E-nose FOX4000: pare of apples, homogenized pare and pulp of apples and diluted homogenates to 25%. 2 grams of each sample were weighted into 10 ml vials (to ensure the repeatability 3 vials for each kind of sample were used). The samples were heated to 50°C for about 3 minutes. 1500 μl of headspace was injected at 2000 μl/s. The signal acquisition lasted 2 minutes.

The resulting E-nose intensities were analyzed by PCA, DFA and SQC.

2. Measurement of maturity indices

Firmness (F) of the apples was evaluated using a electronic penetrometer Penefel DFT 14, with a plunger of 11 mm. Soluble solids(S.S.) were determined using an Abbe refractometer model 2 WAJ Optika. Starch iodine index (SI) was determinate with o solution of iodine. Fruits testing's for maturity were starts three weeks before harvest moment expectations. Maturity indices were fallowed in dynamics once at every five days in preharvest period.

RESULTS AND DISCUSSION

In order to evaluate the capability of a commercial electronic nose to discriminate varieties of apples from different regions of Romania, the resulting E-nose intensities of the analyzed apples were grouped on apple varieties and types of evidence (pare of apples, homogenized pare and pulp of apples and diluted homogenates to 25%) as follows:

- group 1: Golden samples from Insuratei (3 types samples)
- group 2: Jonathan samples from Reghin (3 types samples)
- group 3: Starkrimson samples from Reghin (3 types samples)
- group 4: Pinova samples from Insuratei (3 types samples)
- group 5: Fuji samples from Insuratei (3 types samples)
- group 6: Golden samples from Reghin (3 types samples)
- group 7: Gala samples from Reghin (3 types samples).

Best results were obtained for pare sample. Because of the big number of figures obtained from multivariate statistics (PCA, DFA and SQC; ≈ 12 for each group) only two of them are shown below. For the others are presented in Table 1, the % of variance and the percentages of recognition obtained.

The obtained results indicated that E-nose could discriminate successfully among varieties of apples:

- 12 of 16 PCA plotted graphs were having a % of variance >> 90;
- 13 of 13 DFA plotted graphs were having a percentage of recognition = 100 %.

In Figure 1 and Figure 2 are presented the graph and the chart of Principal Component Analysis and respectively Statistical Quality Control analysis for all groups (pare samples).

The PC on X-axis (Figure 1), represents 99,15% of the global information given by the instrument analysis, with an discrimination index of 91 % of variance. It can be easily observed that the Golden pare samples have well distinct profiles. The Golden samples from Însurăței and Reghin are located on the same axis but on different positions meaning that Golden from Reghin should be harvested before Golden from Însurăței. On the same chart for Pinova variety (on the upper right,) we can observe that harvest period was delayed; for Jonathan is the optimal period. Starkrimson and Fuji varieties are closer like positions and harvest period is more delayed (on the down right) in comparison with Gala which is in climacteric stage, already (consumption maturity). All those were confirmed by SQC. Green field is acceptability area where Fuji variety was considered sample references by the equipment (Figure 2).

Each country has developed its own standard procedure to determine the right time to pick apples. Maturity grade increasing involve maturity indices (F., S.S., and SI) modifying with determinate dynamics on each 5 days in preharvesting period. Every analysed apples variety has established optimal values for those indices, at harvesting (table 2).

The Fuji apples from Însurăței have the most significant content **soluble solids** and **starch index**. Starkrimson apples from Reghin have the highest **firmness**. The Jonathan apples from Reghin have the lowest **firmness** and **soluble solids.**

CONCLUSIONS

Results indicate that electronic nose may be successfully applied as rapid method for discriminating apples, to determine the optimum harvest period. Rapid methods usually refer to methods that take minutes to get a result. In our study, under the mentioned experimental conditions, the E-nose intensities were available for statistics after approximately 20 minutes of analysis. Related to register harvesting date for optimal values of indices (firmness, soluble solids and starch index) we were able to establish next harvesting schedule: Pinova 15 September, Gala 19 September, Jonathan and Golden 20-24 September, Starkrimson and Fuji 4-5 October.

Compared to traditional methods, multivariate analysis combined with modern instrumental techniques (eg, E-Nose) often give new and better insight into complex problems by measuring a greater number of chemical compounds at once. These methods are attractive due to their inherent features of versatility, flexibility, effectiveness, and richness of information.

ACKNOWLEDGEMENT

The authors are grateful to Institute of Food Bioresources and Prof. Dr. ing. Burzo Ioan from USAMV Bucharest for the offered support for this study.

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TABLES AND FIGURES

Table 1

% of variance and the percentage of recognition for some of the groups mentioned at the beginning of the discussion

Group	% of variance			percentage of recognition		
	pare	homogenate	diluted homogenate	pare	homogenate	diluted homogenate
1	91	89	87	-	-	-
2	91	89	-	100	100	-
3	97	94	92	100	100	-
4	98	96	94	100	100	100
5	98	88	-	100	100	100
6	97	95	-	-	100	100
7	92	-	-	100	-	-

Table 2

Typical values used to determine optimum harvest date

Type of apple	Firmness, N/cm^2	S.S (%)	S I (1-9)
Jonathan	8.07	11.7	3-4
Gala	9.425	14.375	3-4
Starkrimson	9.568	13.16	4
Fuji	8.795	15.32	4-5
Pinova	8.50	12.075	4
Golden Reghin	8.878	13.23	3-4
Golden Insuratei	8.626	13.875	3-4

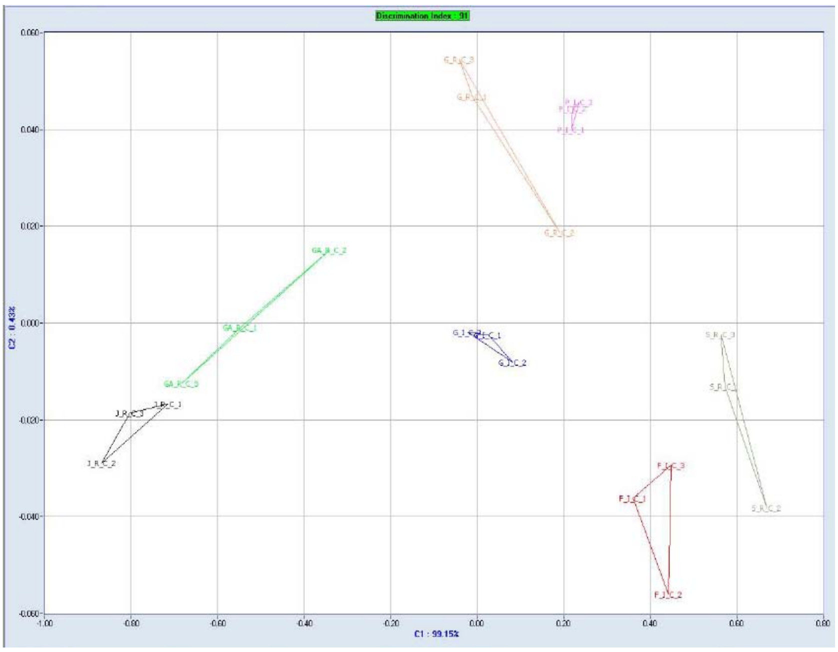

Fig. 1: PCA analyse for pare sample in September

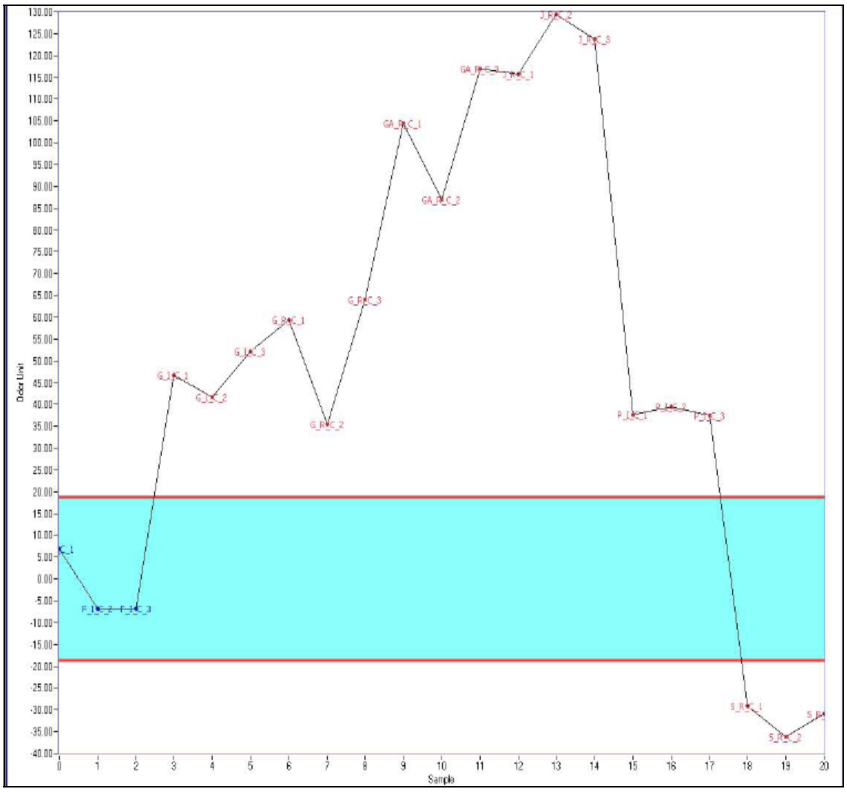

Fig. 2: SQC analyse for pare sample in September

Determination of patulin content of apples juice, through high performance liquid chromatography

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Keywords: mycotoxin, validation, method, limit of detection

ABSTRACT

In the paper are presented results of performed researches for patulin determination from apples juice, through high performance liquid chromatography. Patulin extraction was achieved in acetonitrile, and cleanup of the obtained extract using C.U. Patulin columns (MycoSep®228). The obtained solution is evaporated to dryness under nitrogen and redissolved. Patulin was separated on chromatographic column C18, 150 x 4 mm, 5 µm (*high performance liquid chromatograph Thermo Finnigan*), eluted in mobile phase (acetonitrile/water) and detected on 276 nm, using an UV-VIS „DIODE ARRAY" detector. It was achieved an internal study for validation of method for patulin determination from apples juice, by high performance liquid chromatography. In concentration range 6.25 µg/l – 400 µg/l, the average recovery is 90.50%. Limit of detection (LOD) is 2.91 µg/l, and limit of quantification (LOQ) is 9.71 µg/l. It was evaluated contamination degree of apple juice from commerce, using high performance liquid chromatography. Patulin concentrations of apple juice samples, analyzed are under 50 µg/l, the maximum allowed limit by the legislation in force *(Order 530/2007)*.

INTRODUCTION

Patulin is a mycotoxin produced by molds *Penicillium patulum, Penicillium expansum, Penicillium urticae, Penicillium claviforme, Aspergillus clavatus* and *Byssochlamys* spp., with toxically effects on human and animal body. Patulin was identified, especially, in spontaneous damaged fruits and vegetables by micotoxigen fungus: apples, apricots, bananas, pineapples, and grapes, black currants, raspberry, wild strawberries, cucumbers, tomatoes, green peppers, carrots. Patulin is stable, especially in processed products from apples: apples juice, apples concentrate juice, apples nectar, fruits nectar (which has as ingredient the apples juice also), apples puree, apples in syrup, etc. (Moake, 2005).

From chemical point of view, *patulin* is furo-piranone, with molecular mass 154, stable in acid medium, but unstable in alkaline medium.

It is presented as uncoloured crystals form, rhombics or prismatics, with melting point 110.5°C, with absorption maximum at 276 nm, in alcoholic solution (Dombrink-Kurtzman, 2001).

In the National Institute of Research&Development for Food Bioresources – IBA Bucharest it was developed a method for patulin determination from apples juice through high performance liquid chromatography. This method is accredited by RENAR, according to SR EN ISO/CEI 17025:2005 (accreditation certificate No. LI 417/08.04.2010).

It was evaluated contamination degree of apples juice from commerce, using high performance liquid chromatography.

MATERIAL AND METHODS

For determination of patulin content were analyzed samples of clear apples juice, from commerce. Evaluation of patulin contamination of apples juice, it was achieved, using high performance liquid chromatography. Patulin extraction was achieved in acetonitrile, and cleanup of the obtained extract using C.U. Patulin columns (MycoSep®228). The obtained solution is evaporated to dryness under nitrogen and redissolved. Patulin was separated on chromatographic column C18, 150 x 4 mm, 5 µm (*high performance liquid chromatograph*

Thermo Finnigan), eluted in mobile phase (acetonitrile/water) and detected on 276 nm, using an UV-VIS „DIODE ARRAY” detector.

RESULTS AND DISCUSSION

For patulin determination from apples juice by high performance liquid chromatography, it was realized a calibration curve with 7 patulin standard levels (with each three rehearsals), in concentrations range 0.00625 µg/ml – 0.400 µg/ml. Calibration curve is presented in figure 1.

For linearity domain establishment, of patulin determination method from apples juice, by high performance liquid chromatography, apples juice samples in what was not detected patulin, were “artificial” contaminated with patulin, using patulin standard solution for calibration, with patulin concentration 1 µg/ml.

Thus, there were obtained apples juice samples, with the following patulin concentrations: 10 µg/l, 15 µg/l, 25 µg/l, 50 µg/l, 60 µg/l, 80 µg/l, 100 µg/l, 125 µg/l, 200 µg/l and 400 µg/l. These samples were analyzed for patulin concentration determination.

By graphic representation of patulin concentration in injected sample, function peak area it obtains a right line with ecuation y = 0.0020x, and correlation coefficient (r^2) 0.9997. According to the obtained results, linearity domain of patulin determination method from apples juice, by high performance chromatography, is 5 ppb – 218 ppb.

For *recovery* establishment, in case of patulin determination method from apples juice, by high performance chromatography, apples juice samples in what was not detected patulin, were “artificial” contaminated with patulin, using patulin standard solution for calibration, with patulin concentration 1 µg/ml.

Thus, there were obtained apples juice samples, with the following patulin concentrations: 6.25 µg/l, 15 µg/l, 25 µg/l, 50 µg/l, 125 µg/l, 200 µg/l, 315 µg/l and 400 µg/l. These samples were analyzed for patulin concentration determination.

In concentration range 6.25 µg/l – 400 µg/l, the average recovery had the following values:

- 96.64%, for patulin concentrations < 25 µg/l;
- 90.31%, in patulin concentrations range 25 - 50 µg/l;
- 88.40%, for patulin concentrations > 50 µg/l.

In concentration range 6.25 µg/l – 400 µg/l, the average recovery is 90.50%.

For repeatability estimation, there were analyzed parallel apples juice samples with patulin concentration 25 µg/l, 50 µg/l and 100 µg/l (apples juice in what was not detected patulin, it was „artificial” contaminated with patulin, using patulin standard solution for calibration, with patulin concentration 1 µg/ml) and there were calculated:

- relative standard deviation value RSD(r), for determined patulin concentration
- extended uncertainty
- limit repeatability

In case of 10 parallel samples of apples juice with patulin concentration 25 µg/l (apples juice in what was not detected patulin, it was “artificial” contaminated with patulin, using patulin standard solution for calibration, with patulin concentration 1 µg/ml), relative standard deviation RSD(r), for determined concentration is 3.18%, and extended uncertainty is 4.20 µg/l. Confidence interval is 24.99 µg/l ± 4.20 µg/l. Limit repeatability is: 2.22 µg/l.

In case of 10 parallel samples of apples juice with patulin concentration 50 µg/l (apples juice in what was not detected patulin, it was “artificial” contaminated with patulin, using patulin standard solution for calibration, with patulin concentration 1 µg/ml), relative standard deviation RSD(r), for determined concentration is 1.84%, and extended uncertainty is 4.53 µg/l. Confidence interval is 49.20 µg/l ± 4.53 µg/l. Limit repeatability is: 2.53 µg/l.

In case of 8 parallel samples of apples juice with patulin concentration 100 μg/l (apples juice in what was not detected patulin, it was "artificial" contaminated with patulin, using patulin standard solution for calibration, with patulin concentration 1 μg/ml), relative standard deviation RSD(r), for determined concentration is 1.31%, and extended uncertainty is 5.36 μg/l. Confidence interval is 100.36 μg/l ± 5.36 μg/l. Limit repeatability is: 3.67 μg/l.

For intralaboratory reproducibility estimation, there were performed by three analysts, 8 apples juice samples (analyst A – 3 samples, analyst B – 2 samples, analyst C – 3 samples) with patulin concentration 50 μg/l (apples juice in what was not detected patulin, it was „artificial" contaminated with patulin, using patulin standard solution for calibration, with patulin concentration 1 μg/ml) and there were calculated:

- relative standard deviation value RSD(R), for determined patulin concentration
- extended uncertainty;
- limit reproducibility

In case of 8 samples of apples juice with patulin concentration 50 μg/l, analyzed by three analysts (analyst A – 3 samples, analyst B – 2 samples, analyst C – 3 samples), in the same laboratory, with the same equipment relative standard deviation RSD(R), for determined concentration is 4.75% and extended uncertainty is 4.53 μg/l.
Confidence interval is 49.77 μg/l ± 4.53 μg/l. Limit reproducibility is: 6.62 μg/l.

Using *"signal–to-noise ratio"* recorded by high performance liquid chromatograph, in case of patulin determination from apple juice, in the range 6.25 μg/l - 100 μg/l, there were calculated limit of detection and limit of quantification.

Limit of detection (LOD) is defined as being the concentration of which *„signal–to-noise ratio"* is bigger than 3 (S/N > 3). Limit of detection is the value which fixes inferior limit of work domain.

Limit of quantification (LOQ) is defined as being the lowest concentration of analyt, which can be determined with acceptable precision, under conditions of analysis method, at a *„signal–to-noise ratio"* bigger than 10 (S/N > 10).

In case of proposed method for patulin determination by high performance liquid chromatography, limit of detection (LOD) is 2.91 μg/l, and limit of quantification (LOQ) is 9.71 μg/l.

Proposed method for patulin determination by high performance liquid chromatography is selective. The *patulin* adequate peak is separated by baseline and by other compounds peaks. Resolution (DAB) is min. 2.7.

Using this method there were analysed clear apple juice samples, from commerce, in order to determine patulin content. Over 80% of the analyzed samples had not patulin, and within rest of them patulin concentration was under 50 μg/l, maximum allowed limit by the legislation in force *(Order 530/2007).* In figure 2 it is presented patulin content of apple juice samples, in which was detected patulin (16.85 μg/l – 30.15 μg/l).

CONCLUSION

1. In the National Institute of Research&Development for Food Bioresources – IBA Bucharest it was developed a method for patulin determination from apples juice by high performance liquid chromatography.
2. Patulin is separated on chromatographic column C18, 150 x 4 mm, 5 μm (high performance liquid chromatograph Thermo Finnigan), eluted in mobile phase and detected on 276 nm, using an UV-VIS „DIODE ARRAY" detector.
3. It was achieved an internal study for validation of method for patulin determination from apples juice, by high performance liquid chromatography.
4. In concentration range 6.25 μg/l – 400 μg/l, the average recovery is 90.50%. Limit of detection (LOD) is 2.91μg/l, and limit of quantification (LOQ) is 9.71 μg/l.

5. It was evaluated contamination degree of apple juice from commerce, using high performance liquid chromatography. Patulin concentrations of the analyzed apple juice samples, are under 50 µg/l, the maximum allowed limit by the legislation in force *(Order 530/2007)*.

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FIGURES

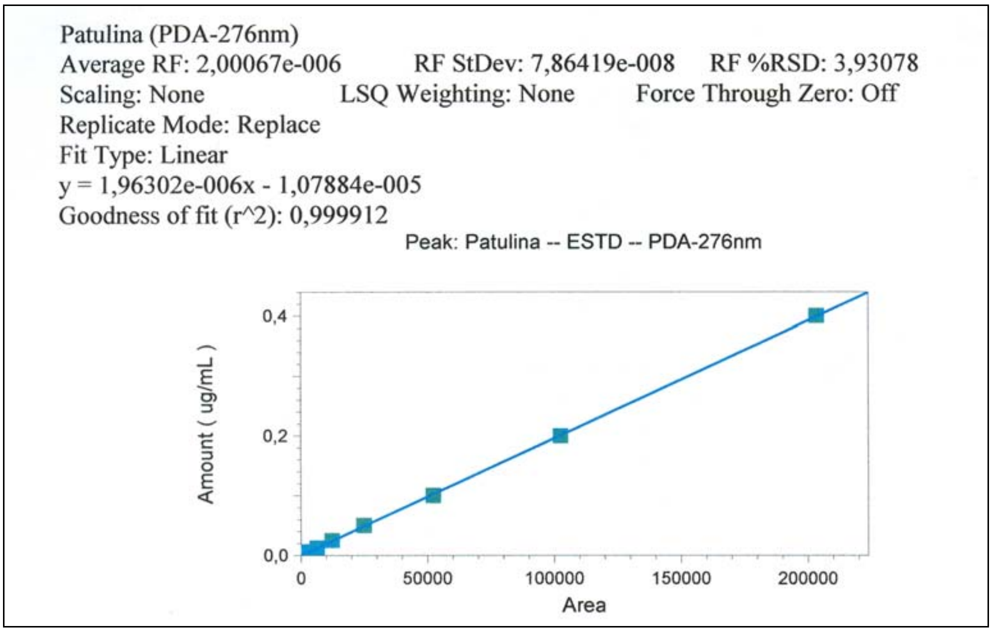

Fig. 1. Calibration curve

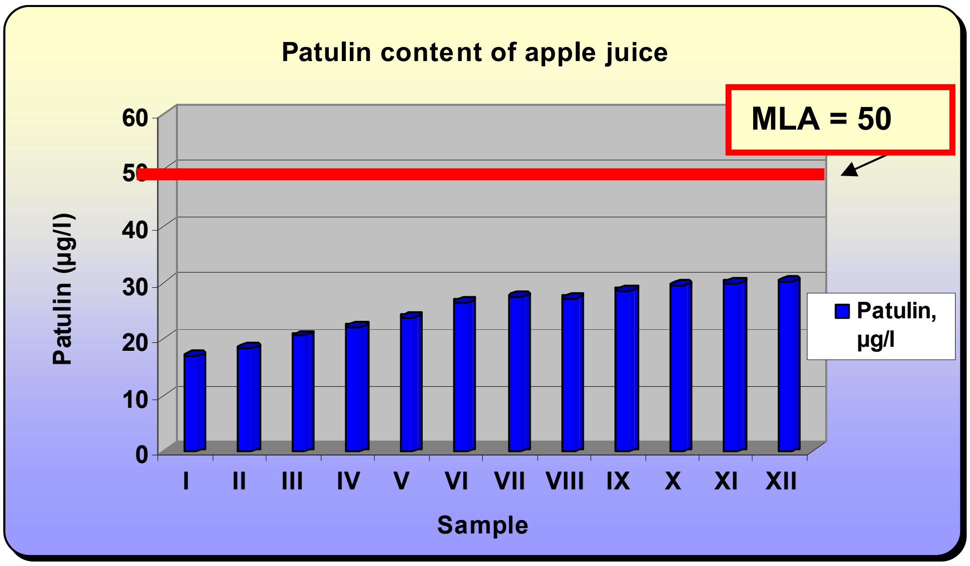

Fig. 2. Patulin content of apple juice

Fig. 3. Samples of clear apples juice analyzed

Studies regarding the implementation of food safety management system on minimal processing horticultural products

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Keywords: CCPs, HACCP, ready to eat

ABSTRACT

HACCP is the abbreviation for the English expression "Hazard Analysis Critical Control Points". To obtain high – quality products, capable of meeting the consumer's demands and complying with the Food safety standards, it is recommended that certain risk-prevention and control methods should be applied. In the minimal processing of horticultural products industry, the application of a HACCP system allows the identification of the key-elements of the technological process. The system analyses the hazard related to the product and the process, indicating the critical control points to the hygienic quality of the product. During the technological process, there is a large number of factors affecting the safety of the horticultural products. Starting from the fact that these products are ready to eat, there are major concerns regarding the level of pesticides and other chemical contaminants, as well as the maintenance of hygiene during harvesting, handling, processing, storage, and commercialisation. In order to prevent or reduce the above-mentioned hazards, the big specialised companies and small producers must apply HACCP prevention methods, not methods based on the final product control (which may affect consumer's health and may lead to important economic loss).

INTRODUCTION

The sanitary status of fresh horticultural products is a foremost quality attribute, even though it is among the less discernible traits for the consumer. Fresh horticultural products are the main source for diet fibre and vitamins, but can convey chemical, physical, and microbial hazards and contaminants or some synthetic pollutants (residues of fertilizers, herbicides and pesticides). Food safety management systems like ISO 22000:2005 and Hazard Analysis Critical Control Point (HACCP) can secure food safety by preventing potential hazard at source points of the process.

In order to guarantee fresh horticultural products safety, it would be desirable to structure the production according to HACCP principles. In the minimal processing ("ready to eat") of horticultural products, the critical control points can be detected mainly for microorganisms.

MATERIALS AND METHODS

The studies were developed on the processing of ready to eat vegetables salad (cabbage and carrots), according the floe diagram described in Figure1.

For each step of the process was performed the risk analysis, in order to identify the chemical, physical and biological hazards correlated to the product and process and also the preventive actions and control measures which are necessary to keep under control these hazards.

In order to the CCPs in all steps where it's possible to implement specific control measures regarding food safety, the CCP decision tree was applied. The control of each CCP, according HACCP principles are planned in HACCP plan and the implementation of the control measures and shown by specific records.

RESULTS AND DISCUSSION

Minimally processed horticultural products are in danger of increasing the metabolic activity which causes their degradation. The natural degradation of freshly cut products determined by processing increases respiration and ethylene production very quickly and the accumulation of phenol substances. Following these processes; the biochemical reactions are responsible for colour change, taste and nutritional composition (loss of vitamins).All these aspects could be minimised by cooling the products before production process. Also the temperature control following production process is very important in order to decrease the negative effects in metabolic activities.

Other preventive measures involved in the reduction of the minimal processed horticultural products degradation are: the correct use of sharp knives and their cutting quality, the strict hygienic rules and effective washing and drying (removal of water excess quantity from the products surface). This kind of products maintains a big part of the microflora after processing. Part of microflora is pathogenic microorganisms like *Listeria monocytogenes, Escherichia coli enterohemoragic, Clostridium botulinum* and *Vibrio cholerae*.

One measure involved in keeping under control the growth of microorganisms regard the packaging of ”ready to eat” horticultural products, under modified atmosphere. So, the level of O_2, reduced from 21% to 2-6% and CO_2 level increases from 0,03% to 3-8%; correlated with cooling and respecting hygiene results the respiration rate and microbial growth are reduced and the shelf life of the products will extend.

Starting from these aspects, in the Table 1 there are presented the process step and related potential hazards including the preventive actions and the control measures, from which one of the most important is the temperature control.

By using the CCP decision tree, in Table 2 there are presented the six CCPs identified, from which, five are focused to keep under control the microorganisms and one for the metallic foreign bodies, although during the packaging process must be respected the cooling temperature.

The HACCP Plan (Table 3) is one of the most important document from food safety management system, which contain the mainly information necessary in order to implement the control measures and keep under control the identified CCPs.

As we know, the monitoring of finished food product is no guarantee of safety because unsafe samples may be not analysed. For that, the HACCP system is a structured approach to the identification, associated with the processing of “ready to eat” horticultural products.

CONCLUSIONS

1. The use of the adequate working techniques and hygiene programmes according the HACCP principles assures the food safety of minimal processing (“ready to eat”) horticultural products.
2. Safe products for consumption can be obtained only by keeping under control the CCPs identified.
3. The temperature control of the process and the product are the mainly issues in order to assure the food safety of minimal processing (“ready to eat”) horticultural products

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TABLES AND FIGURE

Table 1

Hazard analysis regarding the processing of „fourth game" horticultural products

Process step	Hazard	Preventive actions/ Control measures
1. Receiving of raw materials	B- Pathogenic micro organisms C- Pesticides residues - Heavy metals - Fertilizers Ph – Foreign matter	Visual control Supplier assessment *Temperature control of the product*
2. Storage	B - Idem	Sanitation programme Regular maintenance FIFO system *Temperature control during storage*
3. Prewashing Preparation	B- idem Ph – Metal piece from cutting machine	Cleaning programme Right equipment Personal hygiene rules
4. Cutting	B – idem Ph - idem	Cleaning programme Right equipment Personal hygiene rules
5. Washing and disinfection	B – idem C – Disinfectant in excess Ph – Foreign bodies	Cleaning programme for equipment Control of the mechanism for removal of foreign matter; Personal training; *Densification to reduce microbial load*
6. Rinsing	B – idem Ph – Foreign bodies	Water specifications Control of the mechanism for removal of foreign matter Cleaning programme for equipment
7.Drying by centrifugation	- idem	Regular maintenance of equipment Visual control Personnel training
8. Packaging (Metal detection)	B – idem Ph – Metallic foreign bodies C – Unacceptable substances from packaging materials	Cleaning programme for equipment Quality certificates of packaging materials; Personal hygiene rules Equipments maintenance *Removal of metallic objects by metal detector*
9. Labelling	B - idem	Visual control Personnel training
10. Storage	B - idem	Cleaning programme *Temperature control of the storage*
11. Distribution	B - idem	Right transportation vehicles Cleaning programme; Personnel training *Temperature control of transportation vehicle*

Table 2

CCP determination during processing of „fourth game" horticultural products

Process step	Hazard	Decision tree questions				PCC no.
		Q1	Q2	Q3	Q4	
1.Receiving of raw materials	B – Pathogenic organism	Yes	No	Yes	No	PCC1
2. Storage	B – idem	Yes	No	Yes	No	PCC2
3.Washing and disinfection	B – idem	Yes	Yes	-	-	PCC3
4. Packaging (Metal detection)	Ph – Metallic foreign body	Yes	Yes	-	-	PCC4
5. Storage	B – idem	Yes	No	Yes	No	PCC5
6. Distribution	B - idem	Yes	No	Yes	No	PCC6

Table 3

HACCP plan regarding the processing of „four th game" horticultural products

Process step	**CCP Nr.**	**Critical limits**	**Monitoring process**				**Corrective action**	**Verification**
			Responsible	**Method**	**Frequency**	**Records**		
Receiving of raw materials	CCP 1	Temperature products lower than 5 C	Warehouse supervisor	Products temperature control	Each receiving	Receiving sheet	Immediate cooling Return the nonconforming product to the supplier	Laboratory analysis of row materials Vehicle recording paper
Storage	CCP 2	T <5C UR = 95-100%	Warehouse supervisor	Visual control of temperature and relative humidity	Every 2 hours	Storage sheet	Adjustment of faults Hold nonconforme lots	Laboratory analysis of row materials
Washing and disinfection	CCP 3	Water temperature 1-5C Disinfectant conc. in water 90-110 ppm	Production supervisor	Temperature control and disinfectant conc. of washing water	Every products changing and during washing	Liner washer sheet	Prewashing check and disinfection of nonconforme lots Adjustment of water temperature	Laboratory analysis of water and final products
Packaging (Metal detection)	CCP 4	Absence of metal objects >0,8 mm	Production supervisor	Operation control with metal tester with diameter <1mm	Every 2 hours	Packaging control sheet	Adjustment of metal detector Check suspicious products using another detector	Weakly verification
Storage	CCP 5	Storage temperature lower than 5C	Storage supervisor	Visual control of storage temperature	Every 2 hours	Storage sheet	Adjustment of foults Hold nonconform lots	Laboratory analysis of final products – monthly -
Distribution	CCP 6	Temperature during distribution lower than 6C	- Vehicle driver - Quality supervisor	Control of temperature	At each loading and every half an hour during distribution	-Loading control sheet - Temperature recording during transport	Idem	Idem

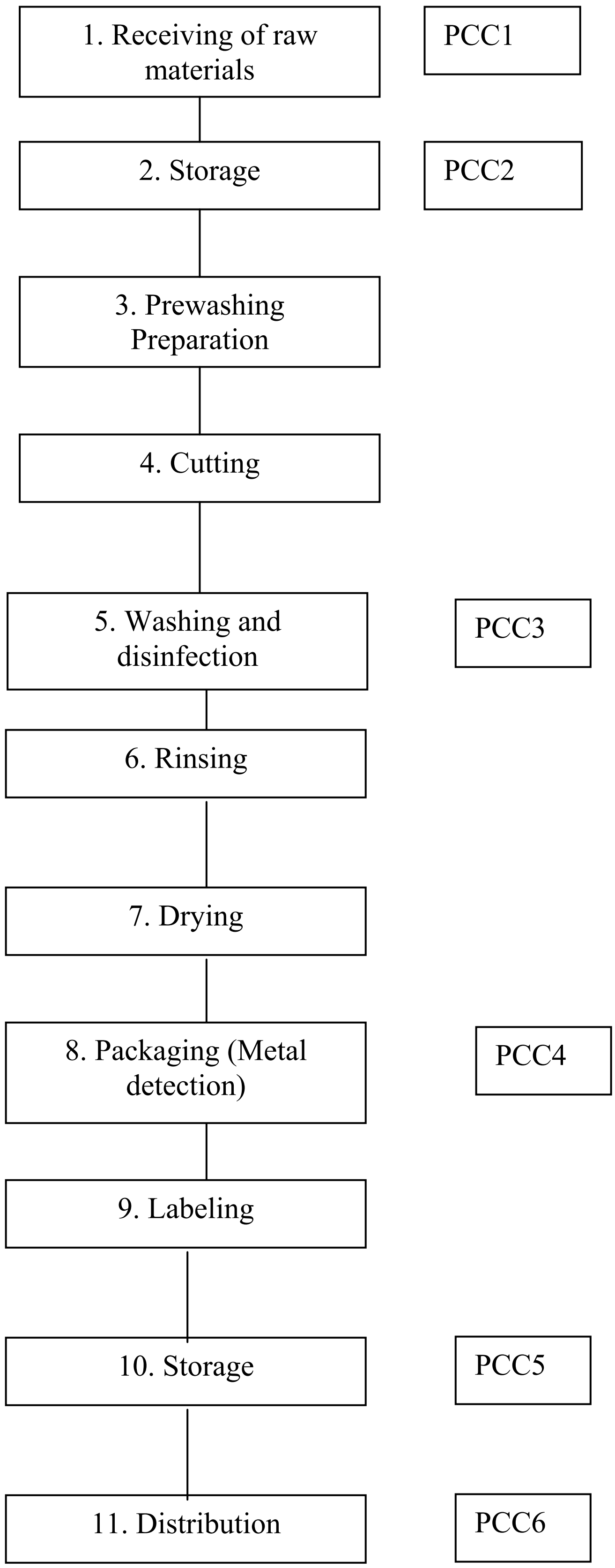

Fig. 1. Flow diagram for the processing of the „fourth game" horticultural products

Some particularities of Global GAP certification process

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Keywords: quality, standards, certification, good practices

ABSTRACT

In order to obtain high quality agricultural products corresponding to the retailer's requirements it's necessary to implement a set of rules, knowing worldwide, as GLOBAL GAP, starting September 2007. GLOBAL G.A.P. is a private sector body that sets out voluntary standards for the certification of production processes of agricultural (including Aquaculture) products around the globe. The objective of GLOBAL G.A.P. certification is to form part of the verification of Good Practices along the whole production chain. GLOBALG.A.P. is an open system, where any producer can apply and receive certification when complying with the objective criteria set out. This normative document GLOBAL GAP General Regulations Integrated Farm Assurance V3.1-Nov09 Parts I to V is obligatory starting on 1st March 2010.

INTRODUCTION

To respond the consumer concerns on food safety, environmental protection, worker health, safety and welfare and animal welfare by:

- encouraging adoption of commercially viable farm assurance schemes, which promote the minimization of agrochemical and medicinal inputs, within Europe and worldwide;
- developing a Good Agricultural Practice (G.A.P.) framework for benchmarking existing assurance schemes and standards including traceability;
- providing guidance for continuous improvement and the development and understanding of best practice;
- communication and consulting openly with consumers and key partners, including producers, exporters and importers.

In order to obtain high quality agricultural products corresponding to the retailer's requirements it's necessary to implement a set of rules, knowing worldwide, as GLOBALGAP, starting September 2007.

What is GLOBALGAP (EUREPGAP)?

- GLOBALGAP is a private sector body that sets out voluntary standards for the certification of production processes of agricultural (including Aquaculture) products around the globe.
- GLOBALGAP is a global scheme and a reference for Good Agricultural Practice (G.A.P.), which is managed by the GLOBALGAP Secretariat.
- Food PLUS GmbH, a non-profit industry owned and governed organisation, legally represents the GLOBALGAP Secretariat,
- GLOBALGAP is an equal partnership of agricultural producers and retailers that want to establish certification standards and procedures for Good Agricultural Practices (G.A.P.).
- GLOBALGAP provides the standards and framework for independent, recognised third party certification of farm production processes based on EN45011 or ISO/IEC
- GLOBALGAP Integrated Farm Assurance standard is a pre-farm gate standard that covers the certification of the whole agricultural production process of the product from before the plant is in the ground (origin and propagation material control points) or from when the animal enters the production process to non-processed end product (no processing, manufacturing or slaughtering is covered). The objective of GLOBALGAP certification is to form part of the verification of Good Practices along the whole production chain.

- GLOBALGAP is a business-to-business tool and is therefore not directly visible to the final consumer.

1. GLOBALGAP membership

GLOBALGAP membership is voluntary and independent from certification (for producers) or approval as a GLOBALGAP approved certifier. GLOBALGAP is an open system, where any producer can apply and receive certification when complying with the objective criteria set out. Members show additional commitment to shape and improve GLOBALGAP as active partners. Members also enjoy additional benefits.

1.1. Available membership

Retailer membership

Retailers and Foodservice organisations interested in supporting and developing GLOBALGAP (EUREPGAP) standards. Members can be nominated and elected to the Board, Sector Committees and the Integrity Surveillance Committee.

Supplier membership

Supplier (for the scopes of Crops, Livestock and/or Aquaculture) that are interested in showing more commitment to GLOBALGAP than receiving certification. Members can be nominated and elected to the Board, Sector Committees and the Integrity Surveillance Committee.

Associate membership

Certification Bodies, Consulting companies, Plant protection or Fertiliser Industries, Universities, etc. and their associations. Certification Body members can be nominated and selected to the Certification Body Committee.

1.2 Membership benefits

- Being visible active member of the major global platform for setting standards for Good Agricultural Practices worldwide;
- Right to participate in and contribute to the various Committees and National Technical Working Groups;
- Discounts for GLOBALGAP seminars, workshop and brochures;
- Display of member organisation logos and names in GLOBALGAP publications, reports, flyers, conferences, events and trade fairs;
- Internet link from the GLOBALGAP web page to the organisation websites;
- Become an official GLOBALGAP Train-the-Public Trainer;
- Access to unprotected versions of the checklists and the Control Points and Compliance Criteria;
- Access to customized statistics and client-based monitoring tools of the GLOBALGAP database as they become available;
- Producer groups can apply for a discount equal in amount to the Option 2 producer registration fees paid in the previous calendar year by the producer group, up to the total annual membership fee;
- Certification Body members are eligible to be co-exhibitor with GLOBALGAP at trade shows and events.

2. APPLICANTS

Any **producer*** of primary agricultural products, which the Integrated Farm Assurance standard covers may apply for GLOBALGAP certification through a GLOBALGAP approved Certification Body.

**In this document, the term "producer" refers to individual producers as well as producer groups.*

For GLOBALGAP certification, the term "producers" is defined as follows:

A person (individual) or business (individual or producer group) representing the production of the products, relevant to the scope (Crops, Livestock or Aquaculture), who has the legal responsibility for the products sold by that farming business.

2.1. Rights of producers

- The CB and producer will agree on Service of Notice terms, which must include a commitment by the CB to confirm the receipt of formal application for (first) registration within 14 calendar days after the CB received the unique GLOBALGAP Number (GGN) from the GLOBALGAP database, and to make the certification decision within a maximum of 28 calendar days after closure of any outstanding non-conformances.
- The service contract between the CB and producer may have an initial duration of up to 3 years, with subsequent renewal or extension for periods up to 3 years.
- Any complaints or appeals against CBs will follow the CB's own complaints and appeals procedure which each CB must have and communicate to its clients. In case the CB does not respond adequately, the complaint can be addressed to the GLOBALGAP Secretariat using the GLOBALGAP Complaints Extranet, available on the GLOBALGAP website (www.globalgap.org)
- A producer may apply to different certification options within the same sub-scope, but may not apply to different options for the same product e.g.:
  Possible: Register Apples under Option 1 and Cherries under Option 2.
  Possible: Register Melons under one Option 2 and peaches under another Option 2
  Possible: Register Apples under Option 2 and Cucumbers under Option 3.
  Impossible: Register Salmon under both Options 1 and 3.
  Impossible: Register Lemons under both Options 1 and 4.
- The CB that has lost its GLOBALGAP approval (through sanction enforcement, bankruptcy, or other reasons) shall contact the producer and inform the producer about his/her right to require the CB to annul the sub-licence agreement and transfer the valid certificate to another CB. Where CB would fail to do so, GLOBALGAP will inform the producers using the contact details registered in the GLOBALGAP database.
- A producer may change from one CB to another CB, and the CBs shall follow the rules set in Annex II.1 "Transfer between CBs". This will not allow the producer to avoid paying the registration and other applicable fees owed to the "outgoing" CB.
- A producer/producer group is able to ask voluntarily from the respective CB(s) for a suspension of one, several or all of the products covered by the certificate. This can happen if the producer experiences difficulty with compliance to the standard and needs time to close any non-compliance out. This suspension will not delay the renewal date, nor will it allow the producer to avoid paying registration and other applicable fees. The producer's status shall change to "self declared suspension" on product level.
- Confidentiality: GLOBALGAP and GLOBALGAP (EUREPGAP) approved CBs will treat any information relating to the producer, including details of products and processes, evaluation reports and associated documentation as confidential. No information is released to third parties without the prior written consent of the producer, except where stated otherwise in this General Regulations document.

2.2 Obligations of producers

- The certificate holder (individual producer in Option 1 or producer group in Option 2) is responsible for compliance of the certified production processes for different products to the GLOBALGAP Control Points and Compliance Criteria and General Regulations within the declared extent of the certificate scopes.

- Producers must register with an approved CB as the first step towards obtaining a GLOBALGAP certificate.
- Producers who are sanctioned by their currently contracted CB cannot change that CB until that CB (the "outgoing" CB) closes out the corresponding non-conformance, or until the sanction penalty period is over.
- Members of a producer group are allowed to leave the group and register with another group with any of the products that have been registered before under the following conditions:
    a) There isn't any pending sanction on the group member issued by the group or any issues, relevant to a producer group member, raised by the CB that have not been closed out,
    b) The contract between the group and the member is respected,
    c) When the group has ceased to exist and/or is cancelled by the CB
    d) Or in special cases where Food PLUS needs to agree on, case by case
- An accepted producer that changes CB, or applies to a new CB for certification of a different product, must communicate the unique GLOBALGAP number (GGN) assigned by GLOBALGAP, to the CB applied to.
- When a producer makes use of the service of different CBs as explained below, the producer must:
    a) Apply during registration to the GLOBALGAP Secretariat for approval through the CB. This will be treated as an exception and the GLOBALGAP Secretariat shall permit it based on a valid justification.
    b) Agree in writing to inform the relevant CBs if one of the CBs issued a sanction (and all detail of the sanction, i.e. non-conformance, time limit for corrective action, etc.) and also to allow open communication between the CBs regarding the scope and details of actions to be taken across CBs (if any).
    c) Agree in writing to allow GLOBALGAP to share information on non-conformances and sanctions between the relevant CBs.
    d) Assign one CB to be responsible for collection of the registration fee or for granting this role to a chosen trustee. The CB must accept this responsibility in the database.
- Accepted producers are responsible for communicating data updates to CBs according to the internal procedures of each CB, such as farm or product area changes and inclusion/de-listing of members within a producers group.
- Producers must commit themselves to follow the requirements established in this General Regulations document, including annual payment of the registration fee established by GLOBALGAP, and declare this in a signed document held by the CB.
- Producers applying for GLOBALGAP must specify, at registration and acceptance, all locations and areas where the product that they are seeking certification for, is grown/produced or transported from and handled under their ownership.
- Producers, who signed a contract with a CB, are obliged to pay the invoices from CB. If payments are not done following contractual conditions, the product will be completely suspended until time of payment.
- Producers shall ensure that any services subcontracted to third parties are carried out in accordance with the requirements of the GLOBALGAP standard.
- Where subcontractors (such as plant protection product applicators, harvesters, or other agronomic activities subcontracted by the producer) have been assessed by a 3rd party certification body which is GLOBALGAP approved, the producer shall receive a report from that certification body where the following information is included:
    a) Date of assessment
    b) CB

c) Inspector/auditor name
d) Name and address of subcontractor
e) GLOBALGAP Control Points covered AND the outcome – a complete list of the Control Points with the "yes" or "no" response to each control point and comments so that it can be used in the calculation of the producer's compliance. Only CPCC relevant to the subcontracted tasks will have been assessed, therefore "N/A" is not applicable.

3 GENERAL RULES OF GLOBALGAP

This normative document GLOBALGAP General Regulations Integrated Farm Assurance V3.1-Nov09 Parts I to V) is obligatory starting on 1st March 2010. The GLOBALGAP Control Points and Compliance Criteria Integrated Farm Assurance V3.0-1-Sep07 and the GLOBALGAP Checklist Integrated Farm Assurance V3.0-1-Sep07 and any other documents released by GLOBALGAP as normative and related to this version, came into force on the 1st of September 2007.

3.1. Registration and acceptance

All relevant information concerning producers applying for GLOBALGAP certification must be recorded for the producer to become GLOBALGAP registered for Option 1, 2, 3 and/or 4. This information will be used by GLOBALGAP to supply the registered party with a unique GLOBALGAP number (GGN), which will be used as a unique identifier for all GLOBALGAP activities. The registration information includes general information and producer registration information. Registration is complete when all registration information is entered and accepted. All products of which the production process is to be certified shall be in the product status "Accepted".

During registration producers and producer groups give access to Food PLUS and the certification bodies to use the registration data for internal processes and sanctioning procedures. Unless explicitly denied by the producer/producer group, GLOBALGAP members will have access to additional data, above and beyond the data available in the minimum release.

If a producer does not agree to the minimum release, the producer is not in agreement with the Sub-Licence and Certification Agreement and cannot be certified nor belong to a producer group seeking certification.

3.2. Registration Acceptance

The registration and acceptance process must be finalized, before inspection can take place, unless an exception is specifically mentioned in the General Regulations.

For the registration to be accepted, the producer shall have:

- signed the Sublicense and Certification Agreement between the CB and the producer, OR the producer shall explicitly acknowledge the receipt and the inclusion of the Sublicense and Certification Agreement with his/her signature on the certification service contract/agreement with the CB and the CB must hand over a copy of the Sublicense and Certification Agreement to the producer.
- been assigned a GLOBALGAP number (GGN), as well as any registration number the CB may assign,
- agreed to pay the GLOBALGAP (EUREPGAP) registration fee as explained in the current GLOBALGAP Fee Table (available on the GLOBALGAP website).

3.3. Certification process

3.3.1. The Control Points and Compliance Criteria (CPCC) document

The GLOBALGAP (EUREPGAP) IFA CPCC document is separated into different modules, each one covering different areas or levels of activity on a production site. These sections are grouped into:

1. **“Scopes”** covering more generic production issues, classified more broadly (All Farm Base, Crops Base, Livestock Base and Aquaculture Base).
2. “**Sub-scopes**” covering specific production details, classified per product type (Fruit and Vegetables, Combinable Crops, Coffee (green), Tea, Flowers and Ornamentals, Cattle & Sheep, Pigs, Dairy, Poultry, Turkey, Salmon, Trout, Shrimp, Tilapia and Pangasius and any sub-scopes that might be added during the validity period of this document).

The sub-scope modules applicable depend on the certificate scope applied for.

It is not possible to certify the respective sub-scope without also verifying compliance to the applicable scope. The inspection of compliance criteria of the scope must be interpreted according to the sub-scope applied for. Any certification applied for that introduces additional sub-scopes into an existing certificate must have the scope inspected taking into account the additional sub-scopes concerned. The scopes are automatically coupled to the sub-scopes according to the choice of sub-scopes applied for.

e.g. 2: the certification of Tea automatically involves the certification audit of the All Farm Base and the Crops Base.

It is possible for some sections as a whole to be not applicable; such as the control points on Final Produce Packing at Point of Harvest in Fruit and Vegetable production if there is no final packing in the field.

3.3.2. Compliance levels

Compliance with GLOBALGAP IFA consists of three types of control points (set out in the Control Points and Compliance Criteria documents) that the producer is required to comply with in order to obtain GLOBALGAP (EUREPGAP) certification. These are Major Musts, Minor Musts and Recommendations, which must be fulfilled with as follows:

a) Major Musts

100% compliance of all applicable Major Must and QMS control points is compulsory.

b) Minor Musts

For all scopes 95% compliance of all applicable Minor Must control points is compulsory for the sum of the control points in the applicable modules. For the sake of calculation, the following formula will apply for each combination of modules:
{(Total number of Minor Must control point/) - *(Not Applicable Minor Musts control points scored)}5%= (Total Minor Must control point Noncompliance allowable)*

e.g. A producer seeks certification for Fruit and Vegetables: The producer needs to comply with 95% of the applicable Minor Musts of the All Farm (AF), Crops Base (CB) and Fruit and Vegetables (FV) modules combined.

e.g. A producer seeks certification for Combinable Crops and Dairy: The producer needs to comply with 95% of the applicable Minor Musts of the All Farm (AF), Crops Base (CB) and Combinable Crops (CC) modules combined and with 95% of the applicable Minor Musts of the All Farm (AF), Livestock Base (LB), Cattle and Sheep (CS) and Dairy (DY) modules combined.

e.g. (Total number of Minor Must control points/module – NA Minor Must) x 5% (122 – 52) x 0.05 = 70 x 0.05 = 3.5. This means that the total number of Minor Must control point non-compliance allowable is 3.5, which must be rounded down. Therefore this producer can only have 3 Minor Must control points that are non-compliant. 70 applicable Minor Must control points – 3 non-compliant Minor Must control points = 67. This gives a compliance level of 95.7%, whereas if 3.5 were rounded up to 4 it would give a compliance level of 94.2% that is not compliant with the certification rule**.**

NOTE: A score for example of 94.8% cannot be rounded to 95% (the pass percentage)

NOTE: In all cases, after an inspection, the calculation to show compliance (or non-compliance) must be available.

c) Recommendations

No minimum percentage of compliance is set. All Recommendation control points in the CPCC must be inspected during the self assessments (Option 1), internal inspections (Option 2) and external inspections by CBs.

3.3.3. Validity of GLOBALGAP certificate

Certificate granting is conditional on compliance by the producer with all the applicable requirements set out in this General Regulations document.

Paper certificate requirements

The certificate issued by a CB must conform completely to the templates for Option 1, 2, 3 and 4 available on the GLOBALGAP website. The paper certificate may only be issued based on the information available at that time in the GLOBALGAP database for that unique GGN.

3.4. CERTIFICATION OPTIONS

Producers can achieve GLOBALGAP certification under any one of the four options described as following:

OPTIONS	COMENTS
Option 1	Individual producer applies for GLOBALGAP certification. The individual producer will be the certificate holder, once certified.
Option 2	A producer group applies for GLOBALGAP group certification. The producer group, as legal entity, will be the certificate holder once certified.
Option 3	Individual producer applies for certification under an approved GLOBALGAP Benchmarked Scheme. The Benchmarked Scheme rules are equivalent to the GLOBALGAP General Regulations. ***Benchmark validation*****:** The individual producer will be the certificate holder once certified. For validating Option 3 certification, producers must be registered in the GLOBALGAP database.
Option 4	A producer group applies for certification under an approved GLOBALGAP Benchmarked Scheme. The Benchmarked Scheme rules are equivalent to the GLOBALGAP General Regulations. ***Benchmark validation*****:** The legal entity representing the producer group will be the certificate holder once certified. For validating Option 4 certification, the legal entity and each one of the approved individual producer members must be registered in the GLOBALGAP database.

Abbreviations

AB	Accreditation Body	**IFA**	Integrated Farm Assurance
CB	Certification Body	**HACCP**	Hazard Analysis, Critical Control Points
CC	Compliance Criteria	**NTWG**	National Technical Working Group
CoC	Chain of Custody	**SC**	Sector Committee
CP	Control Point	**CBC**	Certification Body Committee
CPCC	Control Points and Compliance Criteria	**IAF**	International Accreditation Forum
MLA	Multilateral Agreement	**CL**	Checklist
EA	European co-operation for Accreditation	**BMCL**	Benchmarking Checklist
GFSI	Global Food Safety Initiative	**CIPRO**	Certification Integrity Programme
IPRO	Integrity Programme	**QMS**	Quality Management System

CONCLUSIONS

1. In order to obtain high quality agricultural products corresponding to the retailers' requirements it's necessary to implement a set of rules, knowing worldwide, as GLOBALGAP, starting September 2007.
2. The certification of agricultural producers against GLOBALGAP standard it's performing by accredited certification bodies according EN ISO 45011.
3. To obtain GLOBALGAP certification, the producers must implement the standard requirements and keep records almost 3 month before the registration at the accredited certification body.

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***GLOBALGAP (EUREPGAP) Checklist – Integrated Farm Assurance
***GLOBALGAP (EUREPGAP) Benchmarking Procedures
***GLOBALGAP (EUREPGAP) Benchmarking Cross-Reference Checklist
***EN 45011 or ISO/IEC Guide 65:1996. General requirement for bodies operating product certification systems
***IAF Guidance on the Application of ISO/IEC Guide 65:1996. Issue 2 (IAF GD 5:2006)
***ISO/IEC 17020:2004 General criteria for the operation of various types of bodies performing inspection.
***ISO/IEC 17025:2005. General requirements for the competence of testing and calibration laboratories.
***ISO/IEC 17011 General requirements for accreditation bodies accrediting conformity assessment bodies
ISO 19011 Guidelines for quality and/or environmental management systems auditing.

Research regarding the dynamics of some physiological processes during nectarine and peach fruits storage

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ABSTRACT

Peaches and nectarines fruits ripening process is mainly biochemical and hormonal coordinated. Thus, before maturation giberelines prevailing as against the abscisic acid, ethylene synthesis and respiration rate are maintaining at a reduced intensity, and fruit maturation is hindered. During the maturation process, ethylene synthesis is enhanced and maturation is stimulated. As the climacteric fruits began to mature, there is registered a rapid increase in ethylene biosynthesis, and it decreases as climacteric is established, being greatly influenced by storage conditions. Peaches and nectarines fruits ethylene emission, in the immediate phase and final harvest storage in different environmental conditions, revealed the dynamics of this parameter, confirming the direct influence of air temperature and relative humidity of storage space. Thus, for the fruits stored in ambient conditions, the emission of ethylene has increased as against to the harvesting stage, while in the case of the fruits preserved by freezing, as semi-permeable film, it has declined compared with post-harvest phase

INTRODUCTION

Postharvest quality losses in stored peach are caused predominantly by metabolic changes, mechanical damage, reduction in pulp firmness, physiological disorders and decay (Girardi et.al., 2005). It is known that peaches are part of horticultural products, with a" climacteric phase". In this case, the respiration rate is very high during cell division. At the end of this period and during cells growth in volume, there is a relative decrease of this intensity and a minimum respiratory is realized. At full maturity phase occurs a sudden increase in respiration intensity and this is so called maximum climacteric. After this, sudden decrease in maximum respiratory occurs followed by a slower decrease in the intensity of the respiration, corresponding to overipening or senescence phase. The maximum climacteric is caused by the joint action of a complex of physical, biochemical and structural factors. Harvested fruits, like all living tissues continue to respire throughout its postharvest life. During the respiration process carbohydrates are broken down, so, reducing the rate of respiration is an important consideration in extended life of fruits, and optimizing postharvest quality preservation. Ethylene play an important role in the initiation and continuation of ripening in all climacteric fruits including peach (Rasori et al., 2002) and nectarines (Ziliotto et al., 2008). Also, reduction of ethylene production and/or action is sufficient to improve the postharvest quality of most climacteric fruit. During this period ethylene, ribonucleic acid, proteins content decrease, and a selective decomposition of some cellular structures starts. Temperature of storage space has a stimulating effect on the respiration rate and this effect being similar to the heat amount produced by fruits, too.

MATERIALS AND METHODS

Peach and nectarine fruits have been harvested from an experimental field of SCPP Valul lui Traian – Constanta. The experimental variants were the following: Control (without treatment); V1- organic manure; V2- Foliar fertilizers; V3- Complex mineral fertilizers. Fruits were analyzed in the Laboratory of Plant Physiology, Faculty of Horticulture Bucharest, as regard as the intensity of respiration and ethylene emission, using the method described below.

Ethylene production was measured from three individual fruits per variant, kept in respiration recipients. Gas samples (0.2ml) were taken with a syringe and injected into a gas chromatograph (Fisons GC 8000) equipped with a flame ionization detector (FID). Analyses were carried out in the following conditions: oven 40^0 C; injector 80^0 C; FID at 115^0 C;

column GS Porapak Q; N_2 as the carrier gas, in the presence of air and H_2(60-80;110-120 and 50-80 KPa respectively). The amount of ethylene generated from the fruits was estimated from the peak area compared to that of ethylene standard. Results were expressed as µl $kg^{-1}h^{-1}$, and values represent means of two replicates.

Respiration rate has been measured using a CO_2 analyzer (Riken) and results were expressed as mg CO_2 $kg^{-1}h^{-1}$.

Fruits were then stored in the Laboratory of Technology, Faculty of Horticulture Bucharest, using two storage ways: the first one - under ambient conditions (T = 20^0-22^0 C, RH = 68%), and the 2nd under refrigeration conditions and packaging with a semi-permeable film (T = 2^0 C, RH = 92%). At the end of the storage period the same physiological parameters were determined.

RESULTS AND DISCUSSION

A regard as fruits respiration rate dynamics

Determination of respiration intensity of nectarine and peach fruit emphasized the dynamics of this physiological process, which recorded the highest values at the harvest phase before the storage period, then the respiration rate decreased (Table 1), depending on the storage conditions. Thus, if nectarines before placing in storage, respiration intensity had the lowest values in the control variant, respectively 75.24 mg $CO_2kg^{-1}h^{-1}$ for Delta variety and 89.24 mg $CO_2kg^{-1}h^{-1}$ for Cora variety, while the highest values were noticed at V3 - 102.4 mg $CO_2kg^{-1}h^{-1}$ (Delta variety) and V2 - 123.50 mg $CO_2kg^{-1}h^{-1}$ (Cora variety).

During the storage period, the respiration rate continuously decreased, but differentiated in function of the storage conditions.

Thus, in the case of the variant stored under ambient conditions (Table 2), lower respiratory intensity was observed, but not with a very pronounced degree, because of the higher storage temperature values (20^0-22^0 C). The obtained values ranged from 62.49 mg $CO_2kg^{-1}h^{-1}$ at control (Delta variety); 75.95 mg $CO_2kg^{-1}h^{-1}$ (Cora variety); 90.87 mg $CO_2kg^{-1}h^{-1}$ at V3 (Delta variety), to 100.20 mg $CO_2kg^{-1}h^{-1}$ (V2 - Cora variety).

A sharp decrease in the intensity of respiration was observed in fruit stored in refrigerated and packaged in semi permeable film (Table 3) due to the low temperature regime, respectively 2^0C.

The registered values ranged from 27.80 mg $CO_2kg^{-1}h^{-1}$ (Delta variety) and 19.04 mg $CO_2kg^{-1}h^{-1}$ (Cora variety), for the control variant 37.95 mg $CO_2kg^{-1}h^{-1}$ - V2 (Delta variety), respectively 39.93 mg $CO_2kg^{-1}h^{-1}$.

In the case of peach fruits, respiration dynamic followed the same trend as in the case of nectarine fruits, with the mention that for all variants the determined values have been lower.

Thus, at harvest (table 4) for Cadinal variety, at the control variant the determined respiration rate was 65.20 mg $CO_2kg^{-1}h^{-1}$, while at the end of storage under ambient conditions (Table 5), values were 48.62 mg $CO_2kg^{-1}h^{-1}$, with a remarkable decreasing in the refrigerated and semi-permeable film and 20.06 mg $CO_2kg^{-1}h^{-1}$ (Table 6).

As regard as ethylene emission

Before placing in storage of nectarine fruit (Table 1), ethylene content ranged from 0.60 µl $kg^{-1}h^{-1}$ (V1 – fertilized Cora variety) and 3.65 µl $kg^{-1}h^{-1}$ (V2- fertilized Cora variety). In the case of Delta variety, the highest value has been also noticed at V2 – fertilization variant, being 2.60 µl $kg^{-1}h^{-1}$.

The analysis performed at the end of the storage period pointed out different values, in function of the storage conditions.

Thus, at fruits stored under ambient conditions (Table 2), at 20^0-22^0C, ethylene emission intensity increased, leading to rapid progress and achieve maximum fruit ripening climacteric. Values determined at the end of storage varied between 1.20 µl $kg^{-1}h^{-1}$ (V1 – fertilization) and 7.41 µl $kg^{-1}h^{-1}$ (V2 – fertilization), at Cora variety, practically almost doubled, compared with the initial phase, before placing in storage. In the case of Delta variety, values ranged between 1.52 µl $kg^{-1}h^{-1}$ (V1- fertilization) and 5.31 µl $kg^{-1}h^{-1}$ (V2 - fertilization), which highlights for this variety a doubling ethylene emission compared with the initial data, too.

Preservation by refrigeration conditions in semi-permeable packaging covered with foil, because to low temperatures, high relative humidity and diminished O_2 content, the ethylene emission registered a declined, as against with the initial phase. Thus, values determined (Table 3) varied between 0.11 µl $kg^{-1}h^{-1}$ (V1 – fertilization) and 0.29 µl $kg^{-1}h^{-1}$ (V2 – fertilization), at Cora variety, while at Delta variety (with the same types of fertilization), values varied between 0.09 and 0.39 µl $kg^{-1}h^{-1}$.

At peaches fruits, determination carried out before fruits storage (Table 4) emphasized an advanced maturation stage at Cardinal variety, a characteristic feature which has been found very easy and organoleptic.

Determined values ranged from 0.32 µl $kg^{-1}h^{-1}$ (Control variant) (unfertilized) and 3.24 µl $kg^{-1}h^{-1}$ (V3 – leaf fertilized).

The same difference was determined Southland variety, but values were lower, ranging between 0.11 µl $kg^{-1}h^{-1}$(Control variant) and 0.32 µl $kg^{-1}h^{-1}$ (V3 – foliar fertilization).

While maintaining the environmental conditions (Table 5), as expected, progress has continued to rapidly fruit ripening, such as at the end of storage, values varied between 0.64 µl $kg^{-1}h^{-1}$ at Control variant and 6.31 µl $kg^{-1}h^{-1}$ (V3 - leaf fertilized), (Cardinal variety). At Southland variety, values varied between 0.27 µl $kg^{-1}h^{-1}$ (Control variant) and 0.44 µl $kg^{-1}h^{-1}$ (V3 – foliar fertilization).

Fruits storage by refrigeration and packing with semi permeable film decreased the ethylene emission as in the case of nectarines (Table 6).

Thus, at the end of the storage period at Cadinal variety , values ranged between 0.09 µl $kg^{-1}h^{-1}$ (Control variant) and 1.05 µl $kg^{-1}h^{-1}$ (V3 – foliar fertilized), respectively between 0.05 µl $kg^{-1}h^{-1}$ (Control variant) and 0.14 µl $kg^{-1}h^{-1}$ (V3 – foliar fertilized) at Southland variety.

These obtained results emphasized a different dynamic of the ethylene emission, with the higher values at fertilization - V2 and the lowest ones at fertilization - V1, a comparison made both at the storage beginning and at its end, in different environmental conditions, in the case of nectarines. In peach fruit there were noticed the lowest values at the Control variant and the highest values at V3 – foliar fertilized, with the same mention previously presented for nectarines.

CONCLUSIONS

1. Physiological processes dynamic of peach and nectarine fruits is directly influenced by temperature, air humidity and gaseous composition.
2. On peach and nectarine fruits stored under ambient conditions, respiration intensity decreased at a rate slower than at the harvest moment, while a sharp decrease in respiration rate was observed in fruit stored in refrigerated condition and packaged in semi permeable film.
3. The ethylene emission during storage period increased at fruits stored under ambient conditions and declined to those stored by refrigeration and packed with semi-permeable film.

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TABLES

Table 1

Physiological parameter values before nectarine fruits storage

Variety	Fertilization variant	Respiration rate mg CO^2 $kg^{-1}h^{-1}$	Ethylene µl $kg^{-1}h^{-1}$
Delta	Control	75,24	0,82
	V1	68,42	0,75
	V2	97,15	2,60
	V3	102,4	0,95
Cora	Control	89,24	0,65
	V1	95,80	0,60
	V2	123,50	3,65
	V3	96,82	0,85

Table 2

Nectarine physiological parameter values at the end of fruits storage in ambient conditions

Variety	Fertilization variant	Respiration rate mg CO^2 $kg^{-1}h^{-1}$	Ethylene µl $kg^{-1}h^{-1}$	Storage period -days-
Delta	Control	62,49	1,59	4
	V1	55,21	1,52	4
	V2	84,62	5,31	4
	V3	90,87	1,89	4
Cora	Control	75,95	1,30	5
	V1	82,92	1,20	6
	V2	100,20	7,41	5
	V3	82,49	1,73	6

Table 3

Physiological parameter values at the end of nectarine storage in refrigerated conditions, packed with semi-permeable film

Variety	Fertilization variant	Respiration rate mg CO^2 $kg^{-1}h^{-1}$	Ethylene µl $kg^{-1}h^{-1}$	Storage period -days-
Delta	Control	27,80	0,50	18
	V1	28,55	0,09	17
	V2	37,95	0,39	19
	V3	32,23	0,14	18
Cora	Control	19,04	0,15	22
	V1	26,52	0,11	32
	V2	23,94	0,29	28
	V3	39,93	0,23	40

Table 4

Peaches physiological parameters values before the storage period

Variety	Fertilization variant	Respiration rate mg CO^2 $kg^{-1}h^{-1}$	Ethylene µl $kg^{-1}h^{-1}$
Cardinal	Control	65,20	0,32
	V1	62,14	0,38
	V2	76,25	1,15
	V3	74,30	3,24
Southland	Control	33,23	0,11
	V1	29,64	0,23
	V2	43,73	0,26
	V3	43,01	0,32

Table 5

Physiological parameter values at the end of peaches storage under ambient conditions

Variety	Fertilization variant	Respiration rate mg CO^2 $kg^{-1}h^{-1}$	Ethylene µl $kg^{-1}h^{-1}$	Storage period -days-
Cardinal	Control	48,62	0,64	5
	V1	48,65	0,71	5
	V2	64,14	4,78	5
	V3	64,88	6,31	5
Southland	Control	92,59	0,27	7
	V1	25,05	1,15	7
	V2	30,89	0,39	7
	V3	30,55	0,44	8

Table 6

Physiological parameter values in peaches at the end of refrigerated storage, packed with semi-permeable film

Variety	Fertilization variant	Respiration rate mg CO^2 $kg^{-1}h^{-1}$	Ethylene µl $kg^{-1}h^{-1}$	Storage period -days-
Cardinal	Control	20,06	0,09	20
	V1	19,16	0,12	22
	V2	27,40	0,40	25
	V3	29,00	1,05	22
Southland	Control	2,02	0,05	35
	V1	2,84	0,10	35
	V2	2,55	0,09	37
	V3	2,29	0,14	34

Some specific features of investment promotion in high density culture system in apple

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Keywords: high density system from apple, specific investment, varieties with genetic resistance to disease.

ABSTRACT

The researches performed at the Tree Growing Research & Development Station Voineşti, by the creation in the year 2007 of an apple tree plantation in the high density system, with an disease resistant assortment, open new perspectives for the extension of modern orchards in the private farms of our country's dedicated tree growing zones, which will reach the remarkable performances of the countries with a developed tree growing. The investment at the setting up of an apple tree hectares in the high density system, which raises to 135.000 lei (without the anti-hail system), can be recovered in a relative short time, respectively until the year 6 after plantation, having in view that the maintaining expenses are partially covered from the year 3 – and totally from the year 4 after plantation, due to the remarkable productions registered at the cultivated assortment. The results obtained at the Tree Growing Research & Development Station Voineşti, recommend the extension in culture of the high density apple tree system, due to the high economical efficiency and also for the fact, that it permits the rapid adaptation of the assortments and of the technologies, in accordance with the requirements of the consumption and with the steady increasing general technical level.

INTRODUCTION

As everywhere in the agricultural production, also in the tree growing the most suitable solutions are searched for the increase of the economical outputs per surface unit, by adopting new modern culture systems, which shall assure quantitative and qualitative superior productions.

The modern apple tree culture systems, with a rapid fruit bearing start and with short exploitation duration, represent a periodical and rapid replacement modality of the assortment, by which the introduction of modern techniques and ideas in obtaining productions adaptive to the exigencies of the European quality standards is encouraged.

On the European level, the use of the midget graft bearer M9, of reduced vigour, has been generalized - with trees sustaining and irrigation system, with the orchards covered with an anti-hail net. In the high density tree growing exploitations in France, Italy, Germany, Spain, Swiss, etc., with denseness's of 2500-3000 trees/Ha, they obtain, year after year, remarkable performances, concretized in productions of 40-60 t/Ha.

The researches performed at the Tree Growing Research & Development Station Voineşti, by creating in the year 2007 an apple tree plantation in the high density system, with disease resistant assortments, will represent a model for the extension in the private farms of our country's dedicated tree growing zones, with the possibility to rapidly recover the investments used at the creation.

MATERIAL AND METHODS

The researches were organized at the Tree Growing Research & Development Station Voineşti in spring of the year 2007, following up the promotion of a the high density apple tree system, based on disease resistant breeds – and the adopting of some specific technological solutions, which have as an effect the early fruit bearing start and the permanent fructification on young wood.

The genetic disease resistant apple tree assortment proposed for experimentation: Redix, Iris, Real, Remar, Inedit, Luca, Rebra, Entreprise, Saturn, Golden Lasa, Goldrush, Ariwa, grafted on M9.

The trees were planted at a distance of 4x1 m (2500 trees/Ha), the crown form: Slender Sprindle.

The studies refer to the costs levels for the specific investment at the creation of an the high density apple tree orchard, determined by registering the materials and labour consumption on works groups, both at the creation - and annually, during the tree vegetation, until the fruit bearing.

Also, at the apple tree assortment used for the orchard creation, there were followed up: the fruit bearing precocity, the productions level, the fruits quality in the years 2-3 after planting and other culture aspects, which represent factors which must be taken into account at the promotion in culture of the high density system apple tree orchards.

The soil in the experimental lot was laid fallow on the interval and cleans of weeds on the trees row; it is brown eumezobasic weakly pseudogleized, with a clayish texture, with a weak acid pH (5.7-5.9). The humus content is medium at the surface (2.0-2.9%), medium supplied with nitrogen and weakly supplied with phosphorus and potassium.

The climatically conditions were favourable for the growth and for the fruit bearing of the trees, characterized by a medium annual temperature greater by 0.6^0 C, as compared to the zone's normal (8.8^0 C), with an annual rainfall sum of 693 mm.

For the pest combat, 6-8 treatments - only with insecticides - were applied. The other works were performed according to the technology specific for the high density apple tree orchards.

RESULTS AND DISCUSSIONS

In Romania, after the year 1990, by applying the land fond laws, a part of the intensive apple tree orchards returned to the private producers. Presently, these orchards have grown old, they have an age of over 40 years, the trees have a low production potential, an inferior fruits quality – in limits that cannot be trespassed, indifferently of the level of the applied technologies.

The apple producers will be obliged in the next years to replace the old plantations with modern culture systems, with rapid trees fruit bearing, with breeds demanded by the consumers, those with a the high productivity, with fruits of superior quality, competitive both on the internal market and at export.

The high density apple tree system offers a greater easiness regarding the exchange of the assortment (due to the more reduced exploitation period of these orchards), the increased output at works performing (totally performed on the soil) and also quantitative and qualitative superior productions.

The promotion of the high density apple tree system, where disease resistant breeds are provided for, grafted on weak vigour graft bearers (M9), lead to the identification of new tree growing technologies, which have a positive impact in short time on the productivity increase in the new created plantations, with an immediate profitability in the agro-food chain: production, storage, sorting-packing, marketing. It is also born in mind to realize apple lots with reduced pesticide residues, more and more necessary in the consumers' diet.

The realization on European level regarding the apple tree culture, have reached nowadays remarkable performances in the great cultivating countries, both regarding the assortment and the culture technology.

By promoting the high density apple tree system in our country's consecrated tree growing regions, it is born in mind to rapidly replace the existing plantations, in decline, with the high performance plantations, which shall bear fruits from the second and the third year after plantation - and which reach the maximum potential in the years 5-6 after planting, with the obligation to clear the trees at the age of 15-16 years in view of the assortment's exchange, according to the requirements of the fruits market.

The results obtained at the Voineşti Station in the period 2007-2009 are promising and mandatory to be followed up for establishing the level of the specific investment at the creation of the plantation - and the promotion in culture of the earliest and most productive breeds, which are suitable for the high density apple tree system.

The soil preparation for the planting consisted of clearing the existing orchard, filling up of the resulted unevenness's, the basic fertilization with complex NPK fertilizers, the ground broaching by ploughing at 40cm, performed with a couple of 2 tractors in November 2006, followed by levelling the surface, performed by 2 passes with the discs harrow in spring of the year 2007, before planting the trees.

The proper creation of the plantation was performed by picketing the ground at the planting distance of the trees, respectively at 4x1 m (2500 trees/Ha) and by the mechanized execution of the pits with a 40 cm diameter drill. At planting, seedling material from the field II of the nursery, rods shortened to 65 cm from the soil level, in order to realize the Slender Sprindlecrown form - were used. The trees planting was performed manually, the planting operations being exactly respected.

The installation of the sustaining system was realized in the year 2 after planting. The 3 m long frontal sustaining poles were buried 80 cm into the soil, being anchored – and the middle pols were planted at a distance of 20 m one from the other. Three wires were installed, the first disposed at 60 cm – and the others at a distance of 70 cm one from the other.

Afterwards follows the technological roads and the irrigation system laying out for 1 ha of orchard, the estimated values being provided for.

In the investment, the maintaining works in the year I and II after planting were also provided for, which were performed under the corresponding conditions.

The total specific investment for the creation of one hectare of the high density apple tree system, presented in the table 1, raises to 135.000 lei, where the anti-hail system may be added to, which is estimated at over 40.000 lei/ha.

The presented data demonstrated that the specific investment for the creation of the high density apple tree system on one hectare is high enough, but this can be returned in a relatively short time, respectively until the year 6 after planting, the maintaining expenses being partially covered from the year 3 – and totally, from the year 4 after planting, through the obtained productions.

The productions obtained in the year 3 after planting demonstrate the excellent performances of the high density apple tree system, which can be extended in the consecrated tree growing zones, with the most productive breeds and with fruits with a quality corresponding to the requirements of the market.

From the apple tree breeds cultivated in the high density system, the Iris breed grafted on the graft bearer M9, has the tendency to bear fruit already from the year 2 after planting.

From the year 3 after planting, the 12 apple tree breeds with genetic disease resistance, grafted on the graft bearer M9, realized satisfactory productions, having in view that at the planting, seedling material from the field II of the nursery, rods, without anticipated offshoots were used as support of the fruit bearing buds differentiation, already from the planting year.

From the data presented in the table 2, results that from the studied apple tree assortment, the earliest and most productive Romanian breeds are: Real (7.5 t/ha), Inedit (6.5 t/ha), Iris (6.3 t/ha), Remar (3.8 t/ha).

From the foreign breeds, are remarked, with productions in the year 3 after planting: Saturn (5.8 t/ha), Ariwa (5.5 t/ha), Golden Lasa (5.5 t/ha), Goldrush (5.0 t/ha).

In the conditions of the year (2009), with normal rainfalls, the fruits weight (g) was variable, comprised between 160 g at the Goldrush breed and 230 g at the Rebra breed. The trees being young, they realised fruits surpassing 170g, with a size corresponding to the trading standard. At the majority of the breeds, the fruits had a diameter of over 70 mm. The Goldrush and Inedit breeds present themselves with smaller fruits.

In the period of the experimentation, the studied apple tree breeds presented a very good resistance against scurf (*Venturia inaequalis*) and a reduced attack degree of mildew (*Podosphaera leucotricha*), in the conditions where only insecticides were used at performing the phyto-sanitary treatments. In the year 3 after planting (the first fruit bearing year), a contact product was used at the last treatment, in order to prevent the attack of *Gleosporium*.

After the crown volume and the appreciation of the fruit bearing buds differentiation degree, it is foreseen that in the year 4 after planting, at least 6-8 kg/tree are obtained, with 15-20 t/Ha, a production that will cover the maintaining expenses and will obtain a profit, which will be allocated for a part of the specific investment.

The introduction and the generalization of the high density apple tree system, with disease resistant breeds, in the consecrated tree growing regions, creates the premises for obtaining of apple lots with reduced pesticide residues, beneficial to the consumers.

By promoting the genetic disease resistant apple tree breeds, the treatments number in the orchards is substantially reduced, simultaneously with the lowering of the production costs.

The results obtained at the Tree Growing Research & Development Station Voineşti, recommend the extension in culture of the high density apple tree system, due to the high economical efficiency – and also for the fact that it allows the rapid adaptation of the assortment and of the of technologies, in accordance with the requirements of the consumption and with the general, steadily increasing, technical level.

CONCLUSIONS

1. The specific investment at the financing of one Hectare of apple tree in the high density system, raising to 135.000 lei (without the anti-hail system), may be recovered in a relatively short time, respectively until the year 6 after planting, having in view that the maintaining expenses are partially covered from the year 3 – and totally from the year 4 after planting, due to the remarkable production registered at the cultivated assortment.

2. At the promotion in culture of the high density apple tree system it is mandatory to use weak vigour graft bearers (M9), a sustaining system and the dripping or the micro-jet irrigation.

3. From the studied genetic disease resistant apple tree assortment, the earliest and the most productive breeds, suitable for the promotion in the high density system are: Real, Inedit, Iris, Remar of the Romanian breeds and Saturn, Ariwa, Golden Lasa, Goldrush, from the foreign breeds, which realized productions of 3.8 – 7.5 t/ha in the year 3 after planting and fruits with a quality, corresponding to the requirements of the market.

4. The high density apple tree system, where genetic disease resistant apple tree breeds are previewed, grafted on weak vigour graft-bearers (M9), with a density of 2500 trees/ha (the distance of 4x1m), is recommended for the extension in our country's consecrated tree growing zones, due to the high economical efficiency, the modality of periodical and rapid assortment replacement and obtaining of apple lots with reduced pesticide residues, beneficial to the consumers.

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TABLES

Table 1

The specific investment for the creation of one plantation Hectare in the high density apple tree system

(2500 trees/ha)

Specification	Expenses (lei)			Total
	Materials	Manpower	Mechanical	
A. Financial investments - total	73335	10192	4989	88516
1. Ground preparation (including the basic fertilization)	2734	227	835	3796
2. Technological roads laying out (100 m)	3500	400	250	4150
3. Ground setting up for irrigation	12000	2500	1450	15950
4. Trees planting (including the seedling material)	38951	3345	1984	44280
5. Sustaining means	16150	3720	470	20340
B. Investments for maintaining – total	7970	5720	1640	15330
Year I	2570	2480	700	5750
Year II	5400	3240	940	9580
Investments A + B	81350	15912	6629	103846
Indirect expenses (30%)	x	x	x	31154
Total specific investment	x	x	x	135000

Table 2

The fruit production realized on the year l3 after planting at the genetic disease resistant apple tree breeds, cultivated in the high density system

(2500 trees/ha)

Nr. crt.	Breed/graft-bearer	Production		Medium fruits weight -g -	Consumption period
		kg/tree	t/ha		
1	Ariwa/M9	2,2	5,5	180	Winter
2	Golden Lasa/M9	2,2	5,5	178	Winter
3	Golsrush/M9	2,0	5,0	160	Winter
4	Enteprise/M9	0,5	1,3	195	Winter
5	Inedit/M9	2,6	6,5	170	Winter
6	Iris/M9	2,5	6,3	175	Autumn
7	Luca/M9	1,1	2,8	180	Winter
8	Real/M9	3,0	7,5	185	Summer
9	Rebra/M9	1,2	3,0	230	Winter
10	Redix/M9	1,1	2,8	185	Winter
11	Remar/M9	1,5	3,8	200	Autumn
12	Saturn/M9	2,3	5,8	188	Autumn
A V E R A G E			4,5 t/ha		

The reduction of the environment pollution level and the economical effects by promoting in culture the disease resistant apple tree breeds

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Keywords: genetic disease resistant breed, environment pollution reduction, increased economical efficiency.

ABSTRACT

The researches, performed at the Tree Growing Research & Development Station Voineşti in the period 2006-2008, point out the economical and environment protection effects of some genetic disease resistant apple tree breeds, respectively: Florina, Redix, Iris, Irisem, Real, Remar, grafted on the graft bearer MM 106, cultivated in the intensive system (1250 trees/Ha). These are represented by the production potential of the breeds (25-40 t/Ha), the cost level of performing the phyto-sanitary treatments, which is reduced by over 55%, as compared with the sensible assortment (Ionathan, Golden Delicious, Starkrimson) and by the environment protection, following the reduced level of pesticide residues. Also, the maintenance of the fallow soil on the interval and the grasses covering on the trees row are ecological methods of weeds combat, which maintain a high humidity in the roots zone and a temperature with minimum oscillations, determining the increase of the soil content in organic material, due to the decomposition in time of the vegetal material resulted from the grasses' mowing from the interval between the trees rows.

INTRODUCTION

During the last decades, the apple tree assortment has known a significant change, being promoted in culture breeds which satisfy the ever increasing consumers' requirements. A singular situation is the promotion of the genetic disease resistant apple tree breeds, which represent for the new plantations chain loops of the performing economical technology, with an instant effect, by totally or partially eliminating the fungicide treatments.

We may appreciate that the orientation towards the genetic disease resistant apple tree breeds will be imposed gradually due to the economical efficiency, but also by the fact that this constitutes the main factor for obtaining ecological productions.

By promoting in culture the genetic disease resistant apple tree breeds, adapted to our country's ecological conditions, the quantity of apples with low pesticide content on the market increases, with beneficial influences on the environment.

Due to the reduction of the phyto-sanitary treatments number and of the pesticide products quantities, the costs are reduced by over 55%, a reduction positively reflected in the economical efficiency increase.

The Tree Growing Research & Development Station Voineşti was and remains the promoter of the resistant apple tree assortment, with breeds leading to the increase of the competition level on the Romanian market and preparing the tree growing production for the integration into the European Community.

MATERIAL AND METHOD

The presented data are the object of the researches performed in the period 2006-2008 and point out the economical and environment protection effects by promoting in culture genetic disease resistant apple tree breeds, respectively: Florina, Redix, Iris, Irisem, Real, Remar, grafted on the graft bearer MM 106. The trees were planted in the year 2001, at a distance of 4x2 m (1250 trees/Ha), the spindle-bush crown form being freely flattened in the row direction.

The growth and fruit bearing peculiarities of the studied apple tree breeds were pointed out by the growth vigour, the statistically calculated production and by the production quality registered at the 6 - 8 years old trees. Also the dry substance (DS %) was determined at the harvested apples and the maturation and the fruits consumption periods were registered, depending on the breed.

The cost level at the performing of the phyto-sanitary treatments was determined by registering the expenses with the phyto-protective products, the manual and mechanical works at the genetic disease resistant apple tree breeds, as compared with the sensitive assortment.

In order to establish a suitable method for soil maintenance and biological weeds combat at the Florina breed, grafted on the graft bearer MM 106, the following variants were organized:

V_1 – (Mt) black field;

V_2 – fallow on the interval, with manual soil works on the tree row;

V_3 – fallow on the interval and herbicide treated on the tree row;

V_4 – fallow on the interval and soil covered with grasses on the tree row, with material resulted by mowing the grasses from the interval between the tree rows;

V_5 – fallow on the interval and covered with plastic foil on the tree row.

Observations and determinations were performed regarding the trunk thickness increase, the annual length increase, the production registration and the average fruit weight. Also the soil humidity and the temperature were determined at different moments of the day, depending on the maintenance variant.

The soil of the experimental lots is brown eumesobasic weakly pseudogeised, with a clayish texture, with a weakly acid pH (5.7-5.9). The humus content is medium, at the surface (2.0-2.9%), medium supplied with nitrogen and weakly supplied with phosphorus and potassium.

The climatic conditions were favourable for the trees growth and fruit bearing, characterized by a medium annual temperature greater with 0.6^0 C than the normal of the zone (8.8^0 C), with an annual precipitations sum of 693 mm, with 82 mm lower than 782 mm.

In the experimental field, the soil was maintained fallow on the interval and free of weeds on the trees row (with the exception of the lot where soil maintenance variants were organized).

For the pests combat, 6-8 treatments only with insecticides were applied. The other works were performed conforming to the technology specific for the intensive apple tree orchards.

RESULTS AND DISCUSSIONS

The promotion in culture of the genetic disease resistant apple tree breeds has beneficial influences on the protection of people's health and of the environment.

The recently homologated and promoted in culture apple tree breeds, besides the Florina breed, are of medium or medium-weak vigour, suitable at densities of 1000-1200 trees/Ha, grafted on the graft bearer MM 106 (table 1).

The reference is represented by the average of the 6 apple tree breeds in the period 2006-2008 (35.5 t/Ha).

The statistically calculated production data for the age period of 6-8 years, point out the breeds with a production potential higher than the average of the 6 studied breeds. The apple tree breeds Remar and Redix stand out with very significant differences, with productions of 44.3 t/Ha, respectively 42.3 t/Ha. The breed Iris stands out with distinct significant differences (38.3 t/ha). The other genetic disease resistant apple tree breeds have satisfying productions (23.9 - 37.8t/ha).

The fruits production potential and quality, expressed by the aspect, the fruits weight, DS and taste qualities are arguments for multiplying and extending in the commercial plantations. Under natural keeping and cooling conditions, the fruits of the Redix breed resist until the first decade of March, almost as the fruits of the Florina apple tree breed. Those of the Iris and even of the Remar breeds – resist until November. The Irisem and Real breeds complete the variants conveyor of the breeds with summer – autumn maturation.

The soil maintenance modality has a great influence on the fruits production quantity and quality increase. Under prolonged drought conditions, the grasses cover resulted from the interval between the tree rows assured a better conservation of the water at the roots level, determining a more intense vegetative growth in the water stress periods, having also the role to combat ecologically the weeds growing on the trees row or under the crown projection, without herbicide intervention,

The vegetative growth of the trees, aged 11 years, represented by the trunk girth at the Florina breed, grafted on the graft bearer MM 106, had values between 31.5 and 36.6 cm, with a growth increase of 2.7 and 3 cm, the greater values being registered at V_4, with the soil covered with grasses on the trees row (table 2).

The medium length of the annual growths presents a values comprised between 39.0 cm and 45.3 cm, with insignificant differences between the studied variants, but the greater values are registered at the witness variant - black field, where the weeds do not contribute at the trees growth stopping, they being destroyed by the works applied to the soil.

The medium production at the Florina/MM 106 breed was greater at the variant 4 (35.3 t/Ha), surpassing the witness variant by 10%. The medium fruits weight has values comprised between 148 and 153g, the bigger fruits being registered at the variant 4.

The soil **Humidity** determined during the study years, August, in a depth of 0 – 40 cm, shows different values, depending on the soil maintenance variant and the depth.

In the interval 0-10 cm, variant 4, the humidity was 21.4%, on the trees row as compared with 10.5 – 13.3 at the other variants.

After a rainfall of de 27.3 mm, the soil humidity regime improved in the horizon of 0-10 cm, so that at the surface, the humidity was 19.8 – 26.1% - and at 0-10 cm, it had values of 15.3 – 19.2%. At variant 5, with plastic foil on the trees row, the humidity did not increase, maintaining itself between the same limits as before the rainfall: 11.1 – 12.1%.

Under the conditions of a normal pluviometric regime, the variant maintaining the highest humidity at the soil surface and also in the depth of de 0 – 40 cm was variant 4, fallow on the interval and soil covered on the trees row with vegetal material resulted from mowing the grasses on the interval between the trees rows. At variant 4, in August the humidity was 13.8% at the surface, as compared with 7.8 – 9.6% at the other variants. Also, a higher humidity is maintained at the surface on the fallow interval, but at the depth of 40 cm the humidity reaches over 14%.

The covering of the soil with grasses on the trees row with vegetal material, resulted from mowing the grasses on the interval between the trees rows, has a positive effect also in the case of the temperature regulation, especially on sunny, hot days. The temperature registered in July – August shows that under the grasses cover, at 13 and 15 o'clock, it maintains itself at 26.0 – 27.8^{0}C (almost as at 8 o'clock – 24.5^{0}C) on hot days, as compared with 44.5 – 48.5^0 C at the black field and works between the trees row variants.

The grasses covering deposed on the trees row or under the crown projection, resulted from the interval between the trees rows, contribute at the increase of the organic matter content, due to the decomposition in time of the vegetal material, with beneficial influences on the vegetative growth, the production increase and the apples quality.

The economical and environment protection effects are pointed out by the insecticide - fungicide consumption and by the registered costs at performing the phyto-sanitary treatments of 1 Ha orchard (table 3).

From the presented data results that significant differences are pointed out between the 2 cultivated assortments regarding the total number of noticed treatments, needed during the vegetation period, the pesticide quantities, the fuel consumption and the afferent costs. Thus, in the sensitive breed orchard, the medium number of performed treatments was 15 times, whereas in the resistant breeds' orchard it was 7. The economies realized in the resistant breeds orchard by the elimination of the fungicides in a proportion of 90% and the reduction of those with insecticides and acaricides by 81%, represent 66% - as compared to the sensitive breeds, which means that in the disease resistant breeds orchards by 50% less sprinkles are applied – and their value is 2 times lower, as compared to the classical sensitive assortment orchards. The fuel consumption is reduced by 53%.

Besides the registered beneficial economical effects, the pollution reduction, the more rapid remake of the natural parasites and pest's population and the maintaining of the fruits quality standard are to be added.

CONCLUSIONS

1. The recently homologated breeds, besides the Florina breed, grafted on the graft bearer MM 106, present a series of superior properties, expressed firstly by the genetic resistance against the main diseases, but also by the superior fruits quality, the high productive potential, with important economical advantages.

2. The soil maintenance, fallow on the interval and soil and covered with grasses on the trees row, is considered the variant with perspective, which maintains a high humidity in the roots zone, a temperature with minimum oscillations, prevents the weeds growth on the trees row, without interventions with herbicides - and also contributes to the growth of the soil organic matter content due to the decomposition in time of the vegetal material, resulted from mowing the grasses on the interval between the tree rows. It is the variant which combats ecologically the weeds growing on the trees rows or under the crown projection.

3. As compared to the standard disease sensitive apple tree assortment, for which – in order to maintain a suitable phyto-sanitary status - at least 14 treatments are needed, at the presented apple tree assortment 7 treatments with insecticides for pests combat are needed; 1-2 treatments with fungicides may be applied in the years with abundant rain falls, in order to combat *Gleosporium.*

4. The elimination of the fungicide products, the use of insecticides with a high selectivity degree, correlated with the quality and the productivity of the new homologated breeds, sustain the economical and environment protection effects, being basic arguments for their promotion in culture.

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TABLES

Table 1

The main characteristics of some genetic disease resistant apple tree breeds

Breed	Tree vigour	Production potential		Fruit Weight (g)	DS %	Maturation period	Consumption Period
		t/ha	Dif. + ; -				
Remar	medium	44,3	+ 10,8***	190	12,8	20-25.09	01X-31X
Redix	medium	42,3	+ 8,8***	160	12,5	20-30.09	01X-01III
Iris	medium-low	38,3	+ 4,8**	150	14,0	10-20.09	21IX-30XI
Irisem	medium-low	24,7	- 8,8000	190	14,7	01-10.09	11IX-20IX
Real	medium-low	27,8	- 5,7000	185	12,9	20-31.08	01IX-15IX
Florina	big	23,9	- 9,6000	170	13,1	20-30.09	01XII-01IV

Dl 5% = 2,45; DL 1% = 3,48; DL 0,1% = 5,04

Table 2

The vegetative trees growth, the production and the fruits medium weight at the Florina breed, grafted on MM 106, at different soil maintenance variants

(833 trees/Ha/)

Breed and variant	Vegetative growth			Fruits production		Medium fruits weight g
	Trunk girth		Average yearly growth (cm)			
	cm	Growth increase		T/ha	% of Mt	
Variant 1	31,5	2,9	45,3	32,2	100	149
Variant 2	33,7	2,7	43,7	32,6	101	149
Variant 3	36,6	2,8	44,7	34,2	106	148
Variant 4	34,9	3,0	43,3	35,3	110	153
Variant 5	32,0	2,8	39,0	30,3	94	148

Table 3

Economical efficiency elements of the disease resistant breeds, comparative with those of the orchards with sensible assortments (2006-2008)

Specification	Sensitive apple tree breeds	Resistant apple tree breeds	Economical effects (%)
Applied treatments	15	7	53
Insect-fungicides consumption, of which:	122	54	56
- fungicides	63	6	90
- insecticides-acaricides	59	48	81
Costs, of which:	5404	2045	62
- with phyto-sanitary products	3922	1345	66
- with labour	562	280	50
- with mechanical works	920	420	54
Fuel consumption - litres	90	42	53
- value (Lei)	3420	1596	53

Evaluation of the biological potential of some pear early hybrids in area Bucharest area

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ABSTRACT

The breading of the pear cultivars is a basic activity in fruit-growing research taking into account the **great importance of this specie in nourishment, but which has only 4,3% from the total fruit production in our country. Taking into account the necessity of the perpetual renewal and improvement of the pear cultivars, both for consumers and farmers, we proposed to study three early pear hybrids (H1-13/28, H2-18/28, H3-19/28) from the point of view of the trees vigour, their phenology, production capacity and fruit quality. The researches took place between 2004-2006, in a pear orchard set up in 1997, with trees of one year old, planted at 4/2m distance (1250 trees/ha). The pear trees were grafted on the quince tree rootstock, with a small vigour of growing. Observations were made regarding the permanent structure of the early pear hybrids, the ramified and formation crop capacity, the phonology of floral organs, binding capacity of fruit, productive efficiency, the relationship between the leaf' surface and growing level of the sprouts, fruit quality. The obtained results show the high productive potential of early pear hybrids studied, grown in Bucharest area, an zone which assures the development of physiological and biochemical process at a sustained level, giving a strong long life and a corresponding vegetation state to this species. From the three hybrids, a remarkable evolution has the hybrid H2-18/28, with a superior potential above the other two.**

INTRODUCTION

The breading of pear cultivar is a basic activity in trees research, taking into account by importance of this species in nourishment.

Pears fruits have a high nourishing value due to their biochemical composition: 8-15% sugars, 0,14-0,71% pectin, 0,24-0,65% proteins, acids, minerals, vitamins C, B, PP, A etc. and other substances (N. Cepoiu, 2003). The caloric contribution that pears consumption bring is very important because 100 g fruits contain 10-20 g carbon hydrates, which give to the human body between 40-80 Kcal (Gelu Corneanu et all., 2004).

Thanks to these aspects, the pear is a fruit-growing species found everywhere in the entire world, where the climate is temperate (Hoza D., 2000). It is found on all continents, but the greatest pear quantity is obtained in Europe, where Italy detains the highest production, followed by France, Germany, Spain, etc. Romania is on the 18th place (N. Cepoiu et all., 1993), with a smaller weight than apples, only 4,3%. Generally, it is found in the same area as apples tree, but it lives better in vineyard zone and even in forest steppe (I. Dincu, 1974).

The cultivar is one of the most important factors which determine the success of the culture, the quantity and quality of the production, its economical efficiency. For all these, the cultivars sort improvement of the high quality' more productive, resistant to diseases and pests, which corresponds to consumers exigency, become is a perpetual preoccupation of the pear research (Olga Pasat, 2004).

Numerous international researches admit that the rootstocks are really significant, too. They influence the cultivars which were grafted on them in lots of cases, including the date of the blossom and ripen, grown characteristics, production, survival, etc. (Dozier et all., 1983; Knowles et all., 1984; Okie, 1990; Boyan et all., 1998; Indreias, 2001).

Taking into account the necessity of the permanent renewal of pear sort for both consumers and farmers, we proposed ourselves in this paper to study three early pear hybrids

(H1-13/28, H2-18/28, H3-19/28 grafted on quince), from the trees' vigour point of view, their phonology, production capacity and fruits quality.

MATERIALS AND METHODS

The biological potential evaluation of the early pear hybrids H1-13/28, H2-18/28, H3-19/28, grafted on quinces, was made in a pear plantation founded in 1997, with trees of one year old, planted at 4/2m distance (1250 trees/ha).

The researches took place in 2004-200 period.

Five trees from each hybrid were analysed, avoiding marginal trees.

In the first years, the trees were conducted by dry pruning and green pruning**,** and finally creating a permanent structure of the canopy like a swindle spindle.

In the orchard there were made treatments against diseases and harmful insects, maintaining the culture in a very good healthy.

Numerous observations and measurements were made, in order to register some characteristic elements of planted pear in high densities, during vegetation period and in autumn, after leaves fall, regarding:

- the growth in thickness of the trunk;
- the highness of the tree;
- the vigour of the tree (appreciated through number, diameter and length of the tree skeleton branch);
- tree semi-skeleton branch**;**
- the permanent structure of the swindle spindle canopy;
- the phenology of floral organs;
- productive capacity;
- fruits' quality.

For each hybrid it was established a phonogram of the fruit-bearing organs, starting from the floral button phase to total petals fall, and the registered capacity to bear fruit led to the calculation of the number fruit which well be harvested.

Appreciations were made on the relationship between the surface of the leaf and the level of the branches growing.

To perform these determinations, shoots with length: >40 cm, 21-40 cm, 10-20 cm, 0,5-6 cm were analysed.

To establish the medium surface of a leaf, characteristic of each shoot length were measured 50 leaves.

Knowing the registered crop quantity for each hybrid and the trunk surface, we managed to establish the calculation of the productivity indices.

In order to establish the fruit quality, there were determined the pulp firmness (with the penetrometer mass OFD), the content in soluble dry matter (refractometry method using ABBE refractometer), titratable acidity **(**titrimetric method), C vitamin **(**spectrophotometer method, using UV/VIS V-550 Jasco spectrophotometer).

RESULTS AND DISCUSSION

From the information in table 1, we noticed that the researched pear hybrids have between 1.95 m high –hybrid H3-19/28 and 2.30 m high- hybrid H2-18/28.

Regarding trunk's thickness, we noticed that at hybrid H1-13/28 it grew from 8.50 cm to 9.90 cm (increase growth =1.40 cm), at hybrid H2-18/28 from 8.00 cm to 9.70 cm (increase growth = 1.70 cm), and at hybrid H3-19/28 from 9 cm to 10.43 cm (increase growth =1.43 cm). In conclusion, it is quite remarkable the fact that the values of these indicatory are very closed between hybrids H1-13/28 and H3-19/28, observing a higher difference at hybrid H2-18/28.

Tree skeleton branch vigour, analysed on their diameter makes differs depending on hybrid and its position in tree.

The thickness differences between hybrids are quite small at all three skeleton branch, as it follows: at skeleton branch I the difference is of 1 cm (from 5.50 cm at hybrid H3-19/28 to 6.50 cm at hybrid H1-13/28), at skeleton branch II - of 0.4 cm (from 5.60 cm at hybrid H2-18/28 to 6.0 cm at hybrid H1-13/28 and H3-19/28), and at skeleton branch III - of 0.70 cm (from 5.80 cm hybrid H3-19/28 to 6.50 cm at hybrid H1-13/28), which demonstrates that these hybrids realised an homogeneous structure.

The skeleton branch length presents small variations as well, of: 0.15 m at the first skeleton branch (1.75-1.90 m) and the second (1.65-1.80 m) and of 0.20 m at the third skeleton branch (1.65-1.85m).

The date's analysis from table 2 also shows that there are similar values among hybrids, concerning the number, length and branches diameter, hybrid H2-18/28 making evidence by a better capacity of ramification and fruit formation. All hybrids have three branches, their length vary between 5.55-5.85 m, the diameter is between 150-180 mm, ramification number is between 15-31, and the flower number/tree vary between 2430-2725.

The phenological observation made in early pear hybrid plantation is presented in table 3. The blossom sub-phases, from the floral button phase to total fall of the petals, were taking place at the same time at hybrid H1-13/28 and H3-19/28 and with 2 days earlier at hybrid H2-18/28.

The relative fast succession of blossom sub-phases development took place due to favourable climate conditions.

Analysing the binding capacity (table 4) it is obvious that the binding fruit number varies a little bit between hybrids H1-13/28 and H3-19/28, being bigger at H2-18/28 (305).

Productive efficiency analysis (table 5) of the pear plantation evidences the fact that the least productivity indices were marked at hybrid H3-19/28 (0.19), and the biggest at hybrid H2-18/28 (0.32).

The registered production has similar values at hybrids H1-13/28 (16 kg/tree) and H3-19/28 (16.17 kg/tree), meanwhile, hybrid H2-18/28 obtained a better production (22.77 kg/tree).

The report between the leaves and the formed fruit from pear hybrids is presented in table 6. We can observe that the number of fruits on the branch varies between 5.7 (H3-19/28) and 8.0 (H2-18/28), the number of leaves on the branch between 21.2 (H3-19/28) and 26.0 (H2-18/28), and their foliar surface between 572.4 (H3-19/28) and 702.4 (H2-18/28).

The report between the number of leaves/fruit is comprised between 3.25 at hybrid H2-18/28 and 3.85 at hybridH1-13/28, and the report between leaves' surface and fruit is comprised between 100.42 (H3-19/28) and 87.75 (H2-18/28).

Regarding the biochemical composition of the fruits, we noticed that the values of the analysed biochemical indicators **(**soluble dry matter, titratable acidity**, C** vitamin) are very similar to all three hybrids, but we can observe yet a small difference of hybrid H2-18/28 (fig.1).

The fruit firmness at harvest is comprised between 3.5 kgf/cm^2 at hybrid H3-18/29 and 4.7 kgf/ cm^2 at hybrid H2-18/28, therefore, from this point of view these three hybrids are quite similar too, but a small superiority can be observed at H2-18/28 (fig. 2).

CONCLUSIONS

After two years researches of early pear hybrids H1-13/28, H2-18/28, H3-19/28, gifted on quince, conducted as swindle spindle canopy and planted in Bucharest area we arrived to following conclusions:

- the swindle spindle canopy of the trees is quite easy to make, and the formed skeleton branch number are three, at all hybrids;
- the dimensions of the tree semi-skeleton branch has small varieties between hybrids;
- in Bucharest area, there were optimum climate conditions during researches period, for the floral organs phonology at experimented pear hybrids;
- the fruit number, respectively the production/tree varied, depending on hybrid, the greatest result being obtained at hybrid H2-18/;
- from the point of view of the fruit quality, the determinations showed positive aspects concerning the biochemical composition and textural firmness at all studied hybrids;
- the hybrid H2-18/28 remarks himself by its large number of binding and harvested fruit, by its better production, biochemical composition and fruit firmness, superior compared to the others two hybrids;

The general conclusion on evaluated aspects in our researches is that early pear hybrids: H1-13/28, H2-18/28, H3-19/28 have high biological potential, which gives them the opportunity to optimum plantation with medium density, in the capital area.

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TABLES AND FIGURES

Table 1

Permanent structure of some pear hybrids conducted as swindle spindle canopy

Specification	Hybrid		
	H1-13/28	H2-18/28	H3-19/28
Tree's highness (m)	2,00	2,30	1,95
Trunk's diameter (cm)			
- 2004	8,50	8,00	9,00
- 2005	9,90	9,70	10,43
Growth of the trunk diameter (cm)	1,40	1,70	1,43
Tree skeleton branch - number	3	3	3
- diameter (cm)			
- skeleton branch I	6,50	5,80	5,50
- skeleton branch II	6,00	5,60	6,00
- skeleton branch III	6,50	6,00	5,80
- length (m)			
- skeleton branch I	1,75	1,80	1,90
- skeleton branch II	1,80	1,70	1,65
- skeleton branch III	1,85	1,65	1,73

Table 2

Ramification and fruit bearing capacity at pear hybrids

Specification	Hybrid		
	H1-13/28	H2-18/28	H3-19/28
Number of branches	3	3	3
Total branches length (m)	5,55	5,65	5,85
Branch diameter (mm)	180	165	150
Number of ramifications	15	31	20
Number of flowers/tree	2430	2725	2440

Table 3

Floral organs phenology at pear hybrids

Specification	Hybrid		
	H1-13/28	H2-18/28	H3-19/28
	data		
Floral button phase	11.IV.	9.IV.	11.IV.
First open flower	13.IV.	11.IV.	13.IV.
First fall petals	18.IV.	16.IV.	18.IV.
Total fall of petals	24.IV.	22.IV.	24.IV.

Table 4

Binding capacity of fruits and "possible" fruits for harvest

Specification	Hybrid		
	H1-13/28	H2-18/28	H3-19/28
Binding fruit number	240	305	250
Binding fruit percentage (%)	9,87	11,19	9,83
Remained fruit for harvest	145	207	147

Table 5

Productive efficiency of pear hybrids

Specification	Hybrid		
	H1-13/28	H2-18/28	H3-19/28
Surface of the trunk section (cm^2)	76,93	70,84	84,90
Production (kg/tree)	16,00	22,77	16,17
Productivity indices (kg/cm^2)	0,20	0,32	0,19

Table 6

Report between leaves and fruits at pear hybrids

Specification	Hybrid		
	H1-13/28	H2-18/28	H3-19/28
Number of fruit on the branch	6,0	8,0	5,7
Leaves/branch			
- number	23,1	26,0	21,2
- surface (cm^2)	623,7	702,0	572,4
Report			
- leaves number/fruit	3,85	3,25	3,71
- leaves surface/fruit	103,95	87,75	100,42

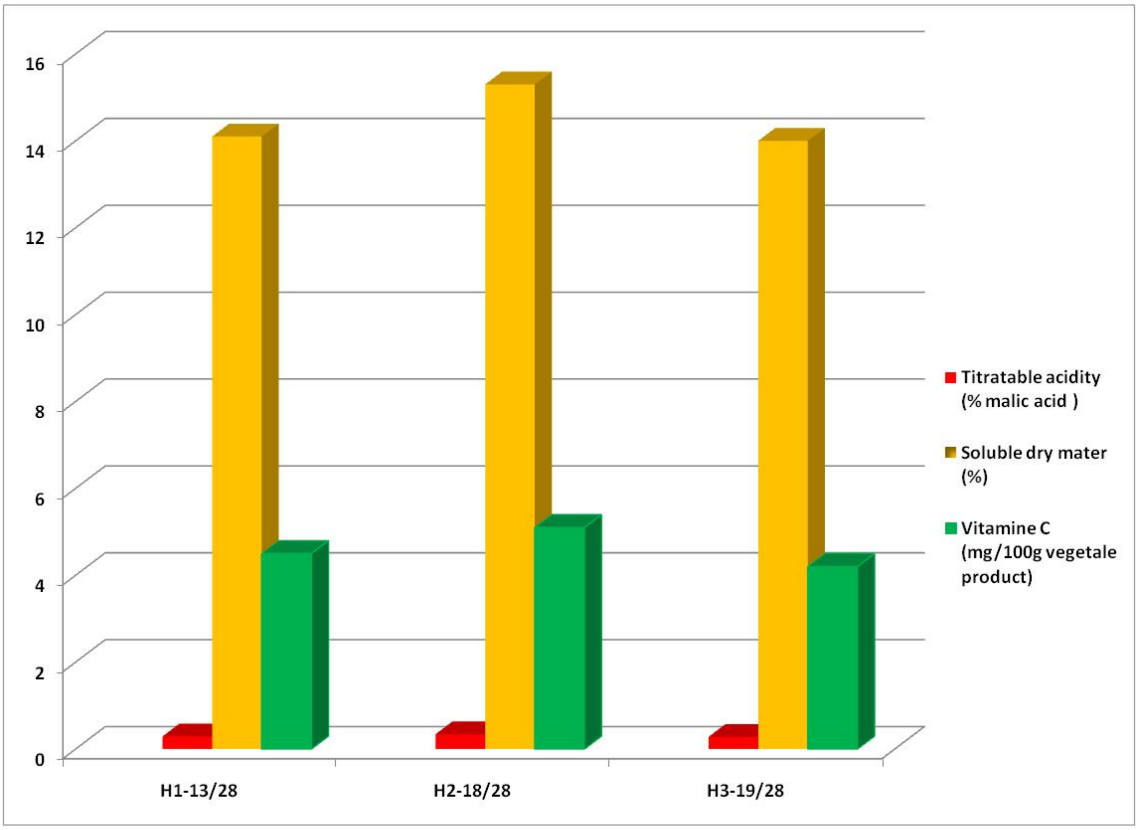

Fig. 1. Some pears biochemical parameters

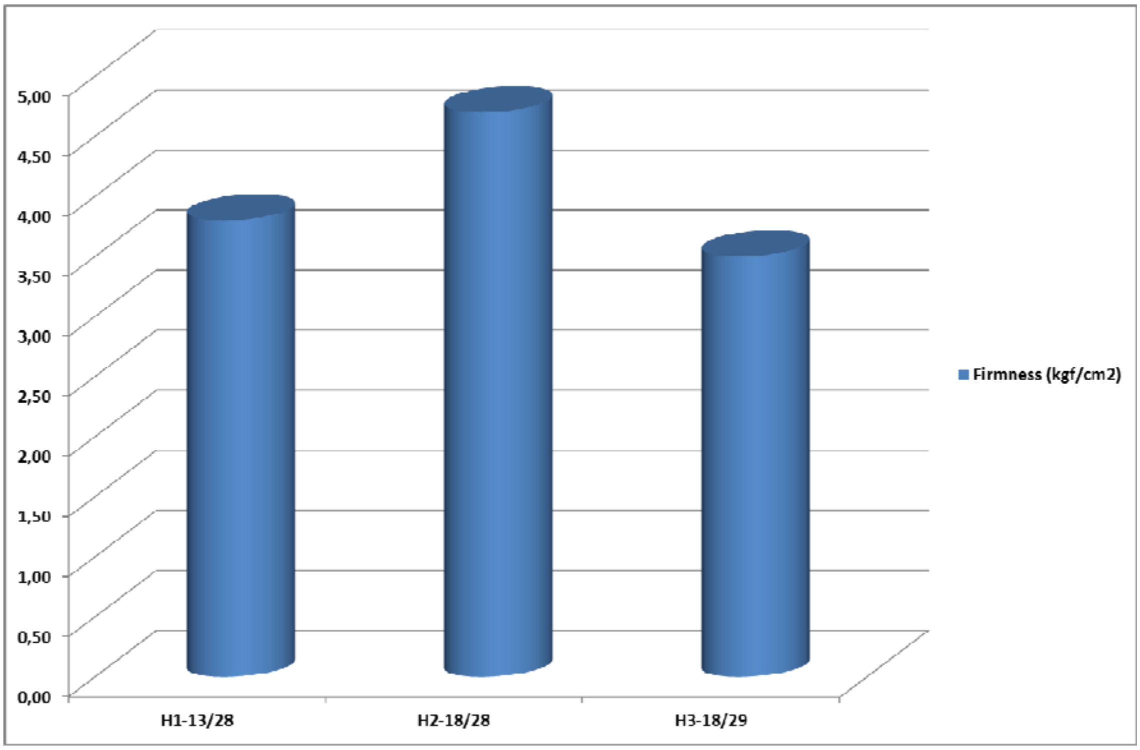

Fig. 2. Pear fruits firmness

Studies on the existence of mineral elements in buds of valuable biotypes of *Pruns cerasifera* Ehrh.

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Keywords: mirobalan, macro elements, spectrometer, micro elements.

ABSTRACT

***Prunus cerasifera* is a more rustic plant which grows almost everywhere, yields more regularly than plum, gives high yields, of course mostly lower quality, but still usable for consumption and fresh food. Also, *P. cerasifera* has other qualities, because that is one of the most widespread rootstock of the world nurseries (70% of rootstocks for stone fruits). Biological material is formed of nine biotypes of *P. cerasifera* from South Romania, collected and placed in the National Collection of the genus Prunus, of the University of Craiova – SCDP Vâlcea, and Working method were used as equipment: mass spectrometer with inductively coupled plasma, ICP-MS, Perkin-Elmer Elan 9000. In nature there are elements favourable or unfavourable plant, everything depends on the amount available to plants, same element can exert favourable or unfavourable effects if there are insufficient or too much.**

INTRODUCTION

In our country there are regions where only few species can grow fruits and people miss fruits.

Prunus cerasifera is a more rustic plant which grows almost everywhere, yields more regularly than plum, gives high yields, of course mostly lower quality, but still usable for consumption and fresh food. Also, *P. cerasifera* has other qualities, because that is one of the most widespread rootstock of the world nurseries (70% of rootstocks for stone fruits).

Given the centres of origin: Caucasus with its altitude and high rainfall regime, Central Asia, Iran and Turkey, the drier climate, then today's spread throughout Europe, North Africa and America can say that this plum, *P. cerasifera* is one of the most plastic species of the genus Prunus (Mirobolanul-V.Sonea, 1957).

The biological material studied comes from South of Romania, Călărași and Dobrogea areas. The purpose of this study was to determine the nutrient content of buds of *P. cerasifera* Ehrh. and the role these play out in the plant, using absorption spectrometry method.

MATERIAL AND METHOD

Biological material is formed of nine biotypes of *P. cerasifera* from South Romania, collected and placed in the National Collection of the genus Prunus, of the University of Craiova – SCDP Vâlcea.

Amount of biological material was 0.5 g mass buds from each biotype.

Working method - were used as equipment:

- mass spectrometer with inductively coupled plasma, ICP-MS, Perkin-Elmer Elan 9000;
- flame atomic absorption spectrophotometer, Avanta PM;
- digital microwave system Milestone.

For mineralization of solid samples was used a microwave digestion systems Milestone. Amounts of approximately 0.5 g sample, accurately weighed 0,001 g, 6 ml nitric acid 65% and 2 ml 33% hydrogen peroxide were placed in teflon-coated pots and were subjected to pressure treatment ends: heating at 180 ° C with ramp of 4.5 ° C/min., maintain for 20 minutes at 180°C.

After cooling, liquid samples were transferred into flasks were brought to volume 50 ml using ultra pure water and were analyzed according to the specific procedures two instruments spectrometers.

Blank (blank site) was created in 6 ml 65% nitric acid and 2 ml 33% oxygen water and was processed under the same conditions as sample.

Mineral elements: Na, Ca, Mg, Fe, Mn, Cu, Se, Al, Cr, Zn, Sr, Cl, Rb, were determined using the measuring instrument calibration standards from stock solutions ICP-MS multi STD3 calibration and K content was determined with flame atomic absorption spectrophotometer using cathode lamp source hollow for potassium.

RESULTS AND DISCUSSIONS

1. Sodium (Na) present in all nine biotypes, with a variation from 0.56 to 1.18 mg/l (Table 1).

Sodium is an element absorbed more slowly than other cations, that its level in plant is low.

Physiological role of sodium is found mainly in reducing transpiration, is the function of maintaining the osmotic pressure in cells and toxic influence of high contents of Na is attributed to adverse effect on water absorption.

2. Potassium (K), also present in all biotypes studied, has values ranging from 39.6 mg/l to biotype Satu Nou up to 53.8 mg/l in Jegălia biotype (Fig. 1).

Potassium is an essential macro element for plant metabolism participating in the synthesis of amino acids and proteins. Potassium stimulates the functioning of enzymes involved in respiration process, carbohydrate metabolism and synthesis of nitrogen and vitamins.

It stimulates the synthesis of chlorophylls and photosynthesis intensity. Increases ability to absorb water of plants and resistance to frost and drought. Accumulates mainly in young tissues and intense rapid increase metabolism, between vegetative shoots, cambium and pericicle.

It is found in large quantities in young explants where determines cell division activity.

Also, it has a role in cell membrane permeability and the viscosity of protoplasm and is very active in the ion exchange membranes.

Potassium deficiency is reflected by reducing plant growth. Potassium content of plant leaves gaps is often below 10 mg/g when the plants well supplied content is 19-60 mg.

3. Calcium (Ca) with potassium plays an important role in regulating the cellular membrane permeability.

In this study was observed the presence of calcium in all biotypes, with values ranging from 73.8 mg/l to 120 mg/l (Fig. 2).

Calcium is absorbed and slowly metabolized by plants, so often deficient in calcium can occur even with good approximation.

It has important implications in mitosis, in the conduct of chromosome organization; it entered in the chemical structure of enzymes. Along with potassium, calcium participates in maintaining cellular fluid balance.

Deficiency of calcium in plant nutrition is manifested by stunted growth, and excess calcium causes a premature age in plant.

4. Magnesium (Mg) composition of the chlorophyll in plants and its deficiency causes serious disturbance in functioning of the leaf, eventually leading to plant death.

Ca-Mg relationship is very close, the two macro elements even being able to substitute in certain metabolic reactions. The study was done on nine biotypes, the amount of Mg ranged from 10.5 mg/l to 25.9 mg/l (Fig. 3).

It is an essential element to plants, essential training for chlorophyll, in the synthesis of carbohydrates, lipids and proteins.

Mg deficiency appearance as yellow-orange stains on the leaf margins and if there is a more advanced stage, tissues can be destroyed.

5. Iron (Fe) is the catalyst of many redox processes and has an essential role in photosynthesis activity of respiratory cytochromes and protein synthesis.

Iron deficiency is shown by chlorosis of green tissues and blocking cell division in meristematic tissues.

The presence of iron is found in all nine biotypes studied, with values from 3, 65 mg/l at Sărulești 11 biotype and up to 6.03 mg/l at Jegălia 10 biotype (Fig. 4).

Iron is used by plants in the form of ferrous and ferric salts, is one of the elements with influence on photosynthesis, nitrogen metabolism, catalyzing the biosynthesis of chlorophyll and carotenoid pigments.

6. Manganese (Mn) activates many enzymes in plants. Manganese deficiency is manifested by leaf chlorosis, sometimes even their necrosis. It manifests itself mainly in trees, especially during periods of excessive rains.

Excess of manganese produces toxic effects, which are manifested in the form of brown spots, appearing on older leaves. During the nine biotypes studied, Mn content ranging from 0.39 mg/l in biotype Sărulești 11, up to 0.68 mg/l at Facla 4 biotype (Fig. 5).

7. Zinc (Zn) is essential for plants. It is absorbed in the living environment by plants as ions.

A good supply of zinc content growth-enhancing of tryptophan, auxinic precursor and is influenced favourably because auxine presence in the plant (Tsui, 1948; Hofner, 1957). The deficiency is manifested in the body by reducing plant growth, arrangement of terminal branches and leaves in the rosette, spotting with yellow of leaves, yellowing and necrosis of young tissues, and buds stop growing, turning in a knob.

In the study of *P. cerasifera* biotypes, zinc value ranged from 0.35 mg/l biotype Jegalia 7 to 0.57 mg/l at Facla 4 biotype (Fig. 6).

8. Aluminum (Al) serves as a catalyst for biochemical reactions. Values obtained by the reactions carried out at nine biotypes of *P. cerasifera* reflect a minimum aluminium value of 0.98 mg/l at Facla 4 biotype to a maximum of 2.39 mg/l at Jegălia 9 biotype (Fig. 7).

9. Crom (Cr), rubidium (Rb) and strontium (Sr) are minerals identified in plant tissues in small quantities, sometimes undetectable, as traces. This element plays well-defined physiological roles, though not known very well yet.

An important role is played by Cr, Rb and Sr detected in the studied biotypes.

Chromium, with a role in plant growth and, especially in their nutrition has values between 0.03 mg/l at Facla 4 biotype and 0.06 mg/l at Jegălia 10 biotype (Fig. 8).

Rubidium (Rb) and Strontium (Sr) stimulate plant growth and developer, enhances metabolic processes, cell division, photosynthesis, stimulate the transition from sleep to active, stimulating absorption.

Values obtained from tests carried out have shown a level of rubidium from 0.07 mg/l at Facla 4 biotype up to 0.16 mg/l at Jegălia 10 biotype strontium value of 0.56 mg/l in Satu-Nou biotype to 0.83 mg/l at Jegălia 6 biotype (Fig. 8).

10. Copper (Cu) participates in many redox reactions is very important in embryogenesis. The deficiency is manifested by brown rot and fading to white tinged young leaves.

Thus, in trees, young shoots has leaves with burned edges or chlorosis, and are stopped flowering and fruition.

At the mirobalan studied biotypes, values ranged from 0.11 mg/l in Satu-Nou biotype up to a maximum of 0.29 mg/l in biotype Jegălia 10 (Fig 9).

CONCLUSIONS

1. Heavy metals such as Cu, Zn, etc. are toxic to most species of plants, where concentrations are too high even if some heavy metals are indispensable to plant low concentrations.

2. In nature there are elements favourable or unfavourable plant, everything depends on the amount available to plants, same element can exert favourable or unfavourable effects if there are insufficient or too much.

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TABLE AND FIGURES

Table 1

The micro and macro elements content in *Prunus cerasifera* buds

No.	Name of sample	Na		K		Ca		Mg		Fe		Mn		Zn		Al		Cr		Cu		Rb		Sr	
		mg/l	mg/100g	mg/l	mg/100g	mg/l	mg/100g	mg/l	mg/100g	mg/l	mg/100g	mg/l	mg/100g	mg/l	mg/100g	mg/l	mg/100g	mg/l	mg/100g	mg/l	mg/100g	mg/l	mg/100g	mg/l	mg/100g
1.	Jegălia 9	1,08	6,58	53,4	325,73	95,7	583,40	18,5	112,71	5,45	33,23	0,52	3,17	0,46	2,78	2,39	14,58	0,05	0,33	0,28	1,68	0,13	0,79	0,63	3,86
2.	Jegălia7	1,06	6,70	53,8	339,36	88	554,86	16,6	104,36	4,46	28,13	0,55	3,46	0,35	2,22	1,84	11,61	0,04	0,24	0,27	1,69	0,11	0,69	0,64	4,01
3.	Jegălia 6	0,73	4,60	53,3	334,73	96,7	607,15	11,7	73,27	4,27	26,80	0,43	2,67	0,53	3,32	1,32	8,28	0,03	0,20	0,26	1,64	0,12	0,76	0,83	5,23
4.	Jegălia 8	0,57	3,81	56	377,33	90,6	610,40	13,4	90,25	4,27	28,75	0,44	2,94	0,45	3,05	1,52	10,22	0,04	0,27	0,16	1,04	0,09	0,62	0,8	5,35
5.	Jegălia 10	1,18	6,05	52,2	266,67	120	615,69	25,9	132,36	6,03	30,82	0,63	3,24	0,43	2,18	2,4	12,29	0,06	0,29	0,29	1,50	0,16	0,82	0,87	4,42
6.	Facla 3	1,15	6,91	48,5	292,63	89,2	538,00	17	102,61	4,58	27,64	0,46	2,79	0,4	2,38	1,75	10,58	0,04	0,24	0,25	1,50	0,12	0,69	0,57	3,45
7.	Facla 4	0,68	4,56	52,1	346,80	110	729,89	13,4	89,35	3,99	26,56	0,68	4,50	0,57	3,76	0,98	6,52	0,03	0,23	0,14	0,93	0,07	0,45	0,79	5,29
8.	Satu Nou	0,56	4,06	39,6	287,42	82,6	599,07	10,5	76,54	3,72	27,00	0,41	2,95	0,38	2,75	1,27	9,22	0,04	0,25	0,11	0,78	0,12	0,83	0,56	4,06
9.	Săruleşti 11	0,75	5,15	49,6	342,49	73,8	509,83	12,4	86,03	3,65	25,25	0,39	2,72	0,45	3,10	1,48	10,22	0,04	0,26	0,19	1,29	0,09	0,61	0,57	3,95

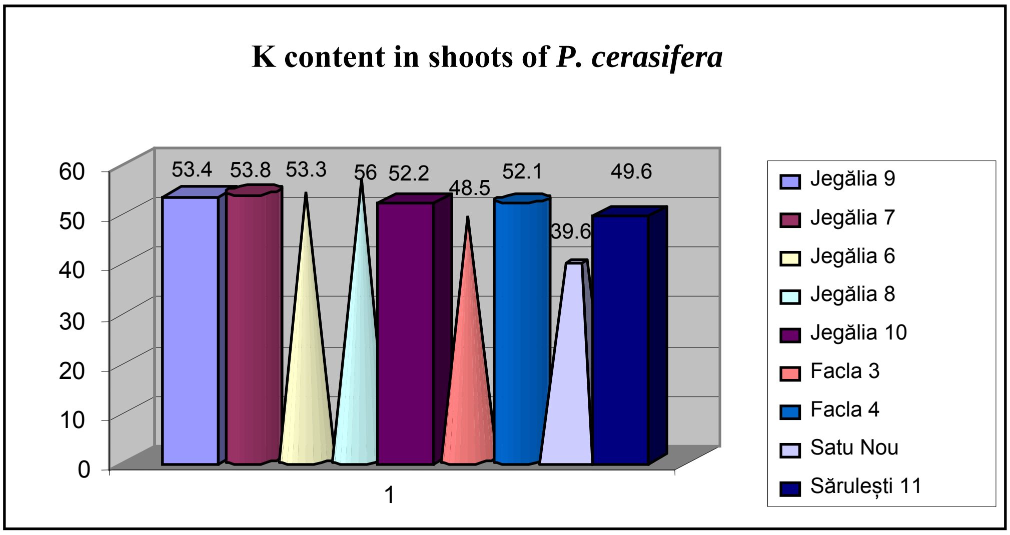

Fig. 1.

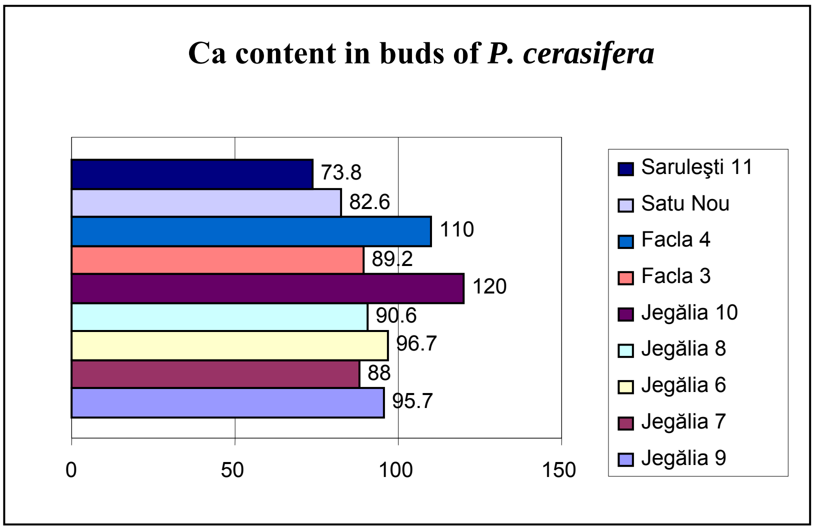

Fig. 2

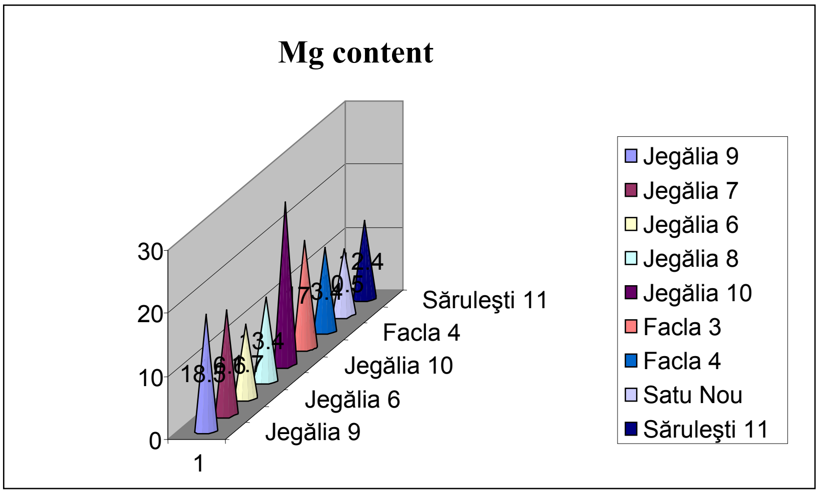

Fig. 3

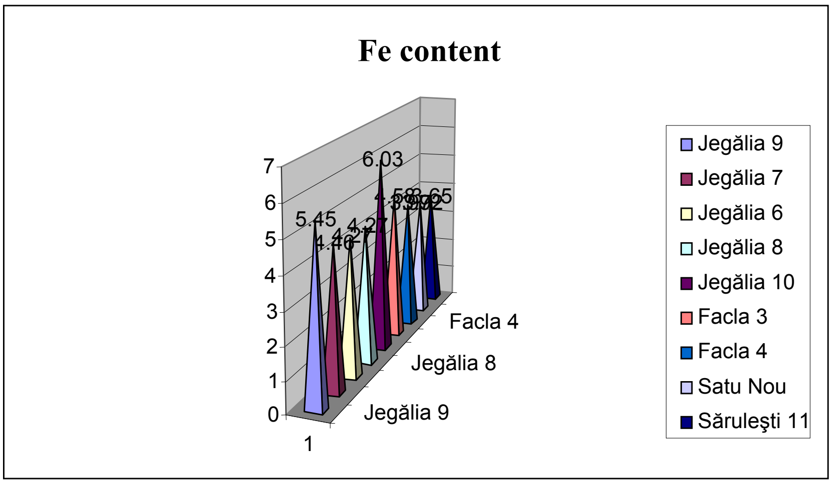

Fig. 4

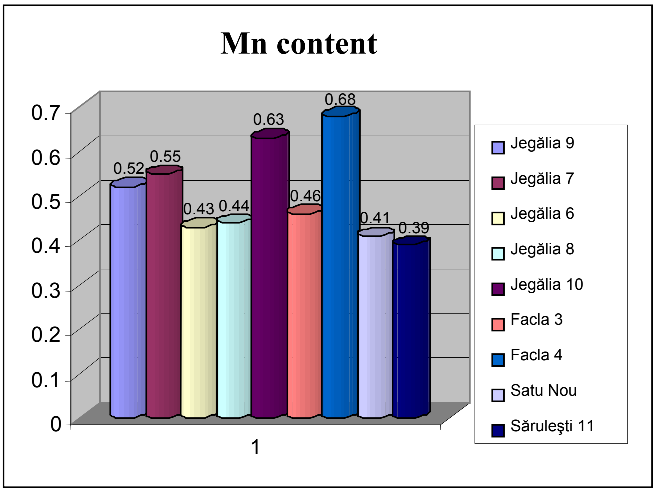

Fig. 5

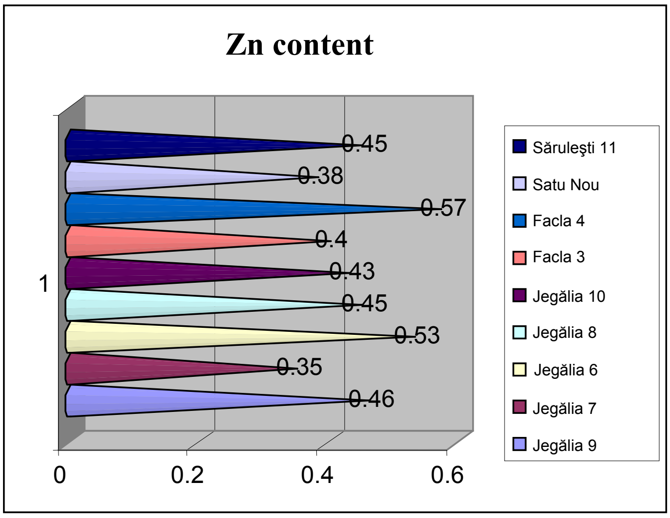

Fig. 6

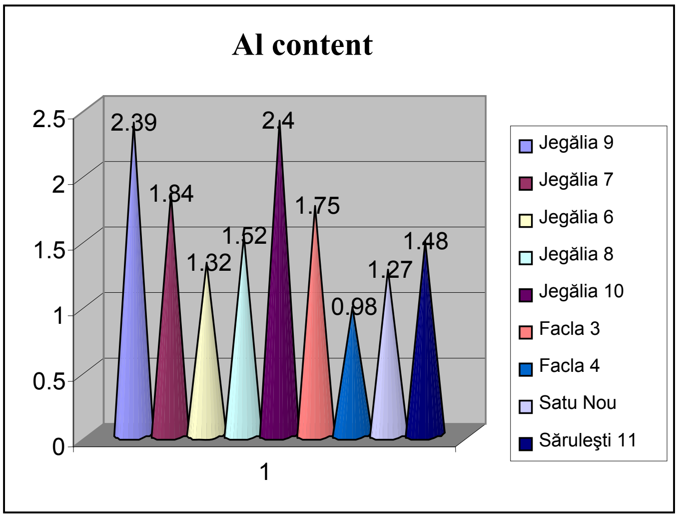

Fig.7

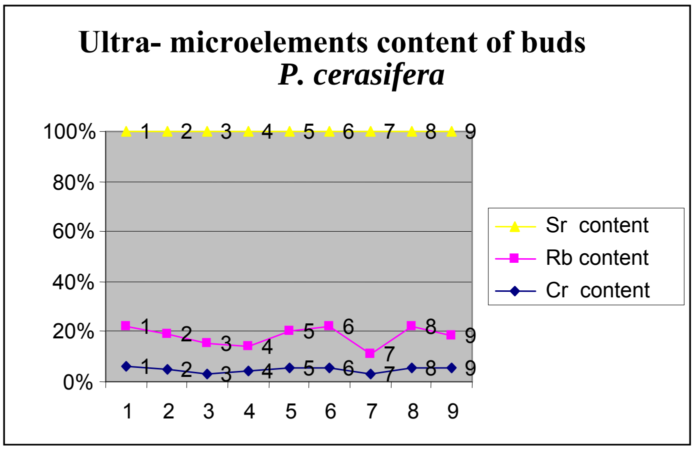
Ultra- microelements content of buds
P. cerasifera
100%
80%
60%
40%
20%
0%
1 2 3 4 5 6 7 8 9
Sr content
Rb content
Cr content

Fig. 8

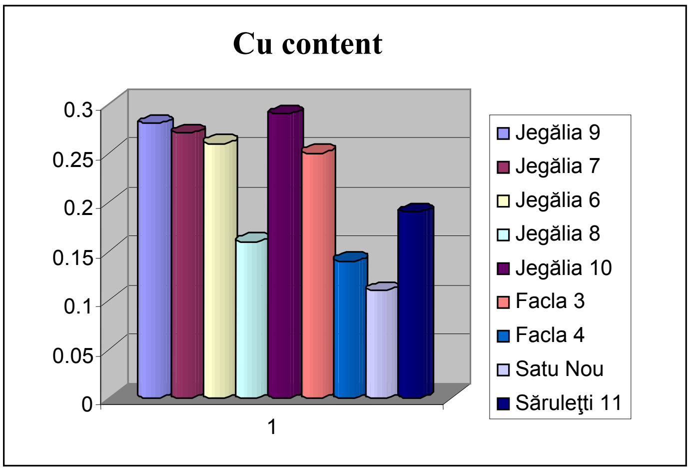
Cu content
0.3
0.25
0.2
0.15
0.1
0.05
0
1
Jegălia 9
Jegălia 7
Jegălia 6
Jegălia 8
Jegălia 10
Facla 3
Facla 4
Satu Nou
Săruleşti 11

Fig. 9

Physiological changes in some apple cultivars under Oltenia's conditions

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Keywords: environmental, factors, photosynthesis, stomatal conductance, processes.

ABSTRACT

In order to obtain good quality crops it is necessary to know the interaction between plants and environmental factors (light, temperature, the CO_2 concentration in the air, soil humidity, soil fertility, etc.). This paper's aim is to study the physiological processes (photosynthesis rate, transpiration rate, stomatal conductance of CO_2) of apple cultivars to environmental factors (temperature, light). Determination of the intensity of the physiological processes in accordance with climate factors has been carried out by using L Cpro+ portable photosynthesis system.

INTRODUCTION

Plants can regulate the movements of water vapours, O_2 and CO_2 through the leaf surface. This is accomplished by opening and closing pores, called **stomata** (sing., stomate), usually found on the bottom side of the leaf. Opening and closing of stomata is controlled by specialized cells called **guard cells** (Martin et al 2010).

The photosynthetic activity is conducted by seasonal changes and diurnal changes (light intensity fluctuations, leaf temperature, air temperature and humidity) (Kositsup et al. 2010).

Under low light levels, the available light is insufficient to support the maximal potential rate of the light-dependent reactions, and thus limits the overall rate of photosynthesis. As light levels are increased, the rate of photosynthesis increases (Hogewoning et al. 2010).

At a particular light intensity, the so-called "light saturation point", the rate of O_2 evolution levels off. Any further increase in the amount of light striking the leaf does not cause an increase in the rate of photosynthesis the amount of light is said to be 'saturating' for the photosynthetic process (Zeiger, 1990). At the light saturation point, increasing the light no longer causes an increase in photosynthesis (Marenco et al. 2009).

In same fruit tree species, there is a diurnal variation in photosynthesis activity. Maximum value was recorded in the morning, followed by its reduction (Chen and Cheng 2009).

Research has been made on environmental factors' effect on physiological processes and on growth and development in fruit tree species, in Romania as well (Burzo et al., 1999; Cosmulescu, 2004, 2007, 2008).

MATERIALS AND METHODS

This study was performed at Vâlcea Research and Development Station for Fruit Tree.

Five apple cultivars were taken under study: Royal Gala, Rubinette, Fuji, Akane and Braeburn.

Determinations of photosynthesis, transpiration intensity and stomatal conductance were carried out by using the portable Lcpro system that enables automatic recording of other parameters as well (stomatal conductance, leaf temperature, incident photosynthetic radiation etc). Lcpro is designed to carry out precise measurements of photosynthesis and transpiration, by automatically controlling the leaf chamber environment. Lcpro leaf chamber contains a system for analyzing and measuring the CO_2 and H_2O. Measuring of CO_2 is carried out through a miniature infrared gas analyzer. Measuring of H_2O is done by using high quality water vapours sensors. Beside gas exchanges, other relevant parameters are being measured as well; various calculations are also automatically carried out, based on recognized formulae.

All measurements, calculations and experimental programs were stored in files on memory cards. The results were graphically represented and statistically interpreted.

RESULTS AND DISCUSSION

Fruit growth is influenced by environmental factors and internal factors. Most representatives environmental factors are: light, temperature, the CO_2 concentration in the air, soil humidity, soil fertility. Sun radiation reaches soil and trees canopy in two forms: direct light and diffuse light. As a result of sun radiation leaf is worming and the process of photosynthesis is beginning. This process increased, reaching maximum value at 37-39˚C (Fig. 1). Any further increase in the amount of temperature striking the leaf does not cause an increase in the rate of photosynthesis. The relationship between leaf temperature and photosynthesis is showed in table 1 (Tch/A). Under experimental conditions given, at cultivar Akane, 25% of photosynthetic rate variation was determined by leaf temperature (the lowest value). At the either side the biggest influence of temperature on photosynthetic rate was obtained at Braeburn (60.69%).

Higher temperatures cause the assimilation stop, respiration intensification and fast decrease of reserve substances; in case of fruit-trees, temperature of 39°C, is considered to be maximum limit for normal development of photosynthetic and growth activity. Photosynthetic rate is lower at Braeburn and higher at Rubinette cultivars (Fig. 1).

Another factor that was taken under study was stomatal conductance for CO_2. Stomatal conductance for CO_2, expressed in mol/m^2/s, represents the value expression of stomatal permittivity for carbon dioxide passing through. The study of this parameter offer information on the way how the plant reacts under different conditions of water supply or temperature, to adjust the intensity of transpiration process, so that to reduce water loss. Relationships between stomatal conductance and leaf temperature (Tch/gs) for all cultivars are showed in table 1. Under experimental conditions given, approximately 21% (Rubinette) – 68% (Fuji) of stomatal conductance variation was determined by temperature. At the temperature of 35-37°C (Fuji), 36-38°C (Braeburn, Royal Gala and Akane) aperture of stomata reaches maximum. For Rubinette this maximum seems to be at 41-43°C (Fig. 2).

Transpiration in fruit trees appears as a result of high temperature. Transpiration is made through all aerial organs, with priority in leaves.

If water availability is reduced, stomata close and evaporation decreases, leading to improved water use efficiency (Fig. 3). Total CO_2 assimilation (the photosynthesis) also decreases, but the plant conserves water and increases its chances of survival. The links between transpiration and stomatal conductance are showed in table 1 (E/gs).

Under low-light levels, the rate of photosynthesis increases as the irradiance level is increased. At a particular light intensity, the so-called "light saturation point", the rate of O_2 evolution levels off. Any further increase in the amount of light striking the leaf does not cause an increase in the rate of photosynthesis--the amount of light is said to be 'saturating' for the photosynthetic process. At this point the rate of the light-independent reactions limits the overall rate of photosynthesis (Fig. 4).

Negative correlation was found between PAR and photosynthetic rate. Under experimental conditions given, approximately 41-84% of photosynthetic rate variation was determined by PAR intensity (Table 1, Q leaf/A). Photosynthetic rate is increasing with the increase of incident radiation, up to the value of 450-650 µmol/m /sec, it remains constant, and above those values of P.A.R. it decreases (Fig. 4).

The slope of the linear phase of the response curve is a measure of "photosynthetic efficiency" - how efficiently solar energy is converted into chemical energy.

Akane has the highest efficiency because the slope of the response curve at low light levels is greater than for the others. When describing the photosynthetic efficiency, we are only concerned with the slope of the line, not the maximal rate of photosynthesis. Thus, although Rubinette has a lower efficiency, it can sustain higher maximum rates of photosynthesis than Akane. Fuji has the lowest efficiency, because has the lowest slope of response curve.

CONCLUSIONS

Plants are using a lot of technique in order to improve water use efficiency and increase its chances of survival.

Both, environmental factors and internal factors are influencing the photosynthesis.

Transpiration rate and photosynthetic rate are influenced by closure or aperture of stomata.

Negative correlation was found between stomatal conductance and leaf temperature and transpiration,

Unfavourable environmental conditions (temperature, light, too much or too little) cause the change in the development of physiologic processes.

ACKNOWLEDGMENTS

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TABLE AND FIGURES

Table 1

Relationship between parameters

Cultivars	Parameters			
	Tch/gs	Tch/A	E/gs	Q leaf/ A
Fuji	y= - 0.0055x^2 + 0.3897x – 6.5139 R^2 = 0,6808	y= - 0,3749x^2 + 27,796x - 503,8 R^2 = 0,4993	y= - 0.0304x^2 + 0.3607x – 0.6156 R^2 = 0,5599	y= - 0.000013x^2 + 0.029975x + 0.006668 R^2 = 0,8410
Akane	y= - 0,0009x^2 + 0.0629x – 0.836 R^2 = 0,3371	y= - 0,1239x^2 + 9,5564x - 172,61 R^2 = 0,2541	y= - 0,0125x^2 + 0.1129x – 0.004 R^2 = 0,5090	y= - 0.0001x^2 + 0.1017x – 5.5414 R^2 = 0,6255
Braeburn	y= - 000016x^2 + 0.1167x – 1.9114 R^2 = 0,3103	y= -0,104x^2 + 7,8949x - 142,66 R^2 = 0,6091	y= - 0.0212x^2 + 0.1997x – 0,2345 R^2 = 0,5097	y= - 0,0002x^2 + 0.097x – 3.4424 R^2 = 0,6770
Rubinette	y= - 0,0004x^2 + 0.0346x – 0.4319 R^2 = 0,2149	y= -0,0477x^2 + 4,2243x - 78,288 R^2 = 0,4886	y= - 0.0071x^2 + 0.1026x – 0.0083 R^2 = 0,6221	y= - 0.0000625x^2 + 0.0709912x – 3.371408 R^2 = 0,7924
Royal Gala	y= - 0.0008x^2 + 0.06168x – 0.9558 R^2 = 0,6018	y= -0,1018x^2 + 7,9805x- 145,27 R^2 = 0,6026	y= - 0.00503x^2 + 0.06148x + 0.0555 R^2 = 0,5474	y= - 0.000038x^2 + 0.055427x – 0.144606 R^2 = 0,4193

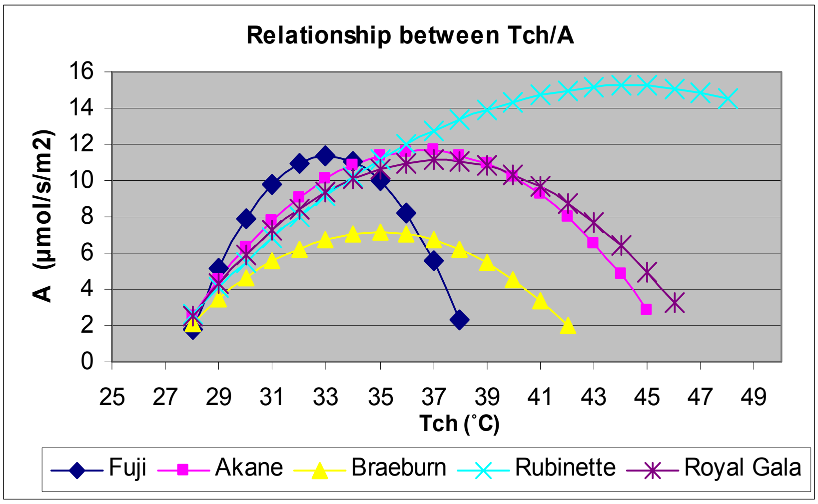

Fig. 1. Influence of temperature on photosynthetic rate

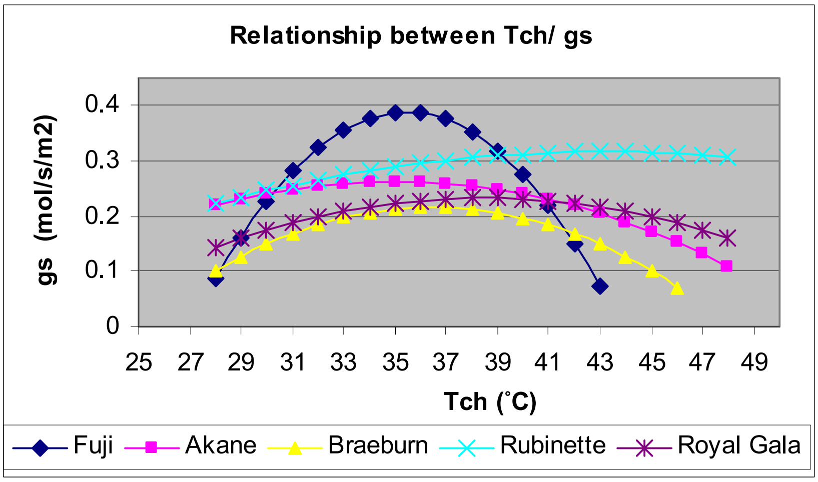

Fig. 2. Relationship between temperature and stomatal conductance

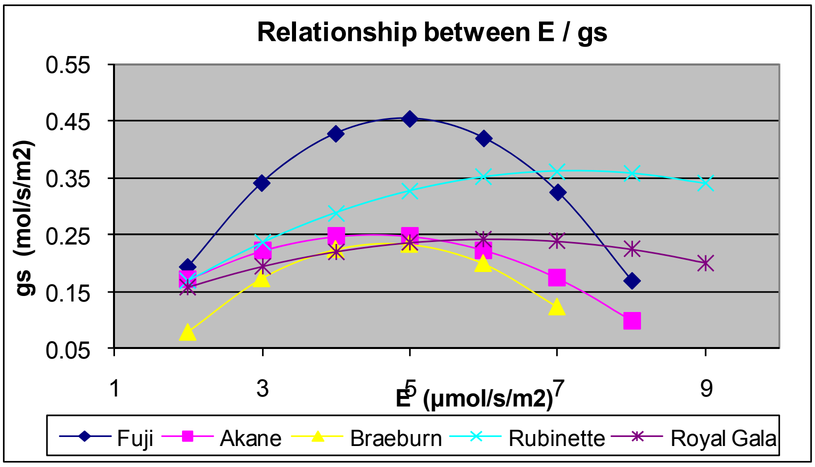

Fig. 3. Relation between stomatal conductance and transpiration

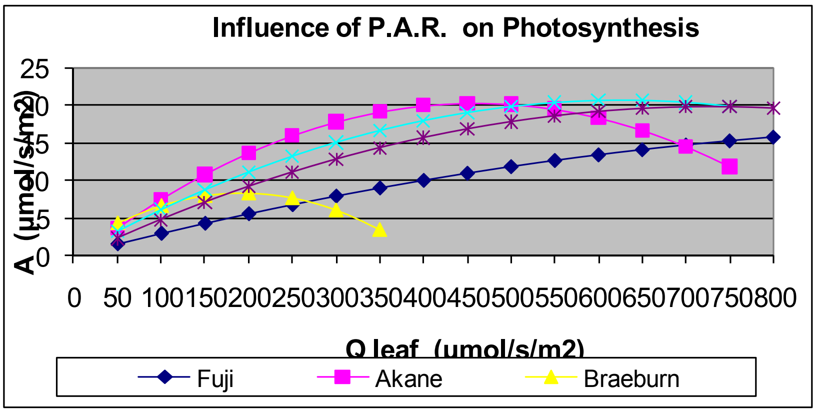

Fig. 4. Relation between P.A.R. incident on leaf surface and Photosynthesis

Preliminary researches on the behaviour of different varieties of raspberry remount in the Bucharest area

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Keywords: Raspberry, relocated, production, quality, mulch

ABSTRACT

The surrounding area of Bucharest is assuring optimal conditions for growing and fructification of the raspberry. The comparative study done with four genotypes for the mulched soil on turns with two organically materials, highlighted the influence of some biological peculiarities regarding the growth and the capacity of production and on the other hand the influence of the mulching material. Generally speaking the same variety had a better behaviour when mulched with pine bark in respect of the mulching with sawdust. In the second year of life the plants had a good fructification capacity. The number of the fructifying runners was between 16 and 25 runners per plant at the summer harvest and between 18 and 21 runners at the autumn harvest. The number of inflorescence fruits has been around 12 and 14 at the first harvest depending on the mulching material and 13 to 20, at the autumn harvest. The productivity at the plant level was of 530- 600 g/plant at the first harvest and 630-1140 g/plant at the second harvest. The quality of the fruits was influenced more by the variety and les of the mulching material.

INTRODUCTION

The interest for raspberry culture is growing, especially in the surrounding area of the cities where is much easier to sell and considerable revenue can be obtained. If in the past cultivation of the raspberry was a major interest in some large state companies, currently, most production it is obtained in the private sector, where it is cultivated on relatively small surfaces. In Romania it is still being sold a lot of raspberry harvested from the spontaneous vegetation, but those berries are often of a low quality, and the production is fluctuating depending on the weather conditions of the year (Hoza D., 2000). The quality of the production is depending on the variety and its performances (Tudor A.T., 1995). At the raspberry more than in other species the variety it can be exploited the productivity potential of an area, and by using the remounted variety it can be obtain fruits off-season with significant material effect. This paper presents the partial results of a comparative study with remounted varieties in the plains conditions.

MATERIAL AND METHODS

Experience was held in the staff field of the Department of Pomology, in a raspberry plantation with the planting distance of 2.5 m between the rows and 0.7 m on the row. The soil has been mulched with two plant material: sawdust and pine bark on turns and between the rows black field has been maintained. The biological material has been formed from the following four biennial fruition genotypes: Gustar, Opal, Elita 89-15-31 and Heritage.

During the researches the followings measurements and determinations were carried out:

- medium height of the plant,
- number of runners,
- number of fructiferous runners,
- number of fruiting branches,
- number of fruits on the branch,

At the harvesting, there have been performed determinations and analyses to the fruits as follows:

- fruit diameter;
- biochemical analysis of the fruits: water, total solids, soluble solids;

- fruit production on the plant, variation and variety;
- fruits weight;
- vitamin C content was determined by the system HPLC, and soluble solids with the digital refractometer.

On the plantation it has been carried out specific work for the young raspberry plantation: irrigation, fertilization, plant protection and maintenance of soil.

RESULTS AND DISCUSSIONS

Plant growth was influenced more by variety, than by the mulch material. From the annual strains that have had around 70-75 cm in the spring, the growth of the variety was different during the vegetation period. The growth rhythm was slightly influenced by the used mulch material (Table 1, Figure 1).The most accentuated growth rhythm was registered by Elita 89-15-31, with around 98 cm, at the mulch with the pine bark and only 54 cm at the Opal variety. Other variants had intermediate values.

The strains capacity of ramification and formation of the fertile runners, in the 2 year of life of the plants was different depending on the variety and mulch material. If the number of the strains left during the pruning was relatively equal on the level of variety, the fertile strains have been less; few of them have reached at the height to differentiate fruit buds. The average number of fertile strains was of 3.25 at the plants mulched with pine bark and 2.75 at the ones mulched with saw dust. The fertile runners formed on the strains has reached 25 at the Opal variety mulched with pine bark, as a maximum value and only 16 at the Gustar variety mulched with pine bark. The mulching material did not influenced in the same way at the used varieties, at least at the first fructification. The average number of fruits on the fertile runners was different at the variants selected, the obtained values being between 9 fruits/runner at the Opal variety mulched with sawdust and 19 fruits/runner at Elita 89-15-31 (Table 2).

The average weight was close between varieties, but with sleight a difference at variety level depending on the mulching material. The average production per plant at the experience level for the summer harvesting, was at around 600 g/plant at the mulching with pine bark and 532 g/plant at the mulching with sawdust. At the varieties Opal and Heritage have been noticed a big difference was given by the mulching material.

At the autumn harvest, the number of the fertile runners was smaller than the number of the fertile strains from the first harvest, counting by the number of formed runners was slightly bigger (Table 3). And the average number of fruits was bigger at the second harvest, as well as the size of the fruits (Photo 1). The bigger fruits and the formed runners have been influenced the production per plant which has reached over 1100 g at Elita 89-15-31 and over 1000 g at Heritage both of them mulched with pine bark. The average production at experimentation level was of 961g mulched with pine bark and 839 g mulched with sawdust.

The biochemical determinations have revealed a good quality of the fruits at both harvests. The small differences have been determinate by the variety as well as the mulched used. All the recorded data is within the tolerance limits of the variety.

CONCLUSIONS

From the preliminary data obtained from the second year of life of the raspberry plantation it can be reached the following conclusions:

- the plains area around Bucharest offers very good conditions for growing and fructifying the raspberry;
- the growing of the plant is easily influenced in a positive way by the mulching of the soil with pine bark

- production and the quality of the fruits was influenced by the variety as well as the mulching
- between the two harvests which are given by the remounted varieties, the 2nd has proven mere consistent in the first year of fructifying.
- for clear conclusions the experience needs to be carried out thought the next years.

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TABLES AND FIGURES

Table 1

The growth dynamics of raspberry plants at some remounted varieties.

Variety	Height of the plant (cm)												The average growth in height (cm)	
	10.03.		14.04		17.05		21.06.		30.07.		31.08.			
	Pine Bark	Saw-dust	Pine Bark	Saw-dust	Pine Bark	Saw-dust	Pine Bark	Saw-dust	Pine Bark	Saw-dust	Pine Bark	Saw-dust	Pine Bark	Saw-dust
Opal	75,82	74,91	80,90	80,05	86,45	85,90	97,05	98,32	111,05	110,02	129,95	130,95	54,13	56,04
Heritage	62,06	60,02	68,90	64,95	72,09	70,86	87,50	90,02	106,20	105,24	139,21	148,56	77,15	88,54
Gustar	75,91	78,64	84,36	89,06	91,35	100,02	114,06	115,98	128,02	140,5	162,87	165,78	86,96	87,14
Elita 89-15-31	125,03	138,36	134,09	145,00	151,69	150,08	165,09	176,50	190,45	195,82	224,01	220,50	98,98	82,14

Table 2

The main morpho-productive characteristics of the raspberries varieties at the first harvest

Variety	Type	No. of strains	No. of fructifying strains	Average no. of fructifying ramifications/ strain	Average no. of fruits/ ramification	Total Number of fruits on the plant	The average size of a fruit		Average total production/plant (g)
							Average diameter (mm)	Average weight (g)	
Opal	Pine bark	4	3	25	10,00	250	12,89	2,48	620
	Sawdust	3	2	18	9,00	162	12,55	2,35	380,7
Heritage	Pine bark	5	3	20	12,00	240	13,2	2,15	516
	Sawdust	4	3	19	10,00	190	13,01	2,09	397,1
Gustar	Pine bark	4	3	16	15,00	240	13,25	2,33	559,2
	Sawdust	5	3	20	12,00	240	12,95	2,89	693,6
Elita 89-15-31	Pine bark	5	4	17	19,00	323	13,25	2,17	700,91
	Sawdust	4	3	18	17,00	306	12,98	2,15	657,9
Media	**Pine bark**	**4,50**	**3,25**	**19,50**	**14,00**	**263,25**	**13,15**	**2,29**	**599,08**
	Sawdust	**4,00**	**2,75**	**18,75**	**12,00**	**224,5**	**12,87**	**2,37**	**532,32**

Table 3

The main morpho-productive characteristics of the raspberries varieties at the second harvest

Variety	Type	No. of strains	No. of fructifying strains	Average no. of fructifying ramifications/ strain	Average no. of fruits/ ramification	Total Number of fruits on The plant	The average size of the fruit		Average total production/ plant (g)
							Average diameter (mm)	Average weight (g)	
Opal	Pine bark	11	3	19	15	285	12,96	2,60	741,00
	Sawdust	10	2	18	13	234	12,85	2,62	613,08
Heritage	Pine bark	14	3	19	19	361	13,90	2,78	1003,58
	Sawdust	11	3	21	16	336	13,65	2,74	920,64
Gustar	Pine bark	12	3	22	17	374	13,02	2,56	957,44
	Sawdust	10	3	20	16	320	12,95	2,65	848,00
Elita 89-15-31	Pine bark	15	4	22	20	440	13,24	2,60	1144,00
	Sawdust	13	3	21	17	357	13,20	2,74	978,18
Average	**Pinebark**	**13**	**3,25**	**20,5**	**17,75**	**365,00**	**13,28**	**2,64**	**961,50**
	Sawdust	**11**	**2,75**	**20,00**	**15,50**	**311,75**	**13,16**	**2,69**	**839,98**

Table 4

Biochemical composition of the raspberry fruits

Variety	2010															
	June- July								August - September							
	Sawdust				Pine bark				Sawdust				Pine bark			
	Water (%)	Total dry substance (%)	Soluble dry substance (%)	Vitamin C (mg/100 g. p.p.)	Water (%)	Total dry substance (%)	Soluble dry substance (%)	Vitamin C (mg/100 g. p.p.)	Water (%)	Total dry substance (%)	Soluble dry substance (%)	Vitamin C (mg/100 g. p.p.)	Water (%)	Total dry substance (%)	Soluble dry substance (%)	Vitamin C (mg/100 g. p.p.)
Opal	85,36	14,64	9,15	24,05	85,20	14,8	9,75	24,82	84,78	15,22	11,25	23,89	83,65	16,35	11,6	24,01
Heritage	81,88	18,12	11,65	17,7	80,27	19,73	11,90	18,95	81,02	18,98	8,50	18,97	80,25	19,75	11,40	19,52
Gustar	86,33	13,67	10,25	28,38	85,32	14,68	10,85	28,69	85,75	14,25	11,05	26,67	84,97	15,03	11,25	25,98
Elita 89-15-31	82,36	17,64	9,55	19,91	82,15	17,85	9,85	20,50	81,95	18,05	15,35	20,01	81,76	18,24	13,35	19,94
Average	**83,98**	**16,02**	**10,15**	**22,51**	**83,24**	**16,17**	**10,59**	**23,24**	**83,38**	**16,63**	**11,54**	**22,39**	**82,66**	**17,34**	**11,9**	**22,36**

Fig. 1. The average growth in height

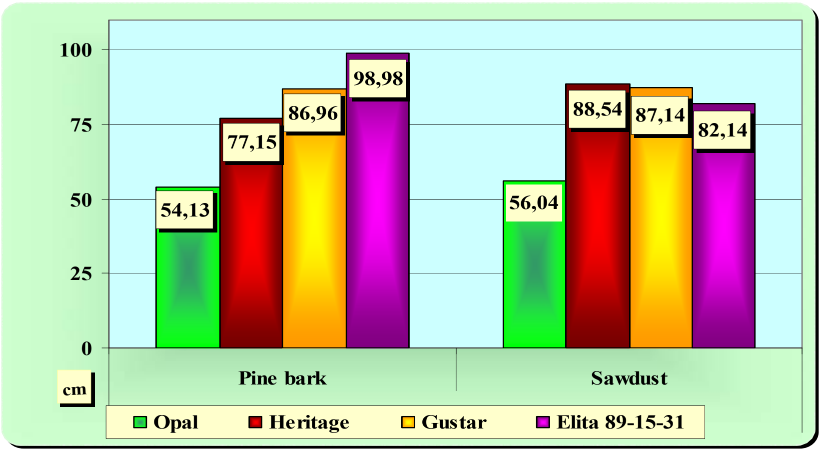
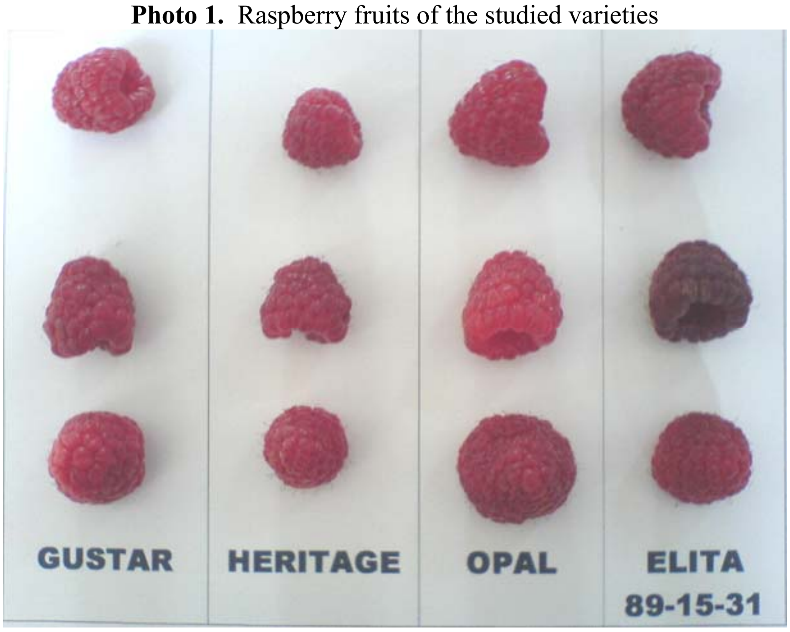


Photo 1. Raspberry fruits of the studied varieties



The influence of altitude and irrigation on the fruit production and quality for apple species, in Sergaia Valley, Syria

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Keywords: apple, irrigation, production, quality, biometric index

ABSTRACT

The apple culture in less favourable conditions imposes the adjustment of the culture technology in order to obtain good results. The comparative analysis of two batches situated at different altitudes and with different water supply conditions showed the different reaction of the apple trees from the growth and fructification point of view. The area with an additional share of water stimulated the growth and fructification of the apple trees, with an increase in production of 20%. The higher area, even if it did not determine a high growth, it ensured conditions for satisfactory growth and fructification, the production and especially the fruit quality being satisfactory for an area atypical for apple culture. The percentage of extra fruits and first ciliated class was with 2-3% higher for the higher area, which sustains the capitalization of these terrains through the planting of apple trees.

INTRODUCTION

The apple culture has a large share worldwide, being situated among the first six species as regard as production and area (Hoza D., 2000). Modern fruit tree plantations recommended planting high density from 3/1 m, with good quality products and management (Balan, 2009). Recently, there have been higher concerns regarding the extension of the apple culture area in the areas without tradition or with less favourable conditions to ensure at least the consumption of the area (Cepoiu, 1993). Arab countries also have concerns regarding the apple culture in locations with higher altitudes where the necessary cold is ensured for the species of worldwide interest. Simultaneously, there are concerns regarding the introduction in culture or the obtaining of some apple tree species less sensitive to cold, which could be extended in the warmer areas where the vernalisation is a problem for the apple trees. In Syria, even though there is no apple culture tradition, in the last decades, there have been concerns regarding the apple culture in well determined locations where at higher or lower altitude satisfactory results can be obtained. In higher areas, where ensuring the necessary cold is not a problem, there are restrictions due to the cold currents that go down the valleys and that can affect the trees during the blooming period. The majority of plantations from these areas have systems of antifreeze protection consisting either of spray systems over the crowns or of stoves with petroleum products that can warm the air in case of hoarfrost or freeze.

MATERIAL AND METHOD

In the present paper there are presented the results obtained from a research conducted in Sergaia Valley, in Zabadanii region, from the foot of the Aeah-Nsoul Mountain, with an altitude of 2364 m, during 2008-2009. The results obtained from two batches were compared, one batch on the valley, with irrigation system, and the other one at the altitude of 1300 m. On both batches two acknowledged varieties were used: Golden delicious and Starking delicious. The planting distance between trees was 7/5 m for the first batch and 6/4 for the second batch. The age of the trees was 10 years and the plant management system consisted of interrupted pyramid. The soil suffered maintenance works on and between the rows and in the plantation works specific to mature plantations were conducted. Four variants were used, as follows:

V1 – irrigated Starking delicious
V2 – not irrigated Starking delicious
V3 – irrigated Golden delicious

V4 - not irrigated Golden delicious

Measurements and determinations regarding the growth and fructification capacity were made, following the trunk growth, the shoot growth, the blooming and fruit forming capacity, the production obtained and some quality parameters.

RESULTS AND DISCUSSION

The comparison of the two locations highlighted the differentiation of the analyzed parameters, with the influence of both the culture area and the additionally applied or not water to ensure proper conditions for the trees. For the batch situated at the foot of the slope, a higher thickness growth rhythm of the trees was registered, as compared to the batch situated at higher altitude (table 1).

The growth differences was caused by the culture conditions, at altitude, even though there is water in reasonable quantity in the first part of the vegetation period; during the summer it reduces as the surface reserve reduces. The beginning of the growth was later at altitude, which probably led to a lower growth rhythm.

The growth of the shoots had largely the same tendency as the trunk growth, registering higher growth for the irrigated trees and lower growth for the trees without irrigation (fig. 1). Between the varieties, the differences were small for both studied locations.

The production capacity of the varieties was good for the given conditions, in an area that has problems from the climate point of view. In the year 2008, the production was slightly higher, reaching an average value of 14,4 t/ha, but with a maximum value of 18,1 t/ha for irrigated Golden delicious variety and 17,2 t/ha for irrigated Starking delicious variety. For the not irrigated batches, the productions was lower, 14,4 t/ha and respectively 13,7 t/ha. The differences between variants were statistically ensured by analyzing the variant

The quality of the fruits was influenced by the culture area, both regarding the ranking of the fruits on quality classes and by the content of certain component. Thus, from the total of harvested fruits, only a part could be ranked as extra and Ist class, approximately 81-87%, depending on the variant, with a slight tendency to dominate the fruit obtained from the not irrigated, at altitude, batch (table 3). If for the extra quality class were more fruits from the irrigated batch, for the first quality class were more fruits from the not irrigated batch, which showed that fruit can be obtain without irrigation in places where there is enough rainfall.

Regarding the content of the fruits of some biochemical components, it can be said that it was not dependence on altitude or irrigation, the values randomly varied, as compared to a direct dependence on a factor (table 4).

The values of the analyzed parameters fall in the limits of the species. It is interesting to observe the low influence given by the local conditions over the content of carbohydrates; the altitude advantages the Starking delicious variety and disadvantages the Golden delicious variety, as compared to the content of vitamin C which is higher for the altitude batch of Golden delicious variety. The acidity is low for both varieties, being less influenced by the culture environment, both varieties belonging to the group of sweet varieties

CONCLUSIONS

This experiment highlights the fact that the culture conditions influenced the growth and fructification of the apple trees, the following conclusions being drawn:

- The studied area ensures reasonable conditions for apple tree growth, the obtained values for the trunk diameter and shoot growth falling in the normal limits for the age of the trees;
- The irrigation leads to an increase in growth for the vegetative part, the trees being slightly more vigorous;
- The production was evidently influenced by the altitude and irrigation, the altitude, not irrigated batch producing with approximately 20% less;

- The higher altitude influenced more the quality of fruits, the fruits being slightly smaller, but ranked better in the first two ciliated classes.

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TABLES AND FIGURE

Table 1

The trunk growth capacity (cm)

Variant	2008	2009	Average	Difference	Significance
V1	15.3	17.4	16.35	116.06	**
V2	11.4	13.1	12.25	86.96	oo
V3	14.9	17.2	16.05	113.93	**
V4	10.8	12,6	11.70	83.05	oo
Average	**13.1**	**15.07**	**14.09**	**100**	**Mt**

DL 5% = 0.61 cm DL 1% = 1.13 cm DL 0,1% = 2.51 cm

Table 2

The production capacity of apple depending on the culture area

Variant	2008	2009	Average	Difference	Significance
Average			**15.64**	**100**	**Mt**
V1	17,2	16.9	17,05	109.03	**
V2	13,7	13.5	13.60	86.97	ooo
V3	18,1	17,5	17.80	113.83	***
V4	14,4	13,8	14.10	90.17	oo

DL5% = 0.46 t/ha DL 1% = 0,85 t/ha DL 0,1% = 1.88 t/ha

Table 3

Ranking the fruits on quality classes

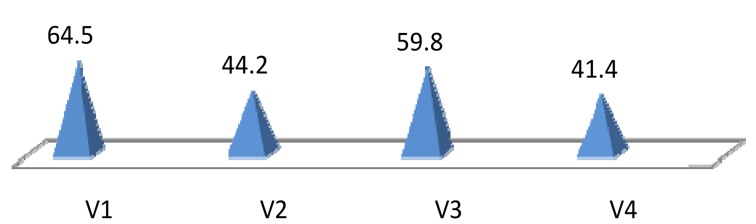
Variant	Extra	Ist	IInd
V1	67	14	19
V2	61	22	17
V3	71	13	16
V4	63	24	13
Average	**65,5**	**18,25**	**16,25**

Table 4

The apple fruit content of some biochemical components

Variant	$N\text{-}NO_3$ (ppm)	$P\text{-}PO_4$ (ppm)	K (ppm)	Total carbohydrates (%)	Vitamin C (mg/100g p.p.)	Acidity (%)
V1	190	103,8	2400	7,25	4,12	0.26
V2	152	138,4	2800	7,90	3,75	0,20
V3	154	55,36	1780	8,15	4,25	0.30
V4	171	69,2	2660	8,00	4,56	0.25

Fig.1. The growth of the shoots (cm)



Preliminary results regarding the storage capacity of some new apple scab resistant varieties

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Keywords: *Malus domestica*, fruit characteristics, sensorial analysis

ABSTRACT

Five scab resistant varieties: Ariwa, Gold Rush, Golden Orange, Rubinola and Topaz cultivated in a superintensive orchard in the Romanian plain, were planted at 3.5 x 1.0 m and led as vertical axe. At the end of the first year in October and then monthly during the storage, fruits main physical and biochemical characteristics were analyzed: fruit weight (g), fruit calibre (mm), flesh firmness (kgf/cm^2), soluble solids etc. Fruit starch content was determined, based on the conversion level in soluble solids by coloration of the fruit transversal section. In February, fruit sensorial analysis have been realised by appreciating the external and internal fruit characteristics by a group of students and teachers using a descriptors list for the ”Level 1” of the “Eurofru” fruit test. The average fruit weight varied from 173.3 g at Gold Rush, 181.5 g at Rubinola and 183.3 g Topaz. Fruit firmness at picking moment, varied between 9.5 kgf/cm^2 for Ariwa and 6.9 kgf/cm^2 for Rubinola, giving an important indication on the fruit earliness and ability to storage. During the storage period the content in soluble solids increased in all the analyzed varieties, reaching a maximum at Gold Rush (16%) and Rubinola (16.8%) after four months of storage. Analyzing the fruit coloured section with iodine in potassium iodide, was possible to see that, at the picking moment some of the studied varieties, were already ripped (Ariwa and Golden Orange). Gold Rush had the best appreciations from the taste quality point of view, 54.54% of the tasters considering it of good quality and 22.72% of them, of excellent quality. From the five studied varieties, Gold Rush had the best storage life and has been appreciated on the first place by the taste panel.

INTRODUCTION

The high importance of apple growing is due to nutritional, prophylactic and therapeutic fruit values, apple trees biological and technological properties and value adding cropping.

Apples are some of the most import components of the human modern nutrition. They are available all around the year as a fresh product and processed in many different ways.

Apple storage capacity is extremely important for the new varieties launched on the market and an objective judgement of their commercial value should include some typical biochemical and sensorial analysis.

For the scab resistant varieties, reaching a high quality level, similar of the non resistant ones is a major goal.

The paper presents the first results from an apple scab resistant varieties trial (Stănică 2008, Stănică et al, 2010), insisting on the fruits characteristics evolution during the storage process.

MATERIALS AND METHODS

The apple orchard was planted on the Romanian plain on a brown-reddish soil. Apple trees of five scab resistant varieties: Ariwa, Gold Rush, Golden Orange, Rubinola and Topaz (Photos 1-5) were planted at 3.5 x 1.0 m and led as vertical axe. A trellis formed with 4.0 m oak wooden poles, 2 wires and bamboo canes was used to lead and to support the trees. The inter row was cultivated with a mixture of perennial grasses and mowed mechanically. Drip irrigation was provided on the row, having a continuous line with auto compensating drippers every 0.5 m. On the row, the soil was maintained clean by hand and mechanical cultivation.

Fruits were picked in mid October and stored in a cold chamber with normal atmosphere at 5°C. At the picking moment and then, every month, fruit physical and biochemical characteristics were analysed as: fruit weight (g), fruit calibre (mm), flesh firmness (kgf/cm^2), soluble solids (%, determined with a handy refractometer BRIX 35HP).

The fruit starch content was determined, based on the conversion level in soluble solids, by coloration of the fruit transversal section with a solution of iodine in potassium iodide (2.4 g iodine in 10 g potassium iodide per 1 litter of water) etc. The colour was after that compared with a conversion diagram and noted from 1, for dark blue to 10, for white, uncoloured.

The fruit sensorial analysis was done by appreciating the external and internal fruit characteristics. The sensorial analysis have been realised by group tasting, with students and teachers in February, after 4 month of cold storage.

The fruit tasting have been done using spread sheets with the most important fruit organoleptical characteristics included in the descriptors list for the ”Level 1” of the “Eurofru” fruit test. The votes were between 1 and 9 for each character. Votes of 1-3 are considered unsatisfying, the ones from 4 to 6 are good and from 7 to 9, very good.

RESULTS AND DISCUSSION

The observation and measurements indicated that the ripening process in apple starts before the apple picking.

At picking time, the fruits were analysed in order to register their status before storage and to indicate exactly the stage of fruit maturity.

Fruit size

Apple weight and diameter are important elements in the appreciation of the fruit commercial quality. Even they are normally determined by the fruit variety, are influenced by the yield, orchard technology, tree age, weather conditions etc. The average fruit weight of the studies varieties varied from 173.3 g at Gold Rush, 181.5 g at Rubinola and 183.3 g Topaz. Fruit size, determined by measuring the fruit diameter, varied between 60-65 mm at Rubinola, 70-75 mm at Gold Rush and 80-85 mm at Topaz.

Fruit flesh firmness

The storage capacity was influenced by the fruit flesh firmness expressed in kgf/cm² and measured with an 11 mm piston penetrometer. For every fruit an average of two measurements was calculated.

As one can see in the table 1, the fruit flesh firmness at the picking moment, varied between 9.5 kgf/cm² for Ariwa and 6.9 kgf/cm² for Rubinola. During the storage, the fruit firmness decreased slightly. After five months of storage, the most firm fruit was Gold Rush (7.8 kgf/cm²) followed by Ariwa (6.6 kgf/cm²) and the softer, Golden Orange (5.1 kgf/cm²). Even after seven months of cold storage at 5°C, in normal atmosphere conditions, Gold Rush maintained the flesh firmness at (6.9 kgf/cm²) (Table 1).

Soluble solids – refractometric index

The apple content in soluble solids is extremely important, that characteristic having a major influence on fruit taste. At picking, fruit content in soluble solids varied from 12.8% at Topaz and 15.6% at Rubinola. During the storage period the content in soluble solids increased in all the analyzed varieties, reaching a maximum at Gold Rush (16%) and Rubinola (16.8%) after four months of storage. Ariwa accumulated the lost content in soluble solids – 14.2% (Table 2).

Starch content

Analyzing the fruit coloured section with iodine in potassium iodide**,** was possible to see that, at the picking moment some of the studied varieties, were already ripped (Ariwa and Golden Orange). For the other varieties, Gold Rush and Topaz, the colour was dark blue on 50 % of the section area (noted with 5) or on 40 % of the section area (noted with 6) for Rubinola.

After three months of storage in all the studied varieties, the starch was hydrolysed in soluble sugars, presenting no flesh blue coloration after the treatment (noted with 10) (Table 3).

Ariwa and Golden Orange are early ripe varieties and they have to be picked at least one month before (at least at 5 colouration stage).

Senzorial Evaluation

An important role in the appreciation of the fruit quality is represented by the fruit colour and aspect, flesh texture, fruit juiciness, flesh taste etc.

Some of the fruit characteristics are presented in the table 4.

From the Figure 1, is possible to see that, the variety Gold Rush had the best appreciations from the taste quality point of view, 54.54% of the tasters considering it of good quality and 22.72% of them, of excellent quality. Rubinola is ranked second with a percentage of 21.73%. Golden Orange was classified on the last place. (Fig. 1)

CONCLUSIONS

At the picking moment the fruits presented a high flesh firmness that indicates a high storage capacity and manipulation resistance.

During the storage period it was registered an accumulation of soluble solids (sugars) with a positive effect on the fruit eating qualities.

The analyzed fruits had the typical colour, weight, shape and calibre for each variety.

From the five studied varieties, Gold Rush had the best storage life and has been appreciated on the first place by the taste panel.

ACKNOWLEDGEMENTS

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TABLES, FIGURE AND PHOTOS

Table 1.

Fruit flesh firmness at the picking moment and during the storage period

Month	X	XI	XII	I	II	III	IV
Variety/Flesh firmness (kg/cm^2)							
Ariwa	9.5	8.0	7.4	6.8	6.6	-	-
Gold Rush	9.1	9.4	9.9	9.0	7.8	6.9	6.9
Golden Orange	7.7	5.6	5.4	5.3	5.1	-	-
Rubinola	6.9	6.6	6.8	6.5	5.9	-	-
Topaz	8.8	8.2	7.0	6.3	5.9	-	-

Table 2.

Evolution of the fruit content in soluble solids (%) during the storage period

Month	X	XI	XII	I	II	III	IV
Variety/Soluble solids* (%)							
Ariwa	13.0	14.2	14.0	14.2	14.2	-	-
Gold Rush	14.0	14.4	14.0	14.2	16.0	15.0	15.0
Golden Orange	13.8	12.4	14.0	14.2	14.4	-	-
Rubinola	15.6	15.6	15.6	16.4	16.8	-	-
Topaz	12.8	13.8	13.9	14.2	14.8	-	-

* determined with a handy refractometer BRIX 35HP

Table 3.

Evolution of the fruit content in starch during the storage period based on the flesh coloration in iodine in potassium iodide

Month	X	XI	XII	I	II	III	IV
Variety/Flesh coloration*							
Ariwa	9.0	10.0	10.0	10.0	10.0	-	-
Gold Rush	5.0	8.0	9.0	10.0	10.0	10.0	10.0
Golden Orange	9.0	10.0	10.0	10.0	10.0	-	-
Rubinola	6.0	8.0	10.0	10.0	10.0	-	-
Topaz	5.0	8.0	9.0	10.0	10.0	-	-

*1, for dark blue to 10, for white, uncoloured (totally hydrolysed starch)

Table 4.

Fruit quality characteristics

Variety	Fruit average weight (g)	Fruit size (mm)	Fruit colour	Base colour	Covering colour	Type of covering colour	Percentage of covering colour (%)	Calix	Fruit shape	Flesh texture	Flesh juiciness	Fruit rust
Ariwa	156.4	60-65	red - pinkish	orange	red	diffuse spotted	51-75	half opened	flat-spherical	fine	low juicy	only around peduncle and calix
Gold Rush	173.3	70-75	yellow-greenish	green – yellowish	orange	diffuse spotted	1-25	opened	tronconical	medium	juicy	absent
Golden Orange	141.4	65-70	yellow-orange	yellow	orange	diffuse spotted	26-50	closed	ovo-sferical	medium	without juiciness	absent
Rubinola	181.5	60-65	red	orange	dark red	complete	76-100	half opened	flat	medium	juicy	only around peduncle and calix
Topaz	183.3	80-85	striped red	green – yellowish	orange	striped	51-75	closed	tronconical	medium	juicy	only around peduncle and calix

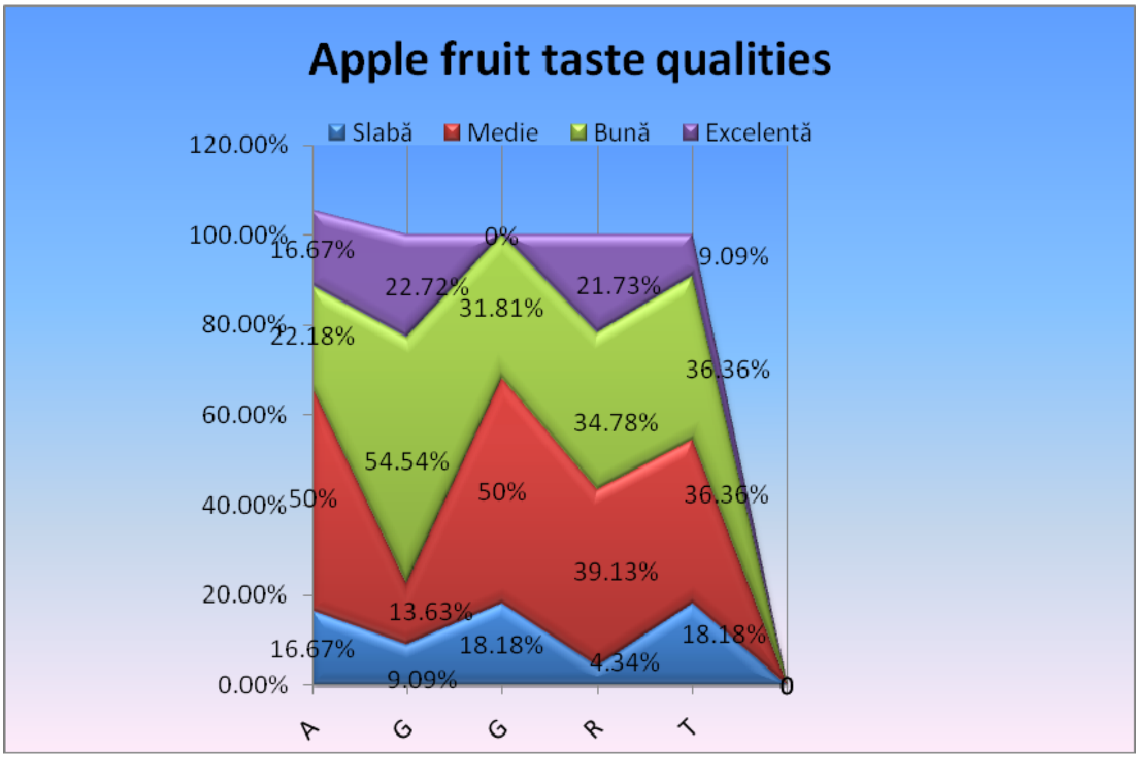

Fig.1. Apple fruit taste appreciation

Photo 1. Ariwa variety

Photo 2. Golden Orange variety

Photo 3. Gold Rush variety

Photo 4. Rubinola variety

Photo 5. Topaz variety

Photo 6. Ariwa coloured with iodine in potassium iodide at the picking moment (15.10.)

Photo 7. Gold Rush coloured with iodine in potassium iodide at the picking moment (15.10.)

Photo 8. Rubinola coloured with iodine in potassium iodide at the picking moment (15.10.)

Photo 9. Topaz coloured with iodine in potassium iodide at the picking moment (15.10.)

Studies upon the influence of manual thinning of Jonathan apples in conditions of Timișoara

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Keywords: weight, production

ABSTRACT

Manual thinning of fruits is a very important process in fruit culture because it is a method of obtaining the optimum quantity of fruits, which have high physical and chemical qualities. At the same time it is a way of reducing the alternation phenomenon, very frequent in apple tree culture. Manual thinning can be done din different stages of fruiting development. It can be applied early in the season to mixed buds, flowers or fruits that have a diameter of 1 cm. This early thinning has a good impact upon the quality of fruits, but it also stimulates the buds differentiation, having and indirect influence upon alternation Jonathan is an apple tree variety also known as "the king of apples", being very appreciated for its qualities. The thinning was done in June, after the physiological fall of apples, leaving only one apple in the group. While doing the manual thinning there is taken away the small, damaged, attacked and inadequate apples and there are left the healthy and large ones in the group. Normally one leaves only one apple in the group at a distance of 10-20 cm between them. The research done in the didactic plot of Fruit Culture Department of our University showed that the manual of Jonathan apples had a big impact upon fruits' weight, but not that much upon the production.

INTRODUCTION

In apple tree culture fruit rate-setting is a very important technological process, which is done differently according to trees' age, vigour and dimensions (Drăgănescu E., 1998). This process can be done by different methods, such as: fruiting pruning, reduction and thinning, having the goals of reducing the number of fruits left on the tress in order to obtain quality fruits and not large productions and also of reducing the alternation phenomenon that is very frequent in apple tree culture (Cepoiu N., 1978).

Apple thinning can be done in different ways: chemical, mechanical or manual, and can be applied in different fruiting phenophases: to mixed buds, flowers or fruits (Ghena N. et all 2004).

Manual thinning can be done din different stages of fruiting development. It can be applied early in the season to mixed buds, flowers or fruits that have a diameter of 1 cm. This early thinning has a good impact upon the quality of fruits, but it also stimulates the buds differentiation, having and indirect influence upon alternation (Gonda I., 2003). When manual thinning is done sometime in June, after the physiological fall of apples when they have 3-4 cm diameter, it has a good influence upon fruits' physical and chemical qualities, but a very small impact upon buds differentiation (Cepoiu N., 1978).

Luckwill (1978) did the correlation between the seasonal changes of gibberellins quantities extracted from seeds and the effect of flowering intensity decrease in the fallowing year of thinning.

Zatyko (1970) concluded that in some years the harvesting moment of winter apple varieties has a significant impact upon flowering and fruiting of next year, being in favour of the fruit trees that were thinned (cited by Gonda I., 2003).

While doing the manual thinning there is taken away the small, damaged, attacked and inadequate apples and there are left the healthy and large ones in the group. Normally one leaves only one apple in the group at a distance of 10-20 cm between them (Iordănescu Olimpia, 2008).

When we want to improve even more fruits quality, we can also do a manual thinning two or three weeks before ripening, so that they become more colourful and tasteful (Iordănescu Olimpia, 2008).

MATERIAL AND METHODS

The research plot was placed in the Didactic Plantation of our University cultivated with different apple tree varieties, which were planted in 1997 at the distance of 4x2 m, grafted on M106 and given a free palmed crown.

The biological material is Jonathan apple tree variety, a very productive variety, also known as "the king of apples", with red coloured fruits. Because of its high productivity, this variety is susceptible to alternation and in this case thinning is necessary.

By this research we observed how manual thinning, done in different intensities, influences Jonathan apples weight, productivity and alternation phenomenon in the period 2008 and 2009.

The experimental variants were:

- V1 – 50% thinned fruits
- V2 – 25% thinned fruits
- V3 – 30% thinned fruits
- V4 – 40% thinned fruits
- V5 – not thinned (control)

The collected data was statistical calculated and interpreted by using the variance analyse method.

RESULTS AND DISCUSSIONS

Of all the results obtained in the years 2008 and 2009, in this paper work we will present two parameters: apples' average weight (g) and average production (kg/tree).

In 2008, Jonathan variety had the highest value of apples' weight in variant 1, which is 150.00 g, being very significant positive to the control variant (V5). All of the other variants had higher values than the ones obtained in the control variant – not thinned (86.62 g) that is why they all registered very significant positive differences to the control (table 1).

In 2009, the situation is similar to the anterior year, meaning that the highest value concerning the apples' weight was obtained in variant 1, where there was done a manual thinning of 50% of fruits, and the average weight was of 150.40 g.

This time we can observe that the control variant (V5) had apples with an average weight of 137.70, higher than in the past year.

In variants 3 and 4 we determined very significant positive differences to the control, the average weight being of 140.80 g, respectively 142.30g.

In variant 2, the value was closer to the one of the control variant, the average weight of apples being of 138.70, that is why it registered a significant positive difference to the control (table 2).

Concerning the average production of Jonathan variety, in table 3 we can notice that the highest value was obtained in variant 4 (40% thinned apples), being of 12.62 kg/tree, but the value was rather close to the one obtained in the control variant (10.82 kg/tree) so there were no significations registered.

In case of the other three variants the situation was similar, even though all of the thinned variants surpassed the control V5 concerning the average weight.

In table 4, we can see that in 2009 the highest average production was obtained in variant 1 (50% thinned apples) of 22.50 kg/tree, followed by variant 4 with 21.70 kg/tree, being very significant positive than the control variant, which had an average production of 14.50 kg/tree.

Variant 3 had also a higher average production than the control variant of 16.30 kg/tree, having a significant positive difference to the control variant.

The average production obtained in variant 2 (25% thinned fruits) was closer to the control variant, which is why the difference was very low and there were no significations registered.

CONCLUSIONS

Fruit thinning is the most efficient method of controlling their quality, by improving the physical and chemical features of fruits.

By comparing the two studied years we can observe big differences concerning fruits' weight and the production obtained per tree, meaning that in 2009 the values were higher than in 2008. This can be explained by the fact that a constant thinning from one year to another, not just by manual thinning of fruits, but also by good pruning, has the effect of a better buds' differentiation and it assures a sufficient nutritive space for fruits, so that they become more attractive and of a higher quality, with an increase of productions.

Even if in variant 5 – the control variant not thinned, the number of fruits left on the trees was higher, the apples had a lower weight, but the production was higher than in the thinned variants. On the trees where manual thinning was done, the apples weighted more, they were more attractive, but the production was lower than in the control variant.

The best results concerning apples' average weight, in the both studied years, were obtained in those variants where the manual thinning was more severe of 50% thinned fruits (variant 1) and of 40% thinned fruits (variant 4), which is why we recommend severe pruning for those interested in quality productions.

Concerning the average production obtained per tree, it had higher values in those variants where manual thinning was not that severe, such as variant 2 (25% thinned fruits) or variant 3 (30% thinned fruits), being recommended for the fruit growers who want high quantity productions.

Out of the studies we have made, we concluded that manual thinning of fruits did not influence directly the apple production, but it had a big impact upon apples' qualities and mixed buds' differentiation in the next years.

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TABLES

Table 1

Jonathan apples' average weight (g) in 2008

Variant	Average value (g)	Relative value (%)	Difference to the witness	Significance
V_1 –50% thinned	150.00	173.17	63.38	XXX
V_2 –25% thinned	100.40	115.90	13.78	XXX
V_3 –30% thinned	117.60	135.76	30.98	XXX
V_4 –40% thinned	139.50	161.04	52.88	XXX
V_5 – not thinned	86.62	100.00	0.00	ct.

DL 5% = 4.09 DL 1% = 5.90 DL 0,1% = 8.85

Table 2

Jonathan apples' average weight (g) in 2009

Variant	Average value (g)	Relative value (%)	Difference to the witness	Significance
V_1 –50% thinned	150.40	109.22	12.70	XXX
V_2 –25% thinned	138.70	100.72	1.00	X
V_3 –30% thinned	140.80	102.25	3.10	XXX
V_4 –40% thinned	142.30	103.34	4.60	XXX
V_5 – not thinned	137.70	100.00	0.00	ct.

DL 5% = 1,03 DL 1% = 1,50 DL 0,1% = 2,25

Table 3

Jonathan's variety average production (kg/tree) in 2008

Variant	Average value (kg/tree)	Relative value (%)	Difference to the witness	Significance
V_1 –50% thinned	12.45	115.06	1.63	-
V_2 –25% thinned	11.54	106.65	0.72	-
V_3 –30% thinned	11.52	106.46	0.70	-
V_4 –40% thinned	12.62	116.63	1.80	-
V_5 – not thinned	10.82	100.00	0.00	ct.

DL 5% = 2.06 DL 1% = 3.00 DL 0,1%= 4.50

Table 4

Jonathan's variety average production (kg/tree) in 2009

Variant	Average value (kg/tree)	Relative value (%)	Difference to the witness	Significance
V_1 –50% thinned	22.50	155.36	8.01	XXX
V_2 –25% thinned	14.60	100.92	0.13	-
V_3 –30% thinned	16.30	112.67	1.83	X
V_4 –40% thinned	21.70	150.00	7.23	XXX
V_5 – not thinned	14.50	100.00	0.00	mt.

DL 5% = 1.67 DL 1% = 2.43 DL 0.1% = 3.64

Hazards analysis at production of fruit-based concentrated products, fortified with iron

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ABSTRACT

In this paper are presented study results concerning hazards analysis at production of fruit-based concentrated products, fortified with iron. On the process flow chart there were identified and evaluated microbiological, chemical and physical hazards, depending on their gravity and probability to occur. There were established suitable control measures for prevention, elimination and/or reduction of an important hazard, at an acceptable level of its likelihood occurrence, for apricots and plums processing as concentrated products, fortified with iron. Critical Control Points (CCPs) on the process flow chart of fruits (apricots, plums), were determined by successively following of questions from „Decisional Tree", and established by Codex Alimentarius. Thus, it was established as critical control point pasteurization operation of fruit-based concentrated products, fortified with iron. In order to establish an efficient system for documentation and records keeping storage, it was achieved HACCP plan.

INTRODUCTION

Food safety is one of the most important factors, which compete with people health, reduction of diseases and, implicitly, of costs from health system, as well as improving of life quality in our country.

Quality of food product is given by (Chira, 2001):

- ✓ sensorial quality (appearance, colour, taste, smell, etc.)
- ✓ presentation quality
- ✓ nutritional quality
- ✓ hygienique quality

Hygienique quality of food products is influenced by microbiological, chemical and physical hazards. Objectives of modern systems for assurance and management of quality are based on hygienic production problem and follows to obtain a safe food product for consumer.

In order to produce food products safe for consumers, at international level it was established management system of food safety, based on HACCP principles (Hazards Analysis and Critical Control Points), as key tool for assurance of innocuity and quality of food products production and trade. This system of hazards analysis in critical control points is based on identification, evaluation and taking under control of all physical, chemical and biological (microbiological and parasitological) hazards, which should occur within production, storage and distribution of food products, in order to assure their innocuity.

For prevention of intoxications or food poisoning, which affect consumers health, it is necessary to identify and to analyze hazards (physical, chemical and biological), which can cause food contamination on the food chain: *primary production → processing → storage → transport → trade of fruit processed products → consumers.*

MATERIAL AND METHODS

It was used HACCP method to achieve study concerning hazards analysis, identification and prevention of their occurrence, at processing of apricots and plums for obtaining of fruit-based concentrated products, fortified with iron.

Critical Control Points (CCPs) on the process flow chart of fruits (apricots, plums), were determined by successively following of questions from „Decisional Tree”, and established by Codex Alimentarius.

RESULTS AND DISCUSSION

Within the National Institute of Research&Development for Food Bioresources – IBA Bucharest it was achieved a HACCP case study, at processing of apricots and plums, in order to obtain fruit-based concentrated products, fortified with iron.

HACCP concept is synonym with *food safety* and it is recognized at international level as *systematic and preventive* approach of microbiological, chemical and physical hazards, associated to production and processing of food products, for consumers protection. This system assures the highest safety of food products, leading to dependence diminution of final decision concerning their safety by final inspection and testing. So, principle based on HACCP system operates is: “*Builds quality and safety in a product, before inspection of end product”.*

In order to achieve HACCP study case on the process flow chart of fruit-based concentrated products, fortified with iron, there were covered the following steps:

- Describe products (product specifications)
- Describe processes and construct process flow charts
- Hazards identification
- Risks analysis
- Establish Critical Control Points (CCPs)
- Establish Critical Limits
- Establish monitoring system
- Establish corrective actions
- Establish verification procedures
- Establish documentation and records keeping

On the process flow chart of apricots and plums, to produce *"Fruit-based concentrated products, fortified with iron",* there were identified and analyzed hazards and there were established suitable control measures for prevention, elimination and/or reduction at an acceptable level of their likelihood occurrence (table 1).

Risk is determined by *gravity* (severity of effect on consumer) of contaminant (of physic, chemical, biological nature) and *frequency* (likelihood, incidence) of its presence in end product, at consumption time.

The existent hazards on the process flow chart of apricots and plums, as *„Fruit-based concentrated products, fortified with iron",* there were passed through questions of decisional tree, thus establishing that *pasteurization* operation represents a critical control point – CCP (table 2). For this critical control point there were established values of critical limits for parameters which will be monitories. To establish critical limits it is taken into account values from which (or under which) product could influence consumer health. These critical limits were established on production technological instructions of *“Fruit-based concentrated products, fortified with iron”.*

Values of critical limits are presented in table 3.

It was established monitoring system of attention points and of critical control point determined, specific for the process flow chart of *“Fruit-based concentrated products, fortified with iron"* (monitoring elements, method and frequency of monitoring, responsible of points monitoring, documentation and records keeping storage).

Also, for determined critical control point on process flow chart of *“Fruit-based concentrated products, fortified with iron"* it was established a HACCP control plan.

In order to verify functioning mode of HACCP system, there were established verification programs.

CONCLUSION

1. In the National Institute of Research&Development for Food Bioresources – IBA Bucharest it was achieved a HACCP case study, at processing of apricots and plums, in order to obtain fruit-based concentrated products, fortified with iron.
2. On the process flow chart of apricots and plums, to obtain *"Fruit-based concentrated products, fortified with iron",* there were identified, analysed hazards and there were established the suitable control measures for prevention, elimination and/or reduction at an acceptable level of their likelihood occurrence.
3. *Pasteurization* operation represents a critical control point (CCP) on the process flow chart for production of *"Fruit-based concentrated products, fortified with iron".*

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TABLES

Table 1

Hazards analysis for production of "*Fruit-based concentrated products, fortified with iron*"

Step in process	Hazards		Hazards analysis[2]			Prevention measures
	Type[1]	Name	G	F	GXF	
Fruits reception (apricots, plums)	B	Bacteria and moulds	3	1	3	- Procedure concerning sanitation of packaging for transport - Periodically control of hygiene status of packaging for transport
	C	• Heavy metals • Pesticides residues (insecticides, erbicides, fungicides) • Chemicals (fuels, lubricants, oils)	3 3 2	1 1 1	3 3 2	- Procedure for selection of suppliers (performing of microbiological and chemical analyses to select suppliers and at reception, periodically) - Qualitative reception according to technical specification - GHP (sanitation of means of transport)
Tins reception	P	Foreign bodies: glass shivers within tins	2	1	2	- Procedure for selection of suppliers - Qualitative reception according to technical specification
Sugar reception	B	• Presence of *Leuconostoc mezenteroides* • Moulds	2 3	2 1	4 3	- Procedure for selection of suppliers; Microbiological and chemical analyses for selection of suppliers and, periodically, for each supplier - Qualitative reception according to technical specification
	P	Foreign bodies: mineral impurities, metallic impurities	1	1	1	
	C	Heavy metals	3	1	3	

Fortification agent reception (ferrous sulfate, ferrous gluconate, ferrous lactate)	C	• Heavy metals (Pb, Hg)	3	1	3	- Procedure for selection of suppliers; Chemical analyses for selection of suppliers and, periodically, for each supplier. - Qualitative reception according to technical specification
Ascorbic acid reception	P	Foreign bodies: mineral impurities	1	1	1	- Procedure for selection of suppliers - Qualitative reception according to technical specification
Raw materials and materials storage	B	• Growing of moulds • Contamination with spores from environment	3 3	1 1	3 3	- Instructions for storage - Monitoring of air temperature and moisture within storehouses - Procedures for maintaining of storehouses - Elaboration of lot sheet for each ingredient and respecting of FIFO principle - Periodically training of personnel concerning storage of raw materials and materials - Supervision of treatments which involve use of chemicals (disinfection substances) - Use of substances for disinfection, according to producer indications - Avoiding of storage on the long term
	C	• Mycotoxins development • Chemicals	3 2	1 1	3 2	
Sorting	B	Moulds Pathogens bacteria	3	1	3	- Respecting of work instructions - GHP (hygiene of sorting belts, personnel hygiene and of work area)
Technological water preparation	B	Microbial charge over allowed limits	2	1	2	- Procedure for water supply (analysis in an authorized laboratory) - Sanitation and disinfection procedures
	P	Contamination with impurities	1	1	1	
Fruits washing	B	Yeasts Moulds	1 3	1 1	1 3	- Work instruction - Personnel hygiene and training - Sanitation of equipments
Cleaning-division	P	Vegetal impurities (stones, pedoneles)	1	1	1	- Work instruction - Respecting of work instructions - Personnel hygiene and training - Sanitation of equipments and implements
	B	Microbial charge from equipments/implements /personnel	2	1	2	
Product preparation	C	Residues of sanitation substances	2	1	2	- Respecting of procedure for sanitation and of work instructions - Periodically personnel training
Tins and caps washing	P	Foreign bodies: Glass shivers within tins	2	1	2	- GMP - Respecting of work instructions - Procedure of equipment maintenance - Respecting of program for personnel training
Dosage	B	Microorganisms	2	1	2	- GHP, GMP (personnel hygiene, sanitation of dosage equipments, hygiene of production area)
Closing	B	Microorganisms (bacteria, yeasts)	2	1	2	- Work instructions (synchronizations of dosage operation with closing operation, correct execution of closing operation) - Procedure of maintenance
	P	Presence of glass shivers, breakage of tins to closing	2	1	2	- Verification of proper functioning of machine to close caps - Maintenance plan of equipments - Elimination of suspect products - Personnel training
Pasteurization	B	Microorganisms	3	1	3	- GHP, GMP (suitable hygiene status of equipments, personnel hygiene and training) - Work instructions

[1]- B - biological
- C – chemical
- P - physical

[2]G (gravity) – low (1), medium (2), high (3)
F (frequency) - low (1), medium (2), high (3)

Table 2

Establishment of critical control points at production of
"Fruit-based concentrated products, fortified with iron"

Step in process	Hazards (B, C, P)	No. question (from decisional tree)				CCP[2]/AP[1]
		Q_1	Q_2	Q_3	Q_4	
Fruits reception	B: Bacteria Moulds	Yes	No	Yes	Yes	AP
	C: Heavy metals Pesticide residues Chemicals	Yes	No	No	-	AP
Tins reception	P: Foreign bodies (glass shivers)	Yes	No	Yes	Yes	AP
Sugar reception	B: Presence of *Leuconostoc mezenteroides* Moulds	Yes	No	Yes	Yes	AP
	P: Foreign bodies (minerals impurities, metallic impurities)	Yes	No	No	Yes	AP
	C: Heavy metals	Yes	No	No	-	AP
Ascorbic acid reception	P: Foreign bodies (mineral impurities)	Yes	No	No	Yes	AP
Fortification agent reception (ferrous sulfate, ferrous gluconate, ferrous lactate)	C: Heavy metals (Pb, Hg)	Yes	No	No	-	AP
Raw materials and materials storage	B: Microorganisms	Yes	No	No	Yes	AP
	C: Mycotoxins development Chemicals	Yes	No	No	Yes	AP
Sorting	B: Moulds; Pathogens bacteria	Yes	No	Yes	Yes	AP
Fruits washing	B: Yeasts; Moulds	Yes	No	Yes	Yes	AP
Cleaning-division	P: Vegetal impurities (stones, pedoneles)	Yes	No	No	Yes	AP
	B: Microbial charge from equipments/implements /personnel	Yes	No	Yes	Yes	AP
Product preparation	C: Residues of sanitation substances	Yes	No	Yes	Yes	AP
Tins and caps washing	P: Foreign bodies (presence of glass shivers)	Yes	No	No	Yes	AP
Dosage	B: Microorganisms	Yes	No	Yes	Yes	AP
Closing	B: Microorganisms	Yes	No	Yes	Yes	AP
	P: Presence of glass shivers	Yes	No	No	-	AP
Pasteurization	B: Microorganisms	Yes	No	Yes	No	CCP1

[1]AP: attention point; [2]CCP: critical control point

Table 3

Critical limits of CCP1 identified on process flow chart of
"Fruit-based concentrated products, fortified with iron"

Step/ Indicator	Target value	Critical value
Pasteurization		
Pasteurization temperature (^{0}C)	100	< 100
Time of pasteurization maintenance, min.	15	< 15
Pressure (at)	0.5	< 0.5

Personal contribution determining the main characteristics of wild cherry selections from experimental field of Sapientia University Târgu-Mureș

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Keywords: wild cherry, rootstock, genotypes

ABSTRACT

Wild cherry (*Prunus avium L. var. Silvestris*) is used as rootstock for sweet cherry growing in all countries. Varieties grafted on wild cherry have a long life of over 50 years, are vigorous and resistant to frost, with a deep-rooting, but are sensitive to drought and excess moisture temporarily. Wild cherry genotypes selection took place in an old cherry tree plantation 30 years of school and field grafting seedlings of Sapientia University Târgu-Mureș, where these specimens came from the nursery as grafted material, but actually seedlings were directed and capitalize on nursery stock. Sampling the selections marked fruit was held in late June 2007. Extracted seeds were kept until the final stratification in moist perlite at a temperature of approx. 10 ° C. Stratification took place in December in wet sand. Seeding was done on March 24, 2008, in separate rows for each genotype on a plot prepared in autumn sowing density was 70 pips per ml. Seedlings emergence took place in three weeks after sowing. Harvesting juveniles held in early November of 2008. During the experiment is made, there were conducted tests and observations regarding: the determination of kernel yield, 1000 kernel weight variability from all 18 selections, the percentage of emergence of seeds, growth vigour of seedlings. From the 18 selected genotypes of wild cherry, 5 types of seeds yield is between values from 15.17 to 19.31%, well above the average yield of seeds, wild cherry characteristic presented in the literature. In the case of the nine selections wild cherry, eastern shelling percentage exceeds 60% which is a particularly valuable attribute to the nursery. Seedlings from the most selections (except the three selections) falls into the category of middle force, with a thickness between 4.1 to 6 mm package. The thickness of the package selections fall in percentage over 50% in one category of value, which shows a great homogeneity of the material. Gathering the above problems, we conclude that wild cherry selections in the study have provided valuable generative lines, with important traits in terms of nursery, such as reduced growth and vigour in high school uniform seedlings.

INTRODUCTION

Wild cherry (*Prunus avium L. var. Silvestris*) is used as rootstock for sweet cherry growing in all countries. In Romania is used in all areas with rainfall exceeding 550 mm. Is compatible with all varieties of cherry, the grafting percentage was very good grip. Varieties grafted on wild cherry have a long life of over 50 years, are vigorous and resistant to frost, with a deep-rooting, but are sensitive to drought and excess moisture temporarily (Gyuró, 1974). Wild cherry tree is resistant to nematodes, rots and *Agrobacterium tumefaciens*, *Pseudomonas spp* but is sensitive to bacterial wilt of saplings that in school, at *Blumeriella jaapii*. Wild cherry tree is sensitive to soil calcium content, does not support more than 4% of active limestone (Hrotkó, 2003). It autosteril so sapling trees are hybrids of generative and seminiferous pollinators (Por and Falub, 1982). Lately wild cherry rootstock is used increasingly less so in the world and in Romania because of high vigour of varieties grafted on it, and for that delay entry of cherry fruit varieties. In Romania is used in proportion of 30% in cherry founding nurseries and will remain in production and research attention only if they will be able to select genotypes that prints a variety of replication height and vegetative (Chira, Asănică, 2006; Chira et al., 2008).

MATERIAL AND METHODS

Wild cherry genotypes selection took place in an old cherry tree plantation 30 years of school and field grafting seedlings of Sapientia University Târgu-Mureș, where these specimens came from the nursery as grafted material, but actually seedlings were directed and capitalize on nursery stock. The planting was also found over 200 copies, which were observed in the vigour of growth, crown shape, capacity and status of health. From this material were 18 genotypes selected because of their characteristics have proved to be valuable as seed parent plants. The next step was the analysis of fruit traits, determining the yield of seeds and checks the behaviour of juveniles in school selection, respectively the percentage of emergence, vigour and uniformity of growth characteristics of the root. Seedlings derived from selections with the best behaviour in school saplings were planted in field grafting. They were grafted on valuable varieties of cherry, in order to check their affinity with those selections.

The examination was conducted on soil layers 0-20 cm and 20-40 cm, 40-60 cm, 60-80 cm, 80-120 cm. The first two levels have a medium clay texture, level three has fine texture of silty clay, and the last two levels have a compact clay texture. The level of groundwater is at 1.5-2 m depth. Soil humus content of 3.9%, 4.9 IN, PAL 32 ppm, 254 ppm KAL, and the reaction is slightly acid, pH 6.3.

One of the basic criteria of cherry cultivation is that the annual average temperature must be between 8-10 ° C. The wild cherry is sensitive to low temperatures and frost as temperatures knowledge of the sites is crucial for the experiment.

Târgu-Mureș is located in the central Transylvanian plateau, 46°32' north latitude and 24°52' east at an altitude of 320 m, with a temperate continental climate with high temperatures up to 35 ° C and summer temperatures from -10 to -15 ° C in winter.

Cherry is moderately to water requirements and can be grown in areas with 500-600 mm annual rainfall. The cherry do not support any extended drought or excessive water. Cherry bear the drought better than excess moisture in the soil, flooding can cause lasting damage to large, because of the suffocated roots (Miliţiu et al., 1961; Budan and Grădinariu, 2000).

The experience has been used wild cherry selections from an area located near the village Săbed of Mureș County, a distance of 17 km north of Târgu-Mureș. Highest altitude above sea level the area where they selected wild cherry genotypes was 491 meters.

The main characteristics of wild cherry selections are presented in Table 1.

In respect of tree vigour is apparent that most of their force is characterized by 61.11% middle, 22.22% of existing trees with high growth, 11.11% and 5.56% less force semi dwarf (Fig. 1a).

Crowns genotypes which have a broad and diffuse, help to lower average height of trees. Most trees respectively 44.44% have broad pyramidal crown form of crown shape, 16.67% are scattered trees, wreath reverse pyramid appears as a percentage of 5.56% and 33.33% of the crowns are narrow pyramidal shape, which is characteristic of wild cherry (Fig.1b)

At trees take in observation the crown rare have 50%, 27.78% have semi rare crown which helps to better ventilation and lighting them and 22.22% of trees crown are dense (Fig. 2).

Production capacity is assessed on a scale of 1-5, where 1 is a low production value and 5 is highest. KM genotypes 1, KM 4, KM 9, KM 16 and KM 29 showed a high production capacity and type KM 13 standing at the opposite end, with the weakest capacity.

Sampling the selections marked fruit was held in late June 2007. Extracted seeds were kept until the final stratification in moist perlite at a temperature of approx. 10 ° C. Stratification took place in December in wet sand. Seeding was done on March 24, 2008, in separate rows for each genotype on a plot prepared in autumn sowing density was 70 pips per ml. Seedlings emergence took place in three weeks after sowing. The main activities of care were repeated watering, weeding weeds in 2-3 weeks; fazial fertilization with 15:15:15 NPK complex fertilizers and foliar fertilizer with micronutrients, maintenance work, loosening soil from pests. For the diseases there were used the following fungicides: Dithane M-45, Topsin Rubigan 12 M 70 WP and EC, and for pest control - wasp leaf cherry (*Caliroa limacina*), Scale of black cherry (*Myzus cerasi*), mites and aphids - were used insecticides: Karate Zeon 5 CS Reldane 40 EC, Sumi-Alpha 5 EC and 10 WP Nissorun.

Harvesting juveniles held in early November of 2008.

During the experiment is made there were conducted tests and observations regarding:

1. Determination of kernel yield - the extraction 4x100 of fruit from the sample of 5 kg.
2. 1000 kernel weight variability from all 18 selections
3. The percentage of emergence of stones - these determinations were made one month after emergence of seedlings.
4. Growth vigour of seedlings - was determined by measuring the thickness of the package.

RESULTS AND DISCUSSION

1.The yield of pips

One of the most important qualities of the different genotypes of wild cherry for their optimal use in the school of juveniles is the efficiency of stone, which is inversely proportional to the weight of fruit. Among the genotypes considered the highest yield of seeds given genotype that had the lowest fruit weight (Table 2).

The flesh of fruits with a value close to 1g, dehydrate easily during cooking, which adversely affect the germination capacity of stoning. Those fruits have higher flesh weight compared with stones - so weight and size of fruit is higher - can be used in food, but less selection of rootstocks.

The largest fruit were measured at KM 10 genotypes (average 3.83 g), KM 13 (3.5 g) and KM 5 (3.46 g) and lowest fruit weight had genotype 1 and KM 3, both with the same average of 1.46 g, followed by 8 KM (1.6 g) KM 2 (1.66 g), KM 1 and KM 4, both with an average weight of 1.83 g of fruit (Fig. 3.).

It must be emphasized that the selection of KM 3 kernel yield was the highest 19.31%, followed by selections KM 2 with 16.86% to 15.31% KM 4, KM 1 and KM to 15.17% in August with 15.00%. In these types, fruit weight was between 1.45 to 1.66 g, which shows that efficiency is inversely proportional to the weight of stone fruit (Figure 4). These results are promising because after *Cerasus avium* literature on kernel yield is between 9-14% (Hrotkó, 1999). The average weight of stones is between 0.22 to 0.34 g values, as compared with normal average weight of fruit.

2. The weight of 1000 seeds

To find the weight of 1000 seeds were measured using digital scales in each type of selected wild cherry.

The smallest mass of 1000 seeds is one of KM type 1230 g, but also one genotypes KM (1290 g), KM 15 (1350 g) KM 4 (1370 g) KM 3 (1380 g) and 8 KM (1390 g) had lower values of the mass of 1000 seeds. Most weight has 13 KM, 3090 g to 1000 seeds. On most selections of 1000 seeds mass range 1500-2500 g values (Figure 5).

3. The percent of rising

Table 3 shows the number of seeds that were planted in each genotype of wild cherry and the number of those seeds that have germinated.

KM 5from type I planted the largest number of seeds, 5833 pieces, trying to get as many seedlings as this genotype have the best features (growth force small scattered semi-dense crown shape), giving a sprouting of 3578 pieces. The best results were obtained from the Eastern type KM 21, where the seeds have sprung 461 666 and we got to a KM worst emergence, in 1790 the sown seeds germinated 284 pieces. The percentage of scientific literature sprouting wild cherry pomace is somewhere between 30-50% values (Hrotkó, 1999), so we can say halfway genotypes (nine selections), we obtained a germination averaged over existing literature. We obtained a 50% sprouting in the types of KM 21 (69.2%), which is the best result, KM 12 (67.2%), KM 11 (66.7%), KM 29 (65.5%), KM 8

(63.5%), KM 10 (62.8%), KM 5 (61.3%), KM 1 (60.8%) and KM 9 (60.8%). Six types of results are averages and the other three genotypes, the results are below the average of 30% emergence, germination lowest achieving the type KM 1 (15.9%) (Figure 5).

4. The examination of package thickness (growth vigour of seedlings)

Based on package thickness measurement values were obtained values which showing that generation progeny of wild cherry types selected have a high degree of uniformity.

Significant difference in the values we obtained only if the selection of seedlings resulting from KM 16, which has significant results from the types of KM 1, KM 2, KM 3, KM 4, KM 5, KM 7, KM 8, KM 9, KM 10, KM 11, KM 12, KM 13, KM 15, KM 21, KM 22 and KM 29. In addition to the KM 16, the other genotypes were obtained mean values which were not significant results apart. KM 1 type of package thickness values approaching KM 16 type, and the results between the two selections there were no significant differences. The worst result was achieved at KM 22, which has significant value to the types of KM 1 and KM 16. Type KM 22, with the worst result on the thickness of the package, has not statistically different from the types of KM 1, KM 2, KM 3, KM 4, KM5, KM 7, KM 8, KM 9, KM 10, KM 11, KM 12, KM 13, KM 15, KM 21 and KM 29, which have average values between 4.73 to 5.70 mm package of thickness (Figure 6).

From Figure 7 it can be seen that the variability of wild cherry selections with uniform thickness on the package. We determined four groups with increasing values: 2.1 to 4 mm, 4.1 to 6 mm, 6.1 to 8 mm and from 8.1 to 10 mm. Results show that the majority of selections, values fall within one category of growth (4.1 to 6 mm), variability in the values obtained are very low, which gives a high uniformity of the vigour of growth, which is very important for nursery viewpoint.

KM 1 genotype the seedlings majority of juveniles respectively 72% are employed in the category of increased from 4.1 to 6 mm growth, and that gives a uniform growth of seedlings, 10% of juveniles belonging to the group with a greater increase (from 6.1 to 8 mm) and the remaining 18% seedlings had a small increase (2.1 to 4 mm).

Regarding the uniformity of seedlings, type KM 1 values shows that one has obtained the best results, followed by types KM 11 and KM 22 which meet low variability, most juveniles (68-72%), fall in category growth of 4.1 to 6 mm. We can assume that the uniformity of wild cherry seedlings is related to predisposition to a auto fertility of wild cherry.

Seedlings derived from genotypes KM 3, KM 5, KM 8, KM 9, KM 12, the rate of 60-66% belong to the category growth from 4.1 to 6 mm, and here is manifested a marked increase uniformity.

To types of KM 2, KM 4, KM 10, KM 13, KM 15, KM 16 and KM 29 results show that 50% of juveniles belonging to category growth from 4.1 to 6 mm, number of juveniles is very homogeneous on growth values.

Types KM 1 and KM 21 KM show that the resulting flocks of juveniles have a greater variability, resulting in a heterogeneous material, which is not beneficial in terms nursery.

CONCLUSIONS

1. From the 18 selected genotypes of wild cherry, 5 types of seeds yield is between values from 15.17 to 19.31%, well above the average yield of seeds, wild cherry characteristic presented in the literature.
2. In the case of the nine selections wild cherry, eastern shelling percentage exceeds 60% which is a particularly valuable attribute to the nursery.
3. Seedlings from the most selections (except the three selections) fall into the category of middle force, with a thickness between 4.1 to 6 mm packages.

4 The thickness of the package selections fall in percentage over 50% in one category of value, which shows a great homogeneity of the material.
5. Gathering the above problems, we conclude that wild cherry selections in the study have provided valuable generative lines, with important traits in terms of nursery, such as reduced growth and vigour in high school uniform seedlings.

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TABLES AND FIGURES

Table 1

Force growth, crown type and capacity of wild cherry genotypes

No. crt.	Genotype code	Force growth	Crown characteristics		Production capacity
			Form	Density	
1.	KM 1	Little	Wide - pyramidal	Rarely	5
2.	KM 1'	Middle	Wide - pyramidal	Rarely	3
3.	KM 2	Middle	Reverse-pyramidal	Rarely	3
4.	KM 3	Middle	Wide - pyramidal	Semidense	4
5.	KM 4	Middle	Wide - pyramidal	Dense	5
6.	KM 5	Little	Disperse	Semidense	3
7.	KM 7	Middle	Narrow-pyramidal	Dense	3
8.	KM 8	Middle	Narrow-pyramidal	Dense	4
9.	KM 9	Middle	Disperse/ Scattered	Rarely	5
10.	KM 10	Large	Narrow-pyramidal	Rarely	3
11.	KM 11	Large	Narrow-pyramidal	Semidense	4
12.	KM 12	Large	Disperse	Rarely	3
13.	KM 13	Middle	Narrow-pyramidal	Rarely	2
14.	KM 15	Semi dwarf	Wide - pyramidal	Rarely	4
15.	KM 16	Middle	Wide - pyramidal	Semidense	5
16.	KM 21	Middle	Narrow-pyramidal	Rarely	4
17.	KM 22	Middle	Wide - pyramidal	Semidense	3
18.	KM 29	Large	Wide - pyramidal	Dense	5

Table 2

Average weight of fruit, shelling percentage and kernel

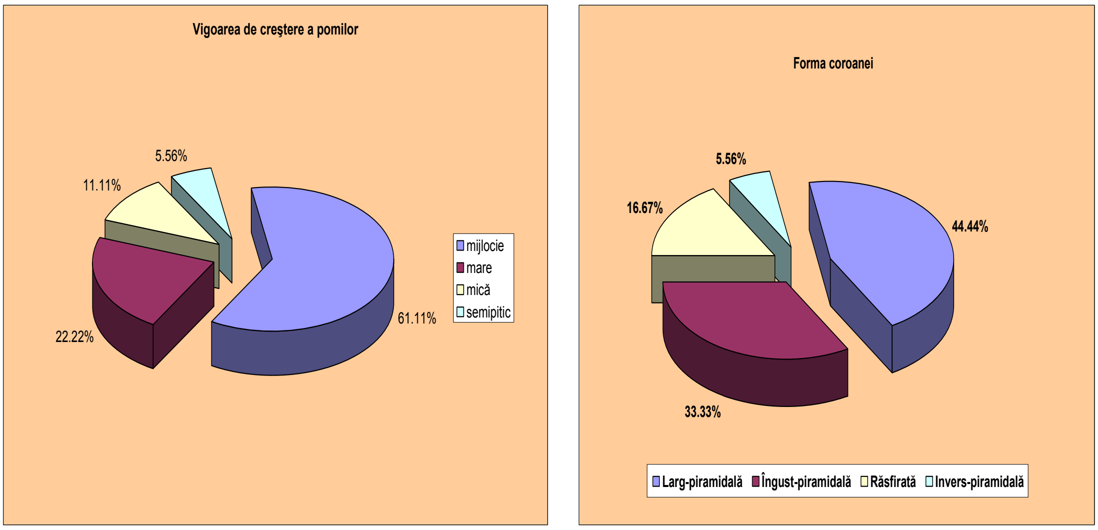
No. crt.	Genotype code	Average fruit weight (g)	The average weight of stones (g)	Flesh (g)	The percentage of pits (%)
1.	KM 1	1.45	0.22	1.23	15.17
2.	KM 1'	1.83	0.28	1.55	15.31
3.	KM 2	1.66	0.28	1.38	16.86
4.	KM 3	1.45	0.28	1.17	19.31
5.	KM 4	1.83	0.28	1.55	15.31
6.	KM 5	3.46	0.24	3.22	6.93
7.	KM 7	2.50	0.26	2.24	10.40
8.	KM 8	1.60	0.24	1.36	15.00
9.	KM 9	2.33	0.27	2.06	9.45
10.	KM 10	3.83	0.26	3.57	6.78
11.	KM 11	2.83	0.26	2.57	9.18
12.	KM 12	2.70	0.24	2.46	8.88

13.	KM 13	3.50	0.34	3.16	9.71
14.	KM 15	2.00	0.26	1.74	13.00
15.	KM 16	3.00	0.30	2.70	10.00
16.	KM 21	2.30	0.22	2.08	9.56
17.	KM 22	2.55	0.26	2.29	10.19
18.	KM 29	2.33	0.26	2.07	11.15

Table 3

Number of seeds sown and the number of pits east

No. crt.	Genotype code	No. sow the seeds (pieces)	No. kernel germ (pieces)	Emergence percentage (%)
1.	KM 1	1790	284	15.85
2.	KM 1'	2425	1474	60.77
3.	KM 2	1883	478	25.40
4.	KM 3	2959	951	32.15
5.	KM 4	2952	966	32.72
6.	KM 5	5833	3578	61.34
7.	KM 7	3560	1255	35.25
8.	KM 8	919	583	63.45
9.	KM 9	2623	1593	60.72
10.	KM 10	1241	780	62.83
11.	KM 11	875	584	66.70
12.	KM 12	866	582	67.20
13.	KM 13	1083	218	20.16
4.	KM 15	683	231	33.85
15.	KM 16	1301	461	35.42
16.	KM 21	666	461	69.18
17.	KM 22	721	293	40.64
18.	KM 29	1001	655	65.45



a **b**

Fig. 1. The vigour of trees growth (%) and crown characteristics (%)

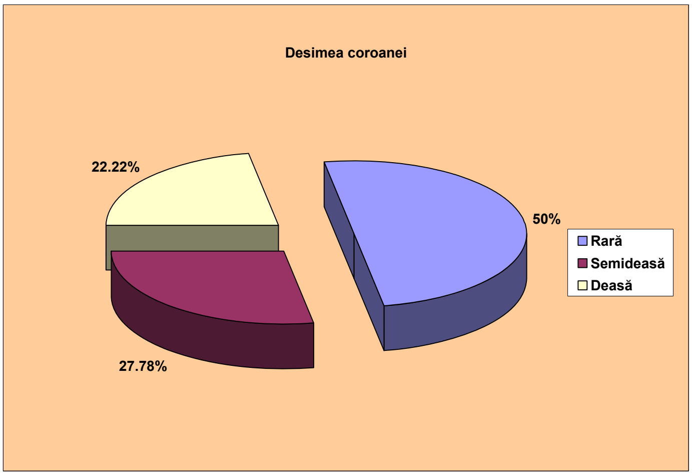


Fig. 2. The density of crown

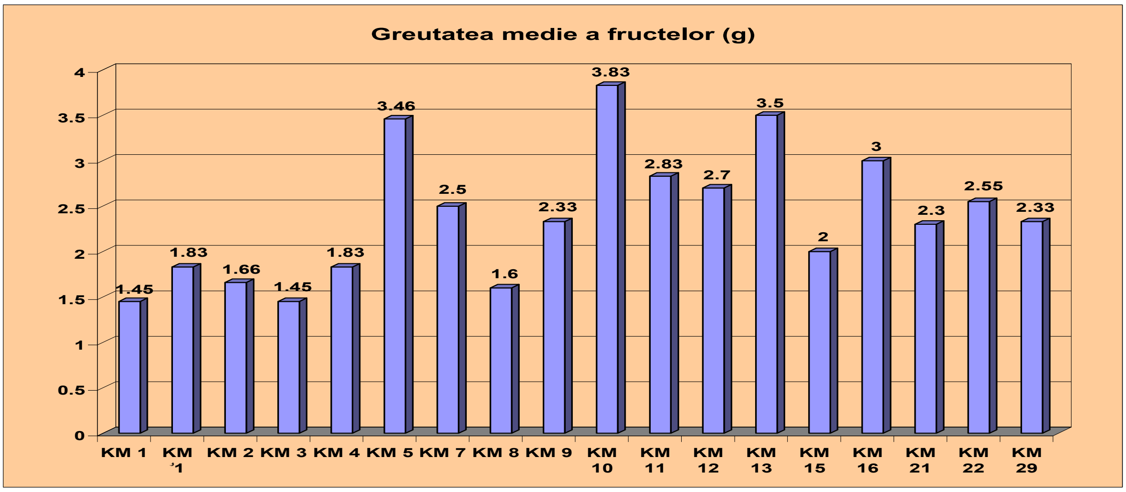


Fig. 3. Medium weight of cherry tree fruits (g)

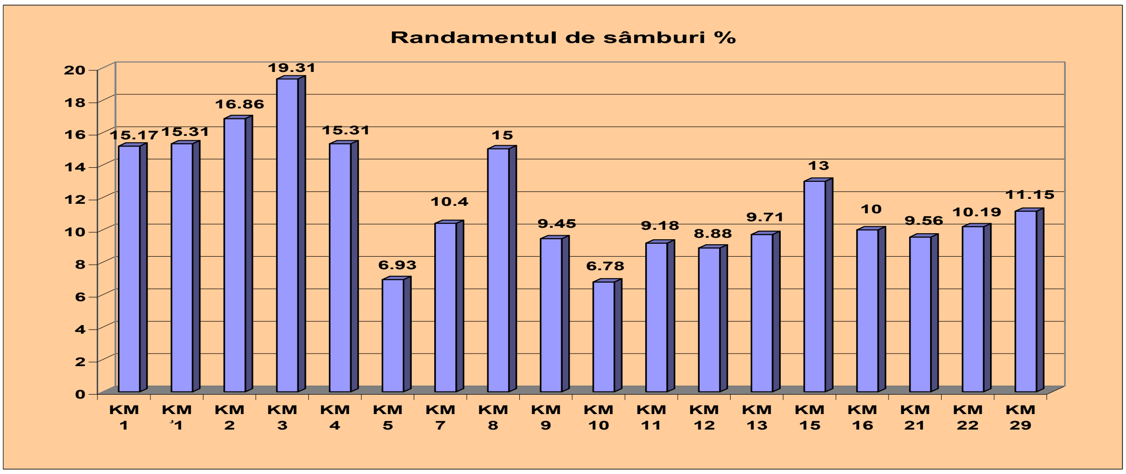


Fig. 4. The yield of seeds (%)

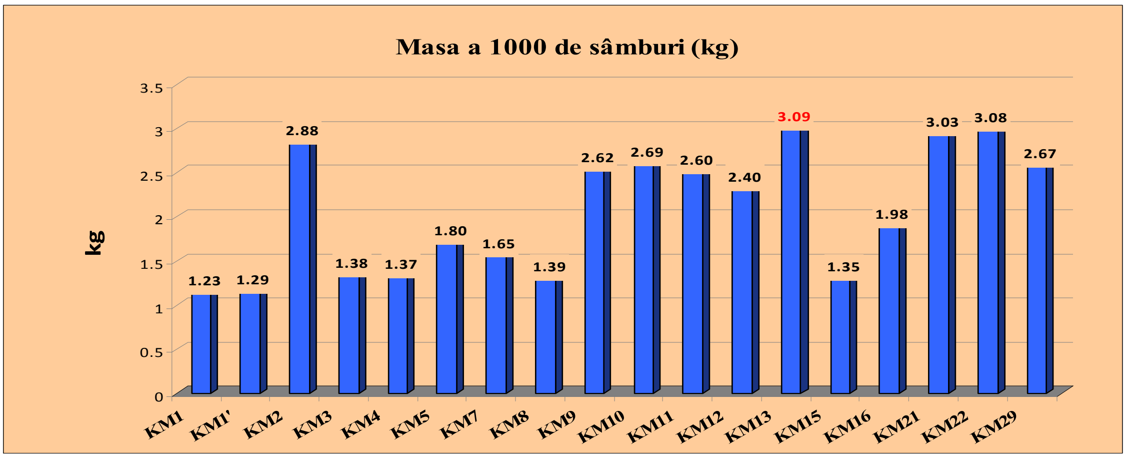


Fig. 5. The variability of 1000seeds weight

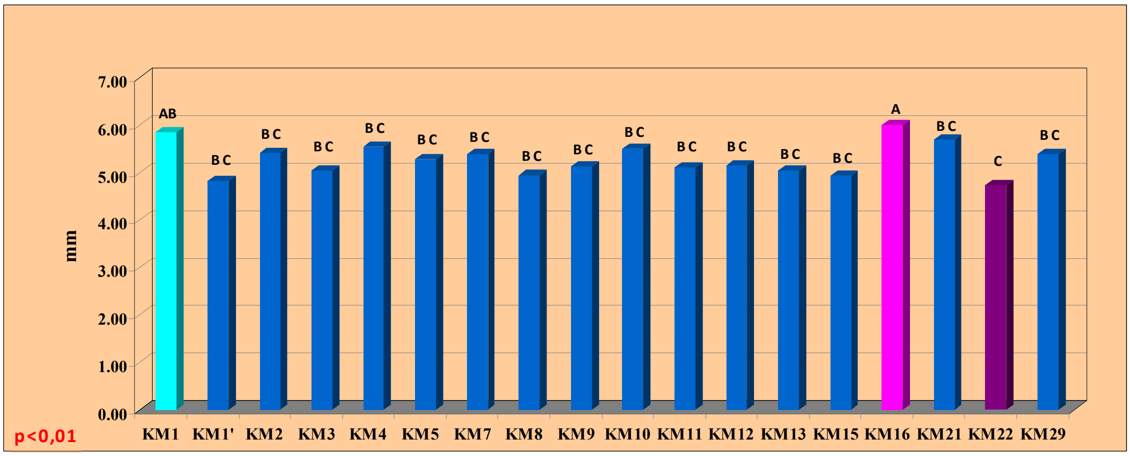


Fig. 6. The thickness of young cherries tree

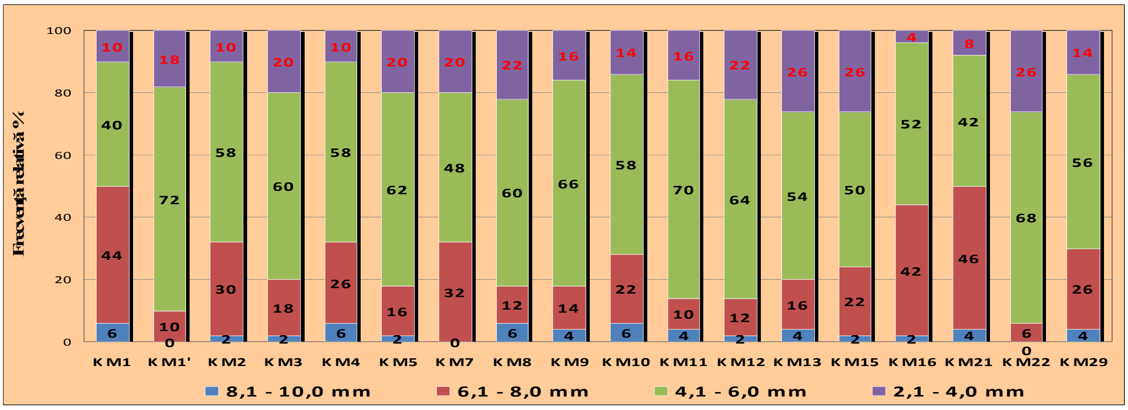


Fig. 7. The variation limits of the vigour of young trees from the selection study

Determination of the development of root system of wild cherry selections

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Keywords: wild cherry, genotypes,

ABSTRACT

Intensive growth culture of cherry and economic efficiency of cherry orchards is a priority of fruit growers and breeders worldwide and in Romania. Besides the classical gardens - tall tree, 600-700 trees per hectare - where it was harvested mechanically or by hand very hard, appearing and intensive orchards - 1000-1500 trees/ha - intensive tree crown, where harvesting is done by hand ground. Intensive orchards need to establish other rootstocks. Intensive culture increases the importance of rootstock, especially for the effect of reducing the waist, which correlated with an appropriate choice of ring shape, has a major influence on intensive growth culture of cherry. Selection of wild cherry genotypes occurred in a plantation of cherry Saplings School and field grafting of Sapientia University Târgu-Mureş, where 200 copies have reached the right nursery grafted material. Of this material were 18 genotypes selected by their characteristics have proved to be valuable as seed parent plants. Seedlings were analyzed characteristics of the selections from the best behaviour in school saplings were planted in field grafting. During the experiment there were performed the following measurements and observations on root system characteristics: number of roots, length of main and secondary roots. These determinations were made by harvesting seedlings, after which they started to sort - and tying their genotypes after stratification seedlings. Statistical data processing was done by Past program, significant role than previously established differences in the degree of freedom p <0.01 giving a 99% difference between genotypes. When examining the root characteristics were taken into account the number of roots, main root length and the secondary. In the number of roots, experience results demonstrate that in all selections, a few seedlings have roots whose thickness is 1.5 mm. For most juveniles is the number of roots of 2-4 pieces. On this character, seedlings derived from three selections (KM 1, KM 21 and KM 7) have values that differ from other families of juveniles significant. For most selections, the main root seedlings have an average length between 8-12 cm values. Seedlings of several selections were average length of secondary roots between 6-8 cm values. We found that the main root length is inversely proportional to the length of secondary roots. Gathering the above, we conclude that wild cherry selections in the study have provided valuable generative lines, with important traits in terms nursery, such as reduced growth and vigour high school uniform seedlings.

INTRODUCTION

In Romania, cherry fruit is grown in most areas and on all forms of relief, mainly in orchards, but also in homes and gardens in addition to the roadside. For the period 2010-2015 is expected to maintain at least the same surface planted with cherry. FAO statistics show a significant reduction of cherry production in Romania in recent years. In 2005 it was produced the worst production in the last 30 years, 32,001 thousand tonnes which was lower by 18,987 tons compared to 2004 and 66,499 tons from 2003. Most cherry production was obtained in 1993 with a record production of 106,400 tonnes.

Evolution of cherry production was influenced by several factors - including climate - which led to a drastic reduction in production. Cherry culture over the past 20-25 years has been concentrated in areas most favourable to the country: the rainfall between 500-600 mm and annual average temperature of 9-10ºC in the counties located in the Carpathian foothills of Oltenia and Muntenia: Argeş, Vâlcea, Prahova, Buzău, Dâmboviţa, Dolj and Olt, in the north-east of Transylvania: Bistriţa-Năsăud, Sălaj, Satu Mare, Maramureş, Bihor and Arad (L. Chira, 2006). Also cherry culture spread around some major cities such as Bucharest, Timisoara, Arad and Oradea.

After existing statistical data (FAO, 2006) areas planted with cherry fell in the last 10 years, to 9317 ha, with 28.31% less than in 1996, when 12,995 hectares cultivated as cherry and sour cherry 3rd place in Romania as a cultivated area where apple plum with 95,478 ha with 72,740 ha, but before the loss, apricots, peaches and nectarines.

Founded in choice of cherry plantations, should consider climate, soil and geographical location of the area. Among climatic factors, most important - in terms of growing cherry - are temperature and precipitation (Kállayné, 2003).

Cherry is a heat-loving species, it is well developed in areas with annual temperatures between 9-10ºC. In cooler regions, where the soil is warm, hard, repeated late spring frosts, cherry falls ill quickly and has a short life (Miliţiu et al., 1961).

After Hilkenbäumer (1964), cherry is a species that has very high requirements to the water. It can be grown in areas with 500-600 mm annual rainfall. Not support any extended drought or excess water.

Cherry prefers deep soils, light, rich in humus (2-3%), sandy loam, sandy clay, with a high permeability, well drained, with groundwater as 1.8 to 2 m.

Ground-cherry tree which bears gleyzation which suffocating roots, determined either by groundwater or by the stagnant over an impermeable horizon, or coastal sources (Chira, 2008).

Intensive growth culture of cherry and economic efficiency of cherry orchards is a priority of fruit growers and breeders worldwide and in Romania. Besides the classical gardens - tall tree, 600-700 trees per hectare - where it was harvested mechanically or by hand very hard, appearing and intensive orchards - 1000-1500 trees/ha - intensive tree crown, where harvesting is done by hand ground. Intensive orchards need to establish other rootstocks. Intensive culture increases the importance of rootstock, especially for the effect of reducing the waist, which correlated with an appropriate choice of ring shape, has a major influence on intensive growth culture of cherry.

Rootstock is the main factor which influences the superior capitalization of various soils, growth vigour, and the fruit enters the quantity and quality of fruit, resistance to frost, pests and diseases of cherry varieties.

Rootstock is characterized by: the vigour of growth, affinity, interact with graft, adaptability to climatic conditions, productivity, longevity printed graft, breeding capacity, uniformity in rooting and propagation.

MATERIAL AND METHODS

Selection of wild cherry genotypes occurred in a plantation of cherry Saplings School and field grafting of Sapientia University Târgu-Mureş, where 200 copies have reached the right nursery grafted material. Of this material were 18 genotypes selected by their characteristics have proved to be valuable as seed parent plants. Seedlings were analyzed characteristics of the selections from the best behaviour in school saplings were planted in field grafting.

The main characteristics of wild cherry selections are presented in Table 1.

Sampling the selections marked fruit was held in late June 2007. Extracted stones were kept until the final stratification in moist perlite at a temperature of approx. 10°C. Stratification took place in December in wet sand. Seeding was done on March 24, 2008, in separate rows for each genotype on a plot prepared in autumn sowing density was 70 pips per ml. Seedlings emergence took place in three weeks after sowing. Harvesting juveniles held in early November of 2008.

During the experiment there were performed the following measurements and observations on root system characteristics: number of roots, length of main and secondary roots. These determinations were made by harvesting seedlings, after which they started to sort - and tying their genotypes after stratification seedlings.

Statistical data processing was done by Past program, significant role than previously established differences in the degree of freedom $p < 0.01$ giving a 99% difference between genotypes.

RESULTS AND DISCUSSION

When examining the root seedlings we counted and measured only those roots which were greater than 1.5 mm thick, the thinnest there have not taken into account.

1. Number of roots

Relative frequency in a population indicates that many plants are in each category, all expressed in percentages. We followed that of seedlings selected genotypes have most roots. Number of roots per plant we grouped into four categories of values: 2-4 pcs., 4.1 to 6 pcs., 6.1 to 8 pcs. and 8.1 to 10 pcs . The highest frequency of juveniles belonging to category 2-4 pcs. roots, this being the most beneficial on rooting, but also the types of wild cherry with 4-6 pcs. roots, these values fits very good results (Figure 1.). Our results are confirmed by literature references, which shows that the wild cherry is characteristic lower rooting capacity (number of roots formed is small).

The best values were obtained from selections KM 1, KM 29, KM 21 and KM 7. KM 1 to genotype most juveniles have entered the category of 4.1 to 6 pcs. (48%), but were 6.1 to 10 pc category and juveniles (2%).

KM 7 type seedlings entered three categories of values, 60% of seedlings with roots 4-6, 2-4 with 36% and 4% with 6-8 roots. KM 21 type seedlings over half (66%) were between 4-8 roots, which is good value for rooting.

Gave good results and juveniles belonging to genotype KM 29, where 42% of seedling roots were 6-8 and 6% were classified in category 8 to 10 roots.

Seedlings selections KM 2, KM 3, KM 4, KM 16 and KM 22 gave good results, 40-48% of juveniles entering the category 4-8 roots.

Genotypes KM 1, KM 5, KM 8, KM 10, KM 12, KM 13 and KM 15 gave poor results because the highest percentage root seedlings were 2-4.

The weakest results were measured in seedlings of genotypes KM 9, KM 11, where 82% of juveniles had between 2-4 roots.

In conclusion, we can say that in the number of roots there is a uniformity of seedlings given that the vast majority (60%) falls into class with few roots (2-4 pcs.).

After statistical processing of data we observed significant differences in genotype KM 21, KM 1 and KM 7, selected over other types. Statistically, the types of KM 2, KM 3, KM 4, KM 10, KM 13, KM 16, KM 22 and KM 29 were not provided with any significant differences from wild cherry selections.

KM genotypes 1, KM 8, KM 12 and KM 15 results, only significant differences with genotype KM 21 but no significant differences with other types.

Three wild cherry selections KM 9, KM 11, KM 5 and have very poor results and significant differences only to genotypes KM 1 and KM 21 KM 7 (Figure 2.).

2. Length roots

Examining the root seedlings it were measured the root length which are important to absorb the nutrient substance and has a huge role in supporting the plant.

It was analyzed statistically there are obtained from KM 16 and KM 9 selections, where juveniles were on average 14 to 16 cm in length, these values gives a significant difference in the types of KM 1, KM 2, KM 3, KM 4, KM 10, KM 11, KM 15 and KM 21, where we measured the shortest primary root.

Type seedlings KM 5, KM 12 and KM 22 were the main root length and mean significant difference from the type of KM 16.

Length of main roots of seedlings from genotypes KM 7, KM 8, KM 29 have values fall between 12.6 to 13 cm, which is an above average result, but no significant differences compared to seedlings and selections KM 9, KM 16, and no types KM 1, KM 3, KM 4, KM 5, KM 12, KM 13, KM 15, KM 21 and KM 22, only the seedlings with the worst results.

Statistically, significant differences in the type of KM 13 points against the best and the worst result.

Length of main roots of genotypes KM 1, KM 2, KM 10 and KM 11 is the smallest; their average value is between 8.76 to 9.88 cm and shows significant differences from KM 7, KM 8, KM 9, KM 13, KM 16 and KM 29, which is above average root length (Figure 3).

It were analyzed statistically the length of secondary roots in all genotypes selected wild cherry. After statistical processing, good results were obtained from seedlings genotype KM 5, where the average length of secondary roots was 8.69 cm. Following genotypes KM 9, KM 12, KM 16, KM 29 and KM 8, KM 4 gave similar results, among them there were no significant differences. These selections have given the best results on the length of secondary roots.

The types of KM 2, KM 13, KM 21 and KM 22 results show that they have no significant differences with those selections that best results nor with those types that have the worst values. The smallest length of secondary roots were measured genotype seedlings km 3, with an average length of 5.62 cm, which are not significant different types seedlings KM 1, KM 1, KM 2, KM 7, KM 11, KM 13, KM 15, KM 21 and KM 22.

The results show that type KM 1, KM 1, KM 11, KM 7 and have values between 5.99 to 6.56 cm, approaching the worst levels and significant differences in the types of wild cherry with good results (Figure 4.).

CONCLUSIONS

1. When examining the root characteristics were taken into account the number of roots, main root length and the secondary.
2. In the number of roots, experience results demonstrate that in all selections, a few seedlings have roots whose thickness is 1.5 mm. For most juveniles is the number of roots of 2-4 pieces. On this character, seedlings derived from three selections (KM 1, KM 21 and KM 7) have values that differ from other families of juveniles significant.
3. For most selections, the main root seedlings have an average length between 8-12 cm values.
4. Seedlings of several selections were average length of secondary roots between 6-8 cm values. We found that the main root length is inversely proportional to the length of secondary roots.
5. Gathering the above, we conclude that wild cherry selections in the study have provided valuable generative lines, with important traits in terms nursery, such as reduced growth and vigour high school uniform seedlings.

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TABLE AND FIGURES

Table 1

The main characteristics of wild cherry genotypes used in research

No. crt.	Genotype code	Force growth	Crown characteristics		Production capacity
			Form	Density	
1.	KM 1	Little	Wide - pyramidal	Rarely	5
2.	KM 1'	Middle	Wide - pyramidal	Rarely	3
3.	KM 2	Middle	Reverse-pyramidal	Rarely	3
4.	KM 3	Middle	Wide - pyramidal	Semidense	4
5.	KM 4	Middle	Wide - pyramidal	Dense	5
6.	KM 5	Little	Disperse	Semidense	3
7.	KM 7	Middle	Narrow-pyramidal	Dense	3
8.	KM 8	Middle	Narrow-pyramidal	Dense	4
9.	KM 9	Middle	Disperse/ Scattered	Rarely	5
10.	KM 10	Large	Narrow-pyramidal	Rarely	3
11.	KM 11	Large	Narrow-pyramidal	Semidense	4
12.	KM 12	Large	Disperse	Rarely	3
13.	KM 13	Middle	Narrow-pyramidal	Rarely	2
14.	KM 15	Semi dwarf	Wide - pyramidal	Rarely	4
15.	KM 16	Middle	Wide - pyramidal	Semidense	5
16.	KM 21	Middle	Narrow-pyramidal	Rarely	4
17.	KM 22	Middle	Wide - pyramidal	Semidense	3
18.	KM 29	Large	Wide - pyramidal	Dense	5

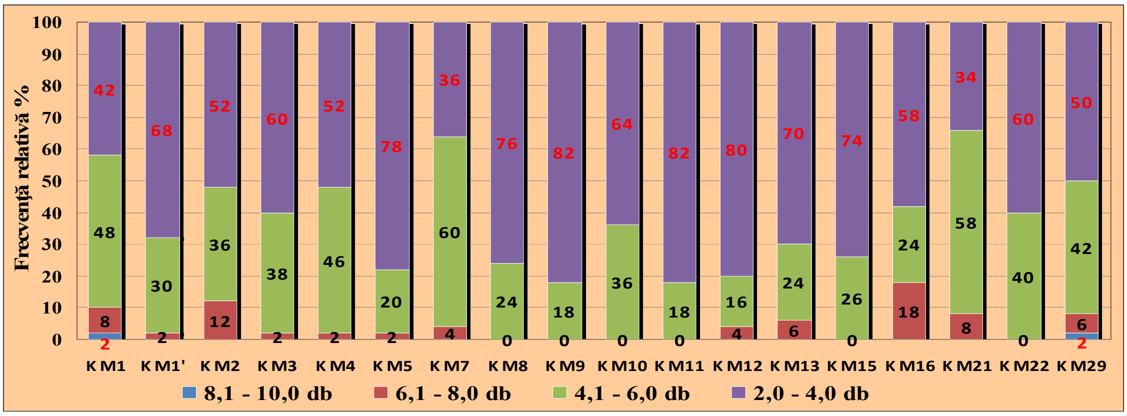

Fig. 1. Variability in the number of roots in seedlings from different selections

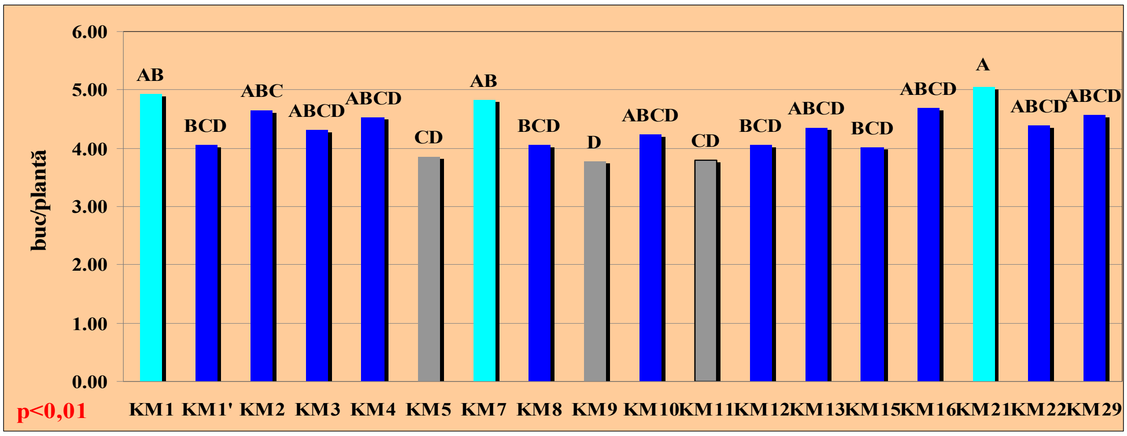

Fig. 2. Significant differences on the number of roots

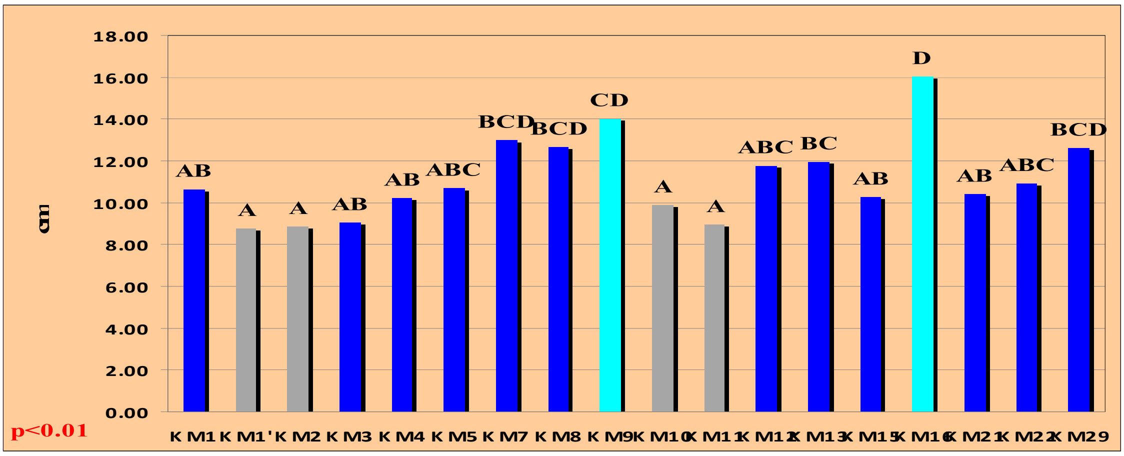

Fig. 3. Statistical analysis on the main root length

Fig. 4. Statistical analysis on the length of secondary roots

The effect of rootstocks on apple tree growth in the fruit nursery

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Keywords: Variety, Feathered trees, Two-year trees, Bench-graft.

ABSTRACT

There were conducted investigations during the period of 2008-2009years in Nursery Fruit Company. As objects of the investigation served three apple varieties and were bench-grafted on five rootstocks. As a result of the researches made it was established that in the first and second fields of the fruit nursery the main indicators of apple tree growth manifest significant increases depending on the increase of rootstocks' vigour of growth used in the process of grafting and the evidence obtained corresponds to the current standards.

INTRODUCTION

The future of the fruit growing development in the world, including Moldova, represents the obtaining of a high production of qualitative, competitive and demanded fruits on the market. To obtain a great fruit production of superior quality can be made only by planting orchards of new type, especially with the superintensive ones, that means having a modern assortment, energetically and ecologically equilibrate advanced technologies, which assure an early fruit production of trees with a rapid yield growth in the first years after plantation (Babuc, et al. 2002, 2009).

From the experience of the countries with a developed fruit growing – Italy, Holland, Poland, etc., the superintensive apple trees are established with crowned apple trees produced during the period of two years (Gudumac, et al. 2007, Peşteanu, 2007, Petre, et al. 2006).

The crowned apple trees in the fruit nursery, being planted in the orchard, have an early fruit production and increase more rapidly the fruit production in comparison with the planted trees without crown (Bielicki and Czynczyk 1994, Sadowski, et al. 2005).

The researched made in Poland (Mika and Krawiec, 1998) confirm that the crowned apple trees in the fruit nursery, produce in the two years orchard an yield of about 3-6 kg/tree of fruits, in comparison with the uncrowned trees, whose productivity constituted 1 kg.

Taking into the consideration that the determinative factor of having an early fruit production in the orchard constitute the type and quality of the planting material, the investigations had the aim to determine the development of apple trees, grafted on different types of rootstock for the apple tree plantations (Babuc, et al. 2009, Petre, et al. 2006).

MATERIAL AND METHODS

The research was carried out during 2008-2009 in the fruit nursery of company „Codru-ST" Ltd., which is located in the central area of Moldova, research items were used for apple varieties: Gala Must, Golden Reinders and Idared bench-grafted on M 9, 62-396, M 26, M 7 and MM 106 rootstocks.

The bench-grafting was performed in March, using the perfected copulation method with detached branch. Grafting site was tied with porous polyethylene tape designed specifically for graft and graft was paraffined.

The obtained grafting was stratified by placing them upright in containers, so that the basal layers (20-25 cm) to be placed in a layer of wet sand. The stratification temperature in the refrigerator was +2...+4^{0}C. To produce grafted trees were used well-developed layers of 10 mm diameter and graft branches with higher biological values.

The first field of tree nursery was established in the second half of April, with bench grafts. Distance of planting grafted plants was 90x35 cm. The aerial part was palisated on a stick of bamboo.

In the second field of nursery, early spring annual stems have been shortened to a height of 75-80 cm above the grafting site. During the vegetation was carried trunk release, being left only 4-5 shoots to form the crown base. To obtain sylleptic shoots on the central axle, when they reached the length of 15-20 cm, it was made the remove of apical leaves without hurting the point of growth. This operation is repeated every 5-7 days for 5-6 times. To stimulate the strong development of shoots are made more frequent irrigation and fertilization based on macro-and micronutrients.

The usual black soil, the content of humus is 2,6%, that is maintained as cultivated field, irrigation is made by sprinkling keeping the soil wet at 75-80% from the capacity of field.

The number of repetition in each variant is 4. The number of trees in each repetition is 20. The researches were made in field and laboratory conditions according to the required methods for doing experiments with fruit growing plants. The main results obtained were statistically processed.

RESULTS AND DISCUSSION

On the basis of the results obtained it was demonstrated that the type of the roostock has an influence on apple tree's growth in the fruit nursery.

The degree of striking the bench grafting in the first field of the fruit nursery during the period of investigation (fig 1), for all the rootstocks take into the study, is between the limits of 95,6-99,1 %.

In 2008 the highest degree of striking was registered by the Gala Must variety that was grafted on MM 106 rootstock, being of 99,1%, and the lowest striking degree – by the Idared variety , being grafted on M 9 rootstock (95,6 %).

Having a more detailed study of this indicator, it may be observed that a lower value was registered at the investigated varieties which were grafted on rootstocks M 9 and M 26. This is due to the fact that this rootstock have already formed a smaller quantity of roots in comparison with the rootstocks 62-396, M 7 and MM 106, that to their hereditary characters form a bigger quantity of roots (Adăscăliţei, et al., 2004, Babuc, et al. 2009, Ghena, et al. 2004).

At the end of the first period of vegetation in the first field of the fruit nursery it was established that the height of trees (tab. 1) for all the varieties and types of rootstocks the investigations were corresponding with the limits of 111-135 cm in 2008 year and 109-125 cm in 2009.

The highest values of graft height were recorded in both years by Gala Must variety grafted on MM 106 rootstock, which has a medium force of growth and is 125-135 cm. The Golden Reinders variety, grafted on the same rootstock, registered intermediary values of this index, being 120-129 cm. At the Idared variety, the highest value of this index was recorded at the same event, being 116-124 cm. With decreasing growth vigour of rootstocks studied, there is a decrease in the value of this index and is 109-111 cm at the Idared variety grafted on the rootstock M 9, and 111-113 cm at the Golden Reinders variety, 114-124 cm at the Gala Must variety grafted on the same rootstock.

The graft diameter at 10 cm above the graft's place in the years 2008-2009, which is affected by increasing the vigour of the rootstocks and varieties investigated was within the limits of 8,3 mm and 10,2 mm. As the graft's height, the diameter increases at the same time with the increase of vigour of growth of the investigated rootstocks.

The leaf surface (fig.2) grows at the same time with the increase of growth vigor of rootstock from 0,20-0,27 m^2/tree to 0,26-0,35 m^2/tree.

At the end of the second period of vegetation in the first field of the fruit nursery it was established that the height of the fruit trees (tab. 2) grows consequently with the vigour of the investigated rootstocks to the limit of 190,25-194,75 cm or with 3-13 %.

The trunk diameter above with 10 cm from the graft's place as an integral indicator, in 2009 had higher values at the grafted trees on rootstock M 7 (16,30-17,00 mm) and respectively the grafted trees on the rootstock M 9, the lowest diameter was of 15,00-15,50 mm due to the fact that this rootstock give the lowest vigour of growth to the fruit trees.

The number of normal leaves formed at the base of the crown at the varieties taken into the study in the second field of the fruit nursery is between the limits of 3,50-4,50 pcs/tree.

The average length depends on the biological peculiarities of the varieties and rootstocks taken into the study and, also their number, so as in the second field of the fruit nursery the values of this indicator is between the limits of 67,24-92,88 cm.

The longest length of normal shoots was registered at all the investigated varieties, grafted on rootstock M 7. The average length of normal shoots was registered at the apple trees grafted on the rootstocks MM 106, M 26 and 62-396.

The number of sylleptic shoots formed from early buds on the extension shoot of the axle, at the varieties taken into the study, depends greatly on the variety's capacity to emit sylleptic shoots, and the vigour of growth of the rootstock researched.

The most pronounced hereditary capacity to form sylleptic shoots on the central axle was registered at the Gala Must variety – 3,50-7,50 pcs/tree with an average length of 23,00-33,39cm, followed by the Golden Reinders variety with 3,50-6,25 pcs/tree with a length of 26,5-43,88 cm and, respectively, by Idared variety with the lowest hereditary capacity to emit sylleptic shoots that had formed 1,75-5,25 pcs/tree with their average length of 31,49-37,96 cm.

If to compare the above mentioned indicators according to the vigour rootstock type, it may be observed that the rootstocks M 27 and MM 106 have formed the greatest number of sylleptic shoots in comparison with the rootstocks M 9 and 62-396 with a low vigour of growth.

The leaf surface of apple trees in the second field of the fruit nursery (fig. 3) is majored concomitantly with the increase of rootstock vigour of growth, from 0,71-0,82 m^2/tree in the case when the varieties taken into the study were grafted on M 9 to 0,89 m^2/tree at the trees of Idared variety grafted on rootstock M 26, 0,95 m^2/tree at the variety Golden Reinders and 1,00 m^2/tree at the Gala Must variety, both grafted on rootstock MM 106, or with 18-30%.

CONCLUSIONS

1. The principal indicators of apple tree growth in the first and second fields of the fruit nursery demonstrate significant increases depending on the increase of rootstocks' vigour of growth that were used in the process of grafting;
2. The parameters of apple trees in the second field of the fruit nursery had registered values that correspond to 1st category of quality according to the present standards on: height, trunk diameter, number of branches, as well as their average length;
3. The biological peculiarities of the types of investigated rootstocks influence apple trees growth and development in the nursery. It is recommended to use for the apple tree superintensive system grafted apple trees on rootstocks M 9, 62-396 and M 26, and for the intensive system – more suitable are considered to be the rootstocks M 7 and MM 106;

4. Superior values of the main indicators of apple tree's vigour of growth in the first and second field of the fruit nursery were registered according to the varieties under the investigation, at the varieties Golden Reinders – a variety of perspective, being followed by Idared – a homologated variety in the Republic of Moldova.

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TABLES AND FIGURES

Table 1

Growth main indicators of apple trees in the first field of the fruit nursery depending on the rootstocks type

Rootstock	Variety					
	Gala Must		Golden Reinders		Idared	
	graft height, *cm*	graft diameter,* *mm*	graft height, *cm*	graft diameter,* *mm*	graft height, *cm*	graft diameter,* *mm*
2008 year						
M 9	124	8,9	113	8,3	111	8,6
62-396	126	9,0	120	8,5	115	8,7
M 26	128	9,6	123	8,9	117	8,9
M 7	131	10,0	124	8,9	118	9,0
MM 106	135	10,2	129	9,4	124	10,0
$Dl_{0.05}$	*1,98*	-	*3,03*	-	*2,86*	-
2009 year						
M 9	114	9,4	111	8,9	109	8,7
62-396	116	9,8	112	9,4	114	8,8
M 26	117	9,8	117	9,5	114	9,2
M 7	120	10,0	117	9,6	115	9,5
MM 106	125	10,1	120	10,0	116	9,7
$Dl_{0.05}$	*2,75*	-	*2,40*	-	*3,01*	-

*- at 10 cm above the graft's place

Table 2

Growth main indicators of apple trees in the second field of the fruit nursery depending on rootstock type, 2009

Rootstock	Tree height, *cm*	Trunk diameter,* *mm*	Crown dimensions			
			normal branches		sylleptic shoots	
			number, *pcs/tree*	average lenght, *cm*	number, *pcs/tree*	average lenght, *cm*
Gala Must variety						
M 9	170,00	15,00	4,50	80,00	3,50	23,00
62-396	176,50	16,33	4,50	73,13	4,00	30,75
M 26	191,25	15,65	4,25	78,78	4,75	33,39
M 7	186,25	16,33	4,25	86,50	7,25	28,00
MM 106	193,75	16,25	4,50	82,94	7,50	31,98
$LSD_{0,05}$	*4,32*	-	-	*2,72*	-	*3,76*
Golden Reinders variety						
M 9	184,50	15,33	4,00	75,63	3,50	35,75
62-396	185,00	17,00	3,50	72,85	3,50	34,50
M 26	191,50	16,50	4,00	81,88	3,75	43,88
M 7	185,00	17,00	4,00	92,88	6,25	26,85
MM 106	194,75	16,13	4,25	74,25	6,00	44,47
$LSD_{0,05}$	*7,71*	-	-	*6,74*	-	*2,79*
Idared variety						
M 9	186,25	15,50	4,00	67,24	4,25	34,38
62-396	182,50	15,68	3,75	72,50	1,75	37,16
M 26	190,00	16,33	4,00	80,30	3,00	32,50
M 7	192,00	16,30	4,00	83,44	4,00	37,96
MM 106	190,25	16,25	4,00	75,94	5,25	31,49
$LSD_{0,05}$	*4,77*	-	-	*5,09*	-	*1,68*

*- at 10 cm above the graft's place

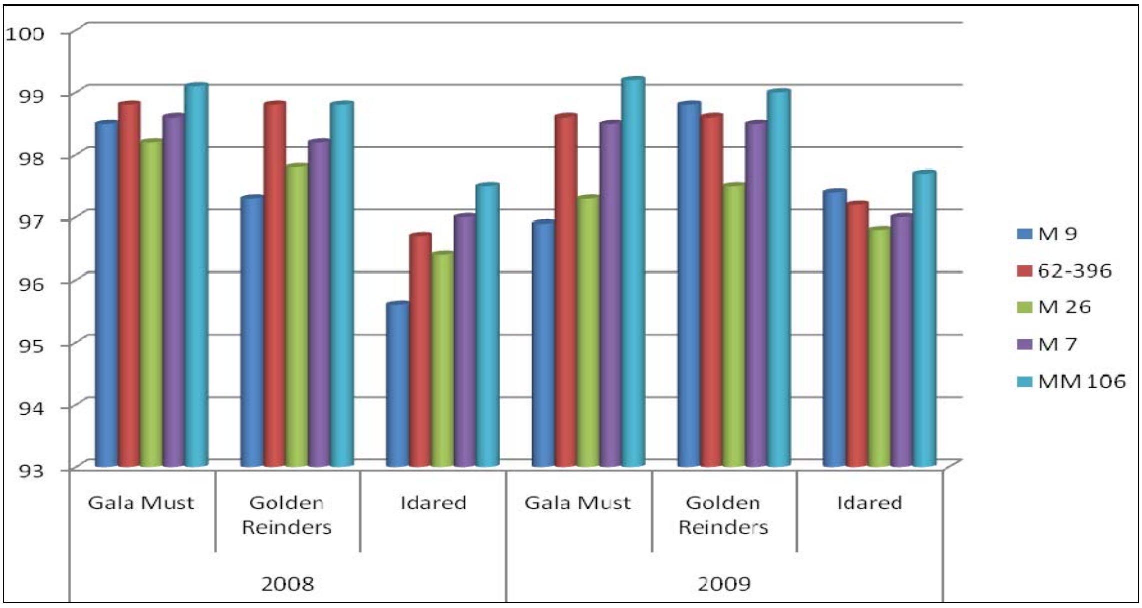

Fig. 1. The degree of striking bench graftings planted in the first field of the fruit nursery, %

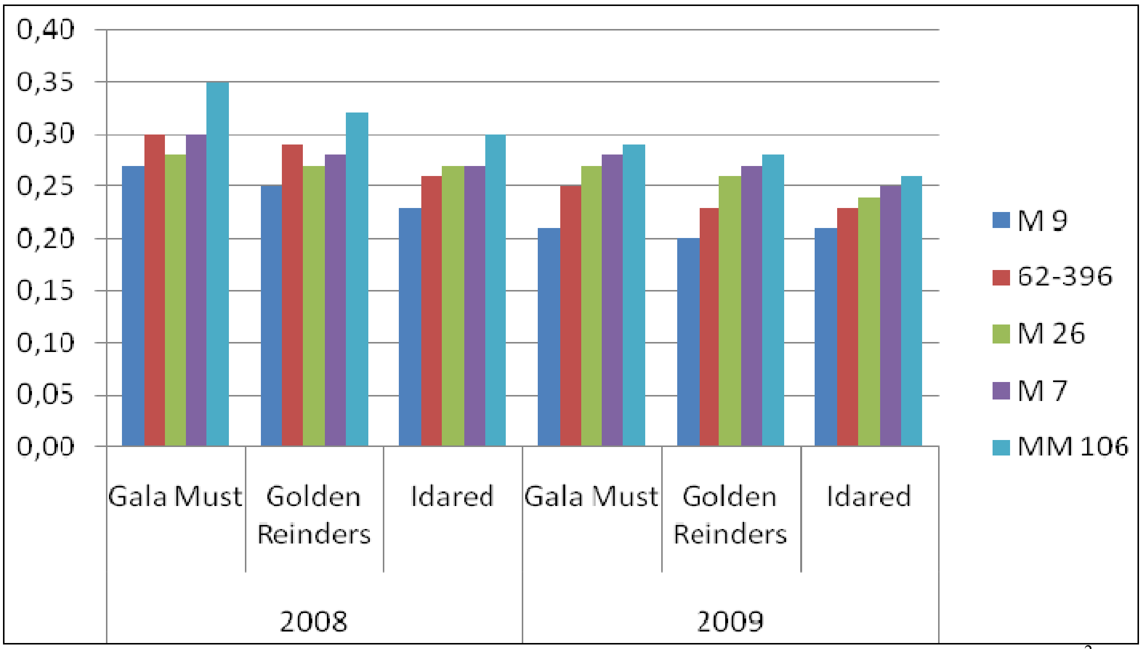

Fig. 2. Leaf surface of apple trees in the first field of the fruit nursery depending on rootstock type, m^2/tree

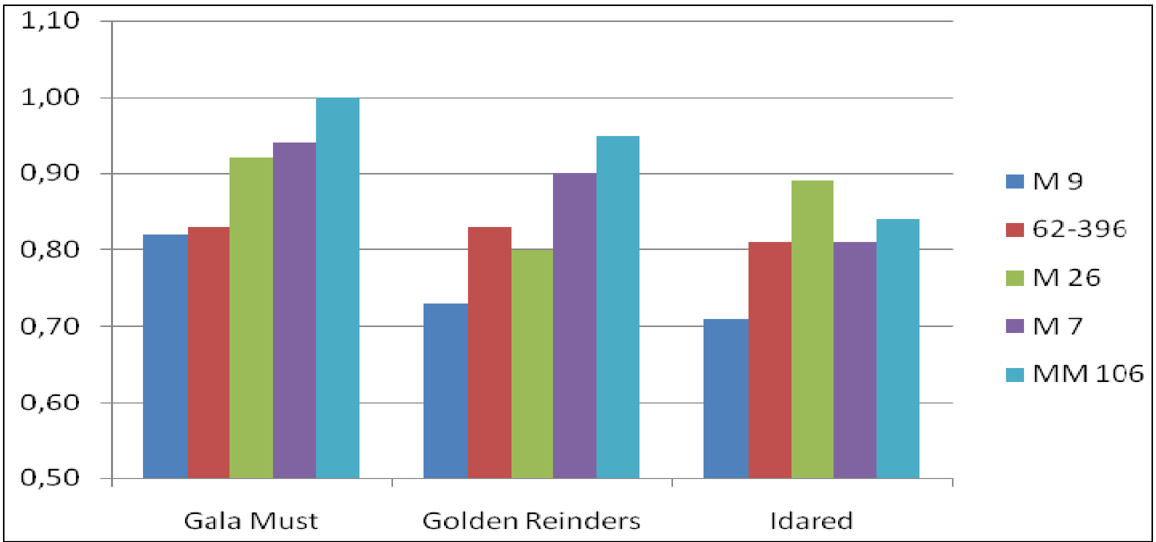

Fig. 3. Leaf surface of apple trees in the second field of the fruit nursery depending on rootstock type, m^2/tree, 2009

Roots development capacity of gooseberry plants

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Keyword: gooseberry, variety, roots, weight, length.

ABSTRACT

Investigations on capacity development and location of barberry root system growing in new conditions were performed in the experimental field plantation located in the Institute of Pomology in 2000. Objectives of the study was to evaluate the development length and location of root mass in soil in plantations in four gooseberry varieties: Donetski krupnoplodnîi, Donetski perveneţ, Şcedrîi, Kolobok on the plantation distances - 2,5 x 0,75m 2,5 x 1,00m, 2,5 x 1,25m. Length and root mass in all species studied (Donetski krupnoplodnîi, Donetski perveneţ, Şcedrîi, Kolobok) were established maximum corresponding between 16320,6 – 12807,5 cm and 2410,4 -1881,8 g on planting distance 2, 5 x 1,25 m.

INTRODUCTION

Gooseberry, having a well developed root system and located deeper in the soil and the growing vigour can increase its production and quality essential.

Agro-biological productivity of plantations of gooseberry depends largely on the force distribution in soil and root system of plant variety, soil type, climate conditions, deep ground water and of course the maintenance of plant. Varieties with a high capacity for regeneration and branching have branched root system in May. It is established that gooseberry root system is adventitious.

Skeleton roots of gooseberry, unlike other tree species are not strictly differentiated horizontally and in depth. Often times they are dual nature, in horizontal spread in upper layers at a depth of 40-80 cm in row and between rows, and then are directed at an angle in depth [3].

Barberry root system is more developed than the blueberry. Most absorbing roots are located in the arable layer of soil to a depth of 10-50 cm, and some reach up to 2 m in depth and more. Roots are placed in part on a 50-70 cm radius from the centre of shrubs their position was in particular in projection machines. Only a small number of roots are found beyond. [5] [6].

Quantitative record of roots on the vertical wall at a distance of 0.5 m from the centre bushes showed that most of them is located at a depth of 20-70 cm, the layers most fertile, well-ventilated, secured maximum water [1].

Barberry root location in a radius of 10 cm from the centre of the bush is at a depth of 10 cm, 20 cm in radius - to a depth of 16-17 cm and 30 cm in radius - to a depth of 17.5 to 21, 0 cm from soil surface. For a not too deep ploughing before planting barberry root system tends to grow more horizontally than vertically [2].

Roots 0.8 to 1.0 cm thick and thicker are very hard to restore, especially in dry regions in the absence of irrigation. Therefore, the roots must be protected from cutting their time of ploughing [4].

As a result of investigations marked with superphosphate shown that each root has its share of stock they feed. That is why fertilizer is recommended to be spread evenly around the plant. [7].

MATERIALS AND METHODS

Investigations on the development and location of gooseberry root system, the new conditions of cultivation were made in the required field fitted the experimental planting on the Research Institute of Horticulture in 2000. The research was carried out according to the methods established for studying roots. The study included four gooseberry varieties: Donetski perveneţ, Donetski krupnoplodni, Kolobok, Scedri. Planting distances - 2.5 x 0.75 m, 2.5 x 1.00 m, 2, 5 x 1.25 m.

RESULTS AND DISCUSSIONS

There are no gooseberry varieties created for the Republic of Moldova. Introduced varieties, new cultivation conditions studied, other than those for which they were created, they can adapt different, being more or less resistant to our climatic conditions can have a high or less harvest, fruit may be with better quality or vice versa. This result can be established in scientific research.

Study gooseberry root system through the experimental excavations on the Fruit Research Institute in 2000 to determine how the location of roots in soil in the central area of Republic of Moldova.

According to available data, most of gooseberry roots were distributed horizontally at a distance of 40-50 cm from the centre of the bushes and only some of them gather in the area of 70-90 cm. Half of the roots are distributed at a depth of 10-20 cm, 30% of them - at a depth of 20-60 cm and the rest - to a depth of 1.0 to 1.2 m. The roots system of gooseberry variety Donetski krupnoplodni is presented in Figure 1.

Namely, that part of the roots, depend on drought resistance of plants, gooseberry bush. At gooseberry the distance between plants in rows 1.0 m provide sufficient development of roots and the root system developed in the varieties studied variant is the distribution of plants on planting schedule 2.5 x1, 25 m.

According to the investigations (table 1) to Donetski Krupnoplodni variety determined to garnish roots length to diameter is 0.3 cm from 9399.5 to 10385.4 cm and the roots to a skeleton and half-frame skeleton with a diameter greater than 0.3 cm is from 5258,6 cm to 5935.2 cm.

Specific varieties under study we report the following: ratio of root length with diameters up to 0.3 and greater than 0.3 cm, calculated on data obtained is different depending on planting distances (from the planting distance pressed) and namely: Donetski krupnoplodni - 1,79 - 1.74 to 1.75; Donetski pervenets - 1.55-1.48 -1.54; Şcedrîi - 1.42 -1.31 -1 38; Kolobok - 1.39 -1.40 -1.42.

Roots mass of Donetski krupnoplodni up to 0.3 cm in diameter (table 2) ranged from 369.1 to 475.3 g and has the largest diameter of 0.3 cm between 1649.4 to 1935.1 g. All these indicators take the same sequence in the other varieties ranged from the following: variety Donetski pervenets: 345.4 to 430.5 g and 1678.4 -1980.4 g; variety Şcedrîi: 334.2 to 395.1 g and 1532.3 to 1815.4 g; variety Kolobok: 357.2 - 361.4 g and 1477.2 to 1520.4 g

According to the results obtained on Donetski krupnoplodni variety has the highest ratio of these indicators, the variety Şcedri respectively lowest and varieties Donetski pervenets and Kolobok hold an intermediate position. Varieties Donetski krupnoplodni, Donetski pervenets and Şcedri planting stuff distances (2.5 x 0.75 m and 2.5 x 1.0 m) provides a higher ratio of these indicators, the first being a variant. But in this respect Kolobok variety acts around. In version 3 the distance between the plant row 1.25 m highest ratios was detected, and a variant 1- the lowest. At first varieties mentioned above has been found that a linear meter of skeleton roots and semi-skeleton recovered most of the roots few meters garnish. In that report Kolobok variety ranges from 1.39 to 1.42. Differences of 0.01 and 0.03 are not significant.

Location gooseberry plants at a distance of 1.0 m in row assures positive roots, regardless of the fact that most developed root system of plants, gooseberry bush varieties studied variant was found in 3 (2.5 x 1.25 m). In this variant, the length of roots garnish brief, half-frame and frame had the following values: 16320.6 cm (Donetski krupnoplodni), 15161.9

cm (Donetski pervenets), 13805.2 cm (Şcedri), 12807.5 cm (Kolobok). Analysis of data on roots mass of garnish, half-frame and frame (tab.2) revealed an analogy placement of variants and varieties studied among the data obtained in the experiment.

CONCLUSIONS

So now, research conducted to study barberry root system according to variety and planting distances allowed us to establish that the development of basic roots of bushes, gooseberry bush largely affect particular variety. When the power increase the shrubs, the roots mass and length are greater. Length and roots mass in all species studied (Donetski krupnoplodni, Donetski pervenets, Şcedri, Kolobok) were established between the peaks corresponding between 16320.6 -12807.5 cm and 1881.8 - 2410.4 g on planting distance 2,5 x 1,25 m.

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TABLES AND FIGURES

Table 1

Roots length depending on variety and planting distances

Variety	Planting distances, m	Roots length, cm		Summary of root length, cm	The ratio of root length with Ø><0.3cm
		with Ø up to 0.3 cm	with Ø bigger than 0.3 cm.		
Doneţki krupnoplodnîi	2,5x0,75	9399,5	5258,6	14658,1	1,79
	2,5x1,00	9895,6	5696,3	15591,9	1,74
	2,5x1,25	10385,4	5935,2	16320,6	1,75
Doneţki perveneţ	2,5x0,75	8274,1	5343,2	13617,3	1,55
	2,5x1,00	8393,4	5677,4	14070,8	1,48
	2,5x1,25	9184,5	5977,4	15161,9	1,54
Şcedrîi	2,5x0,75	7311,7	5147,7	12459,4	1,42
	2,5x1,00	7599,3	5783,2	13382,5	1,31
	2,5x1,25	8009,7	5795,5	13805,2	1,38
Kolobok	2,5x0,75	6951,3	5014,3	11965,6	1,39
	2,5x1,00	7325,1	5218,7	12543,8	1,40
	2,5x1,25	7533,6	5273,9	12807,5	1,42
Limited variation		**6951,3 -10385,4**	**5014,3 -5977,4**	**11965,6-16320,6**	**1,31- 1,79**

Table 2

Roots weight depending on variety and planting distances

Variety	Planting distances, m	Roots weight, g		The total mass of roots, g	The ratio of root mass Ø> <0.3 cm
		With Ø up to 0.3 cm	with Ø bigger than 0.3 cm.		
Donetski krupnoplodni	2,5x0,75	369,1	1649,4	2018,5	0,22
	2,5x1,00	471,4	1719,3	2190,7	0,27
	2,5x1,25	475,3	1935,1	2410,4	0,25
Donetski pervenets	2,5x0,75	345,4	1678,4	2023,8	0,21
	2,5x1,00	413,3	1831,9	2245,2	0,23
	2,5x1,25	430,5	1980,4	2410,9	0,22
Şcedri	2,5x0,75	334,2	1532,3	1866,4	0,22
	2,5x1,00	385,4	1705,7	2091,1	0,23
	2,5x1,25	395,1	1815,4	2210,5	0,22
Kolobok	2,5x0,75	357,2	1477,2	1834,4	0,24
	2,5x1,00	373,8	1461,7	1835,5	0,26
	2,5x1,25	361,4	1520,4	1881,8	0,24
Limited variation		**334,2-475,3**	**1461,7-1980,4**	**1834,4-2410,9**	**0,21-0,27**

Fig. 1. The roots system of gooseberry variety Donetski krupnoplodni

VITICULTURE&OENOLOGY

The flavouring of Fetească neagră wines with oak chips and tannin and its influence on the colour and sensory parameters of young wines

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Keywords: CIELab parameters, chips, lyophylized tannins, sensory analysis.

ABSTRACT

The wines obtained from the Romanian variety Fetească neagră are usually less structured and less coloured, due to insufficient accumulation of natural tannins. Treatments with alternative oak products were used to enhance the colour and sensory parameters of wines from this variety. Enological tannin and an oak chip product were chosen from the products available on the market to be tested. The wines treated were assessed while still young; therefore the results are only showing some trends for the future development of those wines. However, even at 6 months from their production and treatment, the wines showed some difference in the colour and improvement in the sensory profile, compared to controls. The oak chips treatment improves the aromatic profile, which becomes more complex, but has less influence on the wine colour. On the other hand, the treatment with enological tannin seems to make a difference in some colour parameters, while the aroma of the resulted wines is not improved, lacking the expected complexity. For the Fetească neagră variety the application of both products proved beneficial in comparison with the variants of non-treated wines, the chips treatment being preferred by the wine tasters for its effect in aroma enhancement.

INTRODUCTION

The wine obtained from the Romanian Fetească neagră variety is usually less structured and less coloured compared with other varieties. Therefore it was considered that both colour and sensory parameters could be improved by increasing the amount of tannins in the wine, either by aging it in oak barrels or by technological addition of tannin under the form of lyophylized products or oak chips. An increase of the tannin presence in the wine matrix leads to a stabilization of the colour as a result of the formation of tannin-anthocyans complexes. The traditional aging in barrels techiques is, however, time consuming and costly, therefore the alternative methods for oak flavouring are more and more applied by many producers. The results obtained through this type of rapid flavouring are not quite similar with those from aging in barrel, especially in the absence of controlled micro-oxygenation, which is otherwise naturally achieved in oak containers. However, some interesting results can also be obtained with these flavouring methods. The impact of oak on wine flavour is due basically from extraction of volatile aroma and flavour compounds from oak and transfer into wine. Moreover, the addition of exogenous compounds has the advantage of more versatility as far as the dosage and timing is concerned. Various factors can influence the flavour of wines treated with alternative oak products (Campbel *et al.*, 2006), but in this preliminary study we only tried to determine which type of product is more suitable for Fetească neagră wines.

MATERIALS AND METHODS

The wine of Fetească neagră was obtained in 2009 in the Department of Viticulture and Enology of the university from grapes harvested in Pietroasa region, Buzău County. The wines were all produced by maceration-fermentation, in accordance to the traditional technology, in the presence of the commercial yeast Lalvin BM 45, yeast provided by Lallemand and recommended for red wines in which varietal character is to be preserved.

One month from the wine production, in order to enhance some sensory parameters, the flavouring was made by addition of oak chips and lyophylized oak-extracted tannin in various concentrations (Table 1). All variants were produced in triplicates and all the analyses performed for each wine were run in triplicate.

The oak chips were from American oak, medium toasted, provided by Tonnellerie Radoux USA, commercially available under the trade name Pronektar. Generally, the American oak chips release in wines less tannins than the other oak chips, being however more aromatic, adding to wines perceivable aromas of vanilla and cocoa.

The tannin, obtained from toasted French cask oak through a special extraction and desiccation process, was provided by Enologica Vason under the trade name Premium Tostato. This product is very soft tannin, supposed to increase the woody-toasty aromatic profile, with some cocoa notes.

The wines were then analyzed in order to determine the colour parameters. The colour was determined by an Analytik Jena AG Specord 250 UV-VIS spectrophotometer running WinAspect version 2.2.7 special software for colour determination. The colour parameters were obtained with a 1 mm quartz cuvette and using a D65 illuminant, a 10° standard observer and by measuring the transmittance of the wine every 1 nm over the visible spectrum from 400 nm to 700 nm.

The software automatically calculates both tristimulus/trichromatic parameters (X, Y, Z colour coordinates and x, y, z colour coordinates – OIV, 1996) and their transformation into a perceptually uniform space, CIELab parameters. Variations of parameters (ΔL, ΔC_{ab} and Δh_{ab}) can also be calculated, as well as the total colour differences ΔE_{ab}, with respect to a reference point (control samples), being expressed in CIELab units. The formula for the calculation of $\Delta E_{ab} = ((L_1 - L_2)^2 + (a_1 - a_2)^2 + (b_1 - b_2)^2)^{1/2}$ gives a value that represents the colour differences that are readily perceivable by the eye, provided $\Delta E_{ab} > 1$ (Esparza *et al.*, 2009).

The sensory analyses were performed by a panel of 5 winetasters on the basis of a specially designed evaluation sheet (Antoce and Nămoloșanu, 2007). From the main general sensory parameters and specific sensory parameters only those considered relevant for the aromatization with chips and tannins were taken into consideration. The characteristics assessed were astringency and bitterness perception from the general parameters, and fruit note, vegetal note, vanilla, spicy, toasted and oaky notes, from specific sensory parameters. The points awarded for the general sensory parameters varied from 1 to 10, being obtained on continuous scales, while the evaluation for specific sensory parameters was performed on discontinuous scales from 1 to 5 and then normalized to be plotted on the same diagrams as the general parameters. On the basis of this quantitative sensory analysis the sensory profiles for each wine were derived.

RESULTS AND DISCUSSION

In order to evaluate the influence of the alternative oak products on the colour of young Feteasca neagră wines, the trichromatic parameters (Table 2) and the CieLab parameters (Table 3) were determined spectrophotometrically 6 months from the wine's completion of the maceration-fermentation process. Although for both types of experimental variants, with chips (C) and with tannin (T), respectively, the dosage of the product was used in increasing aliquots, the colour parameters did not differ significantly in most cases. The statistic analysis (ANOVA) showed that only the colour of control wines differed significantly from the colour of tannin samples, but these results should be regarded with caution, since the power of the test was small.

The position of all the samples in the *a* versus *b* colour space (Fig. 1a) also shows not a big difference between the oak products treated samples, but a clear difference of the control (untreated sample), which is located towards red colour with a slightly more intense shade of blue (Fig. 1 b). The treated samples have more yellow in their colour, although for all the samples the dominant wavelength was 359 nm, violet. Surprisingly, the treated samples did not show any correlation between the colour position in space and the concentration of the product used.

The differentiation of the colour of treated samples and control is better described by the parameter δE_{ab}, the total colour difference, displayed in Fig. 2. Although statistic tests were inconclusive regarding the existence of a significant difference between the samples, it seems that the chips samples form a group with differences in colour ranging between 0.94 and 1.24, while the tannins samples form a group with δE_{ab} ranging from 1.22 to 1.61. In this case we can assume that the effect of the added tannin modifies slightly more the colour than the addition of the oak chips. This effect is supposed to be clearer for the aged wines, therefore the wines should be analysed again after some more maturation.

Aside of the effect on colour, the alternative oak products are used for the flavours that could be conferred to the wines. The sensory analysis of the produced wines led to interesting conclusions. As expected, the control sample was clearly differentiated by the panellists, being described as having a reductive smell, taste of stems and oxidized mark, fruity aroma of blackberries, dry, but overall well-balanced. Comparing to the control, the chips treated wines (Fig. 3) had an increased astringency and bitterness was not necessarily directly related to the dosage, especially in the case of the astringency. For the samples with higher dosages of chips the oaky flavour becomes dominant, reaching values of 8 and 10 for the samples with 400 g/hl chips and 500 g/hl, respectively. The vanilla flavour also increases with the dosage, but it is overwhelmed in the case of the highest dosage by the oaky aroma. The hints of cocoa, dark chocolate and toast are also variable, depending on the complexity of the wine matrix and not on the dosage.

The wines treated with tannins showed a simpler aromatic profile (Fig. 4), most of the samples having only increased astringency and bitterness compared to the control. The samples treated with lower dosages showed the same vegetal note as the control and some samples displayed a spicy note. However, the tannin samples were less elegant and round than all the samples treated with oak chips.

The panellists ranked the variants in accordance to the overall wine quality, the ranks being as follows, starting with the best: C3, C5, C4, T5, C2, C1, T4, T3, T1, T2, M. The best sample, C3, was described as being more intense aromatic comparing to all the others, but relatively astringent, with a fruity note of bitter cherry. In all the samples treated the mouth feels and roundness was obviously improved compared to the control.

CONCLUSIONS

The treatment of Fetească neagră with oak-derived products is a rapid and cost-efficient alternative to the aging in barrels.

The wines treated and assessed were still young; therefore, most of the features that improve in red wines in time could not be properly evaluated. However, even at 6 months from their production and treatment, the wines showed some difference in the colour and an improvement in the sensory profile.

The treatment with oak chips gives a more complex aromatic profile, but its influence on the colour of the wines is minimal. On the other hand, the treatment with enological tannins stabilizes the colour and enhances some colour parameters, but the aroma of the resulted wines is still lacking complexity.

For the Fetească neagră variety both treatments provided better results than in the case of non-treated wines, with the chips treatment being preferred for the intensification of aroma.

ACKNOWLEDGEMENTS

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TABLES AND FIGURES

Table 1

Variants of Fetească neagră wines treated with alternative oak products

Wine sample	Code	Dosage and timing
M	FNPP	Control
C1	FNPPC1	100 g/hl oak chips (added after fermentation and kept in contact for 5 weeks)
C2	FNPPC2	200 g/hl oak chips (added after fermentation and kept in contact for 5 weeks)
C3	FNPPC3	300 g/hl oak chips (added after fermentation and kept in contact for 5 weeks)
C4	FNPPC4	400 g/hl oak chips (added after fermentation and kept in contact for 5 weeks)
C5	FNPPC5	500 g/hl oak chips (added after fermentation and kept in contact for 5 weeks)
T1	FNPPT1	5 g/hl Tostato tannin (added after fermentation)
T2	FNPPT2	8 g/hl Tostato tannin (added after fermentation)
T3	FNPPT3	10 g/hl Tostato tannin (added after fermentation)
T4	FNPPT4	12 g/hl Tostato tannin (added after fermentation)
T5	FNPPT5	15 g/hl Tostato tannin (added after fermentation)

Table 2

Trichromatic parameters and basic colour percentages determined 6 months after wine production

Wine sample	Trichromatic parameters (average ± standard deviation)					
	X	Y	Z	x % of red	y % of green	z % of blue
M	57.02±1.77	49.47±2.09	53.892.77	0.36	0.31	0.33
C1	58.41±1.42	50.60±1.74	55.71±2.29	0.35	0.31	0.34
C2	58.78±1.48	51.07±1.77	56.17±2.31	0.35	0.31	0.34
C3	59.01±1.48	51.38±1.81	56.37±2.38	0.35	0.31	0.34
C4	58.64±1.69	51.03±2.05	56.01±2.64	0.35	0.31	0.34
C5	58.55±1.69	51.02±2.02	55.81±2.64	0.35	0.31	0.34
T1	59.45±1.68	51.82±2.05	56.78±2.63	0.35	0.31	0.34
T2	59.63±1.55	51.99±1.89	57.08±2.44	0.35	0.31	0.34
T3	59.28±1.71	51.58±1.99	56.66±2.61	0.35	0.31	0.34
T4	59.46±1.40	51.78±1.68	56.97±2.24	0.35	0.31	0.34
T5	58.79±1.53	51.26±1.86	56.22±2.37	0.35	0.31	0.34

Table 3

CIELab parameters determined 6 months after wine production

Wine sample	CIELab parameters (average ± standard deviation)					
	L	a	b	c_{ab}	h_{ab}	δE_{ab}
M	75.73±1.29	21.89±1.25	4.26±0.41	22.31±1.30	0.19±0.01	0.00±0.00
C1	76.43±1.06	22.26±1.17	3.74±0.31	22.57±1.21	0.17±0.01	0.94±0.27
C2	76.71±1.06	21.95±1.10	3.81±0.31	22.27±1.13	0.17±0.01	1.08±0.29
C3	76.90±1.09	21.67±1.18	3.95±0.33	22.02±1.22	0.18±0.01	1.24±0.23
C4	76.68±1.23	21.72±1.31	3.91±0.31	22.07±1.34	0.18±0.00	1.03±0.13
C5	76.68±1.22	21.50±1.19	4.09±0.37	21.89±1.24	0.19±0.01	1.04±0.10
T1	77.16±1.22	21.58±1.32	4.02±0.30	21.95±1.35	0.18±0.00	1.49±0.15
T2	77.26±1.12	21.57±1.19	3.91±0.29	21.93±1.22	0.18±0.00	1.61±0.21
T3	77.02±1.19	21.79±1.07	3.89±0.34	22.13±1.12	0.18±0.01	1.35±0.21
T4	77.14±1.00	21.70±1.12	3.80±0.34	22.03±1.14	0.17±0.01	1.50±0.32
T5	76.82±1.13	21.46±1.24	3.95±0.26	21.82±1.27	0.18±0.00	1.22±0.22

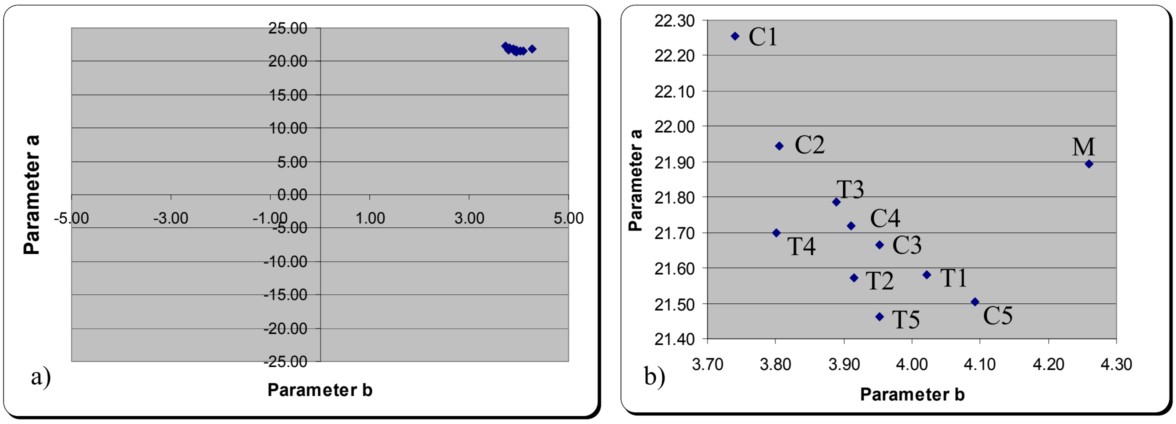

Fig. 1. The position of Feteasca neagra wines in the colour space

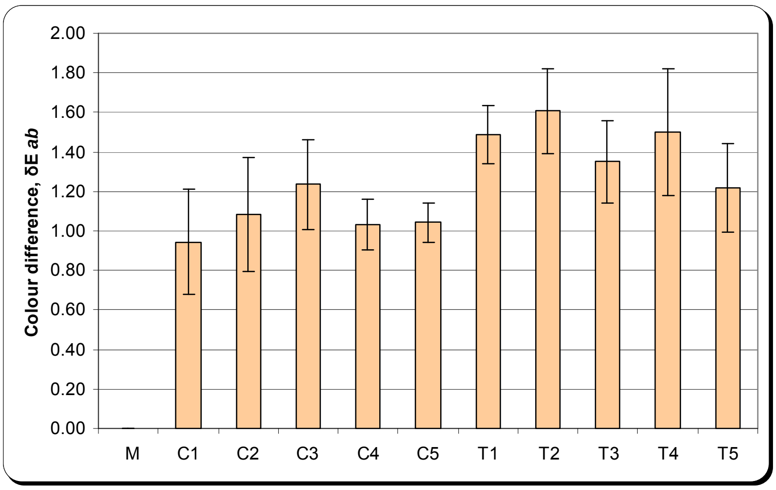

Fig. 2. Colour differences of the samples calculated in comparison with the control (untreated) sample

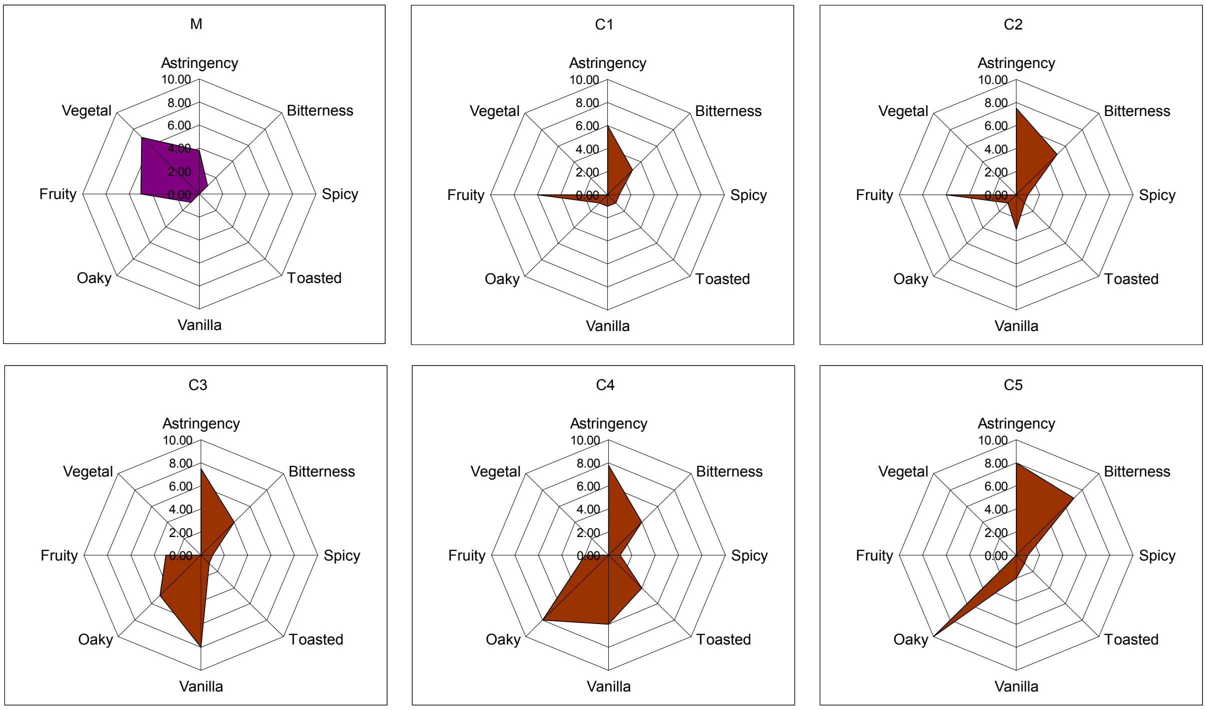

Fig. 3. Sensory profile of the Fetească neagră wines treated with various concentrations of oak chips (0; 100; 200; 300; 400 and 500 g/hl)

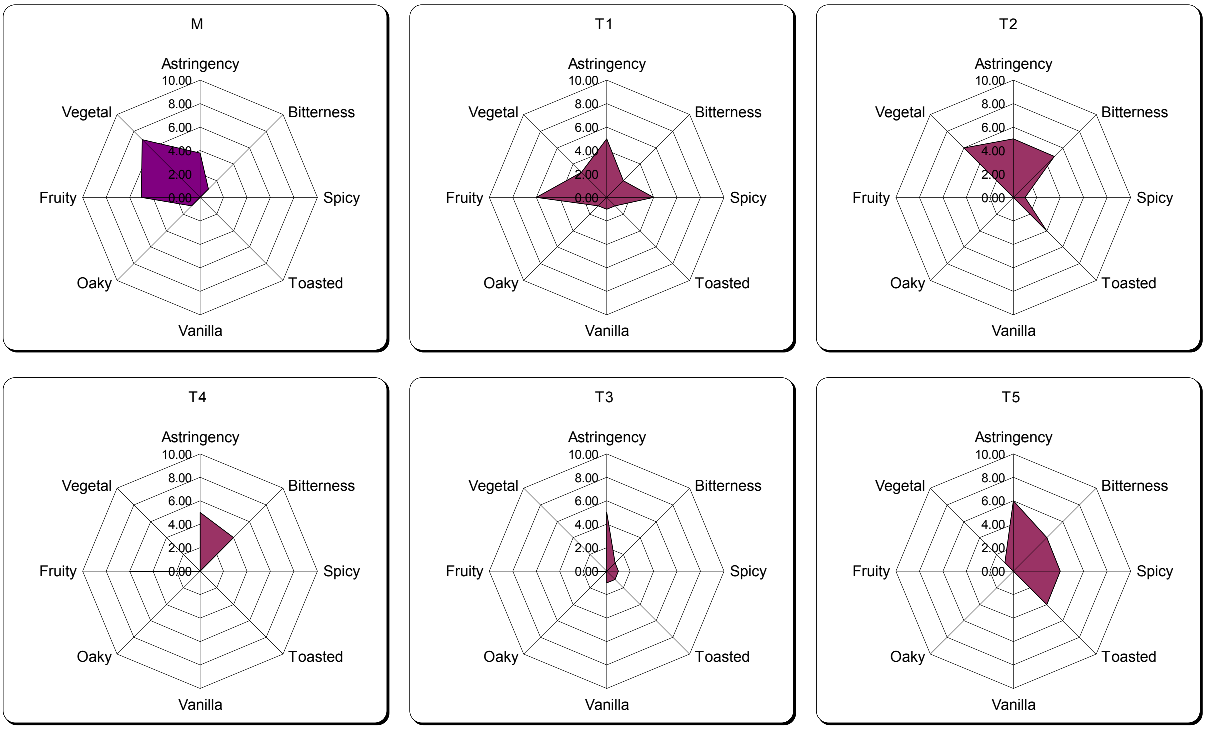

Fig. 4. Sensory profile of the Fetească neagră wines treated with lyophylized oak tannin (0; 5; 8; 10; 12 and 15 g/hl)

The evaluation of the influence of the vine treatments with Nova and Atonik bioregulators on the wine quality of Fetească regală and Fetească neagră varieties

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Keywords: Romanian autochtonous varieties, bioregulators, sensory profile, electronic nose wine differentiation.

ABSTRACT

The wines resulted from Feteasca regala and Feteasca neagra varieties treated with foliar fertilizer NOVA or with biostimulator ATONIK were studied in the terroir of Pietroasa, Buzau county. Physico-chemical and sensory parameters for wines obtained in triplicates from each treated vine plot were determined and discussed comparatively. Significant differences in physico-chemical and sensory analyses parameters were observed in accordance to the type of treatment. The wines obtained from the lots treated with Atonik scored the best results in sensory analyses performed by a trained panel of wine tasters, followed by the wines from lots treated with Nova, in each variety group. The differentiation of wines using a GC-electronic nose and DFA (Discriminant Factor Analysis), as well as their sensory profiles, are also discussed.

INTRODUCTION

Internationally there is a trend for the study of bioregulators in order to use them to improve plant resistance to frost, heat or certain pests, as well as to increase the yield and also the quality of the processed products (Hedin *et al.*, 1988a and b;). For vine plantations there can be found on the market several products from the category of bioregulators (Adsule *et al.*, 2007), most for conventional agriculture, other also for the use in ecologial plantations. Applied in vineyards, these products improve the photosynthesis by extending the range of the light spectrum that can be used for the photosynthesis or by stimulation of chlorophyll pigments accumulation. Due to these biochemically induced changes, biostimulators can leads to faster growth and precocity, to better resistance to various stress factors and pests, but more importantly to a higher accumulation of sugar and other colour or aroma compounds in grapes. This last result is supposed to have a perceivable effect on the wines produced from these grapes and in this work we report some results for Feteasca neagra and Feteasca regala wines obtained in plantations treated with two bioregulators, NOVA and ATONIK.

MATERIALS AND METHODS

Plots of Feteasca neagra and Feteasca regala varieties from Pietroasa vineyard were treated 3 times per season with two European approved bioregulators. The first one, NOVA 11-5-8, is a foliar fertilizer, used in ecological viticulture, with 11% N, 5% P_2O_5 and 8% K_2O, also containing microelements, aminoacids, organic acids, enzymes, glucides and activators. The other, ATONIK, is a biostimulator based on 0.2% sodium *o*-nitrophenolate, 0.3% sodium *p*-nitrophenolate and 0.1% sodium nitro-guaiacolate.

The treatments with the biostimulators were performed 3 times: before flowering, on May 25; at the end of flowering phase, on June 12; and at the end of the intensive growth of shoots phase, on June 23, 2009. The dosage for an atomizer of 15 liters capacity was 120 ml for NOVA and 12 ml for ATONIK.

The experimental variants from which wines were produced in triplicates, for both grape varieties, are described in Table 1.

From all these experimental parcels the grapes were harvested separately and vinified in accordance to the traditional technology for white and, respectively, red wines used in Pietroasa (ONDOV decision 2006).

The wines were analyzed 3 months later, the basic parameters being determined by using the standardized methods approved by the International Organization of Wine and Vine (OIV 1996). The statistical analysis was performed with Sigma Stat Software ver. 2.03 of the SPSS Inc Company.

Blind sensory analysis was performed by a panel of 5 winetasters, in accordance with an evaluation sheet developed for the analysis of varietal typicality (Antoce and Nămoloşanu, 2007). The general parameters evaluated are the perceived acidity, sweetness, astringency, dry content, colour intensity and aroma intensity. In the same time specific parameters, such as the floral note, the vegetal note and the spicy/roasted note, which are important for the construction of a sensory aromatic profile, were also determined.

A finer discrimination between wines was performed by using the volatile compounds fingerprinting obtained with an electronic nose, a dual column gas chromatograph from Alpha-MOS, France (Antoce and Nămoloşanu, 2009). For the sample differentiation, a multivariate analysis named Discriminant Factor Analysis (DFA) was applied, based on the specialized software of the apparatus, AlphaSoft ver 12.3.

RESULTS AND DISCUSSION

The wines produced in the autumn of 2009 were analyzed three months after their production and the results of the main chemical analyses for the Feteasca neagra and Feteasca regala are presented in Table 2 abd Table 3, respectively. For the comparison of means multivariate analysis of variance (MANOVA) was performed and the comparison in pairs by using the LSD Test, with the mean difference significant at the 0.05 level. The significantly different values at this significance level of 0.05 are indicated for each parameter in different letters after the values.

As it can be seen from Table 2, the wines of the Feteasca neagra obtained from grapes treated with Atonik biostimulator have alcoholic strength, dry content and density significantly different than the control wines or the other wines obtained from plantations treated with Nova biostimulator. As far as the other parameters are concerned, such as total and volatile acidity, there is no significant difference between samples. These results correlate with a higher sugar accumulation in the Feteasca neagra grapes obtained in plantation treated with bioregulators (results shown elsewhere), which leads to a higher alcoholic content. The total dry content is, however, the lowest in the Atonik-treated Feteasca neagra wines, indicating an influence of the bioregulator on the accumulation of various compounds in the berries.

For Feteasca regala wines, irrespective of the treatment applied in plantation, there is no significant difference between variants at the level of the basic chemical parameters.

These results show that the influences of bioregulators are more subtle and the differentiation of the wines, there is any, should be performed with more sensitive methods or, at least with methods oriented to the assessment of the specific aroma parameters.

The sensory analysis of the wines showed that there are perceivable differences between the wines; although the evaluation also targeted some of the general parameters such as acidity, sweetness, dry content and so on, but this time the analysis focused on the perception of these wine characteristics in the complex matrices of wines. These differences are due to the reciprocal influences of various compounds on the sensorial level and cannot be completely described by chemical analysis only.

The results of the sensory assessment of the general sensory parameters for Feteasca regala and Feteasca neagra are included in Tables 4 and 5, respectively. The means of the determined parameters were treated statistically with post-hoc Scheffe test and the significant differences are displayed in different letters.

The Fetească neagră wines from ATONIK- and NOVA-treated plantations showed a perceivable higher astringency and again some differences in the dry content. Regarding this latter parameter, we can see that the dry content of NOVA Fetească neagră was perceived as significantly higher than that of the control, somehow consistent with the values obtained chemically, 31.86 g/l in control and 33.5 g/l in the wines from NOVA-treated plantations. Moreover, the perception of the dry content of ATONIK Feteasca neagra wines, although chemically significantly different from the control wines (27.85 g/l in ATONIK versus 31.86 g/l in control), was similar for both variants ATONIK and control. This results could be explained by the higher alcoholic content of ATONIK wine variant (12.20% v./v.) as compared to the one in control (11.50% v./v.) which probably compensated, from a sensory viewpoint, the lack of extract.

An interesting result provided by the sensory analysis of the Feteasca neagra wines highlighted the significantly higher aroma intensity of the wines from ATONIK-treated plantations, scoring 5 on a scale of 10, as compared to 3.7-3.8 obtained for the wines from NOVA-treated or control plantations. This parameter probably also influenced the decision of panelists to rank these wines in the first place among the Feteasca neagra samples (Table 4).

The sensory analysis results for Feteasca regala wines showed more variability between samples. The perceived astringency of all wines differed significantly (Table 5), while the perceived dry content of the wines obtained from Feteasca regala plantations treated with biostimulators, irrespective of the type, was significantly higher (4.7-4.8 points as compared to 2.3 for control). However, concerning the aroma intensity, the panelists perceived the control as being significantly more aromatic (7.16 points out of 10) than the samples produced from biostimulator-treated plantations (6.2 and 5.0, respectively). This more intense aroma of Feteasca regala wines did not influence the selection of the best wine sample by blind tasting, the panelist ranking also the ATONIK variant on the first place. This fact can be explained by a better aromatic quality of the Feteasca regala aroma induced by the treatment with ATONIK bioregulator, as compared to the typical Feteasca regala aroma which is usually characterized as being somehow a "rustic aroma".

On the basis of this sensory analysis, both general and specific assessed parameters were plotted for each variety and plantation treatment on radar diagrams that describe the sensory profiles of each type of wine (Fig. 1 and Fig. 2).

The sensory profiles of Feteasca neagra (Fig. 1) show clearly a more intense total aroma and more intense floral and vegetal notes for the ATONIK wines and a better mouthfill (dry content perception) for NOVA wines.

In Fetească regală wines (Fig. 2), NOVA increases the fruity note of the variety and makes the vegetal note disappear, while ATONIK slightly increases the spicy note, making the wines more interesting.

For more sensitive discrimination of the wines, a gas-chromatograph working on the principle of an electronic nose was also used. The volatile compounds in the headspace of the vials containing the wine samples were analysed and, on the basis of the area values of the most discriminated peaks recorded on both chromatograms for each variant, the wines were perfectly differentiated. In Fig. 3 and Fig. 4 the diagrams of Feteasca neagra and Feteasca regala, resulting by performing on the recorded data the Discriminant Factor Analysis, we can see a very good differentiation of samples in accordance with the raw material used for wine production. In both varieties, the wines obtained from ATONIK-treated, NOVA-treated and non-treated plantations are very well discriminated.

However, the human panellists, as would also be the case with normal consumers, could not discriminate the wines as accurately as the electronic nose. This fact leads to the conclusion that the biostimulators can be used for the increase of yield and sugar accumulation in grapes, without negative impact on the resulted wines. Moreover, the influences detected sensorially in the samples of ATONIK wines of both varieties led to improvement in wine quality, recommending this biostimulator from this viewpoint too.

CONCLUSIONS

From the parameters determined we can conclude that the wines of all variants are well-balanced, with basic physico-chemical parameters within normal limits. However, for the variants treated with ATONIK biostimulator, the alcoholic content of all the resulted wines is significantly higher comparing to the control or NOVA-treated wines, fact that is in accordance with a higher sugar accumulation due to the action of the biostimulators.

From the sensory point of view the most appreciated samples, from both varieties, were those obtained from grapes treated with ATONIK, the aromatic profile being improved and some general sensory parameters also being perceived as being of better quality.

None of the biostimulators had a negative impact on the sensory profile of wines. Since the application of these biostimulators increase the yield and sugar accumulation in grapes (data presented elsewhere), the absence of any negative impact on the resulted wines recommend them for the usage in our plantations.

Although not ranked sensorially in the first place, the also good results of NOVA treatments on the quality of the wines produced recommend it too for the application in practice, especially in the ecological plantations were ATONIK is not allowed. Future studies should be performed in the ecological Feteasca neagra plantation of Pietroasa.

ACKNOWLEDGEMENTS

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TABLES AND FIGURES

Table 1

Experimental variants of wines obtained from parcels of two grape varieties treated with two biostimulators in Pietroasa vineyard

Codification of resulted wine	Grape variety	Treatment in plantation
FRP_Ne_R1 FRP_Ne_R2 FRP_Ne_R3	Fetească regală (FR)	Control (Ne), Not treated
FNP_Ne_R1 FNP_Ne_R2 FNP_Ne_R1	Fetească neagră (FN)	Control (Ne), Not treated
FRP_N_R1 FRP_N_R2 FRP_N_R3	Fetească regală (FR)	Nova-treated (N)
FNP_N_R1 FNP_N_R2 FNP_N_R3	Fetească neagră (FN)	Nova-treated (N)
FRP_A_R1 FRP_A_R2 FRP_A_R3	Fetească regală (FR)	Atonik-treated (A)
FNP_A_R1 FNP_A_R2 FNP_A_R3	Fetească neagră (FN)	Atonik-treated (A)

Table 2

Basic chemical analysis of Fetească neagră wines obtained form grapes produced in plantations treated with ATONIK and NOVA biostimulators

Variant	Alcoholic content, % v./v.	Total acidity, g/l tartaric acid	Volatile acidity, g/l acetic acid	Total dry content, g/l	Density
FNP_Ne	***11.50*** ^{a}	***7.81*** ^{a}	***0.56*** ^{a}	***31.86*** ^{ab}	***0.9938*** ^{a}
R1	12.0	6.97	0.4	30.48	0.9924
R2	11.3	7.39	0.54	32.24	0.9941
R3	11.2	9.07	0.74	32.86	0.9948
FNP_N	***11.90*** ^{a}	***8.03*** ^{a}	***0.60*** ^{a}	***33.50*** ^{a}	***0.9935*** ^{a}
R1	12	8.73	0.54	34.18	0.9936
R2	11.9	6.97	0.53	31.12	0.9927
R3	11.8	8.4	0.73	35.21	0.9943
FNP_A	***12.20*** ^{b}	***8.09*** ^{a}	***0.56*** ^{a}	***27.85*** ^{b}	***0.9916*** ^{b}
R1	12	8.98	0.6	27.36	0.9912
R2	12.1	6.72	0.54	24.18	0.9913
R3	12.5	8.57	0.54	32.02	0.9923

Table 3
Basic chemical analysis of Fetească regală wines obtained form grapes produced in plantations treated with ATONIK and NOVA biostimulators

Variant	Alcoholic content, % v./v.	Total acidity, g/l tartaric acid	Volatile acidity, g/l acetic acid	Total dry content, g/l	Density
FRP_Ne	***11.37*** [a]	***6.90*** [a]	***0.54*** [a]	***24.39*** [a]	***0.9906*** [a]
R1	11.2	6.76	0.6	28.25	0.9926
R2	11.8	7.31	0.47	23.16	0.9894
R3	11.1	6.63	0.54	21.76	0.9898
FRP_N	***11.37*** [a]	***6.89*** [a]	***0.44*** [a]	***22.25*** [a]	***0.9898*** [a]
R1	11.1	7.73	0.53	23.36	0.9908
R2	11.2	6.8	0.4	24.38	0.9908
R3	11.8	6.13	0.4	19.01	0.9879
FRP_A	***11.60*** [a]	***7.22*** [a]	***0.49*** [a]	***25.38*** [a]	***0.9908*** [a]
R1	12.4	7.47	0.67	24.18	0.9892
R2	12.2	6.63	0.47	21.98	0.9897
R3	10.2	7.56	0.34	29.98	0.9936

Table 4
General sensory parameters of Feteasca neagra wines obtained form grapes produced in plantations treated with ATONIK and NOVA biostimulators

Variant	Acidity	Sweetness	Astrin-gency	Dry content	Colour intensity	Aroma intensity	Rank
FNP_Ne	7.567 [a]	0.17 [a]	4.87 [a]	2.533 [a]	4.833 [a]	3.667 [a]	
R1	7.6	0	5	2.5	4.8	3.7	3
R2	7.6	0.2	4.8	2.7	4.8	3.6	3
R3	7.5	0.3	4.8	2.4	4.9	3.7	3
FNP_N	6.667 [b]	0.17 [a]	6.03 [b]	4.267 [b]	4.867 [a]	3.833 [a]	
R1	6.3	0	6.3	3.9	5	4.0	2
R2	7.4	0.3	5.8	4.7	4.8	3.7	2
R3	6.3	0.2	6	4.2	4.8	3.8	2
FNP_A	6.467 [b]	0.30 [a]	5.33 [b]	3.067 [a]	5.000 [a]	5.000 [b]	
R1	6.4	0.1	5.5	3.1	5	5	1
R2	6.5	0.5	5.2	2.9	5	5	1
R3	6.5	0.3	5.3	3.2	5	5	1

Table 5

General sensory parameters of Fetească regală wines obtained from grapes produced in plantations treated with ATONIK and NOVA biostimulators

Variant	Acidity	Sweetness	Astrin-gency	Dry content	Colour intensity	Aroma intensity	Rank
FRP_Ne	3.667 [a]	1.27 [a]	2.10 [a]	2.267 [a]	4.967 [a]	7.167 [a]	
R1	3.7	1.2	1.5	2.5	5	7.5	3
R2	3.6	1.3	2.8	2.2	5	7.5	3
R3	3.7	1.3	2	2.1	4.9	6.5	3
FRP_N	3.633 [a]	1.23 [a]	4.87 [b]	4.833 [b]	4.967 [a]	6.200 [ab]	
R1	3.7	1.2	4.9	5	5	6.6	2
R2	3.6	1.2	4.9	4.7	5	6	2
R3	3.6	1.3	4.8	4.8	4.9	6	2
FRP_A	5.033 [b]	0.17 [b]	3.60 [c]	4.733 [b]	5.100 [a]	5.000 [b]	
R1	5	0	3.5	5.1	5.2	5	1
R2	5	0.3	3.6	4.3	5	4.1	1
R3	5.1	0.2	3.7	4.8	5.1	5.9	1

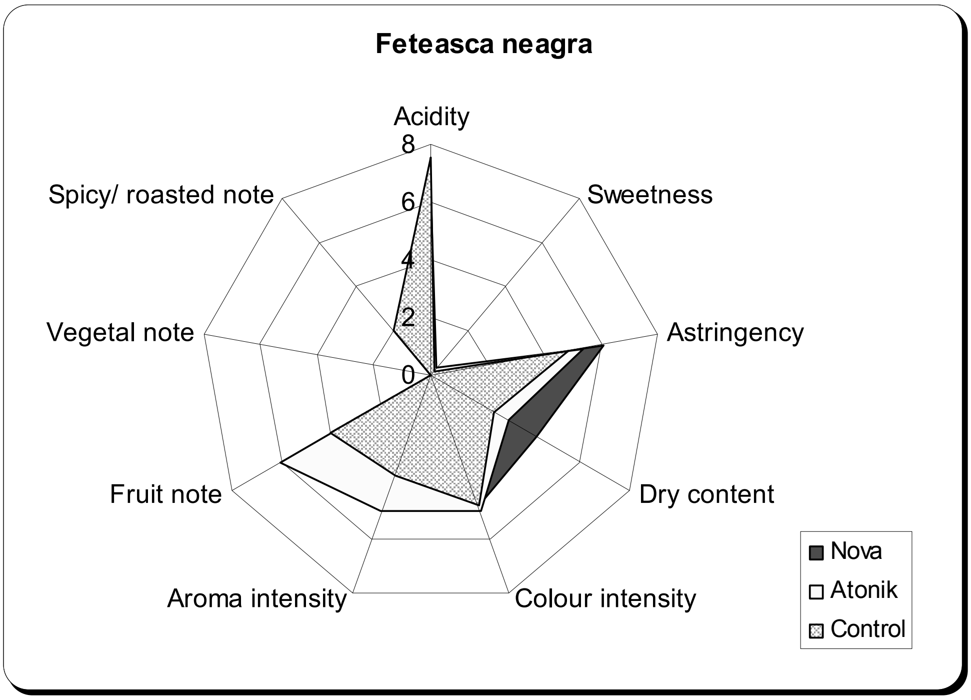

Fig. 1. Sensory profile of Fetească neagră wines obtained from grapes produced in biostimulator treated plantations as compared to control wines from grapes from not-treated ones

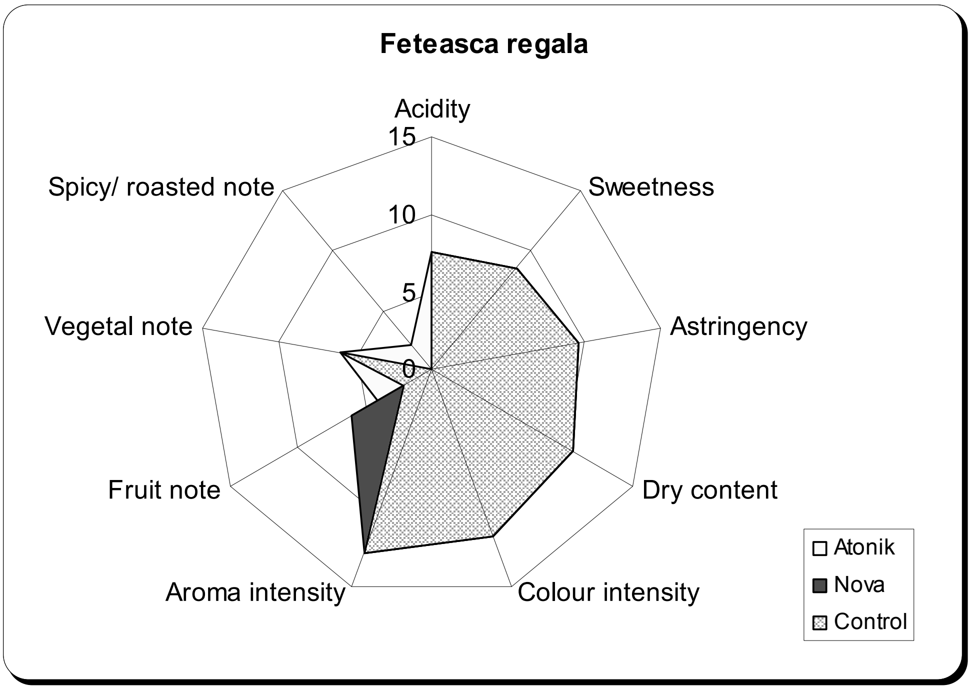

Fig. 2. Sensory profile of Fetească regală wines obtained from grapes produced in biostimulator treated plantations as compared to control wines from grapes from not-treated ones

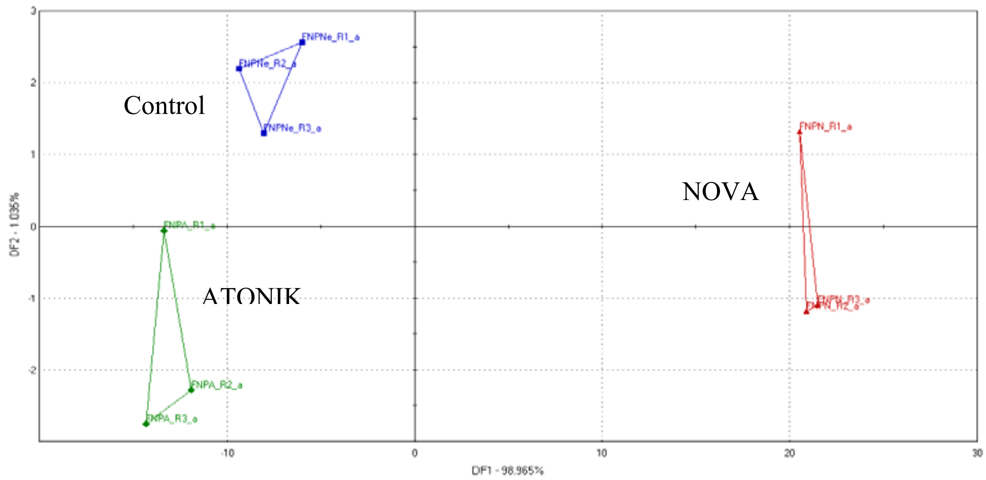

Fig. 3. DFA diagram obtained from data recorded by Heracles electronic nose for Fetească neagră wines from grapes from plantations treated with ATONIK or NOVA or control plots.

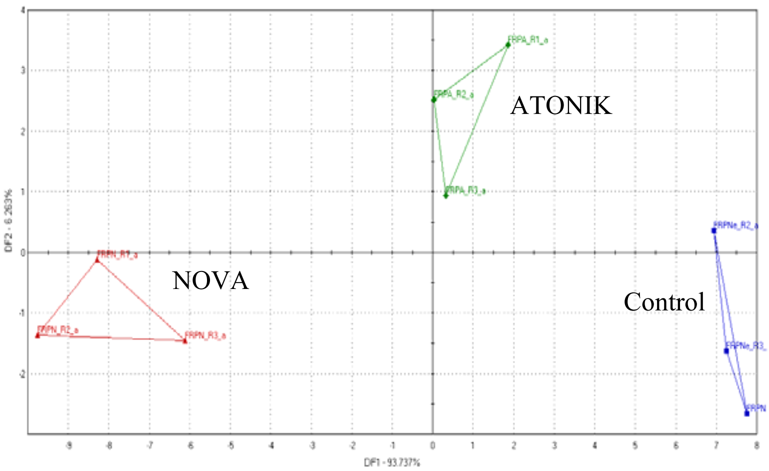

Fig. 4. . DFA diagram obtained from data recorded by Heracles electronic nose for Fetească regală wines from grapes from plantations treated with ATONIK or NOVA or control plots.

Effects of vine treatments with Nova and Atonik bioregulators on the grape quality of Fetească regală and Fetească neagră

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Keywords: Romanian autochtonous varieties, bioregulators, grape full maturity, grape sensory analysis.

ABSTRACT

The Romanian autochtonous varieties, Fetească regală and Fetească neagră, treated with foliar fertilizer NOVA and biostimulator ATONIK were studied in the terroir of Pietroasa, Buzau county, by comparison with control lots. Parameters such as bud loading, grape weight, yield per vine, sugar and acidity accumulation, as well as sensory parameters of grapes at full maturity were recorded and discussed. The determinations in the vineyard were performed in triplicates for each type of treatment and bud load and the data were analysed statistically. The results show a clear effect of both biostimulators on the Feteasca neagră variety, NOVA having a more important influence on both quantitative and qualitative grape parameters, including the sensory ones. For the Fetească regală variety, the influence of biostimulators was more difficult to assess, since the bud load variation in plantations had a more important effect on all quantitative and qualitative parameters than the stimulation treatments. Further investigations need to be carried out in order to establish for each variety the best combination bud load-type of biostimulator.

INTRODUCTION

In order to improve vine resistance to frost, heat or some pests, as well as to improve grapes and wine quality, foliar treatments of vine with fertilizers and/or bioregulators are more and more studied (Norrie and Keathley, 2006; Avenant and Avenant, 2006 a and b; Patil *et al*., 2006). Some of them, aside of the general benefic effect, can even be used in organic (ecologic) agriculture, replacing other products that ar not aproved for this culture. The main expected effects are a higher photosynthetic yield and a faster root growth. One such biostimulator, NOVA, allows the plant to use a larger spectrum of light, with wavelengths from 100-800 nm, while the normal usable range is between 420-680 nm (visible spectrum). This improvement leads to a rapid growth of the plant under light, due to an enzymes stimulation of photosynthesis processes, leading to precocity and higher yield, associated with higher concentration of sugar and other colour or aroma compounds. Another biostimulator, ATONIK, also named Asahi SL (Bralewski *et al*., 2006), having a systemic effect, is also used to increase root development, the vegetative growth and fruit yield, its mechanism being that of increasing the circulation rate of fluids inside the plant and stimulation of chlorophyll pigments accumulation. Other observed effects are the increase in fertility of the flowers and a better resistance to frost, drought and to the phytotoxicity of the herbicides used in plantation.

MATERIALS AND METHODS

For the vine treatments two European approved biostimulators were used. NOVA 11-5-8 is a foliar fertilizer with 11% N, 5% P_2O_5 and 8% K_2O, also containing microelements such as Cu, Fe, Mg, Mn, Bo, Zn, Mo, aminoacids 25%, organic acids, enzymes, carbohydrates and activators. The product is fermented with 200 different species of microorganisms and has no artificial hormones or activators added, being also used in ecological viticulture.

ATONIK is a biostimulator based on chemical compounds with direct effect on the biochemical processes of the plant, including 0.2% sodium *o*-nitrophenolate, 0.3% sodium *p*-nitrophenolate and 0.1% sodium nitro-guaiacolate.

The vines treated with biostimulators during the year of 2009 were located in Pietroasele, Dealu Mare region and consisted of plots of Feteasca regala and Feteasca neagra cultivated in the same way as far as the other treatments, soil and technical works were concerned. Some meteorological parameters of the year 2009 were outside of the 10-year average that is considered normal, with periods colder than usual alternating with other periods hotter than normal, but they are not discussed here in detail. Treatments with NOVA and ATONIK biostimulators were performed 3 times: before flowering, on May 25; at the end of flowering phase, on June 12; and at the end of the intensive growth of shoots phase, on June 23, 2009.The dosage was 2 l/ha for NOVA and 0.75 l/ha for ATONIK applied in solution with a liter atomizer.

The experimental variants, for both grape varieties, aside of the two biostimulators, also included another variable, the bud load. The variants are described briefly in Table 1. As control, the usual bud load for Pietroasa is used, while for the rest of variants with biostimulators, the bud-load is reduced, to confer a balance to the plants.

The basic quantitative parameters (grape weight and yield per vine) were determined in each plot and quality parameters for sugar and totally acidity of grapes were determined by using the standardized methods approved by the International Organization of Wine and Vine (OIV analysis methods, 1996).

The grape full maturity was also confirmed by using a grape sensory analysis method (Antoce, 2007c, Antoce, 2008). The evaluation was performed by using a score sheet with 21 sensory parameters, the results being represented by numbers from 1 to 5 or, in some cases, from 1 to 3. The evaluation sheet was presented in pervious papers (Antoce, 2007-a and Antoce, 2007-b) and comprised visual and tactile parameters and taste parameters of the pulp, skin and seeds.

The statistical analysis was performed with Sigma Stat Software ver. 2.03 of the SPSS Inc. Company.

RESULTS AND DISCUSSION

In order to evaluate the influence of biostimulators, aside of the determinations in the vine plantation at different vegetative phenophases, concerning the fertility, shoots growth and so on (data not shown here), we also measured grape weight, yield and sugar and acidity accumulation at full maturity (Table 2 and Table 3). The data are means of three determinations for each variant and 6 determinations for control, the comparing of means being performed by ANOVA variance analysis, the significant differences being indicated by different letters placed near the values compared. For mean comparison on pairs the LSD post-hoc test was used.

In the case of Fetească neagră variety, the treatment with biostimulators coupled with the reduction of bud load significantly increased the grape weight, so that from 112 g/grape in control plot, the weight increased to 140-144 g/grape in the plots of 15 buds/m^2 treated with biostimulators and to 246-253 g/grape in the plots of 10 buds/m^2 treated with biostimulators. There is, however, no significant difference between the recorded grape weights form plantations treated either with ATONIK or NOVA biostimulator. For this parameter, irrespective of the biostimulator, the bud load influence seems to be more important. The conclusion is valid also for the yield per vine, with the remark that biostimulators coupled with a reduction of bud loads from 20 buds/m^2 to 10 buds/m^2 induced a clear increase in productivity. Thus, the yield of 2.34 kg/vine obtained in plots of Fetească neagră with 20 buds/m^2 is matched by the yield of 2.3 kg/vine obtained in the plot of 10 buds/m^2 treated with ATONIK and obviously exceeded by the yield of 2.7 kg/vine obtained in the plot of 10 buds/m^2 treated with NOVA. For the bud load of 15 buds/m^2, in spite of biostimulation, and although the grape weight is higher comparing to the control, the yield obtained per vine (1.66-1.72 kg/vine) is lower than the one obtained in control lot. This observation suggests that this bud load of 15 buds/m^2 is too high for Fetească neagră treated with biostimulators and as such their effect is not optimally valorized.

Sugar accumulation is indeed higher in all the variants treated with biostimulators, irrespective of the bud load, confirming the fact that these products have an effect on the biochemical processes of the vine. Thus, compared to the 194 g/l sugar in grapes from control plot, in the plots treated with biostimulators the sugars reached values from 200 to 212 g/l. The highest sugar accumulation value, 212 g/l, was recorded also in the plot of 10 buds/m^2 treated with NOVA, the same variant that showed the highest yield per vine.

Concerning the total acidity accumulated in the grapes at full maturity, this was inversely correlated with the sugar accumulation, the highest value being recorded in the grapes from the control plots (10.4 g/l), and while for the grapes from the biostimulated plots the values ranged from 9.31 to 9.96 g/l.

The most equilibrated grape sample, as assessed by grape sensory analysis, was confirmed to be the one harvested from the plot of 10 buds/m^2 treated with NOVA that led to a sensory profile closest to that determined in a previous work for Feteasca neagra (Antoce *et al*., 2008) and recommended for the harvest moment selection. The parameters sensory assessed by the tasters panel and ploted in Fig. 1 are: P1 - berry firmness, P2 - berry witherness, P3 - berry color hue, P4 - berry color homogeneity, P5 - pulp and juice acidity, P6 - pulp consistency, P7 - pulp and juice viscosity, P8 - pulp and juice sweetness, P9 - pulp and juice aroma, P10 - skin thickness, P11 - skin astringency intensity, P12 - skin astringency quality, P13 - skin aroma, P14 - skin bitterness, P15 - seed color hue, P16 - seeds color homogeneity, P17 - seed astringency intensity, P18 - seed bitterness, P19 - seed consistency, P20 - seed astringency quality, P21 - seed aroma.

For Fetească regală grapes, a variety that is notorious for its high yields, the influence of biostimulators was not as obvious as observed for Fetească neagră variety. The grape weight increased in all the cases of treatments with biostimulators, from 124 g/grape in control to 156-165 g/grape in treated vines. However, the number of grapes per vine was lower in the plots treated with biostimulators, leading to yields that were inversly correlated with the bud loads in all the variants. Thus, the highest yield, 8.2 kg/vine, was obtained for the control plot, with a bud load of 20 buds/m^2, followed by the yield of 5.5-5.7 kg/vine in both biostimulated plots with a bud load of 15 buds/m^2 and a yield of 4.5-4.7 kg/vine in both biostimulated plots with a bud load of 10 buds/m^2. This unexpected result seems to reveal that short pruning is not recommendable for Fetească regala. The effect of biostimulators could not be observed in this variety, the grape weight and yields being similar for ATONIK and NOVA treatments made in plots with the same bud load (Table 3).

The effect on sugar accumulation was not so important as it was in the case of Feteasca neagra, but the that fact that biostimulators have an effect on this parameter was also confirmed for the case of the treatments made in plots with loads of 10 buds/m^2, where the sugar accumulation was of 207-210 g/l. The biostimulation in plots with loads of 15 buds/m^2 led to a statistically not-different sugar accumulation (195-200 g/l) as compared to the mean recorded for the control with 20 buds/m^2 (192 g/l).

Same effect of the biostimulators on the quality of grapes was observed on the total acidity too, which was inversely correlated with the sugar accumulation, following the same pattern as regards the influence of bud loads and the type of biostimulator as in the case of sugar accumulation. Thus, the lowest acidity (8.14-8.19 g/l tartaric acid) is observed in the plots with 10 buds/m^2, irrespective of the type of biostimulator used, while the acidity for the the variants in the plots with 15 buds/m^2 ranged between 8.89-9.00 g/l tartaric acid and the acidity of control with 20 buds/m^2 was 9.23 g/l. The mean value obtained for control, although apparently higher than the means of those obtained form the variants in the plots with 15 buds/m^2, was not confirmed by statistical test as being different.

Concerning the sensory profile of the grapes the one obtained for the grapes treated with NOVA in plantations of 10 buds/m^2 was closest to the desirable profile established for this variety in previous years (Antoce, 2008).

These sensory profiles of grapes, however, only give an indication on the optimal harvesting date. In order to assess the effect of biostimulators on the wines resulted from the grapes of these plantations the work should be continued by separate vinifications and evaluations of the grapes of various varieties obtained with or without use of biostimulators.

CONCLUSIONS

The biostimulators applied in the vine plantations of Pietroasa proved to have differentiated effects on the grape quantity and quality parameters in accordance to the grape variety.

In Fetească neagră plantations a clear effect of NOVA biostimulator was observed, this product significantly increasing the grape weight, the grape yield per vine and the sugar accumulation, irrespective of the bud load variations form one plantation to another.

In Fetească regală the influence of biostimulators was not so obvious as observed for the Feteasca neagra variety, the variation of the bud load having in this case a more important influence, statistically confirmed, on all the quantity and quality parameters followed in this work. In some cases, due to the importance of the load, in spite of the application of biostimulators, the quantity parameters were lower than those determined for control platations.

Due to the fact that for all the determined parameters, irrespective of the biostimulator, the bud load influence seems to have a more important effect than the biostimulation, it appears that further investigations should be conducted in order to establish for each variety the best combination bud load-type of biostimulator.

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TABLES AND FIGURES

Table 1

Experimental variants for two grape varieties treated with two biostimulators in parcels with different bud-loads

Experimental Variant	Grape variety	Bud load
FR-Control	Fetească regală	20 buds/m^2
FN-Control	Fetească neagră	20 buds/m^2
FR-Atonik 15	Fetească regală	15 buds/m^2
FN-Atonik 15	Fetească neagră	15 buds/m^2
FR-Atonik 10	Fetească regală	10 buds/m^2
FN- Atonik 10	Fetească neagră	10 buds/m^2
FR-Nova 15	Fetească regală	15 buds/m^2
FN-Nova 15	Fetească neagră	15 buds/m^2
FR-Nova 10	Fetească regală	10 buds/m^2
FN-Nova 10	Fetească neagră	10 buds/m^2

Table 2

Parameters at full maturity for Fetească neagră grapes from plantations with various bud-loads treated with Atonik and Nova biostimulators

Variant	Bud load	Grape weight, g	Yield g/vine	Sugar g/l	Total acidity g/l tartaric acid
FN-Atonik 10	10 buds/m^2	***253***^{b}	***2300***^{a}	***205***^{b}	***9.31***^{b}
		265	2450	201	9.26
		250	2200	208	9.37
		244	2250	206	9.29
FN-Atonik 15	15 buds/m^2	***140***^{c}	***1660***^{b}	***200***^{b}	***9.37***^{b}
		166	1720	196	9.49
		130	1620	203	9.32
		124	1640	201	9.29
FN-Nova 10	10 buds/m^2	***246***^{b}	***2700***^{c}	***212***^{c}	***9.40***^{b}
		251	2810	209	9.47
		241	2610	214	9.37
		246	2680	213	9.35
FN-Nova 15	15 buds/m^2	***144***^{c}	***1720***^{b}	***204***^{b}	***9.96***^{c}
		149	1770	202	9.95
		140	1690	207	9.98
		143	1700	203	9.95
FN-Control	20 buds/m^2	***112***^{a}	***2340***^{a}	***194***^{a}	***10.40***^{a}
		122	2330	194	10.27
		106	2260	193	10.24
		105	2250	189	10.39
		120	2500	193	10.58
		111	2370	195	10.52
		108	2330	200	10.41

Table 3

Parameters at full maturity for Fetească regală grapes from plantations with various bud-loads treated with Atonik and Nova biostimulators

Variant	Bud load	Grape weight, g	Yield g/vine	Sugar g/l	Total acidity g/l tartaric acid
FR-Atonik 10	10 buds/m^2	***165***^{b}	***4500***^{b}	***207***^{b}	***8.19***^{b}
		171	4650	205	8.42
		161	4400	210	8.04
		163	4450	207	8.11
FR-Atonik 15	15 buds/m^2	***156***^{b}	***5500***^{c}	***196***^{a}	***8.89***^{a}
		151	5440	200	8.82
		163	5600	193	9.03
		154	5460	195	8.82
FR-Nova 10	10 buds/m^2	***165***^{b}	***4700***^{b}	***210***^{b}	***8.14***^{b}
		161	4600	220	7.84
		170	4850	202	8.57
		164	4650	208	8.02
FR-Nova 15	15 buds/m^2	***156***^{b}	***5700***^{c}	***200***^{a}	***9.00***^{a}
		152	5550	209	8.88
		154	5600	197	8.95
		162	5950	194	9.17
Control	20 buds/m^2	***142***^{a}	***8200***^{a}	***192***^{a}	***9.23***^{a}
		137	7850	195	9.09
		150	8250	182	9.49
		139	7900	187	9.15
		136	8000	202	9.05
		150	8900	191	9.49
		140	8300	195	9.11

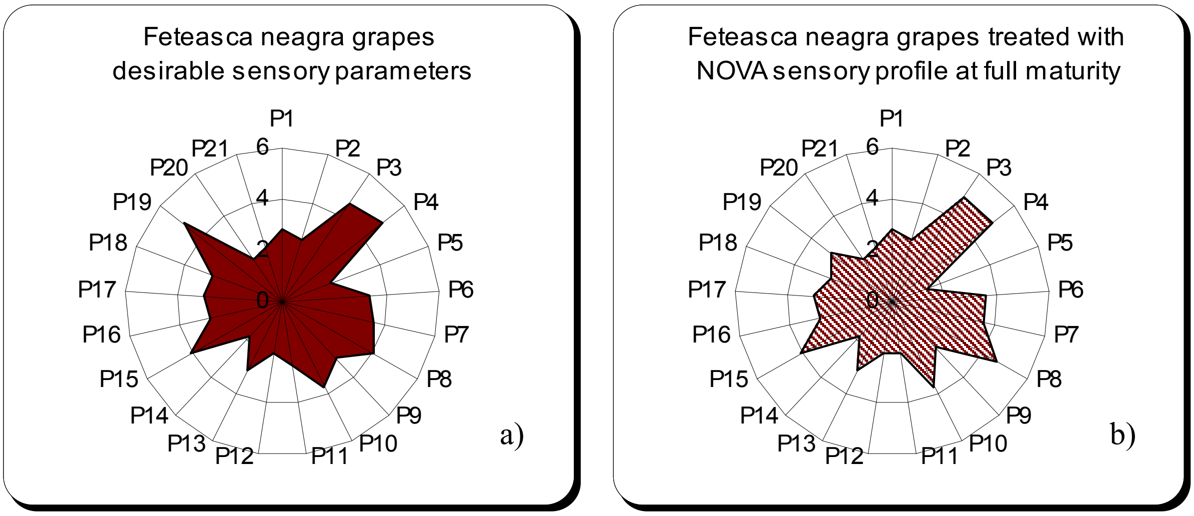

Fig. 1. The desirable sensory profile of the Fetească neagră grapes at full maturity (a) and the sensory profile of the grapes harvested from the NOVA-treated plot of 10 buds/m^2 (b).

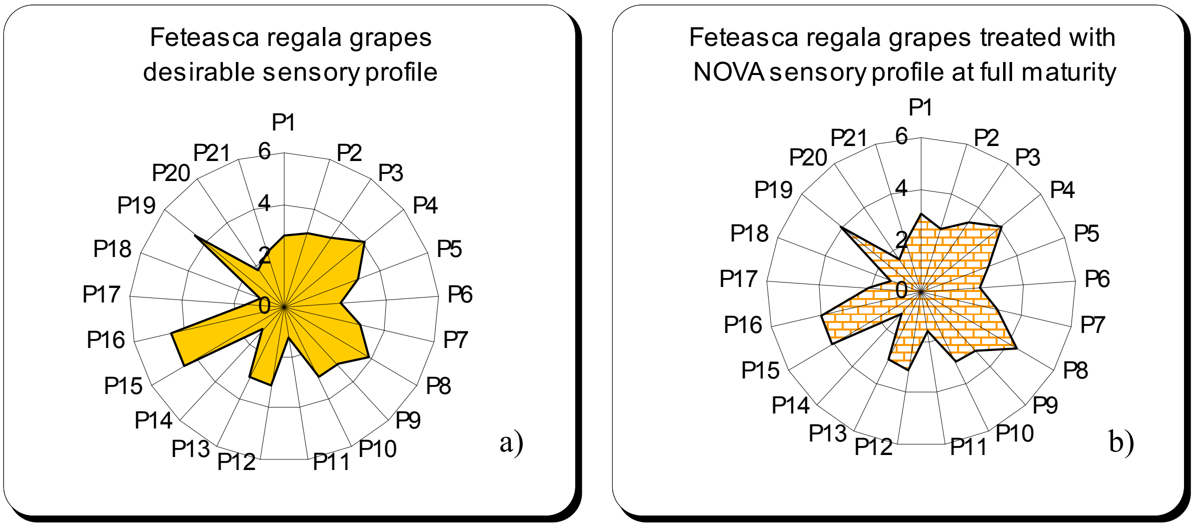

Fig. 2. The desirable sensory profile of the Fetească regală grapes at full maturity (a) and the sensory profile of the grapes harvested from the NOVA-treated plot of 10 buds/m^2 (b).

The influence of the yeast strain selection on the colour parameters of the Pinot noir and Cabernet Sauvignon wines

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ABSTRACT

The trichromatic and CIELab parameters were determined for wines of Pinot noir and Cabernet Sauvignon obtained with various yeast strains isolated in Valea Călugărească viticultural centre in order to select the yeast strains that ensure good colour intensity, hue and chromaticity for the wines. Some selected strains stood out from the viewpoint of colour parameters leading to wines with a higher proportion of red and less blue in their colour, with higher values of chromaticity. The yeast strains that produced wines with significantly different colour parameters were PN III – 10 (sample wine PN-4) for Pinot noir and CSEC III-1 (wine CS-1), CSEC IV – 7 (wine CS-3), CSEC IV – 10 (wine CS-5) and CSEC IV – 11 (wine CS-7) for Cabernet Sauvignon. These differences in colour as compared to the control wines produced with a commercial yeast strain are not always for the better and they do not automatically recommend a strain for winemaking. Also, before recommending some of these selected yeasts other physico-chemical and sensory parameters of the resulted wines should also be assessed.

INTRODUCTION

The colour of red wines is one of the first traits that have a big impact on the consumer preference for a certain wine, playing a significant role in the perception of quality. As a result, the winemaker should precisely monitor wine colour for purposes of research, product consistency and quality control, paying attention to all the possible influences that affect the colour hue and chromaticity. Aside of pigment extraction, maceration time and temperature, anthocyan stabilization through polymerization, condensation and co-pigmentation reactions (Watson *et al.*, 1996; Birse *et al.,*, 2003), another factor that was found to affect the wine colour is the yeast strain (Mazauric and Salmon, 2005, 2006; Bautista-Ortín *et al.,* 2007). The mechanisms through which the yeast could affect the colour are diverse and related to the chemical composition of the cell wall (Morata *et al*., 2003; Morata *et al*., 2006) and also to the exogenous compounds released in the fermentation medium (Bovin *et al.*, 1998; Hernandez *et al.*, 2003, Morata *et al*., 2005). In this preliminary study of the influence of our selected yeasts on the wine colour we investigated the CIELab parameters of the wines produced from two grape varieties with very different natural pigment composition.

MATERIALS AND METHODS

The yeast strains studied were isolated in Valea Călugărească during the winemaking process, in certain stages of the fermentation of wines produced from the grape varieties of Pinot noir and Cabernet Sauvignon. The yeast strains tested are included in Table 1. In order to preserve the typicality of the local wine, the yeasts used for each variety were selected from the same variety must in various stages of the maceration-fermentation process. From the beginning to the final fermentation phase there were four stages in which yeasts were isolated, noted from I to IV. In each stage, 10-15 yeast strains were selected, the Arabic number in the yeast strain codification standing for this stage phase number. From all the selected yeast strains, for this study only *Saccharomyces cerevisiae* strains were used. A commercial yeast characterized by good anthocyan pigments preservation, Fermactive RC (Croitoru *et al*., 2006), was used as control.

The wines were all produced by maceration-fermentation, in accordance to the traditional technology used in Valea Călugărească.

Chemical analyses were performed on wines 6 months after their production. The colour of wines was assessed with an Analytik Jena AG Specord 250 UV-VIS spectrophotometer running special software for colour determination, WinAspect version 2.2.7. The colour parameters were obtained with a 1 mm quartz cuvette and using a D65 illuminant, a 10° standard observer and by measuring the transmittance of the wine every 1 nm over the visible spectrum from 400 nm to 700 nm.

The software automatically calculates both tristimulus/trichromatic parameters (X, Y, Z colour coordinates and x, y, z colour coordinates – OIV, 1996) and their transformation into a perceptually uniform space, CIELab parameters.

In accordance to the CIELab system, the parameters obtained were:

- coordinate *a*, related to red color if $a>0$ and to green color if $a<0$.
- coordinate *b*, related to yellow color if $b>0$ and to blue color if $b<0$.
- parameter *L*, representing the lightness of a coloured object judged relative to the lightness which appears as white,
- parameter c_{ab} or *c* (chroma) representing the chromaticity of a colored object judged relative to the white, or simpler, the purity of the colour or hue intensity
- parameter h_{ab} or *h* (hue-angle in radians) representing the attribute of appearance by which a color is identified according to its resemblance to red (0°), yellow (90°), green (180°), or blue (270°), or a combination of two of these in sequence.

Variations of parameters (ΔL, ΔC_{ab} and Δh_{ab}) can also be calculated, as well as the total colour differences ΔE_{ab}, with respect to a reference point (control samples), being expressed in CIELab units. The formula for the calculation of $\Delta E_{ab} = ((L_1 - L_2)^2 + (a_1 - a_2)^2 + (b_1 - b_2)^2)^{1/2}$ gives a value that represents the colour differences that are readily perceivable by the eye, provided $\Delta E_{ab} > 1$ (Esparza *et al*., 2009).

RESULTS AND DISCUSSION

The wines were analyzed 6 months from their production and tristimulus parameters determined for the Pinot noir and Cabernet Sauvignon obtained with our selected yeasts are shown in Table 2. For both varietal wines, the proportion of blue colour (z parameter) is higher, representing around 35%. The green colour is higher in Pinot noir (around 32%), followed by Cabernet wines (around 30%), while the red proportion is higher in Cabernet wines.

The trichromatic parameters characterizing the Pinot noir and Cabernet Sauvignon wines are plotted in Figure 1 a and b, the control wine being in the centre of each diagram, followed by samples 1-8 in ascending order. The red colour represents 33% of the total colour in most of the Pinot noir, irrespective of the yeast strain used for winemaking, while in Cabernet the red proportion in the total colour varied between 34-36% in accordance with the yeast strain used.

For most of the Pinot noir wines the trichromatic parameters are similar with those obtained for the wine vinified in the presence of the commercial yeast strain used as control. However, of all the Pinots, sample PN-4, produced with the strain PN III – 10, stands out, as far as the trichromatic parameters are concerned. This wine also had the lowest alcoholic concentration (13,59% v./v. as compared to 14.41% in control and 15% in some other wines obtained with other yeast strains) and also the lowest dry content (28.9 g/l as compared to 30.8 in control wine and 33-37 g/l in some other wines obtained with other yeast strains).

The strains used for Cabernet wines showed a greater variability as far as the wine colour is concerned. The strains used for CS-5 and CS-8 (CSEC IV – 10 and CSEC II – 6, respectively) displayed a particular coloured profile and, in the same time, produced wines with lower alcoholic concentration (11.03 and 11.91 % v./v., respectively) than other yeast strains used. These wines, and also CS-3 (produced with yeast CSEC IV – 7) had the highest percentage of red colour, fact confirmed also by CIELab parameters.

The CIELab parameters for all the produced wines are shown in Table 3. The parameters first easily differentiate the two grape varieties, the wines of Pinot noir being less intensely coloured, having the lightness parameter L higher (in the range of L=89-93), the value of L=100 meaning that the sample is transparent. Also the parameter *a* that locates the sample colour on an axis that ranges from "red" to "green" is much higher for all the Cabernet wines (*a*=17-27) as comparing to Pinot wines (*a*=5-11), while the parameter *b*, which refers to the sample colour on an axis that ranges from "blue" to "yellow" is much lower for Cabernet wines (*b*=0-3) as compared to Pinot wines (*b*=4-7). The position of all these samples in the colour space *a* versus *b* represented in Fig. 2 shows clearly that the Cabernet wines are placed towards red colour with a very slight shade of blue, while the Pinot wines wines have less red in their colour composition and more blue hue. The dominant wavelength of the Pinot wines colour is around 589 nm-yellow for all samples (except PN4 in which is 615 nm-orange), while the dominant wavelength for all Cabernet is 359 nm-violet.

The yeast strains selected for the Cabernet Sauvignon wines fermentation have a stronger influence on colour, the resulted wines being more scattered in the colour space *a* versus *b* (Fig. 2). For Pinot noir wines, however, only the selected strain for the PN-4 wine (PN III – 10) had a significantly different effect on the colour, which has more red hue and less blue.

In the CIELab system, the colour space is considered uniform, having three dimensions: L,a,b. Irrespective of the yeast strain applied, the red colour parameter *a* of the resulted wines are inversely correlated with the wine luminosity (lightness) *L*, in both varieties (Fig. 3 a and c), while for the yellow parameter *b* no correlation could be established (Fig. 3 b and d).

As also confirmed by tristimulus parameters, the highest chromaticity values are encountered for the wine samples PN-4 and CS-3, CS-5 and CS-8 (Fig. 4 a and b). The yeast strain affected the perception of chromaticity for all the Cabernet samples. The hue is not so much affected by the yeast strain used for the winemaking of Pinot noir (Fig 4c), only PN-4 displaying a visible difference. In the CIELab system a difference $\boldsymbol{\delta c_{ab}}$ or $\boldsymbol{\delta h_{ab}}$ of 0.2 and a difference $\boldsymbol{\delta E_{ab}}$ of 1 will be just noticeable to the human eye and the values higher than this are displayed in italic font in Table 3. The colour differences that are clearly observable for any consumer are those obtained in PN-4 (Fig 5a) and the Cabernets, which are all different from each other (Fig 5b). The CS-1, CS-3, CS-5 and CS-7 form a group with a clear difference in colour as compared to the control Cabernet wine, the strains used for these wines being the most interesting for further investigations and selections.

CONCLUSIONS

The differences induced in colour parameters by the application of several yeast strains selected in Valea Călugărească viticultural centre showed that the yeast strain alone can visibly influence the colour of red wines produced in the same conditions.

Some selected strains stood out from the viewpoint of both trichromatic parameters and CIELab parameters of the resulted wines. As far as the colour is concerned, the most interesting results were obtained for the strains PN III – 10 used in PN-4 Pinot noir wine and CSEC III-1 (CS-1), CSEC IV – 7 (CS-3), CSEC IV – 10 (CS-5) and CSEC IV – 11 (CS-7). These differences in colour comparing to the control produced with a commercial yeast strain should be considered with caution when the strains are recommended for winemaking. Before making any recommendation the other physico-chemical and sensory parameters of the resulted wines should also be assessed.

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TABLES AND FIGURES

Table 1

***Saccharomyces cerevisiae* yeast strains selected in the viticultural centre of Valea Călugărească and used in red wine production**

Wine sample codification	Grape variety	Codification of the yeast strain in accordance to the stage of selection form must in fermentation
CS-0	Cabernet Sauvignon (ecological plantation)	Control yeast FERMACTIVE RC
CS-1		CSEC III - 1
CS-2		CSEC IV - 1
CS-3		CSEC IV - 7
CS-4		CSEC IV - 8
CS-5		CSEC IV - 10
CS-6		CSEC III-10
CS-7		CSEC IV-11
CS-8		CSEC II - 6
PN-0	Pinot noir	Control yeast FERMACTIVE RC
PN-1		PN III - 5
PN-2		PN III - 7
PN-3		PN III - 8
PN-4		PN III - 10
PN-5		PN IV - 2
PN-6		PN IV - 4
PN-7		PN IV-7

Table 2

Trichromatic parameters and basic colour percentages determined 6 months after maceration-fermentation for the Pinot noir and Cabernet Sauvignon wines produced with the specific selected yeasts

Wine sample	Trichromatic parameters					
	X	Y	Z	x % of red	y % of green	z % of blue
PN-0	82.0826	81.0295	85.4491	0.3302	0.3260	0.3438
PN-1	82.7895	81.8307	86.8453	0.3292	0.3254	0.3454
PN-2	82.9677	81.9222	85.7671	0.3310	0.3268	0.3422
PN-3	81.0098	79.5061	83.6831	0.3317	0.3256	0.3427
PN-4	77.4313	73.6012	81.5879	0.3329	0.3164	0.3507
PN-5	81.2182	79.4940	83.4563	0.3326	0.3256	0.3418
PN-6	81.7197	80.6415	84.9484	0.3304	0.3261	0.3435
PN-7	81.7621	80.5102	85.3272	0.3302	0.3252	0.3446
CS-0	67.1144	58.3671	67.9244	0.3470	0.3018	0.3512
CS-1	70.5598	64.2191	71.8314	0.3415	0.3108	0.3477
CS-2	65.0921	57.0118	63.5668	0.3506	0.3071	0.3423
CS-3	60.0874	50.1218	57.4344	0.3584	0.2990	0.3426
CS-4	64.5411	55.8095	64.1638	0.3505	0.3022	0.3473
CS-5	62.4065	52.3410	60.0306	0.3571	0.2994	0.3435
CS-6	65.7435	56.7011	66.9071	0.3472	0.2995	0.3533
CS-7	70.6193	64.1211	73.0817	0.3399	0.3085	0.3516
CS-8	64.6796	55.3240	65.8774	0.3479	0.2976	0.3545

Table 3
CIELab parameters determined 6 months after maceration-fermentation for the Pinot noir and Cabernet Sauvignon wines produced with the specific selected yeasts

Wine sample	CIELab parameters							
	L	a	b	c_{ab}	h_{ab}	$\delta\ c_{ab}$	$\delta\ h_{ab}$	$\delta\ E_{ab}$
PN-0	92.1448	5.0619	6.9685	8.6129	0.9426	0.0000	0.0000	0.0000
PN-1	92.5001	4.8793	6.6088	8.2148	0.9348	*-0.3981*	-0.0078	0.5376
PN-2	92.5405	5.0438	7.4284	8.9789	0.9743	*0.3660*	0.0318	0.6070
PN-3	91.4628	5.9397	7.0378	9.2093	0.8698	*0.5963*	-0.0728	*1.1137*
PN-4	88.7336	10.6912	3.8325	11.3574	0.3442	*2.7445*	*-0.5984*	*7.2910*
PN-5	91.4574	6.3651	7.1896	9.6023	0.8462	*0.9894*	-0.0964	*1.4899*
PN-6	91.9719	5.1117	7.0217	8.6852	0.9415	0.0723	-0.0010	0.1876
PN-7	91.9133	5.4456	6.6548	8.5989	0.8850	-0.0140	-0.0576	0.5471
CS-0	80.9425	22.7635	0.8744	22.7803	0.0384	0.0000	0.0000	0.0000
CS-1	84.0797	16.6554	3.1547	16.9516	0.1872	*-5.8287*	0.1488	*7.2353*
CS-2	80.1862	21.5525	3.2049	21.7895	0.1476	*-0.9908*	0.1092	*2.7331*
CS-3	76.1440	27.4987	1.6431	27.5477	0.0597	*4.7674*	0.0213	*6.7852*
CS-4	79.3941	23.5005	1.5323	23.5509	0.0663	*0.7707*	0.0279	*1.8367*
CS-5	77.4843	27.1159	1.6199	27.1643	0.0597	*4.3840*	0.0213	*5.6088*
CS-6	80.0112	23.7568	0.1029	23.7571	0.0043	*0.9768*	-0.0341	*1.5650*
CS-7	84.0288	17.0007	2.0897	17.1287	0.1223	*-5.6516*	0.0839	*6.6492*
CS-8	79.2275	24.7614	-0.3951	24.7646	-0.0160	*1.9843*	-0.0544	*2.9230*

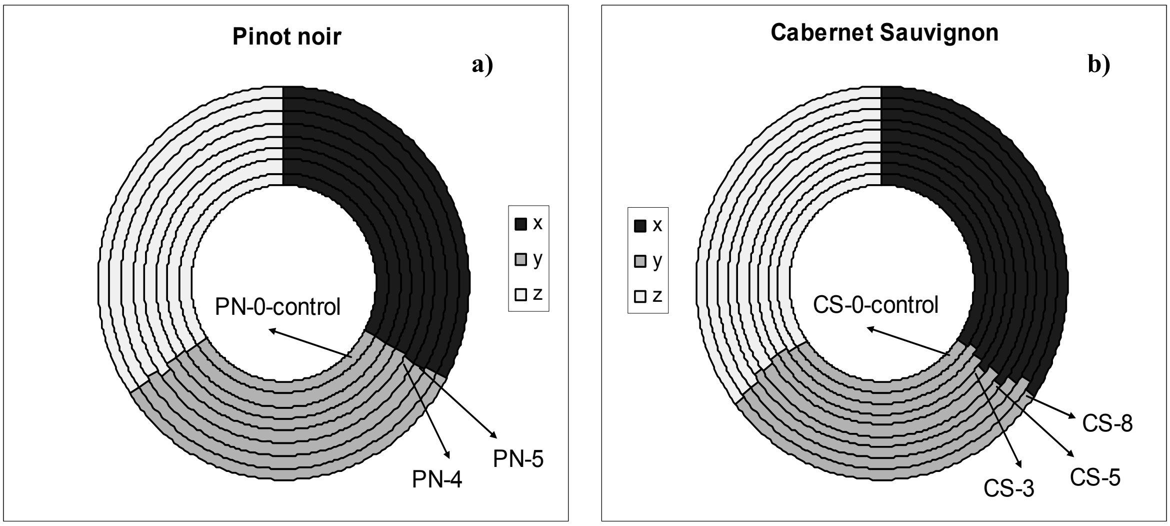

Fig. 1. The proportion of red (x parameter), green (y parameter) and blue (z parameter) for Pinot noir and Cabernet Sauvignon wines vinified with selected yeast strains, 6 months after winemaking

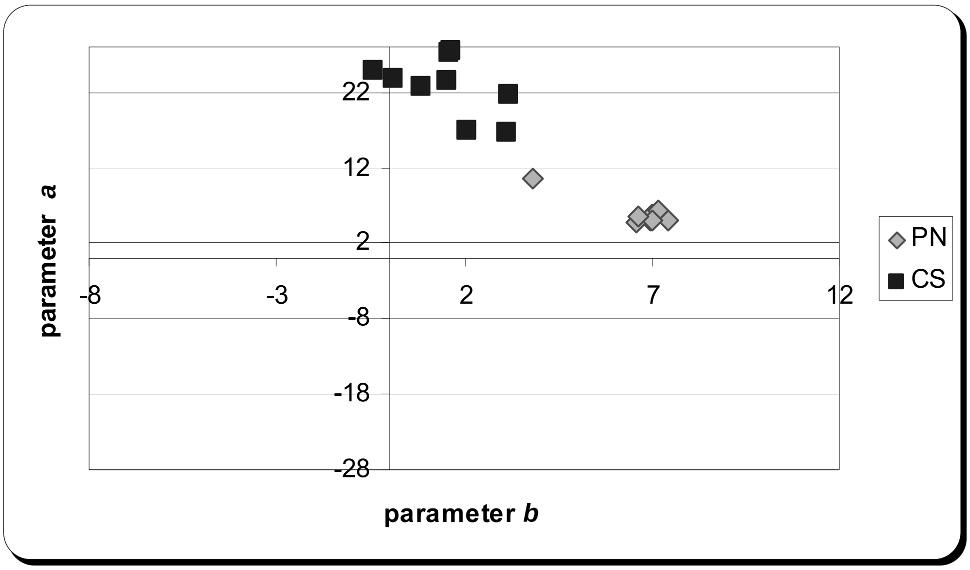

Fig. 2. The position of Pinot noir and Cabernet Sauvignon in the colour space

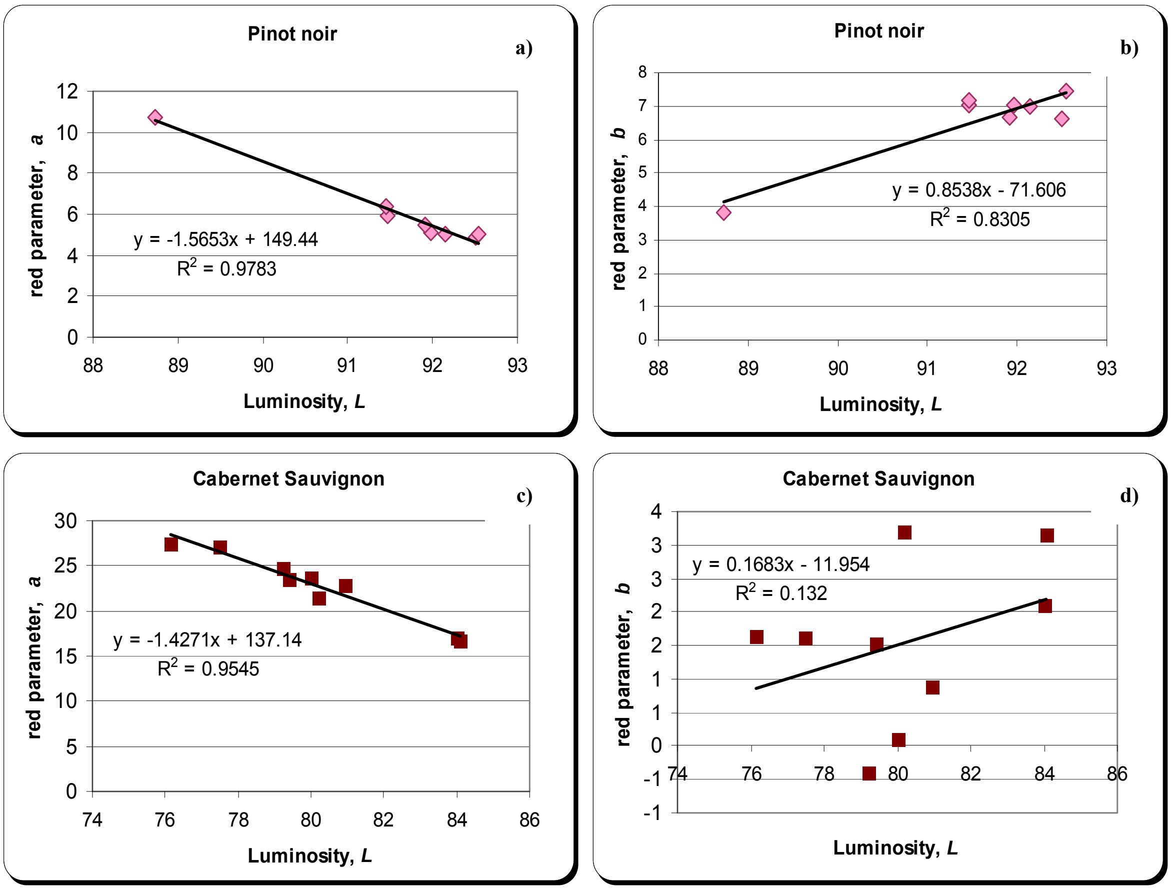

Fig. 3. Correlations of colour parameters with the luminosity of the wine samples of Pinot noir and Cabernet Sauvignon in accordance to the yeast strain

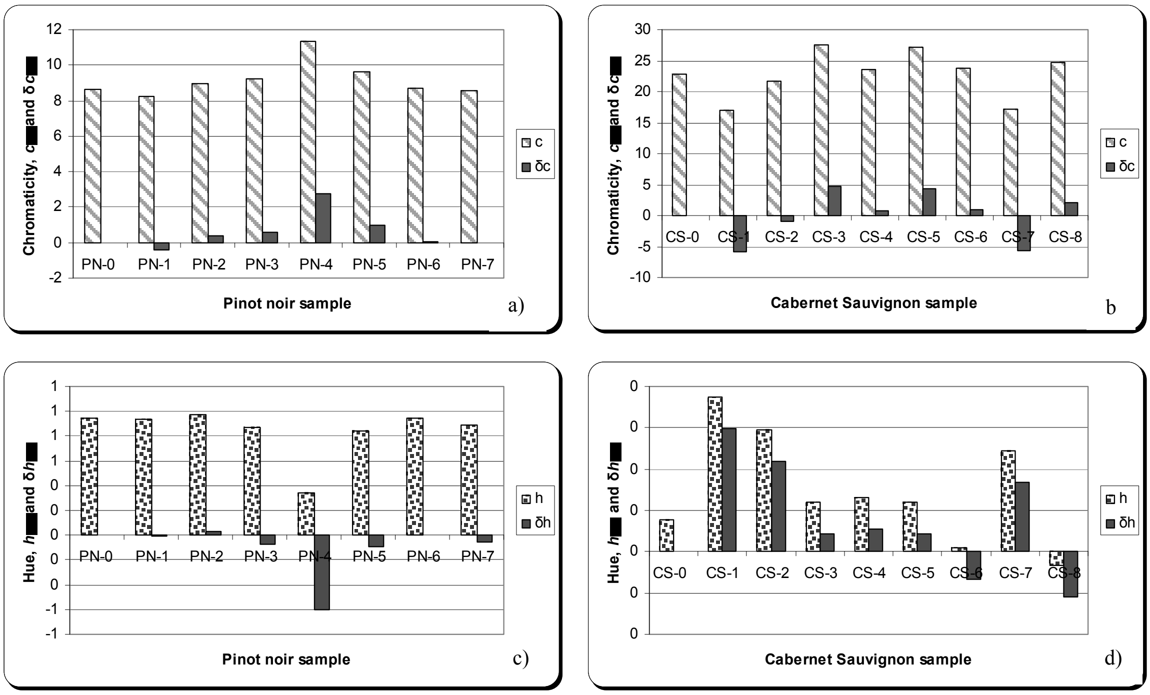

Fig. 4. Chromaticity and hue parameters for the wine samples of Pinot noir and Cabernet Sauvignon in accordance to the yeast strain

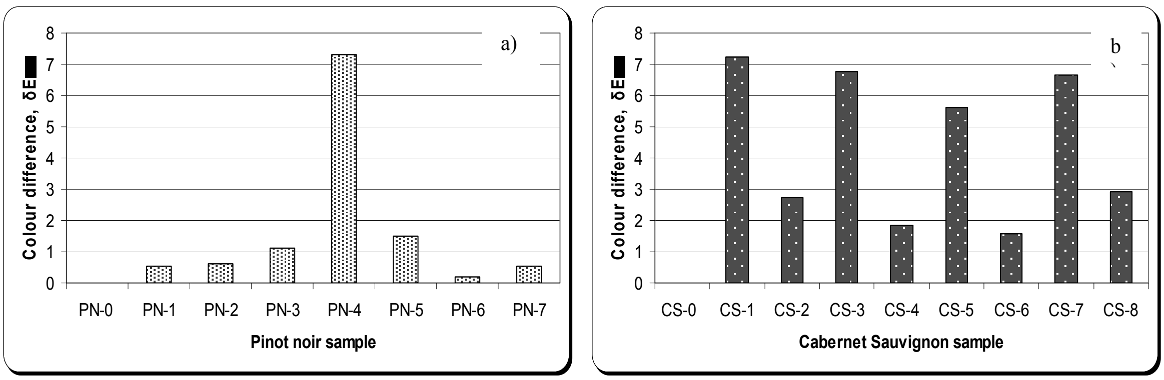

Fig. 5. Colour difference for the wine samples of Pinot noir and Cabernet Sauvignon in accordance to the yeast strain

Evaluation of the growth rate of some yeast strains selected in Dealu Mare region for wine production

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Keywords: growth rate, winemaking, microbial calorimetry, yeast selection.

ABSTRACT

The growth rates of 10 yeast strains selected from the vineyards and wines of Valea Călugărească and Panciu were evaluated by the use of a calorimetric technique. The yeasts were selected in both conventional and ecological vine plantations, but also in various phases of must fermentation. A high rate of growth is important for selected yeast if it is to outgrow the other naturally occurring yeast strains in the must. Of all the 10 yeast strains evaluated the *S. cerevisiae* strains isolated, irrespective of the geographical origin or type of plantation (conventional or ecological) proved to have the best potential for winemaking, as far as the growth rate constant is concerned, being included in a group with statistically similar growth rates. The growth rates of these *Saccharomyces* selected yeasts were higher than that of the control yeast, EC 1118. The non-*Saccharomyces* strains grew more slowly, the lowest growth rate being recorded for a strain later identified as *Kloeckera spp.* The studies will continue for the strains that showed rapid growing with the evaluation of ethanol tolerance and then for the determination of the sensory and chemical profile of the wines obtained using these yeasts.

INTRODUCTION

In the most traditional method for wine production the fermentation of grape must is achieved by the yeasts naturally occurring in the vineyard, the final wine bearing the chemical and sensorial characteristics imposed by a succession of microorganisms. Although many would advocate this way of winemaking for the reason of preserving the traits of the territory and providing a wine typical for the production region (Clemente-Jimenez *et al*., 2004; Di Maro *et al*., 2007; Sun *et al*., 2009), many others are reluctant, due to the multitude of accidents that may occur due to natural flora (Swiegers *et al.*, 2006; O'Kennedy, 2008), such as stuck fermentations, sensory deviations etc. (Antoce and Namoloşanu, 2005). As a result, in modern winemaking, fermentation of grape musts is more and more conducted by inoculation with selected yeasts. Because inoculation with commercial yeasts, which are selected in very distant plantations or are even genetically engineered, although providing good quality wine in the end, it could be argued that the local typicality of the wines is largely wiped out and replaced by other flavours. For this reason, in order to preserve the local typicality of wine, but avoid the drawbacks of spontaneous fermentation, the selection of the best yeasts from those naturally occurring in the same vineyard is a good alternative. Considering the fact that they must that is to be inoculated with the isolated and selected yeast is not sterile, aside of a killer factor that is not taken in consideration here, one of the main characteristics that such a selected yeast should have is a fast growth rate, to be able to quickly multiply and overwhelm the existing microflora, thus avoiding the off-flavours that might occur due to the presence of these last ones.

MATERIALS AND METHODS

The isolation and selection of yeasts was performed in the period of 2007-2009 in the vineyards of Panciu, from a conventional Fetească regală culture, and Valea Călugărească from a Pinot noir conventional plantation and also from an ecological Cabernet Sauvignon plantation. The yeasts were then conserved (Nicolae *et al.*, 2010) and identified by biochemical and genetic tests (data reported elsewhere), and for the ones with oenological potential the growth rate constant was first evaluated. The yeasts evaluated in this paper are presented in Table 1 and, as it can be seen, not all of them are from the *Saccharomyces* genus, the one that is considered the most important for quality winemaking. As a control yeast, a commercially wide-spread *Saccharomyces cerevisiae* yeast strain (EC1118) was used.

The growth rate constant of each strain was calculated from the growth thermograms recorded with the use of an isothermal calorimeter (Antoce and Takahashi, 1996; Antoce *et al*., 1997). For each yeast strain 4 glass vials with 5 ml glucose-peptone broth with 20 g/l glucose were inoculated with approximately 1 million yeast cells and incubated in the calorimeter. In short, the heat evolved during the growth of each culture is recorded by a computer under the form of a growth thermogram (Antoce, 1998) and the growth rate is calculated after the growth thermogram is integrated, on the portion located between 3% and 30% of the microbial growth described by the resulting *f*(*t*) curve (Fig. 1), portion which is generally assimilated with the exponential growth of a microbial culture (Antoce, 1998). Then this portion of a thermogram is fitted with the following equation, which simulates the exponential growth:

$$N = N_0 \cdot e^{\mu (t-\tau)}$$

where, N is the number of cells at time t, N_0 is the inoculums size (the number of viable cells at $t = 0$), τ is the lag time and μ is the growth rate constant.

The data were processed by specially designed software for the calorimeter (Antoce, 1998) and the statistical analysis was performed with the Sigma Stat software ver. 2.03 from SPSS Inc.

RESULTS AND DISCUSSION

The calorimetric experiments performed for all the ten isolated yeast strains allowed the determination of the growth rate constant μ on the basis of the integrated growth thermograms recorded by the computer and fitted with an exponential equation of growth. In Fig. 2 the integrated growth thermogrames, named *f*(*t*), are presented for all the yeasts, in a complex experiment, in which the growth was evaluated in the presence of ethanol in various concentrations (data presented elsewhere). For the purpose of this paper, that is for the evaluation the growth rate constant in the absence of an inhibitor, the determination was performed only for the first four curves, which were recorded for the case of yeast grown in a control medium without ethanol and which served as controls for the other experiments.

By processing the data recorded under the form of the *f*(*t*) curves the growth rates constants for a culture in the absence of any inhibitor were calculated and are included in Table 2.

The tested yeast strains showed various growth rate constants, on the basis of which thet could be placed in several groups. Most of the yeasts belong to a group with a growth rate around 0.4, group which includes the following species and strains: CSEC B-2 (*Candida utilis*), CSEC B-3 (*Rhodotorula glutinis*), PN5 IV-15 (*S. cerevisiae*), CS SF – 8 (*S. cerevisiae*), SC 6 a (*S. cerevisiae*), SC 6 b (*S. cerevisiae*). Among these, the last four, all of genus *Saccharomyces*, are considered the most suitable for wine fermentation, having growth rates similar or higher than the control yeast, EC1118.

The yeast strains that presented similar growth rate constants are identified in Table 2 with the same letter and are the strains with growth rates that were not found to be statistically different by performing an ANOVA analysis (one way analysis of variance). For examples, strains PN5 IV-15, CSEC B-2, CS SF – 8, SC 6 a, SC 6 b (noted with a), PN5 IV-18 şi EC 1118 (noted with b) and so forth have similar growth rate.

The ANOVA test was followed by a multiple comparison test, the Tukey test, which better identifies the statistical differences between yeast strains as far as the mean of the growth rate constant is concerned. The results of Tukey tests are presented in Table 3.

For a rapid selection of the yeasts more suitable for must fermentation and wine production, the growth rates of all tested yeasts are plotted in Fig. 3.

As it can be seen, the yeasts selected from ecological Cabernet Sauvignon, either directly from the grapes or from the fermenting must, have similar high growth rate constants, being from this viewpoint suitable for winemaking. In the same group of high growth rate constants we find other three *Saccharomyces cerevisiae* strains, the SC 3 a, SC 6 a and SC 6 b originating in the Panciu region. Another *S. cerevisiae* strain, PN5 IV-15, selected in a Pinot noir plantation in Valea Călugărească, completes the group.

The remaining yeasts, as far as the growth rate constant is concerned, do not belong to any group classified in accordance to the yeast genus or yeast geographical origin. It should be emphasized that the lowest growth rate is recorded for the strain PN5 B-B-6, selected in a Pinot noir plantation, which was later identified as belonging to the *Kloeckera* genus. This yeast differs from the rest of the tested ones not only by its growth rate, but also by the pattern of the growth, the heat evolved during its incubation in the calorimeter showing a different profile (Fig. 2, second plot on the left).

CONCLUSIONS

The growth rate constant determination for the ten yeast strains selected in Panciu and Valea Călugărească region for the production of local wines showed a differentiation in two main groups: one including the *Saccharomyces cerevisiae* strains and another including the other genera strains.

The calorimetric evaluation is a technique very suitable for the rapid determination of the growth potential of a microbial culture. The calorimetric results for these yeasts showed that 6 strains, PN5 IV-15, CSEC B-2, CSEC B-3, CS SF – 8, SC 6 a and SC 6 b, have similar high growth rate constants, the ANOVA and Tukey tests showing that, with a 95% probability, there is no statistical difference among them regarding this parameter. All of these strains were identified as *Saccharomyces cerevisiae* strains and they will be later on evaluated for their oenological traits. A strain later identified as *Kloeckera spp*. was found to have the lowest growth rate (0.251 ± 0.008), being considered unsuitable for wine production.

The *S. cerevisiae* yeast strains selected in this work displayed higher growth rates than the control yeast strain, EC 1118, a commercially available yeast, a strain selected in Epernay-Champagne region, very used internationally in quality wine production.

The evaluation of the growth rate constant provides important information regarding the possibility of a rapid growth in the grape must destined for fermentation, but this parameter is not sufficient to recommend certain yeast for wine fermentation. The determination of the growth rate is the first step in the procedure of yeast evaluation for oenological applications, but should be followed by an ethanol tolerance test and then by several tests on grape musts, for the evaluation of the chemical and sensory profile of the final wine. Especially the non-*Saccharomyces* strains should be approached with caution, being the most prone to introduce non-typical flavours in wine. However, they should not be disregarded either, since in recent years some non-*Saccharomyces* yeast have been introduced in the process of winemaking, even if in most cases it has been done mostly for research purposes (Jolly *et al*., 2006).

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TABLES NAD FIGURES

Table 1

Yeast strains selected in Panciu and Valea Călugărească vineyards for which the growth rate constant was determined

No.	Yeast strain codification	Yeast species	Comments
1	PN5 IV-15	*Saccharomyces cerevisiae*	Selected from Pinot noir conventional plantation of Valea Călugărească
2	PN5 IV-18	*Saccharomyces cerevisiae*	Selected from Pinot noir conventional plantation of Valea Călugărească
3	CSEC B-2	*Candida utilis*	Selected from Cabernet Sauvignon ecological plantation of Valea Călugărească
4	CSEC B-3	*Rhodotorula glutinis*	Selected from Cabernet Sauvignon ecological plantation of Valea Călugărească
5	PN5 B-B-6	*Kloeckera spp*	Selected from Pinot noir conventional plantation of Valea Călugărească
6	CS SF - 8	*Saccharomyces cerevisiae*	Selected from ecological Cabernet Sauvignon must at the end of fermentation at Valea Călugărească
7	SC 3 a	*Saccharomyces cerevisiae*	Selected from Fetească regală conventional plantation of Panciu
8	SC 6 a	*Saccharomyces cerevisiae*	Selected from Fetească regală conventional plantation of Panciu
9	SC 6 b	*Saccharomyces cerevisiae*	Selected from Fetească regală conventional plantation of Panciu
10	EC 1118	*Saccharomyces cerevisiae*	Commercially available yeast

Table 2

Growth rate constant of the selected yeast strains in YPG broth in the absence of growth inhibitors

No.	Yeast strain	*f*(*t*) curve (no. 1-4)	growth rate constant, μ	Similarity of growth rate (ANOVA)
1.	**PN5 IV-15**	1	0.42121	
		2	0.41774	
		3	0.40905	
		4	0.41674	
		Average ± standard deviation	0.416 ± 0.005	**a**
2.	**PN5 IV-18**	1	0.34604	
		2	0.36629	
		3	0.35197	
		4	0.35311	
		Mean ± standard deviation	0.354 ± 0.009	**b**
3.	**CSEC B-2**	1	0.39043	
		2	0.45528	
		3	0.40685	
		4	0.39106	
		Mean ± standard deviation	0.411 ± 0.031	**a, c**
4.	**CSEC B-3**	1	0.42819	
		2	0.42249	
		3	0.43192	
		4	0.43707	
		Mean ± standard deviation	0.430 ± 0.006	**c,d**
5.	**PN5 B-B-6**	1	0.24134	
		2	0.25585	
		3	0.25901	
		4	0.24599	
		Mean ± standard deviation	0.251 ± 0.008	
6.	**CS SF - 8**	1	0.40506	
		2	0.42846	
		3	0.39395	
		4	0.40282	
		Mean ± standard deviation	0.408 ± 0.015	**a,c, e**
7.	**SC 3 a**	1	0.37827	
		2	0.37367	
		3	0.37349	
		4	0.37015	
		Mean ± standard deviation	0.374 ± 0.003	**f, g**
8.	**SC 6 a**	1	0.42062	
		2	0.3948	
		3	0.43268	
		4	0.42047	
		Mean ± standard deviation	0.417 ± 0.016	**a,c, d, e, g**
9.	**SC 6 b**	1	0.44752	
		2	0.39519	
		3	0.44154	
		4	0.42683	
		Mean ± standard deviation	0.428 ± 0.023	**a, c, d, e**
10.	**EC 1118 (control)**	1	0.36187	
		2	0.35927	
		3	0.37741	
		4	0.39151	
		Mean ± standard deviation	0.372 ± 0.015	**b, c, e, f**

Table 3

Pair wise comparisons of the mean responses for the growth rate constant of the selected yeast strains in YPG broth in the absence of growth inhibitors (Tukey test)

Comparison (yeasts from Table 2)	Different of means	No. of pairs	Factor q	Test Power P	Significant difference for P<0.050
No. 4 vs. No. 5	0.179	10	23.191	<0.001	Yes
No. 4 vs. No. 2	0.0756	10	9.770	<0.001	Yes
No. 4 vs. No. 10	0.0574	10	7.422	<0.001	Yes
No. 4 vs. No. 7	0.0560	10	7.243	<0.001	Yes
No. 4 vs. No. 6	0.0223	10	2.889	0.578	No
No. 4 vs. No. 3	0.0190	10	2.458	0.766	No (not tested)
No. 4 vs. No. 1	0.0137	10	1.776	0.956	No (not tested)
No. 4 vs. No. 8	0.0128	10	1.652	0.972	No (not tested)
No. 4 vs. No. 9	0.00215	10	0.278	1.000	No (not tested)
No. 9 vs. No. 5	0.177	10	22.914	<0.001	Yes
No. 9 vs. No. 2	0.0734	10	9.492	<0.001	Yes
No. 9 vs. No. 10	0.0553	10	7.144	<0.001	Yes
No. 9 vs. No. 7	0.0539	10	6.966	0.001	Yes
No. 9 vs. No. 6	0.0202	10	2.611	0.702	No (not tested)
No. 9 vs. No. 3	0.0169	10	2.181	0.864	No (not tested)
No. 9 vs. No. 1	0.0116	10	1.498	0.985	No (not tested)
No. 9 vs. No. 8	0.0106	10	1.374	0.992	No (not tested)
No. 8 vs. No. 5	0.167	10	21.540	<0.001	Yes
No. 8 vs. No. 2	0.0628	10	8.118	<0.001	Yes
No. 8 vs. No. 10	0.0446	10	5.770	0.010	Yes
No. 8 vs. No. 7	0.0432	10	5.592	0.014	Yes

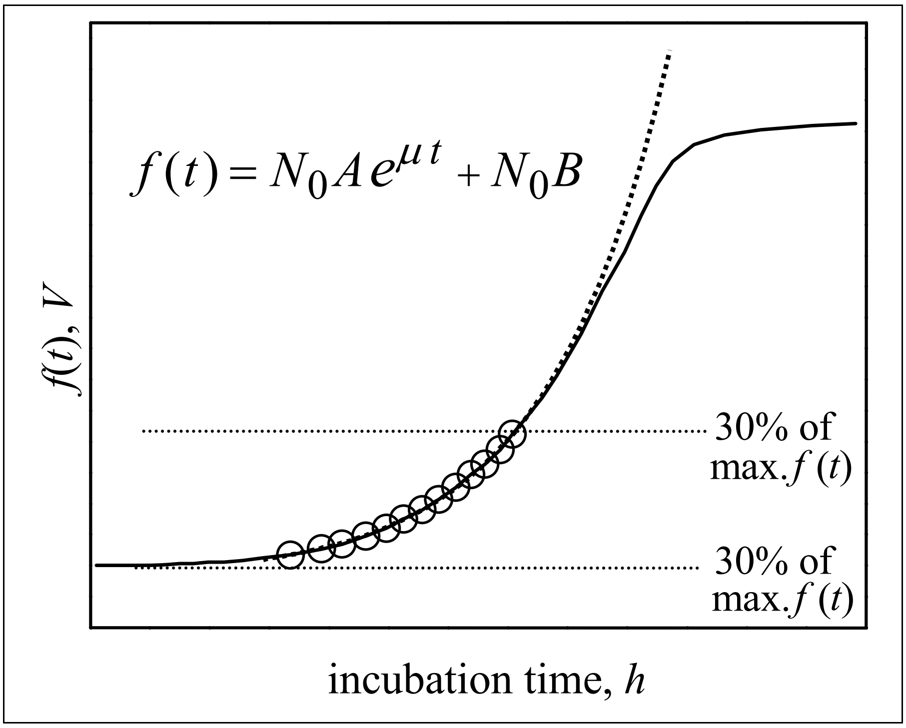

Fig. 1. Determination of the growth rate constant μ of a yeast strain incubated in the calorimeter. The initial portion of the $f(t)$ curves, situated between the 3% and 30% of their maximum height, is fitted by regression analysis on the basis of an exponential equation for growth which allows the determination of.

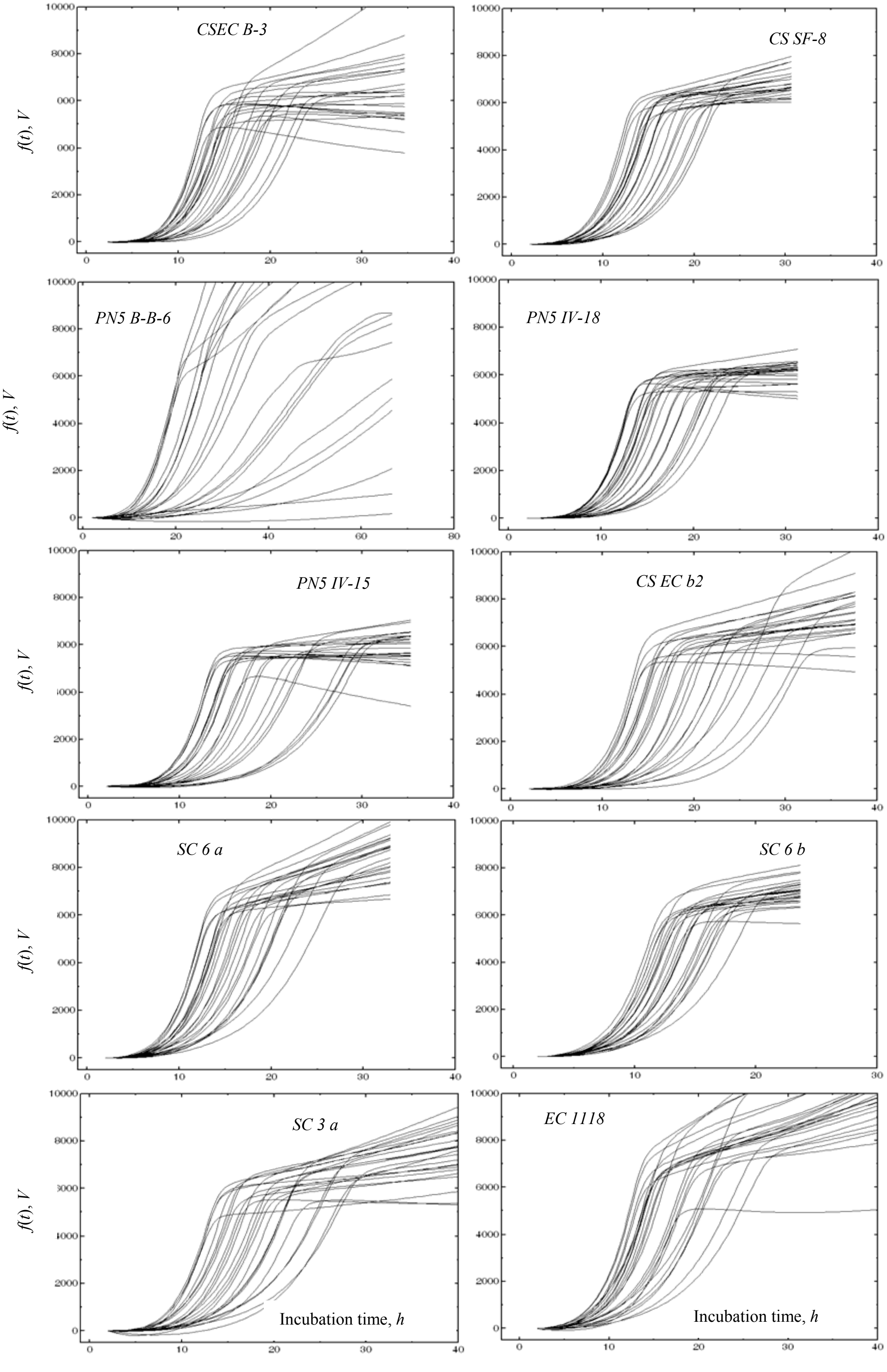

Fig. 2. The integrated growth thermograms, *f*(*t*) curves, obtained in a complex experiment, in which ethanol was added in progressive concentrations as an inhibitor. The growth rate constant μ of an yeast strain in the absence of inhibitors was determined for the first 4 curves recorded for each strains, that were obtained in growth medium without ethanol.

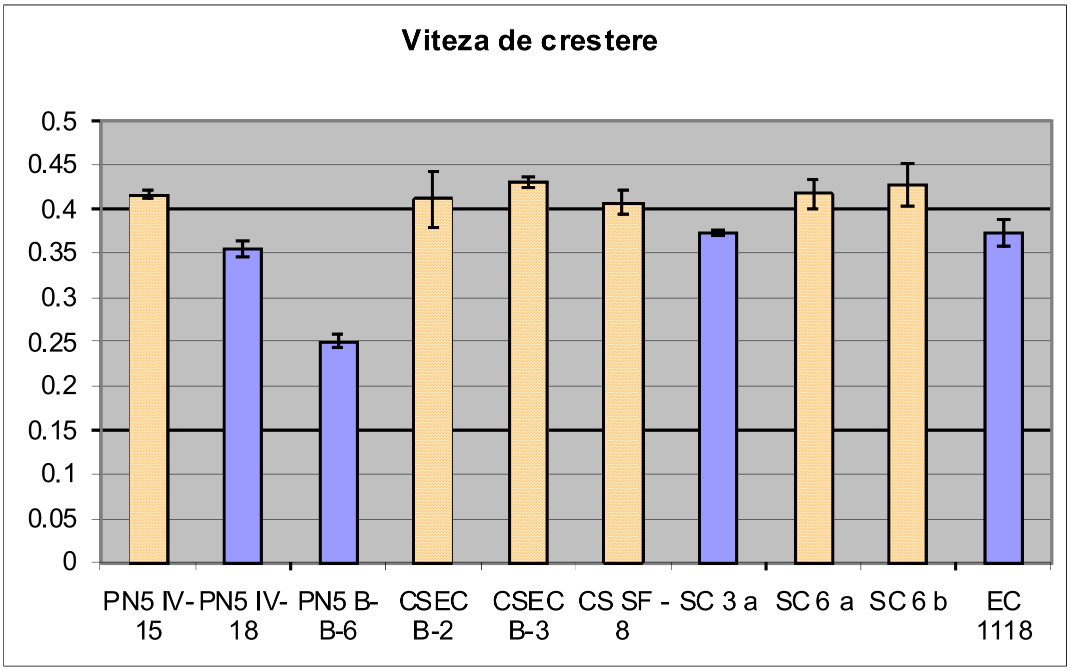

Fig. 3. The growth rate constant μ of the 10 yeast strains selected in local vineyards determined calorimetrically in YPG broth. (In dotted pattern is marked the group of yeasts with statistically similar growth rate constants)

Evaluation of Feteasca neagra wine from Murfatlar vineyard by new sensorial methods and physico-chemical analysis

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Keywords: sensory analysis, olfactory profile, taste profile.

ABSTRACT

Sensory profile of wine is very important information for the wine consumer. It is found in the literature, in brochures or presentation of wines, or in summary form on their label. Among red high quality wines like Pinot Noir, Cabernet Sauvignon and Merlot, has been made recently noted Fetească neagră wines, provided from one of the oldest Romanian varieties. In this paper we have studied four varieties of Fetească neagră wines obtained in autumn 2008 in three centres of Murfatlar vineyard: Murfatlar, Medgidia and Cernavodă. These were sensory examined by a group of specialized tasters and authorized members of the Association of Certified Tasters in Romania. To express tasting results it was used a points system based on the assessment after a scale from 0 to10, for a range of visual characteristics, olfactory and taste, the rating is directly proportional to the intensity of the analyzed character. Based on scores given by each member of the tasting jury the arithmetic mean was calculated for each character and the physico-chemical analysis were achieved by standard methods and were conducted in the laboratory of SCDVV Murfatlar. The characteristics analyzed by the new methodology of sensory analysis are more explicit, is not giving differential notes, the scale is the same for all of the examined characteristics. By using this system, we can reproduce very well the sensory profile of wine - in this case, the Fetească neagră wines from Murfatlar vineyard.

INTRODUCTION

Murfatlar vineyard with its three centres: Murfatlar, Medgidia and Cernavodă, is favored by natural conditions proper to the cultivation of vines. Although is famous for its demisweet and natural sweet wines, white and red, who won among internal consumers and foreign partners a well-deserved reputation, lately at Murfatlar are obtained dry white and red wines, highly valued by consumers.

Among red wines like Pinot Noir, Cabernet Sauvignon and Merlot, has been made recently noted the Fetească neagră variety, one of the oldest Romanian varieties: is of the same generation or even older than the famous black varieties: Tempranillo from Spain, Touriga Nacional from Portugal, Cabernet Franc from France, Baebera of Italy. It may be one of the few Romanian varieties today "alive", whose origin is not questioned.

MATERIAL AND METHOD

This paper is based on tasting conducted in a workshop entitled ”Evaluation of varietal wines by sensory analysis methodology and physico-chemical analysis” of the most representative red wines from the wine region of Dobrogea, obtained during 2008-2009, and in this paper we present the results for the local variety of Fetească neagră.

The tasting was made by a group of 14 specialists: teachers, technologists, chemists, engineers, representatives of wine producing units in Dobrogea, of which six are members of the Association of Certified Tasters Romania (ADAR). To express the results of tasting, we used “The descriptive tasting sheet” developed by a panel of tasters from Valea Călugărească on a points system based on the assessment after a scale from 0 to10, for a range of visual characteristics, olfactory and taste, the rating is directly proportional to the intensity of the analyzed character. Based on scores given by each member of the tasting jury was calculated the arithmetic mean for each character, these results stand in the preparation of the figures which are presented in this paper. There were evaluated sensory 4 varieties of Fetească neagră wines from SCDVV Murfatlar, SC Fruvimed, SC Vinex Cernavodă, and SC Murfatlar

Romania. The sensory descriptors of the varietal wines were presented in the tasting sheets and the sensorial profile was presented graphically. The results of this paper are only part of a larger study conducted on wines obtained at the Murfatlar vineyard. The physico-chemical composition of the wine was evaluated based on the general composition parameters (density, alcoholic strength, total acidity, volatile acidity, reducing sugars, total extract, nonreduced extract).

RESULTS AND DISCUSSION

Sensory profile is highly subjective, mainly due to the method organoleptical evaluation which is used. Through this study we were able to reduce the subjectivity in assessing the sensory profile of wines. To highlight the quality of the sensorial profile determined by the new methodology for each varietal wine will be presented the obtained profile. The Fetească neagră wines of Murfatlar vineyard, harvest of 2008 had an intense cherry red colour. Complex flavours, pleasant and original, determined by the grapes flavour from which they came from, had notes of fruits (raspberries, cherries, red currants, blackberries), dried figs, oak flavour in some cases suggesting dried prunes (Fig, no. 1, 3, 5, 7). The acidic feeling of wine was balanced, characteristic for the variety, interfering beneficial, leaving behind a persistent pleasant memory; the wine was round and had a normal alcoholic strength (Fig. no. 2, 4, 6, 8) being rich in tannins, share of tannins with astringent properties has been slight, and those with properties of smoothness was normal.

The Physical-chemical analyses were performed by standard methods conducted in the laboratory of SCDVV Murfatlar; results obtained for each manufacturer are listed in Table 1.

Wines obtained from Fetească neagră variety are dry wines (2.7, 3.4, 3.3, 4.0 g/l sugar), with an alcoholic content of 12.5, 12.2, 11.7, 13.1 % vol., volatile acidity of wines had values of de 0.76, 0.50, 0.72 and 0.56 g/l (acetic acid), wines are extractives, the nonreduced extract content is (26.9, 23.6, 24.0 and23.8 g/l). To highlight the composite profile of wines and to be able to represent on an axis system all the components which influence the characteristics of wine, we reduce the values of some parameters with high concentrations by multiplying with a subunit number and increased some parameters by multiplying the over units factors. Selected factors were applied for all wines, so that they can be compared. Factors used in wine are: alcohol x 0.7; extract x 0.3, volatile acidity x10. Composite profile of Fetească neagră wine is shown in Fig. 11, 12 and 13.

CONCLUSIONS

The new system to express the sensory characteristics of wines is to grant points for a number of features, on which can be drawn by a suggestive schematic representation. Analyzed characteristics are more explicit and differentiated noted; the scale was the same for all characteristics examined.

By using this system, we can reproduce very well the sensory profile of wine - in this case, the Fetească neagră wine from Murfatlar vineyard.

Normal alcoholic potential like acidity, extract, colouring substances are in perfect harmony, which gives to the Fetească neagră wine a fine and smoothness quite specific, distinguishing as a high quality wine.

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TABLE AND FIGURES

Table 1

The physical-chemical composition of Fetească neagră wine from Murfatlar vineyard

No	Parameter	Um	Fetească neagră- SC Murfatlar Romania	Fetească neagră- SCDVV Murfatlar	Fetească neagră- SC Vinex Cernavodă	Fetească neagră- SC Fruvimed Medgidia
1	Density	g/ml	0,99223	0,9935	0,99273	0,9948
2	Alcoholic strength	% vol	13,1	11,7	12,2	12,5
3	Sugar	g/l	4,0	3,3	3,4	2,7
4	Total acidity	g/l acid tartaric	5,52	5,72	4,94	5,63
5	Volatile acidity	g/l acid acetic	0,56	0,72	0,50	0,76
6	Total extract	g/l	27,8	27,3	27,0	29,6
7	Nonreduced extract	g/l	23,8	24,0	23,6	26,9
8	SO_2 total	mg/l	115,9	100,8	69,0	107
9	SO_2 free	mg/l	24,6	29,5	19,7	21

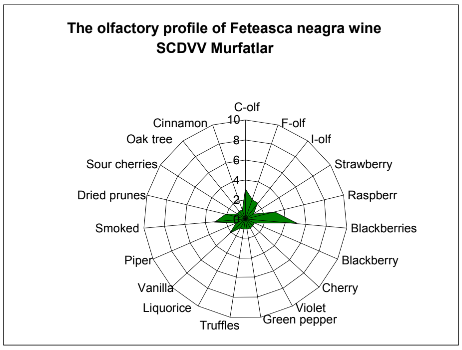

Fig. 1. The olfactory profile of Fetească negră wine SCDVV Murfatlar

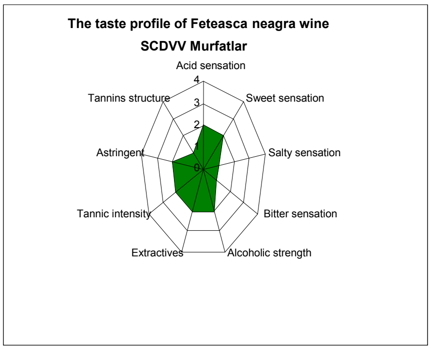

Fig. 2. The taste profile of Fetească neagră wine SCDVV Murfatlar

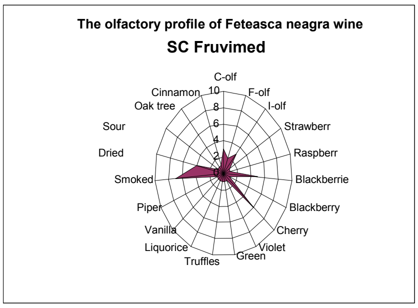

Fig. 3. The olfactory profile of Fetească negră wine SC Fruvimed Medgidia

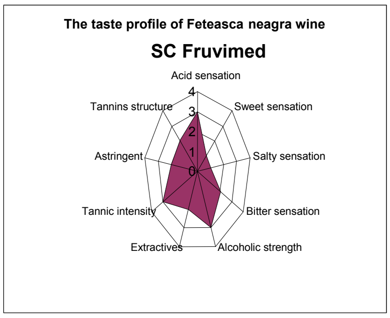

Fig. 4. The taste profile of Fetească neagră wine SC Fruvimed Medgidia

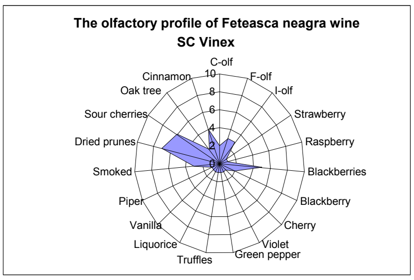

Fig. 5. The olfactory profile of Fetească negră wine SC Vinex Murfatlar

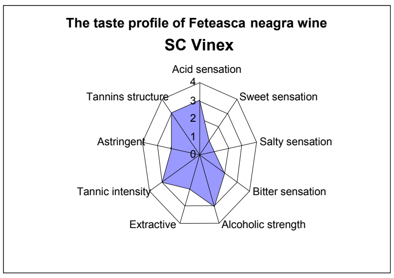

Fig. 6. The taste profile of Fetească neagră wine SC Vinex Murfatlar

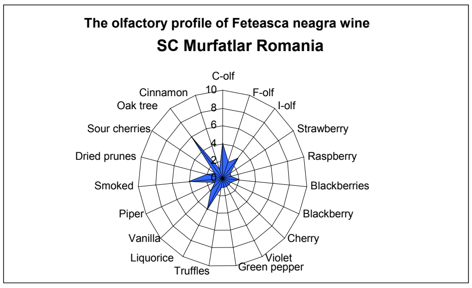

Fig. 7. The olfactory profile of Fetească negră wine SC Murfatlar Romania

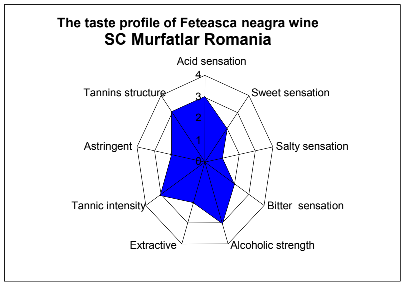

Fig. 8. The taste profile of Fetească neagră wine SC Murfatlar Romania

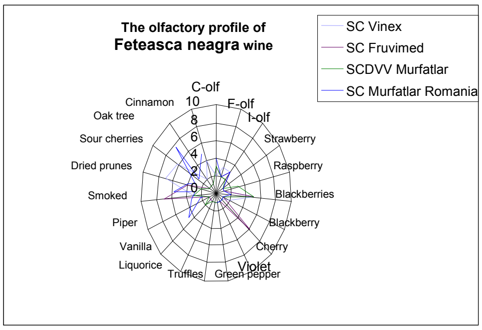

Fig. 9. The olfactory profile of Fetească negră wine

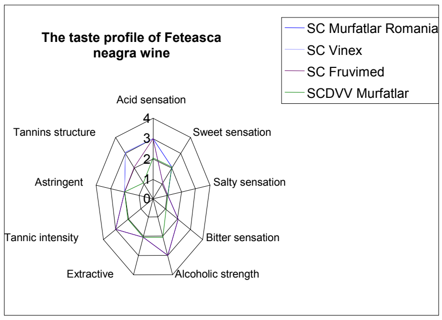

Fig. 10. The taste profile of Fetească neagră wine

Fig. 11. Composite profile of Fetească neagră wine, 2008, SC Fruvimed and SC Vinex

Fig. 12. Composite profile of Feteasca neagra wine, 2008, SCDVV Murfatlar and SC Murfatlar Romania

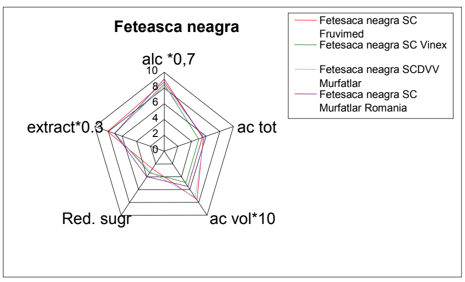

Fig. 13. Comparative composite profile of Feteasca neagra wine, 2008

Morphological characterization of local grapevine varieties using fractal analysis of the leaves

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Keywords: Fractal dimension, HarFA soft, Box - Counting Method, ampelography

ABSTRACT

The shape of the leaf is one of the most important morphological characteristics of the Vitis Genus. The characterization of leaf architecture through the fractal analysis method is a modern research alternative, which coupled to new tools in the shape analysis of leaves opens interesting prospects for ampelographic research.

This paper presents a morphological evaluation of eight local grapevine varieties (Vitis vinifera L.), through determining the fractal dimension of the leaves contour and the degree of section. The results show that the leaves of varieties with sectional leaves, with rare and elongated teeth, are characterized by great fractal dimensions compared to leaves of varieties with entire or shallow lobed leaves with small and sharp teeth. The fractal dimension of the leaves and the degree of section are invariable descriptive parameters which can be used together with other ampelographic descriptors in the characterization and discrimination of grapevine varieties.

INTRODUCTION

The origin of the grapevine varieties, their hetrogeneity and the frequent cases of homonymy and synonymy, often resulted in doubtful classification (Mancuso, 2001). Fractal analysis supplements the classic methods used in ampelography such as the ampelographic descriptors method using the common codes UPOV-OIV-IPGRI charts, 1997 and the ampelometric method (Ravaz, 1902) based on representing morphological characters as quantitative measurements and allows the usage of informatics resource in this science.

The term ”fractal”, derived from the Latin fractus (broken, fractured), has been first used in 1975 by the Benoit Mandelbrot, in order to describe an irregular and complex structure in nature, characterized by two main features: self-similarity and fractal or fractional dimension. Fractal dimension, also named Hausdorff-Besicovitch dimension, measures the degree of irregularity and fragmentation of a structure, given by the formula:

$$D = \log N/\log(L/l)$$

In order to be characterised as fractal, a shape should have the fractal dimension a greater than its topological dimension (euclidean).

Although the grapevine leaves don't have the self-similarity of well-known fractals in nature (fern, broccoli, sunflower leaves), there is the possibility of using fractal analysis due to the complexity of their structure (Ţârdea and all., 2008). The studies have shown that the table grapevine varieties with sectional leaves, with great and rare teeth, are characterized by great fractal dimensions and small values of ampelometric ratios (Ţârdea and Oancea, 2008).

The fractal dimensions for the leaves of the Sangiovese R10 variety, cultivated in very different ecopedoclimatic conditions showed no significant difference statistically, thus demonstrating that fractal dimension might be considered independent from weather conditions and might be used constantly as an invariable descriptive morphological parameter in ampelographic research (Mancuso, 2001).

This paper aims to make a morphological characterization of 8 local grapevine varieties (*V. vinifera L.*): Galbena de Odobeşti, Plavaie, Fetească regală, Fetească albă, Fetească neagră, Sarba, Francusa and Furmint, using the fractal analysis of leaves.

MATERIALS AND METHODS

The biological material consisted of 15 adult leaves for every studied variety, situated on the middle part of the shoot (leaves 5-9), because this area shows lower variability of ampelographic characters. The leaves have been collected during the blooming stage (the beginning of July), from the grapevine collection of the Research and Development Station for Winegrowing and Winemaking Odobești. Afterwards they were pressed and scanned, and the images were processed with Paint and Irfanview in order to obtain black and white images.

One of the most common methods for calculating the fractal dimension of a structure is the Box – Counting Method. The procedure consisting in determining the number of cells needed to cover the measured surface according to length 1 of these cells (fig. 1). For various length of cell 1, the cells covering the figure are counted and then it is represented as logarithmic coordinates log N = f (log.l). The slope of the straight line is the fractal dimension (D) of the shape or structure under analysis. The main advantage of this method is the lack of difficulty in implementing it in various computer programs and the possibility of applying it to any type of image.

In this work, HarFa soft (Harmonic Fractal Analysis) from Applied Chemistry and Physics Institute, Brno University of Technology, Czech Republic was used. This soft is a modified version of traditional Box-Counting method, through which three fractal dimensions are obtained: one characterize the black plane (DB), the second characterize the white plane (DW) and the third (which is the most important piece of information), characterize the black -white border of black object (DBW). The fractal dimension of the leaf is the slope of the straight line "Black & White" (Zmeškal, 2001). In figure 2 is given the HarFa screen with a black-white image of a leaf from Fetească albă.

In order to determine the degree of leaf section, it has been calculated the ratios ampelometric d_1/N_2, with d_1 the distance from the basis of the upper lateral sine at the level of the petiolar node, and N the length of the upper lateral nervures. The Student test of the Microsoft Excel – Data Analysis software was used to process the data mathematically and statistically.

RESULTS AND DISCUSSION

The results are shown in tables 1 and 2, and the figures 3 and 4 show the fractal dimensions for the leaves from Plavaie and Sarba varieties. The data resulted showed that the average values of fractal dimensions of the leaves from the grapevine varieties studied, range from 1.2168 for Francusa and 1.2494 for Feteasca neagra. Medium values have been obtained for Plavaie (1.2179), Feteasca regala (1.2189), Furmint (1.2209), Galbena de Odobesti (1.2296), Feteasca alba (1.2340) and Sarba (1.2387).

The Student test for determining the significance of the differences show significant and very significant diferences ($p \leq 0.05$), between Fetească neagră and Plavaie, Francusa and Furmint, between Sarba and Plavaie, Francusa and Furmint, as well as between Fetească albă and Francusa (table 3).

Average ampelometric values of the d_1/N_2 ratio, which characterize the degree of section of leaves varied between 0.3118 for Sarba variety and 0.7753 for Plavaie, with average intermediary values for the following varieties: Galbena de Odobești (0.7476), Furmint (0.7257), Fetească regală (0.6534), Francusa (0.6062), Fetească albă (0.5153) and Fetească neagră (0.3988).

It has been observed that the grapevine varieties with sectional leaves and great, rare and elongated teeth (Fetească neagră, Fetească albă, Sarba), have great values for the fractal dimension and low values of the ampelometric ratios d_1/N_2, while the grapevine varieties with entire leaves or shallow lobed leaves, with short and sharp teeth (Galbenă de Odobești, Plavaie, Francusa, Furmint, Fetească regală), have lower values for the fractal dimension and great values of the ampelometric ratio d_1/N_2.

In order to determine the correlation between the fractal dimension of the leaves and the ampelometric values of the d_1/N_2 ratio, a correlation quotient (r) has been calculated. According to the Colton classification (1974), the resulted data, presented in table 4, show a good negative correlation for the grapevine varieties: Fetească albă (- 0.7425) and Furmint (- 0.6381) and an acceptable negative correlation for Sarba (- 0.3546), Plavaie (- 0.2966) and Fetească regală (- 0.2848). The varieties Galbenă de Odobești, Francusa and Fetească neagră have shown a weak correlation or no correlation.

CONCLUSIONS

1. Fractal dimension may be used as an invariable descriptive morphological parameter in ampelographic research.

2. Leaves of grapevine varieties with sectional leaves, with rare and elongated teeth, are characterized by great fractal dimensions compared to leaves of varieties with entire or shallow lobed leaves with small and sharp teeth.

3. There is a good negative correlation between the fractal dimension of the leaves and the degree of leaf section or some of the analysed varieties (Fetească albă and Furmint).

4. Fractal analysis as a method in the discriminator analysis of grapevine varieties requires an evaluation of fractal dimension over several years, in order to establish a method standard.

AKNOWLEDGEMENT

The authors are grateful to Prof. Servilia Oancea for making the HarFA (Harmonic Fractal Analysis) software available for the determination of the grapevine leaves fractal dimension.

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TABLES AND FIGURES

Table 1

The fractal dimension of the leaves for local grapevine varieties studied (average values)

Variety	Fractal dimension	Standard deviation
Galbenă de Odobeşti	1.2296	0.0319
Plavaie	1.2179	0.0276
Francusa	1.2168	0.0174
Furmint	1.2209	0.0204
Fetească regală	1.2189	0.0721
Fetească neagră	1.2494	0.0241
Sarba	1.2387	0.0242
Fetească albă	1.2340	0.0229

Table 2

Ampelometric values of the d_1/N_2 ratio (average values)

Variety	d_1/N_2 ratio	Standard deviation
Galbenă de Odobeşti	0.7476	0.0594
Plavaie	0.7753	0.0753
Francusa	0.6062	0.0940
Furmint	0.7257	0.0635
Fetească regală	0.6534	0.1081
Fetească neagră	0.3988	0.0582
Sarba	0.3118	0.0474
Fetească albă	0.5153	0.0674

Table 3

Significance of the differences for the fractal dimension of the leaves/Student Test

Variety	G.O.	Pl.	Fr.	Fur.	F.r.	F.n.	S.	F.a.
GO	0							
Pl.	0.2918	0						
Fr.	0.1842	0.8994	0					
Fur.	0.3841	0.7335	0.5567	0				
F.r.	0.6054	0.9576	0.9117	0.9191	0			
F.n.	0.0650	0.0024**	0.0001***	0.0016**	0.1316	0		
S.	0.3862	0.0365*	0.0063**	0.0386*	0.3232	0.2341	0	
F.a.	0.6668	0.0926	0.0233*	0.1104	0.4473	0.0833	0.5898	0

G.O. = Galbenă de Odobeşti; Pl. = Plavaie; Fr. = Francusa; Fur. = Furmint;
F.r. = Fetească regală; F.n. = Fetească neagră; S. = Sarba; F.a. = Fetească albă
* = $p \leq 0.05$; ** = $p \leq 0{,}01$; *** = $p \leq 0{,}001$

Table 4

Correlation between the fractal dimension of the leaves and the d_1/N_2 ratio

Variety	Fractal dimension	d_1/N_2 ratio	Correlation quotient (r)
Galbenă de Odobeşti	1.2296	0.7476	- 0.2105
Plavaie	1.2179	0.7753	- 0.2966
Francusa	1.2168	0.6062	- 0.0747
Furmint	1.2209	0.7257	- 0.6381
Fetească regală	1.2189	0.6534	- 0.2848
Fetească neagră	1.2494	0.3988	- 0.2086
Sarba	1.2387	0.3118	- 0.3546
Fetească albă	1.2340	0.5153	- 0.7425

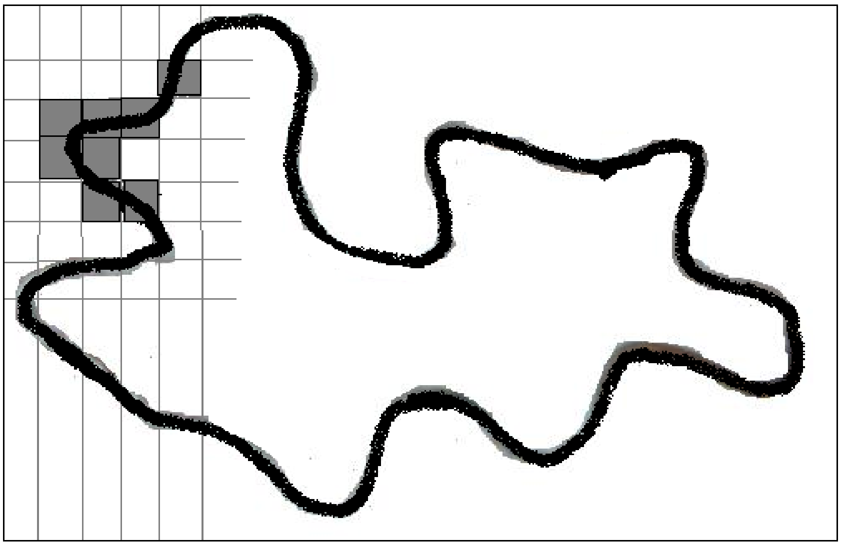

Fig. 1. Box- Counting method for determining of fractal dimension (source: Oancea, 2007)

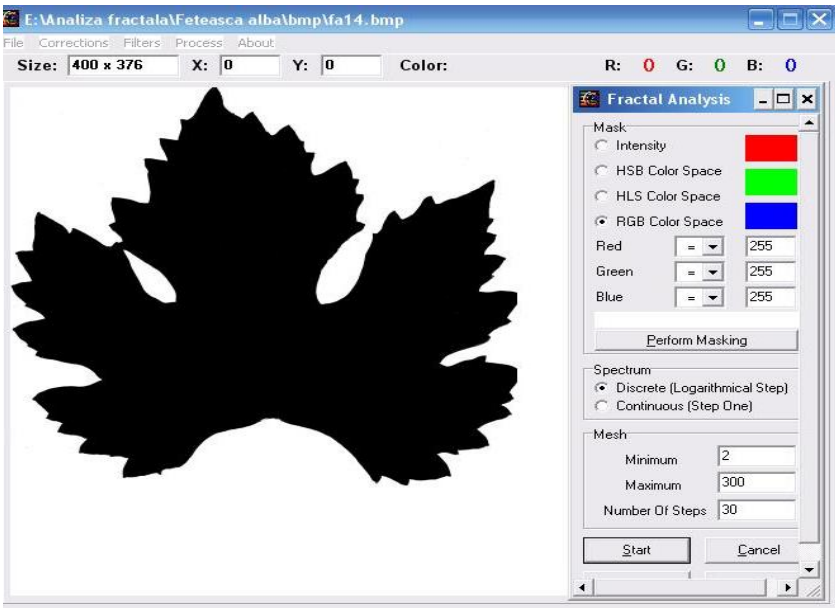

Fig. 2 HarFA screen with a Feteasca alba leaf

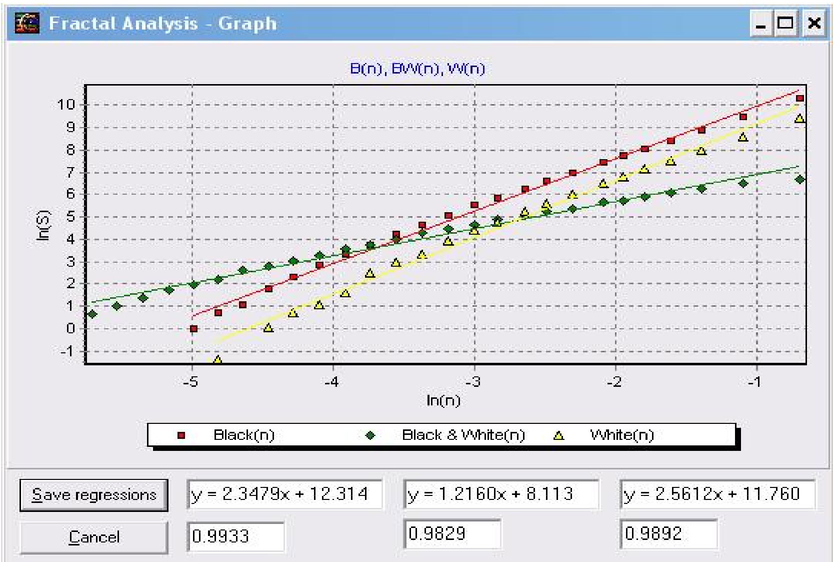

Fig. 3 - Fractal dimension for Plavaie leaf

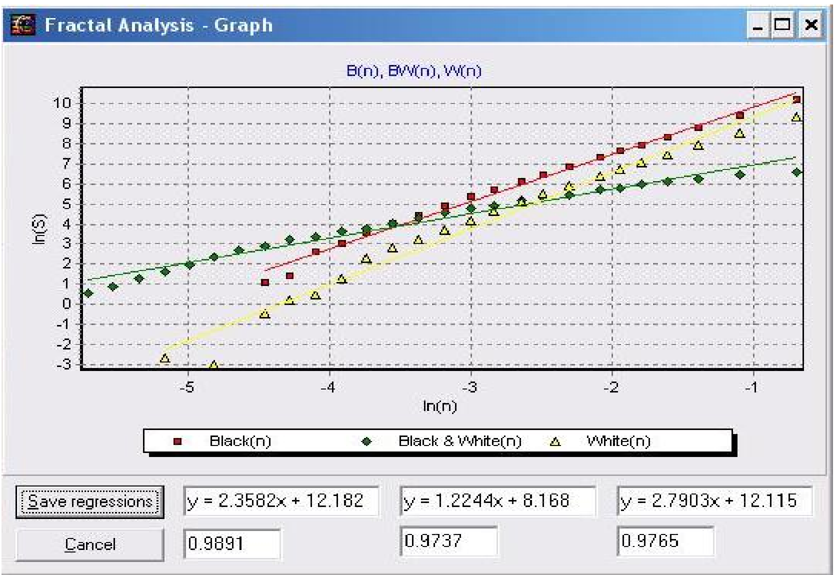

Fig. 4 –Fractal dimension for Sarba leaf

Research on relations between growth-yield balance indices and grape yield quality on some varieties created at S.C.D.V.V. Blaj

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Keywords: Ravaz index, growth-yield balance index, renewed dry matter of vegetative vine part, sugars

ABSTRACT

In terms of 2009, at SCDVV Blaj over Astra, Blasius, Selena and Fetească regală varieties determinations were made to calculate growth-yield balance indices. The highest value of the Ravaz index had the variety Fetească regală, 8.11 and smallest variety Selena, 3.56 assigned values within the normal range. Gowth-yield balance index stands out with the maximum variety Selena (21.94), and the minimum at Fetească regală variety (10.97), which expresses an imbalance between growth and fructification. The variety with the highest renewed dry matter of vegetative vine part is Fetească regală (941 g/vine) and the minimum is at Astra (358 g/vine), expressing a variety production below potential. It have highlighted the positive correlation between growth-yield balance index and the accumulation of sugars and negative correlations between Ravaz index, renewed dry matter of vegetative vine part and berries sugar content.

INTRODUCTION

Pruning grapevine is not only to maintain the temporal shape oh vine, but also to achieve a balance between growth and fructification, in terms of obtaining an optimal quality (Geanina Belea, 2008).

Optimizing quality of wine production is a basic element of viticulture, in this context stated today that *great wine is made in vineyard* (Fregoni, 2003) or *concept of quality begins in vineyard* (Schlamp, 2001).

Relationship between growth and fructification it can be expressed by various vegeto-productive indices of balance, such as: sugar productions, Ravaz index, growth-yield balance index, renewed dry matter of vegetative vine part.

Production of sugars (g/vine) was calculated by Martinez and Sanchez in 1998.

Growth-yield balance index was design by Maccarone and Scienza, 1996, and it expresses the relationship between growth and fructification and shows the percentage share of the vegetative part, expressed by weight of removed wood at pruning to achieving grape production. Values calculated by different authors, were 22.1 to 33.5 - Celoti et al., 2000, at Cabernet Sauvignon; 18 to 23 - Dejeu et al., 2003, at Fetească regală.

Ravaz index calculated by different authors is 2.2 to 3.7 after Celotti et al., 2000, for Cabernet Sauvignon, 2.5 to 6.1 after Lopes et al., 1997, for the same variety; 1.89 to 7.45 after Corino et al., 2002, for Pinot noir.

Renewed dry matter of vegetative vine part was estimate by summing the values of dry pruning weight and dry yield grapes; the optimal values are estimate by Carbonneau, 2003, between 1325 and 1705 g/vine.

MATERIAL AND METHOD

The research was conduct at S.C.D.V.V. Blaj on varieties Astra, Blasius, Selena and Fetească regală grafted onto Kober 5BB. The vineyard was establish in 2001. Training system is Guyot with periodic replacement arms with a load of 35 buds/vine, pruned in bearings rings (spurs with 2 bud and canes of 10 to 12 buds).

During technological maturation period, the grapes were harvested on 30 vines of each variety and it was determined the average grape yield per vine. Sugar content was determined by refractometric method. At pruning, were weighed separately annual and multiannual wood eliminated.

Based on grape yield and pruning weight, growth-yield balance indices were calculated.

Sugars production (g/vine) was calculate as the product of the sugar concentration (g/l) x grape production (kg/vine) x 0.72 (l/kg).

Growth-yield balance index is the ratio of pruning weight x 100/grape yield + pruning weight.

Ravaz index is the ratio between grape yield and pruning weight.

Dry matter was calculate using the formula fresh pruning weight x 0.47 (after Martinez and Sanchez, 1998), where 0,47 is the ratio of dry pruning weight/fresh pruning weight. Dry substance of grapes was calculate by multiplying the grape yield x 0.23 (this value represents the ratio of dry weight of grapes/fresh weight).

Growth-yield balance indices were correlate with sugars accumulation.

RESULTS AND DISCUSSIONS

The climate in the vineyards from Transylvanian plateau, is generally characterized by average values of heat balance and an average relative duration of the growing season.

Ecoclimatic conditions of 2009 can be characterized by values and indices following factors: overall heat balance 3565.6ºC, active heat balance 3331.9ºC, useful heat balance 1422,0°C, 1.33 heliothermic index, hydrothermal coefficient 1.5, wine bioclimatic index 7.6. Also, the rainfalls have a level of 507.6 mm, under multi-annual average (639.60 mm), average temperature 10.5°C above the average multi (9.3°C) and the actual amount of 2316.8 hours of sunlight hours over multi-annual average (1371 hours) in Blaj wine growing center. These conditions favoured the development of growth stages, veraison, grape maturation and ripening of canes, physiological and biochemical processes affecting the synthesis and accumulation of reserve substances on the vine.

In 2009, the highest grape yield per vine was at Fetească regală 3.27 kg/vine, followed by Blasius to 2.64 kg/vine. At very small difference was Selena with 2.00 kg/vine and the lowest production recorded by Astra with 1.04 kg/vine. Best sugar accumulation was at Astra with 219.6 g/l and Selena with 201.2 g/l. Blasius and Fetească regală varieties accumulated lower quantities of sugar, 188.4 g/l respectively 175.7 g/l. All data are show in Table 1.

Considering the vine vigour after pruning weight, Selena variety is highlighted with 0.562 kg/vine, followed by Fetească regală - 0.403 kg/vine and Astra, 0.253 kg/vine.

Sugar production per vine values ranged between 164.44 g/vine at Astra, and 413.20 g/vine to Fetească regală variety. It can see that the value of sugar production per vine is influence by the grape yield.

Regarding growth-yield balance indices, they recorded values fit within their optimum. Thus, Ravaz index values were between 4.11 (Astra) and 8.11 (Fetească regală).

During climatic conditions of 2009, the growth-yield balance index stands out with the highest value at Selena variety (21.94) and the lowest at Fetească regală (10.97), which expresses a very large production at the expense of overall vigour for this variety.

The variety with the highest renewed dry matter content is Fetească regală (941 g/vine), followed by Blasius (826 g/vine) and Selena (724 g/vine) and the lowest it can notice at Astra (358 g/vine).

Between growth-yield balance index and berries sugars accumulation in berries grape indices correlations were made to see to what extent their value influenced the sugar content.

The correlation between sugar production values on vine (g/vine) and sugar content of grapes (g/l) is significant negative linear (r=0.99*). The situation in this case is determined by the varieties which have accumulate a larger quantity of sugar and the production had a lower amount (figure 1).

Ratio values between grape yield/pruning weight (Ravaz index) and sugar concentration are established correlations of negative linear regression, thus the increasing of Ravaz index values decreases the content of sugars in grapes (Figure 2).

Low values of the ratio grape yield/pruning weight (4.11 at Astra to 3.56 at Selena) determine great concentrations of sugars (219.6 g/l Astra and 201.2 g/l Selena) and high values (5.65-Blasius and 8.11-Fetească regală) results in low accumulation of sugar (188.4 g/l-Blasius and 175.5 g/l-Fetească regală).

Regarding the third index studied, the link between values of growth-yield balance index and accumulation of sugars determines the existence of a positive linear correlation, but the correlation ratio is insignificant (r = 0.82). Maximum concentrations in sugars (201.2 to 219.6 g/l) are obtained at values of growth-yield balance index from 19.57 to 21.94 (Astra, Selena respectively), while for the index values from 10.97 to 15.03, the accumulation of sugars is lower (175.5 g/l at Fetească regală and 188, 4 g/l at Blasius).

Watching the nature of the link between renewed dry matter of vegetative vine part (pruning weight + grape yield) and accumulation of sugars in berries, it sees a significant negative linear correlation for these two variables (r = 0.97*) (figure 4).

In literature, Geanina Belea (2008) shows that minimum values of dry matter accumulation lead to low sugars content in grape berries. In this case, the reverse situation is explained by the low grape production (1.04 kg/vine-Astra and 2.00 kg/vine-Selena) for varieties that have the highest sugar content (219.6 g/l and 201.2 g/l).

The optimal value of renewable dry matter of vegetative vine part (826 g/vine-Blasius, 941 g/vine-Fetească regală) are corresponding to the minimum concentrations of sugars (175.5 g/l-Fetească regală and 188.4 g/l-Blasius).

CONCLUSIONS

1. Climatic conditions of 2009, in Blaj wine growing center, favoured getting a quality crop of grapes for sugar content (g/l).

2. The highest grape yield per vine was at Fetească regală 3.27 kg/vine, followed by Blasius to 2.64 kg/vine, and lowest - Astra 1.04 kg/vine. Best sugar accumulation was at Astra-219.6 g/l and Selena with 201.2 g/l. Blasius and Fetească regală accumulated lower quantities of sugar, 188.4 g/l respectively 175.7 g/l.

3. Growth-yield balance indices values (index Ravaz, growth-yield balance index, renewed dry matter of vegetative vine part) at studied varieties were fit in optimal values.

4. Correlation between sugar content of grapes and sugar production on vine, Ravaz index and renewable dry matter of vegetative vine part were linear and negative while between sugar accumulation and growth-yield balance index correlation was linear and positive.

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TABLES AND FIGURES

Table 1

Quantity of production, sugar content and the amount of wood removed annually from cutting

Variety	Grape yield kg/vine	Sugars g/l	Pruning weight kg/vine
Astra	1.04 c	219.6 a	0.253 c
Blasius	2.64 b	188.4 ab	0.467 ab
Selena	2.00 bc	201.2 ab	0.562 a
Fetească regală	3.27 a	175.5 b	0.403 b

DS 5% - grape yield/vine - kg/vine = 0.56-0.59
DS 5% - sugars must content - g/l = 30.04-40.13
DS 5% - pruning weight - kg/vine =0.10
*values designated by the same letter within each main column do no differ significantly ($p \leq 0.05$)

Table 2

Growth-yield balance indices

Variety	Sugars production g/vine	Ravaz index	Growth-yield balance index	Grapes dry substance g/vine	Wood dry substance g/l	Renewed dry substance of airy part g/vine
Astra	164.44	4.11	19.57	239	119	358
Blasius	358.11	5.65	15.03	607	219	826
Selena	289.73	3.56	21.94	460	264	724
Fetească regală	413.20	8.11	10.97	752	189	941

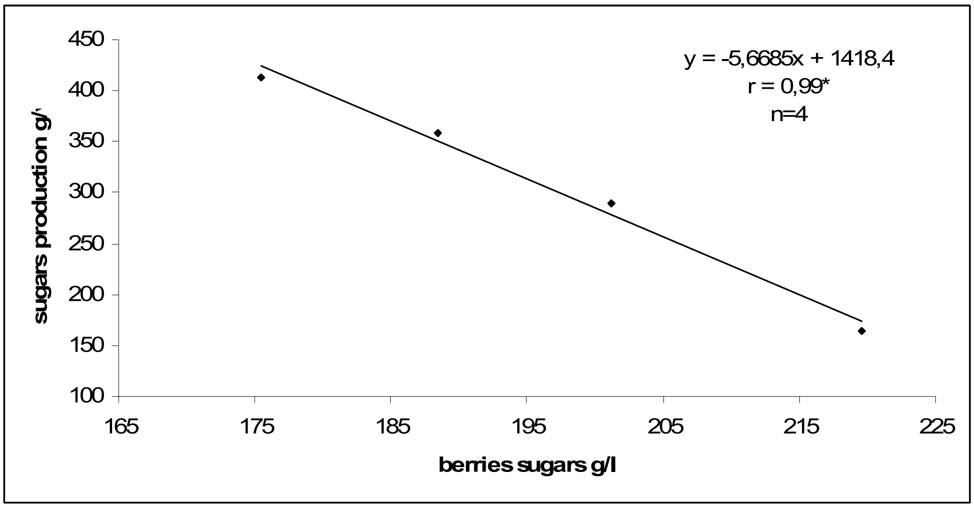

Fig. 1. Correlation between sugar production/vine and grapes sugar content (g/l), in 2009 at S.C.D.V.V. Blaj

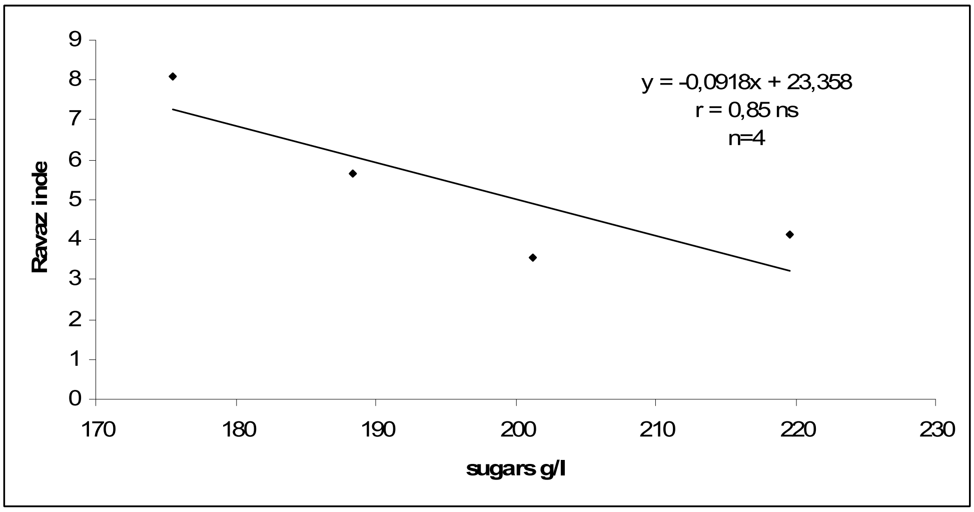

Fig. 2. Correlation between Ravaz index and grapes sugar content (g/l), in 2009 at S.C.D.V.V. Blaj

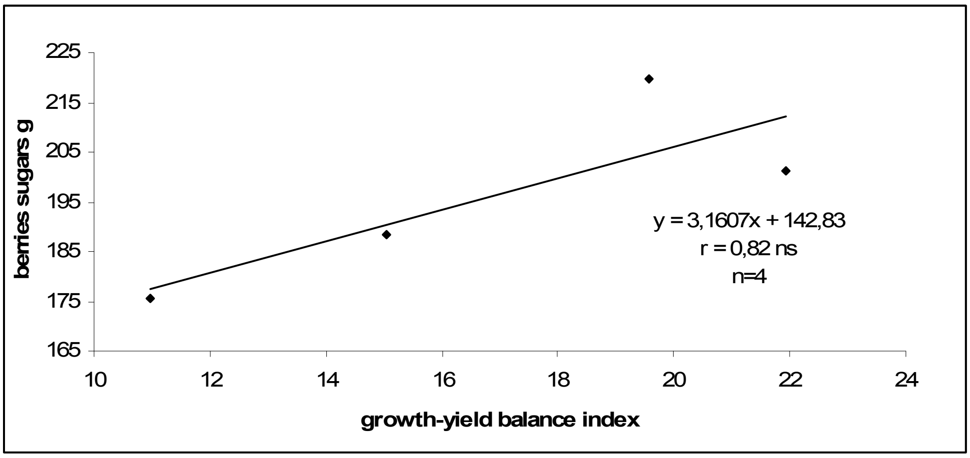

Fig. 3. Correlations between values of growth-yield balance index and sugars accumulation (g/l), in 2009 at S.C.D.V.V. Blaj

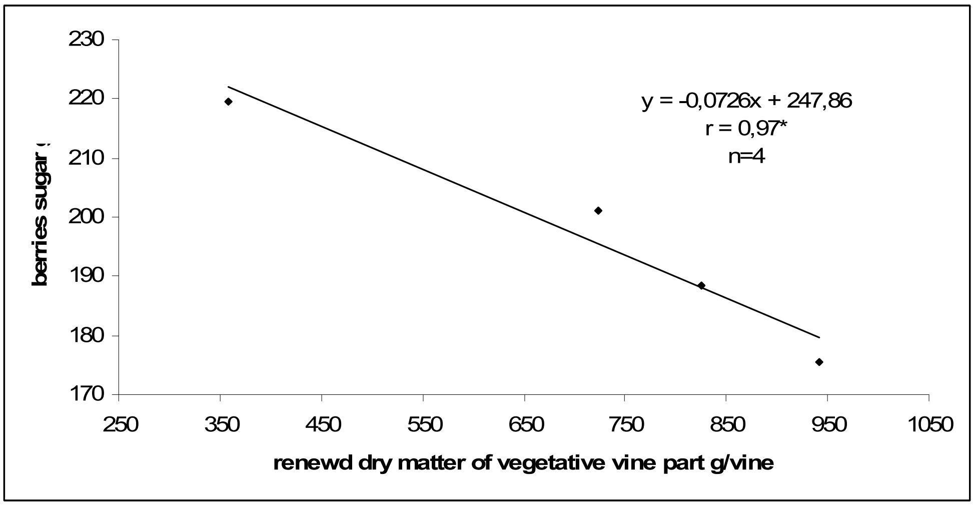

Fig. 4. Correlations between renewed dry matter of vegetative vine part (g/vine) and sugars accumulation (g/l) in 2009

Fig. 5. Astra variety – original picture

Fig. 6. Blasius variety – original picture

Fig. 7. Selena variety – original picture

Fig. 8. Fetească regală – original picture

Buds viability and carbohydrates canes content of some varieties created at S.C.D.V.V. Blaj during winter 2009-2010

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Keywords: grapevine, starch, canes, low temperature, carbohydrates

ABSTRACT

Low temperatures during dormancy of grapevine is the main stress factor affecting plant growth and development and the quantity and quality of grape yield in next year as well. In this work paper, it have make observations on the level of critical temperatures in winter 2009-2010, the amount of carbohydrates and bud viability in varieties Astra, Blasius, Selena and Fetească regală. Critical period for vines, in wine growing centre Blaj was in January when there were seven consecutive days of frost, with temperatures of -22°C. The carbohydrate content ranged from 17.78 g % (Blasius) and 13.09 g % (Fetească regală). Most viable buds showed the variety Fetească regală, 50.95 % and the lowest Astra, 36.12%. Duncan test was used to test for significant differences between varieties. It have been highlighted insignificant correlations between buds viability and canes diameter, carbohydrate canes content and cane diameter and significant correlation between buds viability and carbohydrate canes content.

INTRODUCTION

In Blaj wine growing centre, the 2009 was favourable for vine culture, achieving quality harvest and the monthly average temperatures in September and October higher than average for this area, favoured synthesis and accumulation of reserve substances in plants organs.

Different factors which help vine resistance at low temperatures are studied by many researchers. Thus, resistance to winter temperatures was studied by Vasudevan, 1997; Pedryc et al, 2004. Also, winter resistance was correlated with vine varieties accumulation of carbohydrates (Smith and Holzapfel, 2009) and accumulation of reserve substances depending on shoots or canes vigourness (Dawn, 2004, EL-Mogy, 2006, Samra, 2008).

Stored carbohydrates are thought to have a strong influence on the differentiation of inflorescences in young buds. Carbohydrates are stored in the roots, trunk, cordons, and canes or spurs. These carbohydrates were stored the year before bud differentiation, or two years before the crop. This means that growing conditions and vine strength two years in the past help determine the current year's fruitfulness.

MATERIAL AND METHOD

As biological material, were used Astra Blasius, Selena, grape varieties created at S.C.D.V.V. Blaj and Fetească regală, planted in 2001 at 2,00 m between rows and 1,2 m between vines on row.

From each variety it was choose 25 vines. Training system was Guyot with periodic replacement arms, pruned in bearing rings, spurs with 2-3 buds and canes with 6-8 buds, and bud load of 35 buds/vine or 20 buds/m^2.

The canes for determining carbohydrates were harvest at 3 weeks from the leaves fall. (10 canes from each variety).

To determine total carbohydrates from canes it was used anthrona regeant method improved by S.C.D.V.V. Blaj and consists in extracting soluble sugars with 80% volume alcohol solution, the starch with 52% volume solution and treatment with anthrona (C14H100) 0.2% solution. The colour intensity obtained (with transparent blue-green colour shades), is determined with photocolourimeters.

In late February, of each variety were harvested 20 canes, from the vines base, middle and top. Harvested canes were brought and kept in the laboratory and were maintained in water at temperature of 22-24ºC for 48 hours, for tissue rehydration. After that, every cane's buds were analyzed. There buds beginning from the bottom to top of the cord were longitudinally cut with razor blade and a binocular examined, being noted in table with "+ "viable buds and with "– "dead ones. Viability for primary, secondary and tertiary buds was monitored.

Canes vigour was done by measuring canes diameter at the middle of internodes before testing buds viability by sectioning. Measurements were made with an electronic calliper.

During January and February the evolutions of minimum and maximum temperatures in air were record.

RESULTS AND DISCUSSIONS

Temperature level may be optimal, minimum and maximum. Minimum harmful depends on: the period of vegetation, species or cultivated varieties, vines, physiological readiness of the vine; vineyard management applied during the growth in the last season.

As a different organ, winter bud is affected from a critical minimum of -18±3ºC, depending on the biological features of different varieties of vines (Cornelia Bian, 2006).

In winter 2009-2010, low temperatures of -21.4ºC were recorded in January and -12,0ºC February. In Table 1 it is show absolute minimum temperatures that have affected fruit buds, on decades in winter months.

Compared with the average values of a normal year, almost all days of January month in 2010 recorded minimum temperatures, the number of days with very low temperatures were high (7 days), causing significant loss of shoots in all varieties.

Observing the data in Table 2, at Blaj wine growing centre temperatures below -18°C are quite common, both in January and February.

Each year, at S.C.D.V.V. Blaj, the degree of maturation of canes is determined by chemical and colorimetric analysis of carbohydrate content in vines organs - canes.

In studied varieties, starch content reached a maximum of 10-13 g% when the temperature reached negative values, which corresponded in 2009 with the third decade of October. During cold season, starch gradually hydrolyzed into carbohydrates. Three weeks after leaf fall, soluble carbohydrate intake values in the four varieties ranged from 8.38 g % at Astra to 10.68 g% at Blasius.

Substances reserve accumulation in 2009 was good, carbohydrate values are above 13% in all studied varieties, which indicates a good ripening of the canes.

Analyzing data from Table 3, it can be find significant differences in both of the two forms of carbohydrates and the ratio of soluble carbohydrate content and starch. Thus, the highest total carbohydrate content is on Blasius with 17.78 g%, followed at significant distance by Selena-15.46 g% and Astra-14.59 g%. Fetească regală has the lowest content in carbohydrates -13.09 g%.

With rising temperatures, a new polymerization process takes place, so that in spring amounts of starch and soluble sugars would be in balance.

Climatic conditions and in particular the influence of air temperature during the dormancy is a factor with direct influence on the viability of buds.

Winter bud viability testing is carried out on late February, to know pruning type.

These results help determine and calculate the number of winter reserve buds per vine and vine hectare, corresponding to vigour and vine age, environmental conditions, characteristics of varieties, to have a balance between quantity and quality of the harvest.

The lowest bud viability values are at Astra, both primary buds 36.12% and 34.72% from secondary buds, and the highest values are at Fetească regală 50.95%, respectively 61.21%, values below the normal range (Table 4). Loss of main fruit buds, for all four varieties, showed values between 49.05% - 63.88% and secondary buds between 38.78% -

65.28%, that means that the low temperatures in winter 2009-2010 affected bud resistance, thought that the level of protective reserve substance was good.

To know the length of bearing elements (spurs and canes) that are to be left on the vine at pruning, it was examined the viability of buds on the canes length. Thus, for all four varieties was determined the fruitfulness potential of canes on three intervals along the length of cane. Data are shown in Table 5.

The percentages of viable primary buds at Astra variety are distributed in proportion to cane length, the differences being unsignificant (38.10% at the bottom, 35.79 % in the middle and 35.51 on top). Regarding Blasius variety, fertile area is located to the top cane to internodes 9-12 (the percentage of viable primary buds is 47.81%), so it is recommended pruning in long canes of 10 to 12 buds. The same situation is encountered at Selena, the percentage of viable primary buds at internodes 9-12 is 45.95%. Fetească regală fruitful cane area is located on internodes 4-8, viability of primary buds being 56%.

Correlation between canes diameter and bud viability. Viability of primary buds was correlated with increased vigour of the variety, to see to what extent canes diameter value affects winter eyes resistance to critical temperatures during the winter dormant.

After measurements, the most vigorous was Astra variety, with a diameter of 8.04 mm, followed by Selena-7.54 mm, Blasius-7.09 mm and the smallest diameter was at Fetească regală-7.12 mm.

Correlation coefficient value between the main bud viability and cane diameter is r=0.61 - insignificant, which does not indicate a strong link between the two characters studied in this case (figure 1).

Buds seem to be a weak carbohydrate sink compared to the growing shoot. Rapid shoot growth can be expected to draw carbohydrates away from the buds, reducing their fruitfulness. More vigorous shoots tend to have lower carbohydrates than weaker shoots. Indeed, vigorous vines tend to have lower fruitfulness, but this is also partly due to shading (Devin Carroll, 2008).

From the graphical representation (figure 1) is noted that the actual, experimental results, quite faithfully follow right regression. Largest deviation from the regression has Fetească regală, due to the difference of almost 20 percent of it and varieties Astra, Blasius and Selena varieties in the bud viability.

Correlation between the maturation degree of canes (content of total carbohydrates) and main buds viability. Many studies point to the role of low carbohydrates. Buds with lower carbohydrates levels are more likely to die. Grape varieties that tend to have more carbohydrates also tend to be more resistant to winter frost (Collins and Rawnsley, 2005). A study in Virginia found les bud viability in several varieties with low carbohydrate (Riesling, Syrah and Viognier) than in one with high carbohydrate (Chardonnay) (Vasudevan, 1997).

In this case, the correlation coefficient r=0.97 has a significant value, so that the content of reserve substances influenced the viability of fruit buds (Figure 2).

It is generally known that more than 13 g% carbohydrates in canes provides a good resistance of fruit buds to low temperatures during winter. In this case, negative correlation between the two characters studied at Astra, Blasius, Selena and Fetească regală during winter 2009-2010, shows an opposite actually. Thus, Fetească regală, with a carbohydrate content of 13.09 g%, has canes viability, above 50%, while Astra, Blasius and Selena, with a content of reserve substance more than 14.50 g%, and have viable buds less than 40%. This can be explain by the fact that low temperatures in winter 2009 - 2010 recorded in the wine growing centre Blaj affected fruit buds of studied varieties.

Correlation between carbohydrate canes content and canes diameter. Excessive vegetative growth with fast growing canes soaks up carbohydrates so that they are not available to the buds. Several studies have found less content of carbohydrates in more vigorous shoots (thicker and with longer internodes), but the correlation is not strong, and not found in all studies (Dawn, 2004, EL-Mogy, 2006; Samra, 2008). Vigorous shoots tend to have lower carbohydrate levels, because the carbohydrates are flowing to the new growth. Vegetation also increases shading, another factor that increases necrosis. Farming practices that discourage excessive growth might improve fruitfulness. However, if these same practices decrease carbohydrate production, the net effect on fruitfulness might be zero or negative.

Value of correlation coefficient r=0.85 is insignificant, carbohydrate content and diameter of canes, in this case indicates no connection and a negative correlation between these two variables studied, as is apparent in the graphical representation (figure 3).

This, however, can be justified by the fact that different varieties have different growth vigour and a different ability to synthesis and accumulation of carbohydrates.

CONCLUSIONS

1. In winter 2009-2010, low temperatures recorded in Blaj wine growing centre affected bud viability at Astra, Blasius, Selena and Fetească regală varieties.

2. Substances reserve accumulation in 2009 was good, carbohydrate values are above 13% in all studied varieties, which indicates a good ripening of the canes.

3. The lowest bud viability values are at Astra, both primary buds 36.12% and 34.72% from secondary buds, and the highest values are at Fetească regală 50.95%, respectively 61.21%, values below the normal range.

4. It have been highlighted insignificant correlations between buds viability and canes diameter, carbohydrate canes content and cane diameter and significant correlation between buds viability and carbohydrate canes content.

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TABLES AND FIGURES

Table 1

Absolute minimum temperature record on air (ºC), at S.C.D.V.V. Blaj

Month / 2010	Decade			Critical period
	1 – 10ºC	11 – 20ºC	21 – 31ºC	
January	-15.0	-4.5	-21.4	22 – 28 January
February	-12.0	-0.8	-2.5	-

Table 2

Air medium temperature and absolute minimum temperature on air (ºC), at S.C.D.V.V. Blaj

Month	Year	Air medium temperature (ºC)	Absolute minimum temperature in air (ºC)
January	2009	- 2.5	- 18.0
	2008	- 1.7	- 17.4
	2007	3.4	- 6.5
	2006	- 5.6	- 20.2
	2005	- 2.5	- 13.0
	2004	- 4.4	-19.0
February	2009	0.3	-11.4
	2008	2.3	-11.9
	2007	3.8	- 7.8
	2006	- 0.4	-18.0
	2005	- 0.9	- 22.1
	2004	0.5	-17.2

Table 3

Grapevine cane content on reserve substances – carbohydrates, at S.C.D.V.V. Blaj

Variety	Soluble glucides (g %)	Starch (g %)	Total carbohydrates (g %)	Raport glucides/starch
Astra	9.64	4.95	14.59 bc	1.95
Blasius	10.68	7.10	17.78 a	1.50
Selena	9.26	6.20	15.46 b	1.49
Fetească regală	8.38	4.71	13.09 c	1.78

DS 5% for total carbohydrates (g %) = 1.50-1.59

*values designated by the same letter within each main column do no differ significantly ($p \leq 0.05$)

Table 4

Viability of primary, secondary and tertiary buds, at S.C.D.V.V. Blaj

Variety	Viable buds		Dead buds	
	a%	b,c %	a%	b,c%
Astra	36.12	34.72	63.88	65.28
Blasius	37.87	38.51	62.13	61.49
Selena	36.58	45.53	63.42	54.47
Fetească regală	50.95	61.21	49.05	38.78

a- primary bud

b,c – secondary, tertiary buds

Table 5

Viability of primary buds on cane lenght %

Variety		Viability of primary buds on strings lenght %		
		1- 3	4 – 8	9 – 12
Astra	a	38.10	35.79	35.51
	bc	34.65	34.21	26.96
Blasius	a	33.34	25.00	47.81
	bc	31.66	42.00	44.69
Selena	a	33.34	35.00	45.35
	bc	32.50	51.00	45.95
Fetească regală	a	41.66	56.00	50.00
	bc	55.83	60.50	64.69

a - primary bud

b,c – secondary, tertiary buds

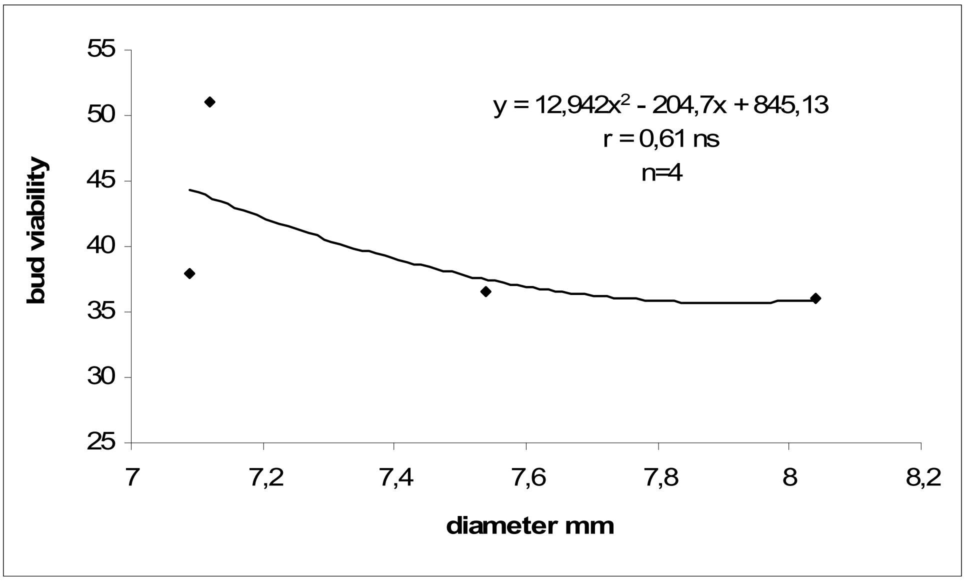

Fig. 1. Correlation between canes diameter and buds viability

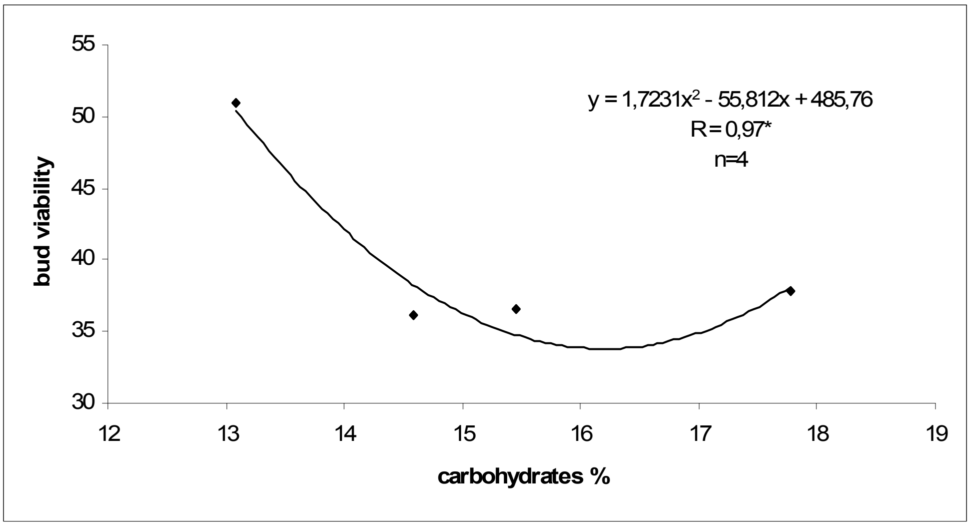

Fig. 2. Correlation between total carbohydrates canes content and main buds viability

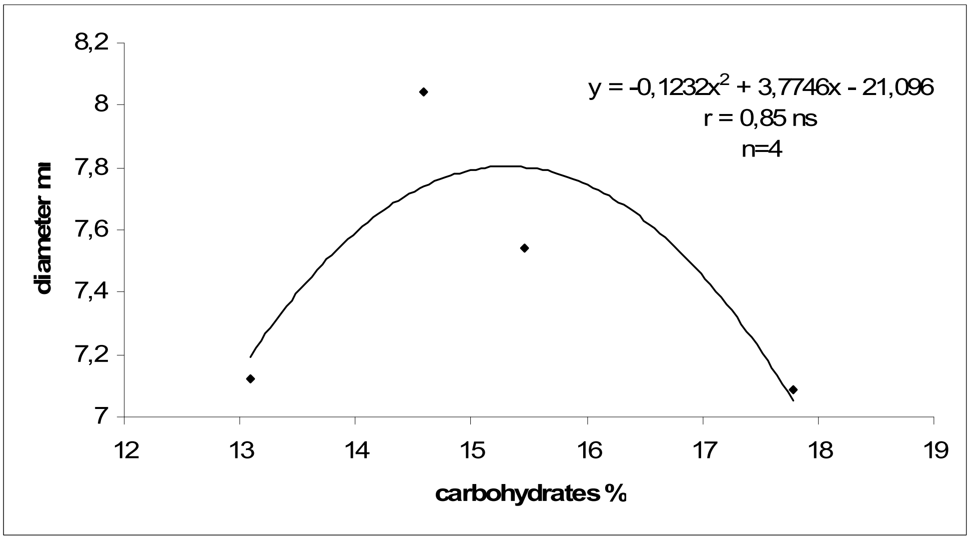

Fig. 3. Correlation between total carbohydrate canes content and canes diameter

The study of new elite of Cabernet Sauvignon for obtaining red choise wines

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Keywords*:* elite, red choice wine, fertility, productivity

ABSTRACT

The study was performed in the Comparison field during the period 2004 – 2008. There were carried out observations and taken samples from the 7-14-23 elite (clonal selection of Cabernet Sauvignon) and from the control Cabernet Sauvignon cl 7 Drăgăşani, created in 1976 by the researchers M. Neagu, P. Baniţă, Daria Basamac, M. Mărculescu. There were studied: the phenological data, the fertility coefficients, the productivity indices, the physiologic characteristics and the technological characterization. It was observed that the elite were more valorous than the control. This important elite is in course of admit in culture.

INTRODUCTION

The Drăgăşani vineyard offers very favourable pedoclimaic conditions for planting grape varieties for obtaining red wines and especially red choice wines. The appreciation is based upon the long-time existence in culture of Cabernet Sauvignon, Merlot, Pinot noir and Porto grape varieties and upon a lot of studies regarding the quality of wines and the favourable conditions for obtaining them (Macici et al., 1974; Mihalca et al., 1974; Teodorescu et al., 1959; 1980). Along time, at SCDVV Drăgăşani were created more *vinifera* varieties, the majority appreciated also outside the country, as: Crâmpoşie selectionata, Tamâioasă românească cl 104 Drăgăşani, Sauvignon cl 62 Drăgăşani, Novac, Negru de Drăgăşani, Cabernet Sauvignon cl 7 Drăgăşani, Victoria.

MATERIALS AND METHODS

Situated in the great geomorphological unit called Getic Piemont, the Drăgăşani vineyard covers the Olteţ Platform. Situated at 44˚30'nordic latitude, and 23˚27'eastern latitude, at 182 meters altitude, in West and N-W of Drăgăşani city, in the inferior Olt piemontan region covering the hills that are starching on the both sides of the river Olt, from Strejești to Ionești, on a length of 60 km and width of 20 km, belongs to the A3 oenoclimatic zone which includes regions and lawns that are producing red choice wines with COD (Teodorescu, 1980).

The Cabernet sauvignon variety figures as a basis variety for obtaining red choice wines in the wine-growing areas situated in the subcarpathic hill zone from Muntenia and Oltenia (Prahova, Buzău, Arges, Olt, Vâlcea, Dolj, Mehedinţi Counties), in Dobrogea, in the western part of the country (Arad, Timiş and Caraş – Severin Counties) and in the southern part of Moldova (Galaţi, Vrancea, Vaslui Counties). An exception is the presence of this variety in the Uricani wine-growing area (from Iaşi County) in which is a favorable climate (Oslobeanu et al., 1991).

The study was carried out in the Comparison field of SCDVV Drăgăşani, between 2004-2008, on a plantation created in 1983, on a brown forest medium podzolite soil, situated in the Dealul Olt middle slope, having a S-E exposure, the results being compared with Cabernet Sauvignon cl 7 Drăgăşani.

The both clones are grafted on Berlandieri & Riparia Kobber 5 BB, with 2 meters between the rows and 1.2 meters between the vines on the row. The system of culture is classic, unprotected. For the fertility coefficients and the productivity indices we used the descriptors introduced by the ICDVV Valea Calugărească.

The analysis on must was made with the Carl Zeiss hand-refractometer and the acidity with the titrimetric method.

RESULTS AND DISCUSSIONS

As regard as the phonologic data (Table 1), it can be observed that the bud break and the blooming are taken place in the same time at the both clones, while the early maturation and the full maturation are a little bit earlier at the elite. In the second table we can see that the elite are more vigorous and have a superior maturation of the tendril and, also, the disease resistance. About the resistance to frost, drought and floral accidents, the values are identically. Both have good resistance at disease and very good at the floral accidents and clems.

In order to obtain the fertility coefficients and the productivity indices average, first we have to calculate the averages of total copse, fertile copse, total number of inflorescences and the weight of a grape (tables 3 and 4).

Excepting the fertility coefficient which is greater at the control, all the others characters studied are superior to the elite (table 5).

The both clones have the fertility coefficient great (73.54% - elite and 72.17% – the control), the absolute coefficients are middle (1.40 and 1.42) and the relatives are small (1.03). The absolute productivity index is middle (131.32 and 130.9) and the relatives are small (96.61 and 94.97).

In the last table (table 6) it can be seen that the 100 grape weights is bigger at the control. The contents in sugar and acidity are oscillating with a maximum in sugar of 223.5 g/l and a minimum of 164 g/l (both at the elite). The averages are 198.9 g/l (7-14-23) and 198.2 g/l (Cabernet Sauvignon cl 7 Dg). The acidity have close values with a maximum of 7.64 g/l conveyed by H_2SO_4 and a minimum of 4.25 g/l conveyed in H_2SO_4. The both extremes are at Cabernet Sauvignon 7-14-23. The averages are 5.90 g/l (7-14-23) and 6.11g/l at Cabernet sauvignon cl 7 Drăgăşani.

The anthocyanin content and the productivity in must are, also, superior al the elite.

CONCLUSIONS

From the elite it can be obtain red choice wines with COD (Controlled Origin Denomination), as the control.

The elite have superior values comparing with the control.

It can be successfully growth in Drăgăşani Vineyard.

The elite can be tested in other vineyards well known for obtaining red choice wines with COD and is part of the Cabernet Sauvignon clones group obtained by the Romanian researchers along time, together with Cabernet Sauvignon cl 7 Dg, Cabernet Sauvignon 4 Is, Cabernet Sauvignon 33 VI, Cabernet Sauvignon 131 St and Cabernet Sauvignon 54 Mn. (Oprea and Moldovan, 2007; Bernaz, 2007).

These clones are usefully for replacing Cabernet Sauvignon variety due to the decline of its productivity potential (Mărculescu et al., 1994).

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TABLES

Table 1

Phenological data

No.	Code Variety (Hibrid)	Variety (Hibrid)	Budbreak	Blooming	Early maturation	Full maturity
1.	7-14-23	Cab. Sauvignon	11-04	30-05	08-08	30-09
2.	Mt.	Cab.Sauvignon7	11-04	30-05	09-08	02-10

Table 2

Physiologic characterization

NR. CRT	CODE (Hibrid)	VARIETY (Hibridul)	Vigour	Tendril maturation	Frost resistance		Drought resistance	Floral accidents		Disease resistance					
					Lost eyes %	Tendril		Meiere %	Margeluire %	*Plasmopara*		*Oidium*		*Botrytis*	
										F %	1 %	F %	1 %	F %	1 %
1.	7-14-23	Cab.Sauvignon	32,6	23,2	3	Very good	Good	3	1	1,25	0,55	1,48	0,76	1,38	0,66
2.	Mt.	Cab.Sauvignon7	28,2	19,7	3	Very good	good	3	1	2,18	0,91	2,60	1,05	1,62	0,85

Table 3

Elements of fertility and productivity

Nr Crt.	CODE variety (HIBRID)	VARIETY (Hibrid)	R1				R2				R3				R4				R5			
			Copse no		Inflorescences no	Average of a grape	Number of copse		Inflorescences no	Average of a grape (g)	Copse no		Inflorescences no	Average of a grape (g)	Copse no		Inflorescences no	Average of a grape (g)	Copse no		Inflorescences no	Average of a grape (g)
			Total	Fertile			Total	Fertile			Total	Fertile			Total	Fertile			Total	Fertile		
1.	7-14-23	Cab.Sauvignon	30,2	22,2	32,1	95	30,1	21,8	31,5	93	29,7	21,9	30,8	96	30	22,3	28,8	88	30,4	22,4	32	97
2.	Mt.	Cab.Sauvignon7	30,0	22,0	31,5	93	29,8	21,5	31,3	91	29,7	21,7	30,7	95	30,4	22	29	88	30,3	21,2	31,5	94

Table 4

Averages of total copse, fertile copse, inflorescences and grape weight

Code	Elite/clone	Total copse	Fertile copse	Total inflorescences	A grape weight
7-14-23	Cab. Sauvignon	30,08	22,12	31,04	93,8
Mt	Cab. Sauvignon 7	30,04	21,68	30,08	92,2

Table 5

Fertility coefficients and productivity indices

Nr. crt	Clona/ elita	Fertile copse %	Fertility coefficients		Productivity indices	
			relatif	absolute	relatif	absolute
1	7-14-23	73,54	1,03	1,40	96,61	131,32
2	Mt	72,17	1,03	1,42	94,97	130,9

Table 6

Technologic characterization

Nr. Crt	Code Variety (Hibrid)	Variety (Hibrid)	100 grapes weight	R1		R2		R3		R4		R5		Anthocyanins - mg/l	Mal-vine	Prod of must ml
				Sugar g/l	Acidity g/l H_2SO_4	Sugar g/l	Acidity g/l H_2SO_4	Sugar g/l	Acidity g/l H_2SO_4	Sugar g/ l	Acidity g/l H_2SO_4	Sugar g/l	Acidity g/l H_2SO_4			
1.	7-14-23	Cab.Sauvignon	120	223.5	4.6	206	4.25	195	6.66	164	7.64	206	6.37	984.74	nu	720
2.	Mt.	Cab.Sauvignon7	134	217.1	4.28	197	4.65	187	7.6	175	6.66	215	7.35	841.76	nu	710

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The determination of some physical and chemical characteristics of wine using spectrophotometer methods

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Keywords: spectrometric technique, content of methanol, content of citric acid, antocyans, color, quality

ABSTRACT

In this paper are presented the advantages of use the spectrometric method in the characterization of wines. The content of methanol, citric acid and antocyans are evaluated by using a spectrophotometer UV/VIS Perkin Elmer Lambda 25, with double-beam. The color and the absorption spectrum of different sort of wine: red, rose and white (Pinot Gris and Cabernet Sauvignon – Valea Călugăreasca area and Rose – Drăgăşani area) from the same year (2008) were investigated.

INTRODUCTION

Wine is a hydroalcoholic solution containing hundreds of compounds that come from grapes or during winemaking and storage. Several of these compounds affect wine aroma that, besides being a parameter of quality, act as a «finger print» for each wine variety. In fact, some of these odor compounds are characteristic of certain varieties whereas the concentration of other compounds, although present in all wines, varies according to the type of wine. (Mestres and al., 2000)

The literature describes several analytical methods for analyzing quality of wines, mostly involving the gas chromatographic or spectrometric technique. These methods check the quality parameters that determine their suitability (detection and quantification limits, recoveries and reproducibility). From analytical perspectives, these parameters are the essential bases necessary to validate any method and guarantee its application.

The paper presents the advantages of using spectrometer methods in the study of some physical and chemical characteristics of wines and a case study on different Romanian wines.

MATERIAL AND METHODS

The studied wines are: *Pinot Gris* and *Cabernet-Sauvignon* from the Valea Călugărească area and *Rose* from the Drăgăşani area. All wines are produced by a local private producer, in the same year (2008).

The spectral studies were made using a spectrophotometer UV/VIS Perkin Elmer Lambda 25, with double-beam. The measurements were made in UV-VIS region, between 300 and 700 nm (figure 1).

To verify the accuracy of the spectral recording, the spectrophotometer was calibrated before starting work. The photometric scale was checked by the recording of a spectrum for a standard solution (K_2CrO_4 (0.04 g/L) in 0.05 M KOH aqueous solution at 25^0C), using the quartz cuvettes of 1 cm. Comparing the absorbance values indicated by device with the standard, it has confirmed that the spectrophotometer UV/VIS Perkin Elmer Lambda 25 is calibrated.

The color of wine is one of the most important parameters in the study of wine quality. (Niskanen and al., 2009). By spectrometric methods, the chromatically characteristics of wine are expressed by *nuance* and *intensity* of color (Sudraud, 1990). But the chromatic parameters, in the *tristimulus coordinates* (X, Y, Z) define better the wine colour.

For the plot of the transmission (or absorbance) spectrum of wines, we used the quartz cuvettes of 0.1 cm, having the distilled water in the reference cuvette.

Using the absorbance values at wavelengths 445, 495, 550 and 625 nm (read to three decimal places), the tristimulus coordinates (X, Y, Z) are calculated with the equations:

$$X = 0,42*T_{625} +0.35*T_{550} +0.21*T_{445}$$
$$Y= 0.20*T_{625} +0.63*T_{550} +0.17*T_{445}$$
$$Z= 0.24*T_{495} + 0.94*T_{445}$$

The colour coordinates were determined and the chromaticity diagram was plotted.

By using spectrometric method, we can establish the maximum limits over that the chemical compounds can harm consumers.

For example, an amount over 500 mg methanol/L affects the quality of wine. The ***methanol*** from the wine is obtained during the alcoholic fermentation by the enzymatic pathway, by the hydrolysis of the soluble pectin from the grapes, under the action of pectin-methyl-esterase enzyme. The determination of methanol from the wine is made after its separation from wine by the distillation, by the spectrometric dosage. Methanol from the wine distillate is oxidized to formaldehyde with potassium permanganate, acidified with phosphoric acid. The amount of formaldehyde resulting is proportional to the methanol content from the wine. Formaldehyde formed is determined by the color reaction with chromotropic acid, measuring the color intensity with spectrophotometer at 575 nm. To determine the methanol content of wine is necessary to draw the calibration curve.

Another element from wine, which may be determined by spectrometric analysis, is ***citric acid***. The addition of maximum 1 g/L citric acid in wine corrects the deficient acidity of wines. The determination of citric acid is based on the reaction of citric acid from wine with acetic anhydride in the basic medium, when is formed a compound whose maximum absorbance is measured with spectrophotometer at a wavelength of 363 nm.

The quantitative determination of ***antocyans*** is made by the spectrometry in visible and is based on the colour change of antocyans versus pH. The absorbance variation for the antocyans colour is measured, at two pH values, namely 0.6 and 3.5, compared with the distilled water. The measurements are taken at the wavelength of 520 nm, the absorbance of the samples being proportional to the antocyans content.

RESULTS

The transmission spectra for wine's sample were plotted using spectrometer methods (figure 2). It remarks that the absorbance curve for *Cabernet Sauvignon* is like the literature data; the other spectra (for *Pinot Gris* and *Rose*) are flattened due to the optic path very short (0.1 cm cuvette).

Knowing the transmission values at wavelengths 445-495-550-625 nm, the tristimulus values (X, Y, Z) were calculated and the color coordinates (x, y) were determined (table 1). Based on these, the chromaticity diagram can be draw (figure 3).

The chromatically characteristics were completed by the lightness of colour (Y %). The values of the lightness of color are between 0% - black and 100% - white. The gradation of relative brightness (Y) remarks from the table 1: close of maximum for white wine (Pinot Gris – Valea Călugărească) and the lowest brightness for the red wine sample.

For white wine, the absorbance measured at 420 nm (compared with distilled water) was 0.01081 (using cuvette of 0.1 cm). This result estimates the oxidation state of colour.

Spectrometric technique enables to estimate the values of citric acid, methanol and anthocyans in the samples studied. The results for chemical characteristics of these wines are presented in table 2.

In figure 4 are presented the calibration curves of citric acid (a) and methanol (b). Using the equations of regression line:

$$y = -0.026 + 1.367 \cdot 10^{-3} x$$

for citric acid and

$$y = 0.0012 + 3.267 \cdot 10^{-4} x$$

for methanol (Dumitru and al., 2010), were determined the citric acid and methanol content of wine samples; the results are presented in table 2.

Normally, the red wines are affected by malolactic fermentation, so they contain less citric acid than white wines. But, it remarks a light supracitraj to Cabernet Sauvignon sample, which reflect deficiencies in the technical preparation and conservation of wines by local producers, compared with winery institutions.

Regards the quantity of methanol, it remarks that the white and rose wines comply with the limit of 250 mg/l, while red wines exceed the maximum permissible value of 400 mg/l.

The highest anthocyans content is observed in Cabernet Sauvignon wine (reflected in low brightness colour of this sample). Ranging depend on sort, vineyard and grape wine technology, free antocyans binds with tannins forming complexes. During the wine storage, anthocyans oxidation can occur, which leads to the intensification of colour.

CONCLUSIONS

The spectral analysis has a high sensitivity and is very accurate. The spectrometry is one of the most widely used techniques due to its sensitivity (up to $1*10^{-10}$ mol/l), specificity and reliability. Other advantages of spectrometer method are: require small quantities (mg) of studied substances and it is very quickly (the time of analyzing is the order of minutes).

The complete analysis of colour showed chromatically differences between white, rose and red wines.

Chemical analysis of wine samples showed deficiencies of the manufacturing, bottling and storage processes, due to the lack of necessary technological equipment or to the lack of needed knowledge by local producers. Thus, there had been a supracitraj and a slight exceeding of maximum amount of methanol allowed, to Cabernet - Sauvignon sample.

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TABLES AND FIGURES

Table 1

Chromatically characteristics for different sort of wine (2008)

Sort of wine	Coordinates of color (x, y)	Lightness of the color Y %
Cabernet – Sauvignon Valea Călugărească	(0.3590, 0.3041)	48.243
Rose Drăgăşani	(0.3196. 0.3236)	90.527
Pinot Gris Valea Călugărească	(0.3111, 0.3174)	99.359

Table 2

Chemical characteristics for different sort of wine (2008)

Sort of wine / Parameter	Cabernet Sauvignon Valea Călugărească	Pinot Gris Valea Călugărească	Rose Drăgăşani
Citric acid, g/l	1.06	0.32	0.252
Methanol, mg/l	484	140	241.126
Antocyans, mg/l	234	0	32.192

Fig. 1. The spectrophotometer UV/VIS Perkin Elmer Lambda 25

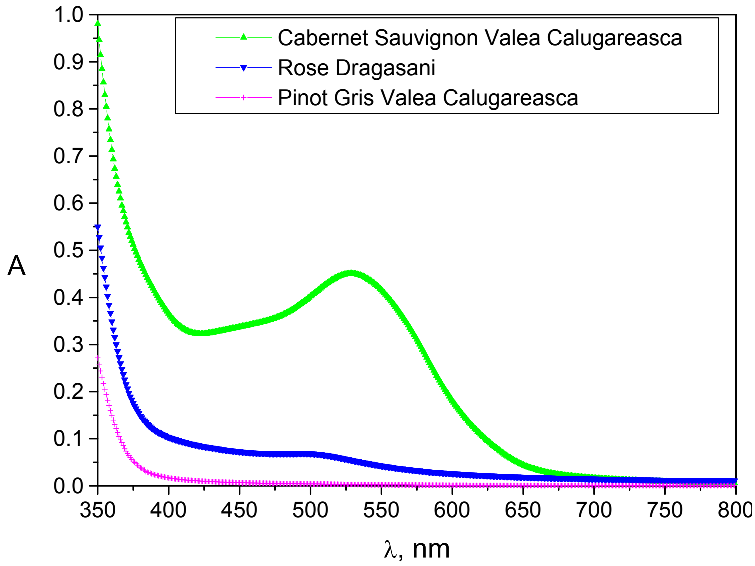

Fig. 2. The transmission spectra

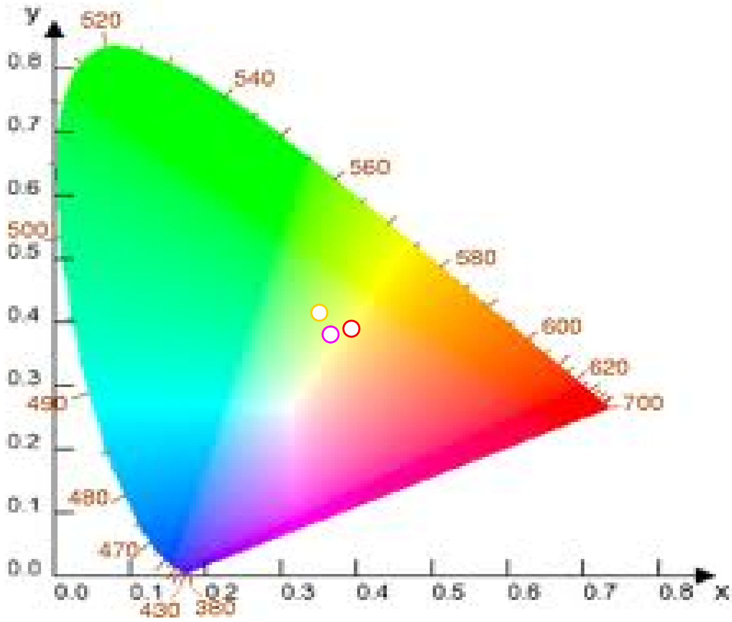

Fig. 3. The chromaticity diagram

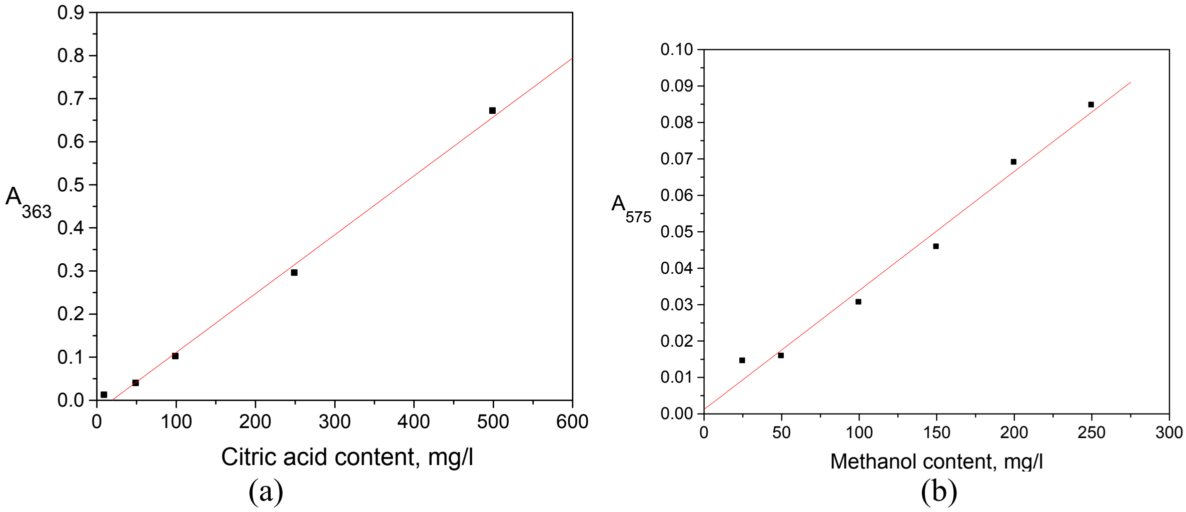

Fig. 4. The calibration curves of citric acid (a) and methanol (b).

Physical – chemical and microbiological analysis of different Romanian wines

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Key words: quality, limits OIV, local producer, yeasts

ABSTRACT

In this paper are presented the analysis results of two wines: Fetească Albă and Rose from Drăgăşani area. These wines were produced in 2008 by a local producer. We chose to study these Romanian wines because we intended to check if their parameters are within limits imposed by International Organization of Vine and Wine (OIV). In the same time, study of wines from certain wine growing region is very important for fermentative processes and for insurance of wine stability.

INTRODUCTION

Wine is an alcoholic beverage resulting from the fermentation of grapes or grape juice. It is of particular interest for several reasons: its use in religious ceremonies in many cultures, the historical importance of the wine trade from very early times. Most important perhaps as an agricultural product it reflects more than any other the variety of the land, climate and conditions under which grapes are grown, making wines very much more variable than any other product.

The role of microorganisms in wine qualities is well known in these days. The species of yeasts used for alcoholic fermentation in wine making process contribute to developing or reduction of some properties of wine. Different types of bacteria (lactic acid bacteria, acetic acid bacteria) improve the properties of wine too or lead to unwanted changes of it (Popa et al., 2000). The study of yeasts from certain viticultural region is important for rational use of these microorganisms for ensuring and control of wine stability (Pomohaci et al., 2001).

Romania, as vineyard land, follows the OIV and EU requirements and standards through the vineyard and wine law no. 244/2002 (Ţârdea, 2007). Thus, the quality of wine on the market is guaranteed by the application of international rules of analysis and technology control of wines produced both by wineries institutes and the local producers.

MATERIAL AND METHODS

The studied wines are: *Fetească Albă* and *Rose* from Drăgăşani area. All wines were produced by a local private producer, in the same year (2008).

The preliminary examination of samples includes the colour analysis and the microbiological stability.

Usual, the nuance and the intensity of wine colour are calculated by optical methods (Niskanen I. et al, 2009). But the CIE established that the colour could be exactly definite by chromatically parameters: lightness, chromaticity and purity. Thus, we used the spectrometrical method in tristimulus coordinates (CIE – Lab – 76) for the colour analysis, as parameter of wine's quality. The absorption spectrums were measured on a Perkin Elmer Lambda 25 UV-VIS spectrophotometer, with double-beam. Based on transmittance values, we determined the color coordinates (x, y) for every sort of wine.

For investigated wines, the indirect technique for the determination of the number of colony - forming units per ml (CFU/ml) was used. Each 0.2 ml of 10^{-1} and 10^{-2} wine dilutions was inoculated on the culture media: solid YPG medium (yeast extract - peptone - glucose), Carr medium and Lafon-Lafourcade medium. After 24 hours incubation at 27°C, the colonies were counted using the Funke Gerber colony counter and the number of colony - forming units per ml was calculated, taking into account the average values of all the three repetition and the factor of dilution. The CFU/ml for yeasts, lactic acid bacteria and acetic acid bacteria was established.

Then, a large set of chemical analysis was performed. For each wine were determined: the minim alcohol content (the alcoholmeter titer), the relative density, the total acidity, the contents of methanol, glycerol, acetaldehyde, SO_2 and antocyans.

The alcoholmeter titer and the relative density were determined by pycnometry method.

The content of methanol, citric acid and antocyans were determined by spectrometric methods. Methanol in wine distillate is oxidized to formaldehyde, which is wrapping color reaction with chromotropic acid, measuring the color intensity at 575 nm. The citric acid in wine reacts with acetic anhydride in basic medium, forming a compound whose absorbance is measured at 363 nm. The content of antocyans is determined based on changes in absorbance at 520 nm wine samples at two pH values: 0.6 and 3.5.

The total sugar was determined by refractometry, measuring the percentage of the soluble solids, after prior removal of alcohol and volatile compounds from wine.

Total acidity, acetaldehyde and SO_2 were determined using volumetric method. The acidity was determined by titration with an alkaline solution of sodium hydroxide in the presence of bromothymol blue. The acetaldehyde separated by distillation of wine was established in a combination aldehido-sulfur, which was subjected to iodometric titration. SO_2 was assayed by titration with iodine solution.The main problems encountered in analysis of sulfur compounds in wine are the low concentration levels and the highly reactive nature of these compounds (Mestres and al., 2000).

RESULTS

The absorbance spectra are presented in figure 1. The curve of the white wine is more flattened due to the optic path very short (0.1 cm cuvette – we used the same cuvette for both wines). The absorbance values for 420nm, 520nm and 620nm contributed to the estimate of the colour parameters.

The preliminary analysis of wines regarding the colour shows that the nuance and the color intensity are higher for the rose sample (table 1). For old wines, the value of nuance is over unit (1-1.5), because the absorbance A_{520nm} corresponding to red color decreases due to the anthocyans copolymerization with tannin in wine.

The color coordinates accurately determine the color of wine on the chromaticity diagram. Considering the dominant wavelength, the real colors of wines are: ***dull yellow*** for *Fetească Albă* sample and ***crimson*** for *Rose* sample.

The analysis of wine showed that the wines do not have abundant specific microbiota. Thus, the sample of rose wine had presented lactic acid bacteria, acetic acid bacteria and yeast, too (figure 2). We can say that this wine had stability in terms of alcoholic and malolactic fermentation, because the determined values were small. The white wine sample, Fetească albă, has presented only the yeast (2300 CFU/ml), (figure 3), showing microbiological stability, quite high for a wine produced by the local producers.

The studied wines were characterized by a normal real ionic acidity (pH = 3.63 for Rose and pH = 3.27 for Fetească Albă); also, they had a good alcoholmeter titer (11,44% vol – rose wine and 10,56% vol for the white wine).

The results for the main chemical parameters of studied wines were in table 2.

Acetaldehyde is one of the main parameters in the wine quality control, because the antioxidant capacity of wines is correlated with the concentration of acetaldehyde. The Romanian wines have an acetaldehyde concentration form 20 to 2000 mg/L for some oxidative wines. Colour, taste and wine bouquet (flavour) are affected by the content of acetaldehyde. Acetaldehyde is responsible also for alcoholic intoxication because it is a very reactive compound towards proteins, amino acids and glutathione (Rotariu et al., 2004). Because the acetaldehyde content is over 200 mg/l, the studied wines are oxidative.

Acetaldehyde concentration is closely related with the SO_2 content of the wine. A very stable combination formed between SO_2 and acetaldehyde ($K = 2.4*10^{-6}$). Free SO_2 is responsible with the antioxidant activity. For our sample, the free SO_2 content is higher for the white wine. The aromatic contribution of SO_2 is considered detrimental to wine quality and the Fetească Albă sample didn't respect the limits for total content of SO_2 imposed by OIV.

The addition of citric acid in wine is allowed to correct deficient acidity of wine; the condition is that, ultimately, the wine does not contain more than 1g/l citric acid**.** Over this limit, the wines lose naturally and are suspicious of supracitraj**.** From table 2 it remarks that the samples respected this limits.

The antocyans content from the rose wine indicated the predominant of yellow pigments.

Regards the quantity of methanol, it remarks that the samples respect the limit of 250 mg/l recommended for white and rose wines.

CONCLUSIONS

The colour of studied sample, objectively determined by using CIE – Lab – 76 colour space, is normal for a wine produced by local producer; yellow pigments prevail in the *Rose* sample.

The studied wines correspond to the wines produced by the local producers, regarding the microbiological stability. In this case, the alcoholic fermentation is spontaneous, under the action of natural microbiota and the wines stabilization is not very emphasized.

Although they were characterized by a normal ionic acidity (pH) and good alcoholmeter titer, they are not high quality wines, because one of the main criteria is a lowest acetaldehyde concentration. In addition, the sample of Fetească Albă does not respect the limits for total content of SO_2 imposed by OIV.

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TABLES AND FIGURES

Table 1

The parameters of color

Sort of wine	Fetească Albă Drăgăşani 2008	Rose Drăgăşani 2008
nuance: $N_C = \frac{A_{420}}{A_{520}}$	1.32	1.44
colour intensity: $I_C = A_{420} + A_{520} + A_{620}$	0.08809	0.16896
colour coordinates (x, y)	(0.3133, 0.3189)	(0.3111, 0.3174)

Table 2

The chemical parameters

Analysis	Fetească Albă Drăgăşani 2008	Rose Drăgăşani 2008
Acetaldehyde mg/l	255,2	221,76
SO_2 (free), mg/l SO_2 (total), mg/l	76.8 332,8	32 92,8
citric acid, g/l	0.202	0.252
Methanol, mg/l	109.9	241.126
Antocyans, mg/l	0	32.192
Glycerol, mg/l	9,66	10,58
Methanol, mg/l	109,9	161,26

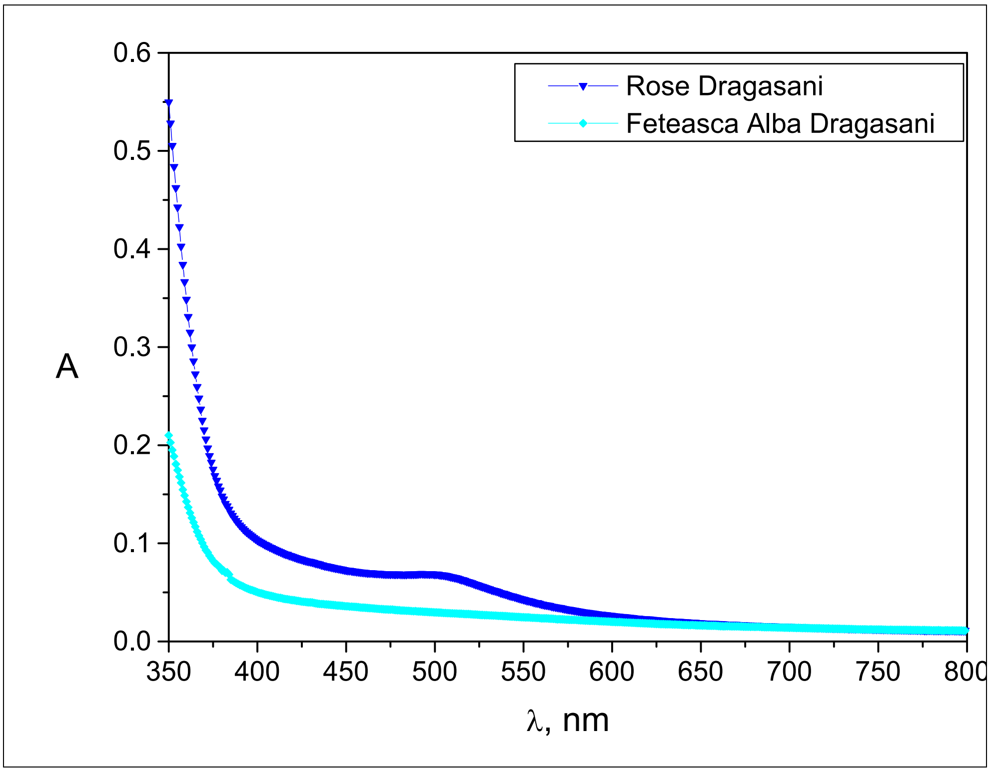

Fig. 1. The absorbance spectra

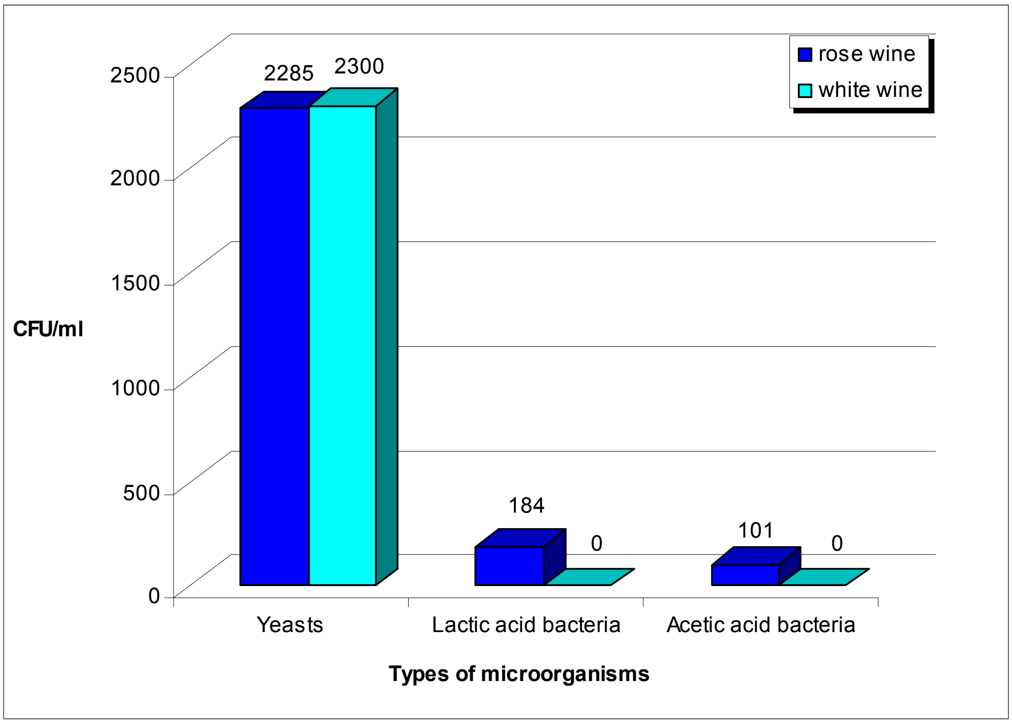

Fig. 2. Microbiota from studied samples

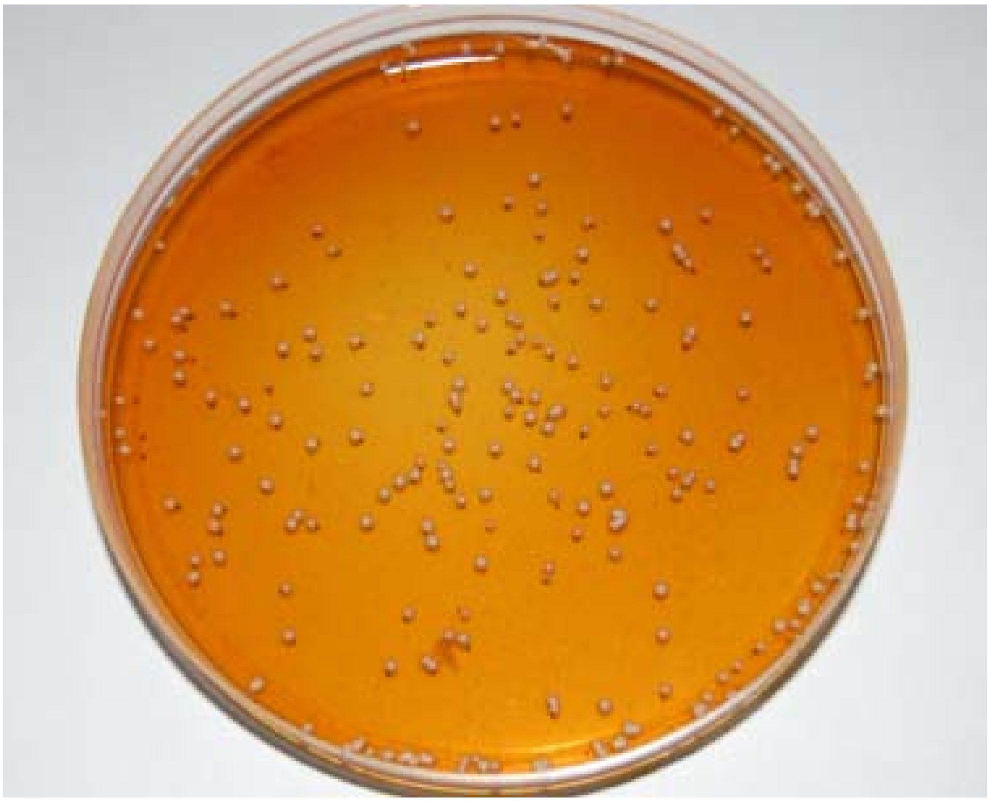

Fig. 3. Yeast colonies from white wine, on the YPG medium (original)

Morphological and biochemical modifications in grapevine in the presence of fleck virus

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Key words: *Vitis*, GFkV, sanitary status, farm

ABSTRACT

The paper presents the influence of fleck virus (GFkV) infection over the growth and development of grapevine variety Chardonnay, in a farm. The results of TAS-ELISA testing confirmed the precarious sanitary status of this genotype in all viticultural areas of the world. During of active growing period of grapevine plants were made records on shoots length and fertility, and the content of assimilating pigments in leaves was analyzed. The results regarding the growth components were correlated to the heterogeneous agrotechnical conditions and any the less to the phytosanitary status of grapevine plants. Thus, the visual sanitary selection as the first step of selection with the aim of multiplication of virus - free grapevine biological material is not sufficiently and should be supplemented with laboratory tests. The study is useful in the case of field inspections, for symptoms observation, clonal and sanitary selection of valuable genotypes identified in degraded viticultural plantations (aged and/or found on soils subjected to natural erosion process). In order to investigate the influence of viral infection on the grapevine growth and development processes, it is recommended that further researches in the plantation of infected vines with virus/virus complex, compared with healthy plants to be made under uniform conditions of culture.

INTRODUCTION

Fleck virus (GFkV) infects naturally a large number of varieties and *Vitis* species. The symptoms are expressed on *Vitis rupestris* and consist of the clearing of veins of third and fourth order, producing localized translucent spots; the leaves with intense flecking are wrinkled, deformed and twisted toward the upper side. The fleck is a ubiquitous disease, being found in all grapevine producing countries of the world. No information is available on individual susceptibility (Martelli, 2003; Martelli and Boudon-Padieu, 2006).

The effect of viral diseases should be taken into consideration that some viruses induce symptoms clear, detectable when the selection is made, while others express symptoms later, as influenced by agro-climatic conditions, scion-rootstock combination, virus-host combination or simple aging of the plant (Walter and Martelli, 1996; Walter, 1997). Following the field experiments, it has been considered that generally, the own-rooted grapevine is more tolerant to virus infection (Garau et al., 1997).

This paper underlines the influence of the GFkV infection and also the agrotechnical conditions over the growth and development processes of grapevine, cv. Chardonnay.

MATERIAL AND METHODS

V. vinifera L., cv. Chardonnay plants in the farm were studied from the point of view of GFkV presence, the influence of virus infection over the grapevine growth and development and the content of assimilating pigments in leaves.

In order to select the infected and the control (healthy) plants, the upper leaves samples were collected from 10 vines belonging to Chardonnay cv. from two plantations of the same culture areas (PI and P II), situated at 200 m distance, 5 vines from each plantation (PI 1 – PI 5 and P II 1 – PII 5, respectively). Erosion phenomena of the soil were observed in P II.

TAS-ELISA (triple antibody sandwich - enzyme-linked immune-sorbent assay) method with commercial reagents (SEDIAG, France) has been used for GFkV detection.

Given that the ELISA is a qualitative analysis, the result of the test is evaluated by "positive" or "negative".

The ELISA tests have not registered positive results for other specific viruses: grapevine fan leaf and arabis mosaic viruses (GFLV+ArMV), grapevine leaf roll associated viruses serotypes 1, 2, 3 (GLRaV -1, 2, 3), grapevine virus A (GVA) in the studied plants.

In order to study the influence of GFkV infection on grapevine growth and development, the shoots length and fertility has been evaluated for each plant.

Also, leaf samples from the node 5 for biochemical analysis were taken for the composition of assimilating pigments (chlorophyll a, chlorophyll b and carotenoids) evaluation. The pigments extraction was performed from fresh plant material, in 80% acetone and their concentration was expressed in mg% fresh matter.

Statistical significance of differences between GFkV infected variant compared with the control (healthy) was analyzed by SPSS 10 for Windows taking $p<0,05$ as significant according to simple T – test.

RESULTS AND DISCUSSION

GFkV testing by TAS-ELISA method

Following the ELISA tests, virus free (control) and GFkV infected grapevine plants were detected. The interpretation of ELISA result has been done by calculating the detection threshold as twice of the average OD 405nm values of negative control (OD = 0,123). A sample is considered infected if the corresponding OD is greater than this threshold; the sample can be considered "doubtful" if its OD value is close to the threshold. All values corresponding to the ELISA negative samples were lower than the twice negative control (2 x DO = 0,246).

The test was validated on the basis of the controls values (positive control OD = 0,961; negative control OD = 0,123; extraction buffer OD = 0,115; substrate control OD = 0,105).

All plants from PI were GFkV infected and those from P II were virus free (Table 1).

ELISA test results confirmed the precarious sanitary status Chardonnay variety wine from all viticultural areas of the world (Habili and Symons, 2000; Prodan et al., 2003; Uyemoto and Rowhani, 2003; Vigne et al, 2003; Qiu and Avery, 2006).

Shoots growth and fertility of grapevine in the presence GFkV

After shoots length measuring and number of inflorescences registration for each of 10 vines, the mean of the shoots length and the fertility relative coefficient were calculated (Fig. 1).

The infected plants did not show significant morphological changes as a result of GFkV presence. However, due the heterogeneous agrotechnical conditions in plantations PI and PII differences on the appearance of plants, their growth and development were observed. Although in PII the plants were not infected with GFKV, the grapevines had a deficient supply of nutrients due to erosion phenomena present in the soil. As a result, there were not positive correlations of measurements of components of growth with the presence of virus infection.

The content of assimilating pigments (chlorophyll a, chlorophyll b and carotenoids)

Quantitative determinations of pigments revealed some differences between healthy and virus infected grapevines which are not correlated with the presence of GFkV infection because of the heterogeneous conditions of the culture (Table 2).

However, the average value of chlorophyll a is higher in the healthy material, but the chlorophyll a + chlorophyll b is higher in infected plants. Also, the ratio chlorophyll a/chlorophyll b is higher in infected plants, as observed in previous experiments (Buciumeanu and Vişoiu, 2001).

Although, the appearance of chlorosis due to poor nutrition has been observed in healthy plants, carotenoids content is higher in virus infected material.

CONCLUSIONS

The GFkV infected grapevine plants did not present symptoms of the virus disease. Thus, the positive sanitary selection as the first step of selection with the aim of multiplication of healthy grapevine biological material is not sufficiently and should be supplemented with laboratory tests.

The results of ELISA tests increased the level of knowledge about the presence of viral infection and have confirmed the precarious sanitary status of the grapevine, variety Chardonnay. Due the heterogeneous agrotechnical conditions in the plantations of virus infected and healthy grapevines, were observed differences on the appearance of plants, their growth and development, the content of assimilating pigments, but were not possible significant correlations between morphological and biochemical changes, and the presence of viral infection.

In order to study the influence of viral infection on the processes of grapevine growth and development, it is recommended that further research on the plantation of infected vines with virus/virus complex, compared with healthy plants to be made under uniform conditions of culture.

The results contribute to thoroughgoing researches concerning the sanitary selection of a valuable genotypes identified in damaged viticultural plantations (old and/or located on soils subjected to natural erosion), in order to conserve and maintain in the culture of local varieties, resistant to stress factors.

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TABLES AND FIGURES

Table 1.

ELISA values obtained in grapevine GFKV testing, Chardonnay cv.

Plantation	Plant	OD_{405nm}	Results
P I	P I - 1	0,366	Positive
	P I - 2	0,515	Positive
	P I - 3	0,539	Positive
	P I - 4	0,622	Positive
	P I - 5	0,282	Positive
P II	P II - 1	0,114	Negative
	P II - 2	0,110	Negative
	P II - 3	0,115	Negative
	P II - 4	0,122	Negative
	P II - 5	0,113	Negative

Table 2.

The content of assimilating pigments (chlorophyll a, chlorophyll b and carotenoids) in GFkV infected grapevines belonging to Chardonnay cv., compared to the control (healthy)

Biochemical parameter	Variant	Statistical parameters		
		Mean ± standard error mean	Standard deviation	Significance of difference between means (p<0,05)
Chlorophyll a mg%	GFkV infected	0,363±0,051	0,115	not significant
	Control	0,297±0,012	0,020	
Chlorophyll b mg%	GFkV infected	2,037±0,216	0,483	not significant
	Control	1,781±0,092	0,206	
Chlorophyll a/b	GFkV infected	0,176±0,007	0,017	not significant
	Control	0,166±0,002	0,004	
Chlorophyll a+b mg%	GFkV infected	2,473±0,289	0,647	not significant
	Control	1,879±0,177	0,395	
Carotenoids mg%	GFkV infected	0,678±0,056	0,125	not significant
	Control	0,605±0,029	0,066	

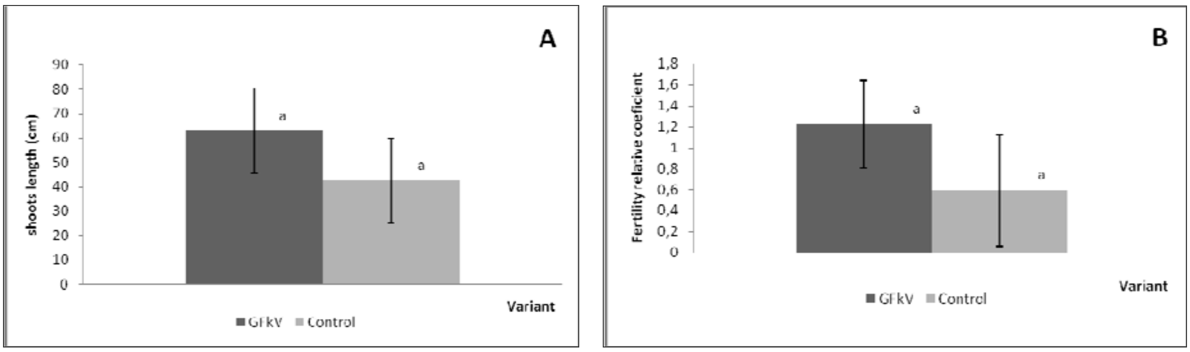

Fig. 1 Effects of GFkV infection on the shoots length (A) and fertility relative coefficient (B) to Chardonnay cv. The values are means, the bars indicate standard deviations and „a" represents statistical signification of differences between means at p<0,05

Studies regarding the chemical composition of grape stalks of local varieties of Fetească with applications in obtaining bioethanol

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Keywords: crop wastes, renewable energy, biofuels

ABSTRACT:

The issue of renewable energy from agrochemicals sources is still studied.

As energy crops affect the balance of natural ecosystems recovery of energy from waste crops is required. Cereals, especially straw, were used as models, but their quantity is insufficient. Therefore it is recommended to identify new sources of energy.

The purpose of the paper is to study the chemical composition of plant material from two grape stalk local varieties: Fetească Regală and Fetească Neagră.

Grape stalk is an untapped agricultural waste which possesses significant quantities of energy. It was found that native varieties of Fetească show considerable amounts of chemical composition in starch, cellulose, hemicelluloses and lignin.

INTRODUQTION

Bioenergy can offer a significant contribution to the future challenge of a more sustainable energy mix and in the medium-term also to the fulfilment of the Kyoto commitments that the EU is determined to implement [Chiaramonti et al., 2002].

The quantities of non-renewable (conventional) energy resources are limited and they have a considerable negative environment impact for example increased greenhouse gas emissions. Therefore, one of the challenges for society is to meet the growing demand for energy for transportation, heating and industrial processes; also to provide raw materials for the industry in a sustainable way and to reduce greenhouse gas emissions. Our energy systems will need to be renewable and sustainable, efficient and cost-effective, convenient and safe [Mojovic et al., 2009; Jouve, 2006; Blanch et al., 2008].

These problems make it urgent to develop alternative energy resources that are both renewable and environmentally friendly. Bioethanol produced from renewable biomass such as starch, sugar or lingocellulosic materials is believed to be one of these alternatives. It is expected to be one of the dominating renewable biofuels in the transport sector within the twenty years to come. The transport sector itself is considered as one of the largest energy consumers as well as environmental pollutant. According to International Energy Agency statistics [OECD/IEA, 2007] the transportation sector accounts for about 60% of the world's total oil consumption. It is responsible for about one fifth of CO_2 emission on a global scale. According to Balat M. and H. Balat, 2009, motor vehicles account for more than 70% of global CO emissions and 19% of global CO2 emissions. This could be alleviated by using biofuels and it is expected that by 2030, one third of the EU and US need of energy for road transportation can be met by converting biomass to biofules [de Pous, 2009, Mojovic et al., 2009].

Bioethanol has already been introduced on a large scale in Brazil, the US and European countries. Bioethanol currently accounts for more than 94% of global biofuel production, with the majority coming from sugar cane [de Pous, 2009].

Bioethanol produced from renewable biomass, such as sugar, starch, or lignocellulosic materials are one of the alternative energy resources, which is both renewable and environmentally friendly. Although, the priority in global future ethanol production is put on lignocelluloses processing, which is considered as one of the most promising second-generation biofuel technologies, the use of lignocelluloses material for fuel ethanol is still under improvement. Sugar-based (molasses, sugar cane, sugar beet) and starch-based (corn, wheat, triticale, potato, rice, etc.) feedstock are still currently predominant at the industrial level and they are, so far, economically favourable compared to lignocelluloses [Mojovic et al., 2009].

Lignocellulosic materials from agriculture and forest management are the largest sources of hexose (C-6) and pentose (C-5) sugars with a potential for the production of biofuels, chemicals and other economic by-products. Lignocelluloses are composed of cellulose (40–50%), hemicelluloses (25–35%) and lignin (15–20%) [Kaparaju et al., 2009]. A review of plant science textbooks reveals the general opinion that hemicelluloses often functions as a food reserve [Winkler and Williams, 1938].

More recent studies on the composition of hemicelluloses have led to other theories as to its physiological function besides those of food reserve and structural reinforcement. The support for this theory is founded on the supposed decrease of pectin during the period of tissue maturation and on the apparently successful attempts to convert pectin to hemicelluloses by mild alkaline hydrolysis, by hydrolysis with water under pressure and by mild oxidation [Winkler and Williams, 1938].

The same work also reported about the increasing processing of agricultural wastes as low-cost source different products [Spigno et al., 2007].

Presumably, a better understanding of the physiology of the grapevine would result in improved viticultural practices. It would serve as a suitable basis for evaluating the analytical results obtained by studying the carbohydrate nutrition of the vine and also for interpreting data only pathologically affected vines [Winkler and Williams, 1945].

The difference would have been larger had the hemicelluloses content of the normal material been expressed as percentage on a carbohydrate-(starch and sugar) free basis. The appearance of a normal hemicelluloses content during the period of rapid growth and before starch storage actively begins, points to its function as a structural material. The starch content, which is the principal reserve in this case, fluctuated widely in each part of the vine. In certain cases (bark samples of canes and trunk) starch was absent during the period of the summer minimum. The mature wood had slightly more hemicellulose than the young shoots [Winkler and Williams, 1938].

There is a comparatively laroye spring increase of' starch in the bark and wood of the spurs - an increase not explained by the decrease in sugar content. It was also found that the total carbohydrate content of Concord grape stems became markedly greater during the dormant period. Such findings might hypothetically be explained by one or several assumptions: (1) by transformation to or from other materials, such as fat, hemicelluloses, or unknown substances; (2) by transport of sugars from another part of the tree; or (3) by sampling and analytical error. DAVIS in an unpublished analysis of the same material could not account for this increase by the disappearance of hemicelluloses [Winkler and Williams, 1945].

To present the data of reserve constituents on a starch and sugar-free, dry-weight basis would seem more satisfactory for mature tissues, at least for changes occurring within a given tissue. In such mature tissue the water, starch, and sugar-free fraction is undoubted more constant than the water content; hence the results expressed in terms of that fraction offer a more nearly exact basis for comparison [Winkler and Williams, 1945].

This circumstance may be understood most readily by reference to the starch + sugar values, which show that throughout this period the summation of these carbohydrates remained essentially constant, even though individually each had undergone large fluctuations. There have been many investigations, mostly micro-chemical, of the winter disappearance and reappearance of starch. That the starch does not completely disappear during the dormant season in the plants he classifies as "starch" or "non-fat" trees. Perhaps with the very low starch storage that seems to occur in many "fat" trees, practically all the starch would disappear, for the sugar quantity produced may "control" the hydrolysis [Winkler and Williams, 1945].

In this work, a brief review of the state of the art in bioethanol production and biomass availability is given, pointing out the progress possibilities on starch-based production. The progress possibilities are discussed in the domain of agricultural wastes for bioenergy value.

This study focuses on the dry weight, carbohydrate, and fibre content of stalks grape Fetească regală comparatively with Fetească neagră break before leaves (stadium dormant, close to the beginning of the active phase).

MATERIAL AND METHODS

The biomass used in the experiment is the grape stalk, Fetească Regală and Fetească Neagră from the collection of the Wine growing Department of the Horticulture Faculty, University of Agronomical Sciences and Veterinary Medicine Bucharest. All reagents are analytically pure.

Right after prelevation the samples are dried at 50^{o}C until reaching constant weight [Spigno si colab., 2008; Faithull, 2002; AOAC, 1995].

The dried grape stalk is minced and sifted through a 3/3 mm sieve. All samples have been analyzed three times. After that the extract is prepared according to Spigno and colab. 2008, for the soluble substances dosing. For determining free reducing glucids DNS was used [Mandels and colab., 1976], glucids hidrolisis for total glucids determination was conducted according to Petrescu and colab., 1967. Pentose quantification was made with orcinol in acid environment [Iordachescu and Dumitru, 1982]. Sugar content determination was conducted according to Halhoul and Kleinberg method, (1972). Polifenols determination after Hiuneburg and colab. method, (2006) requires Folin-Ciocalteu reagent.

From the biomass the next analysis can be made: residues after complete burn, organic substance [Petrescu and colab., 1967; Faithfull, 2002; AOAC, 1995], total nitrogen and total protein through Kjeldal method [Petrescu and colab., 1967; Iordachescu and Dumitru, 1982], amidon with potassium iodide in acid environment [du Boil and Schaffler, 1974], NDF with SDS [Faithull, 2002], ADF with cetazol replacing CTAB with similar results [Faithull, 2002].

RESULTS AND DISCUSSION

Large fluctuations of the sugars in "mature" tissues occurred only through interconversions of starch and sugars in the dormant season. After winter cane pruning, the root system comprised 59% of the total vine dry weight; however, the roots contained 84% of the total starch, 75% of the nitrogen, and 77% of the phosphorus stored in the vine due to higher tissue concentrations of these components. Other nutrients having greater amounts in the roots than in shoots were aluminium, iron, copper, and zinc, which made up to 96%, 90%, 73% and 69% of the vine's total, respectively. Relative to *Vitis vinifera*, 'Concord' grapevines are tolerant of acid soils, and the accumulation of toxic metal ions such as aluminium in 'Concord' roots may be a part of that variety's low pH tolerance (soil pH in this study was 5.2–5.5). Potassium, sodium, and manganese preferentially accumulated in trunks and cordons, while calcium, magnesium, copper, and boron were equally distributed into above- and belowground tissue [Bates et al., 2002].

The results from agricultural waste from Cuyo Region-Argentina of the are: proximate analysis: Ash 10.16 wt %, Humidity 15.69 wt %, Volatile matter 51.08 wt %, Fixed carbon 23.07 wt % and elemental analysis of grape stalk (wt %) as received C 46.143; H 5.737; N 0.366; O 37.594; S 0.000. A typical chemical composition of grape stalk is 70-80% water, 1%

potassium bytartrate, 2-3.5% tanic substances, 2-2.5% mineral matter, 1-1.5% nitrogenised substances, and 1% sugar [Amaya et al., 2005]. Elemental analysis of grape stalk waste generated in wine production (supplied by a wine manufacturer from the Empord`a-Costa Brava region Girona, Spain) was performed with an elemental analyser showed the material composition to be: 42.38% C, 0.8% N and 5.81% H [Martınez et al., 2006]. When physical activation under standard conditions was used, considering as such those adequate for most of the lignocelluloses materials, grape stalk was totally transformed in ash [Deiana et al., 2009].

When grape stalk was submitted to a conventional physical activation it was not possible to obtain acceptable products, turning in some cases completely into ashes. An explanation to this behaviour was found in its high mineral water content. From these results it is apparent that this raw material has an anomalous high ash content, especially when it is compared with other carbonaceous materials also used to obtain activated carbon, such as eucalyptus wood and fruit stones (peach, olive, apricot, etc.) that have around 1% ash [Amaya et al., 2005].

A distinctive characteristic of grape stalk is its high potassium content, with also remarkable quantities of sodium and calcium [Amaya et al., 2005].

Appearance biomass vine rope royal variety Fetească Regală and Fetească Neagră, after being ready to release for lignocellulose saccharification and alcoholic fermentation is presented in Fig. 1.

Moisture determination from grape vine stalk Feteasca Regala and Feteasca Neagra presents values of 33.44 respectively 41.05 (fig. 2). A study from Uruguay and Argentina shows that water was found in grape vine stalk in 70-80%. Also the grape vine stalk analized in Romania contained 16% water [Amaya et al., 2005; Deiana et al., 2009]. The grape stalk used in this work [Deiana et al., 2009] came from different kinds of grapes (Torrontés, Syrah, Chardonnay, Merlot, Malbec) and were provided by Bodegas y Vinedos Nesman, a winery from San Juan, Argentina.

Humidity from grape stalks are obtained from the end of August to mid-October cultivated in the Mediterranean areas in 20-70% [Bertran et al., 2004].

Ash and organic substance was determined from Fetească regală (3.54, respectively 96.46%) and Feteasca Neagra (3.38, respectively 96.62%) grape vine stalk (fig. 3). Other studies present 10%, respectively 10.16% ash content [Deiana et al., 2009], [Amaya et al., 2005].

Comparations of the total and free glucids can be found in figure 4. These quantities are 31% higher for Feteasca regala and 33% higher for Fetească neagră.

Winkler and Williams (1945) determined reducing glucides for the Carignane grape vine stalk with values between 3,8-6,3% [Winkler and Williams, 1945].

Comparations for the pentose and sugar quantities for Fetească regală and Fetească neagră can be found in fig. 5. It can be seen that sugar represents 25-30% of the value of pentose. Also, the values for Feteasca regala are significantly higher than those for Feteasca neagra. For Carignane grape vine stalk sucrose presents values between 3.6-5.1% [Winkler and Williams, 1945].

The comparative study of amidonquantity for Feteasca regala and Feteasca neagra can be found in fig. 6. The values are between 5-6% and slightly higher for Feteasca neagra than Feteasca regala.

Winkler and Williams (1945) determined the amount of amidon for the Carignane grape vine stalk with values between 11,3-15,2% [Winkler and Williams, 1945]. Carbon reserves in grapevine have long been studied. They consist mainly of starch, but significant amounts of soluble sugars may appear during winter depending on the temperature. Seasonal dynamics of starch and soluble carbohydrates have been described in the canes of some varieties. Pinot noir grape vine stalk presented amidon values of 1,1-4,2% in spring and 2,5-12,5% in winter, depending on the age of the vine [Zapata et al., 2004].

At the beginning of the season, both starch concentration and total starch per vine were greater in woody roots than in woody shoots. Woody roots stored 12% to 14% starch and woody shoots stored 3.5% to 4.5% starch. By bloom, all woody structures contained 1% to 2% starch [Bates et al., 2002]. At the whole perennial parts level, starch concentration was high at dormancy and did not vary significantly until stage activately [Zapata et al., 2004].

There is rich interest in the reproductive physiology of woody plants. For example, it has been shown that there is a strong relationship between flower development and carbohydrates.

In *Vitis vinifera* L., the pathways of inflorescence and flower development contrast with those for many other species in several aspects, with stresses delaying or stopping reproductive development. For example, low temperatures near flowering affect ovule development and pollen tube growth. These responses are mediated by perturbations in carbohydrate physiology. Indeed, shading the leaves reduces photosynthesis and carbohydrate supply to the developing inflorescences, causing flower abscission and lower yields. The reaction to stresses differs according to the genotypes. 'Gewurztraminer' and 'Pinot Noir' have different rates of flower abscission, related to the sugar content in the inflorescence during flower development. Efforts to understand this behaviour would be improved by developing a reliable model of flowering and carbohydrate physiology [Lebon et al., 2005].

Trunks, cordons, and thick woody roots lost weight during the same period, which accounts for early shoot and fine-root dry-weight gain being larger than net vine dry-weight gain at bloom. Starch decreased in all permanent vine structures from dormancy to bloom. At the beginning of the season, both starch concentration and total starch per vine were greater in woody roots than in woody shoots. Woody roots stored 12% to 14% starch and woody shoots stored 3.5% to 4.5% starch. By bloom, all woody structures contained 1% to 2% starch [Bates et al., 2002].

Comparations for the total N and total protein quantities for Feteasca regala and Feteasca neagra (fig. 7) are higher for Feteasca neagra than Feteasca regala. Total protein is directly proportional with the quantity of total N.

In grapevine Pinot noir, N reserves are located predominantly in the roots and are made by aminoacids (mostly arginine) and proteins. The grape vine stalk harvested at the age of 1 year contained 0,66% N [Zapata et al. 2004]. The total N content in the grape vine stalk from the mediterranean area is 1,1% [Bertran et al., 2004].

In fig. 8 you can find comparations for the quantity of polifenols in Feteasca regala si Feteasca neagra. Also, comparations for the quantity of fibre in Feteasca regala si Feteasca neagra can be found in fig. 9. It has been observed that ADF is higher in Feteasca regala, while NDF is higher for Feteasca neagra.

Cellulose content was in agreement with that reported in the literature for Spanish grape stalks, and with other researchs who reported a content of cellulose + lignin ranging from 15% to 40%. Hemicelluloses content was lower than that indicated, by Lorenzo et al. (2002) but in agreement, with Winkler and Williams (1938) who reported a hemicelluloses content ranging from 12 to 20% d.b. depending on the year period and on the cross-section of stems [Spigno et al., 2008].

The vinies employed-*Vitis vinifera var. Carignane*-were just completing their fourth annual growth ring in the trunk at the beginning of the samplino period. During the year, eighteen collections were made. The first, oln Nov. 6, came just before leaf fall. The vines taken were distributed bv removinog every twenitieth vine throughout the plot, omitting end vines and those of abnormallyv weak or strong development [Winkler and Williams, 1945].

CONCLUSIONS

Grape stalk, an abundant waste of viticulture industry, is a great raw material for obtaining bioethanol. Shows the advantage of greater amounts of starch, and increased fiber percentage, considering that the vines, rope is not a dedicated source of fermenting sugar and starch free.

Starch is an energy reserve for the grap vine during winter, when the plant enters the dormant phase. It can be easily hidrolized to free fermentable sugars. Previous studies showed that amidon is directly proportional with the age of the vine.

The results of the studies chemical composition of grape stalks showed that it is possible to obtain bioethanol, comparable to commercial products.

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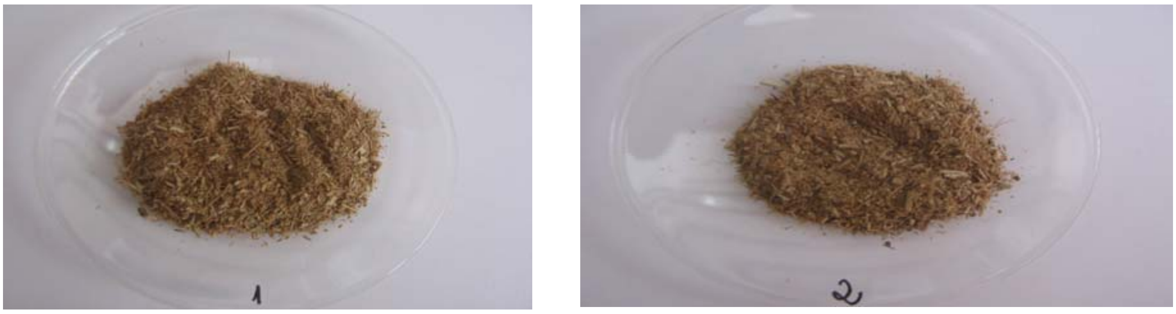
FIGURES



1. grape vine stalk feteasca regala   2. grape vine stalk feteasca neagra

Fig. 1. Biomass aspect.

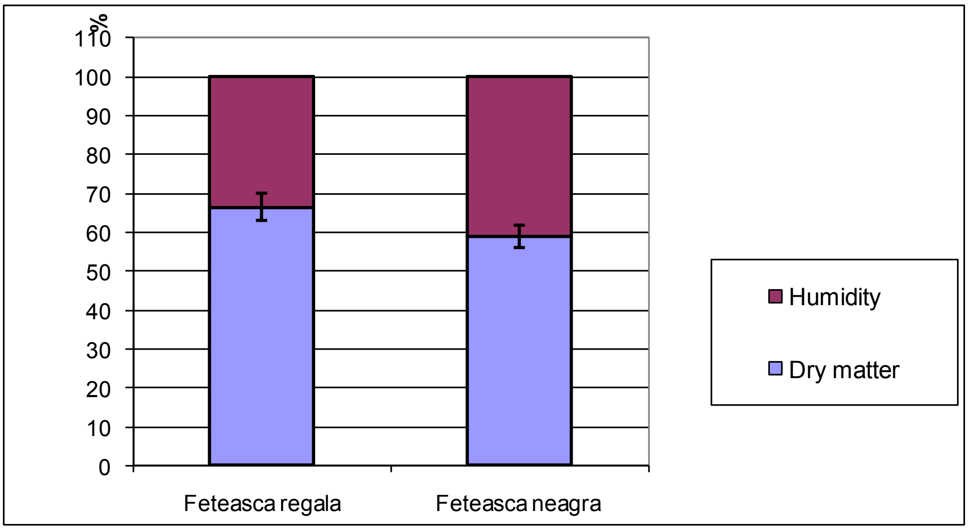


Fig. 2. Humidity determination from grape vine stalk Feteasca regala si Feteasca neagra.

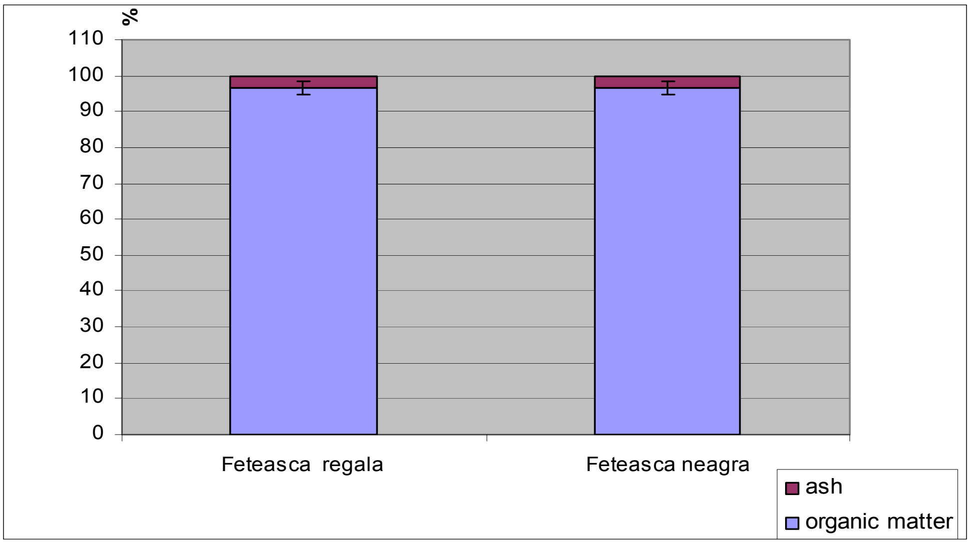


Fig. 3. Determination of organic substance and ash in the grape vine stalk Feteasca regala si Feteasca neagra.

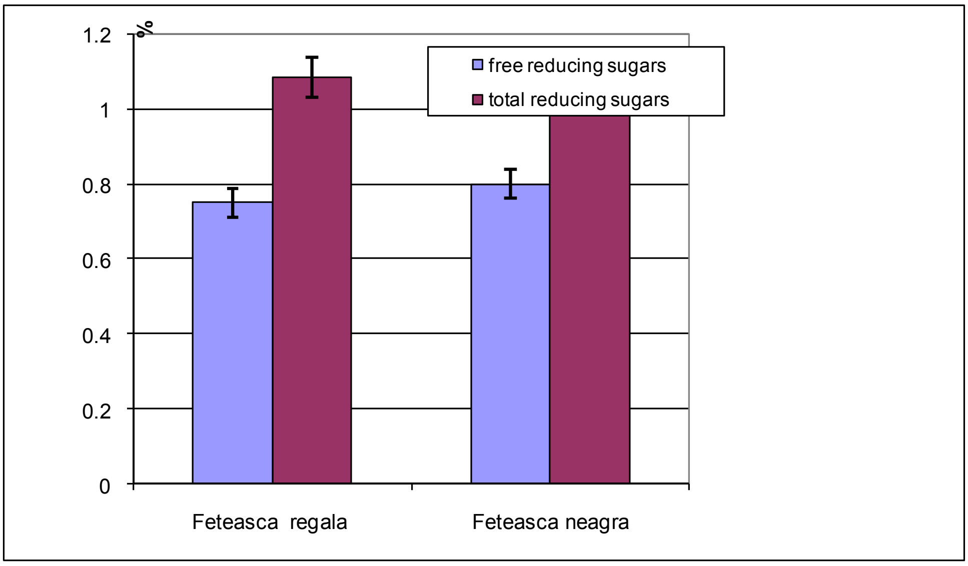


Fig. 4. Comparation of the free and total glucid quantities for Feteasca regala si Feteasca neagra

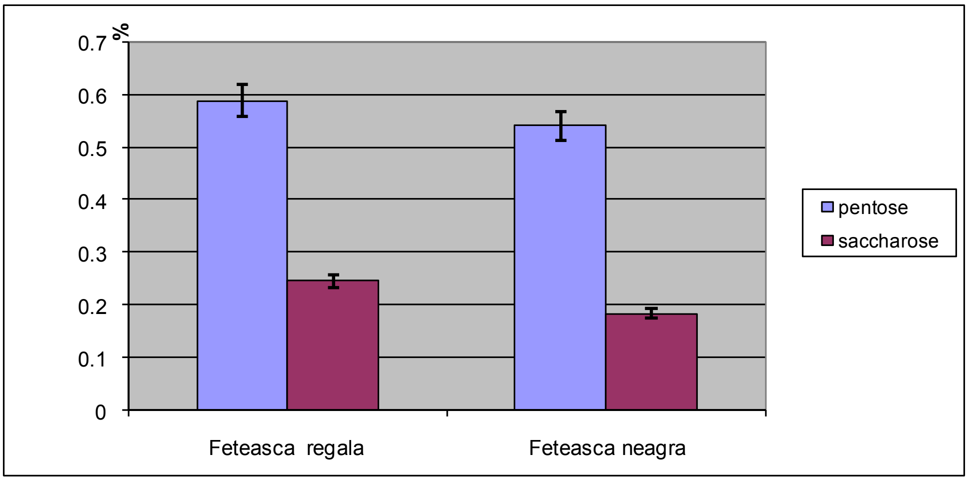


Fig. 5. Comparations for pentose and sucrose quantities for Feteasca regala si Feteasca neagra.

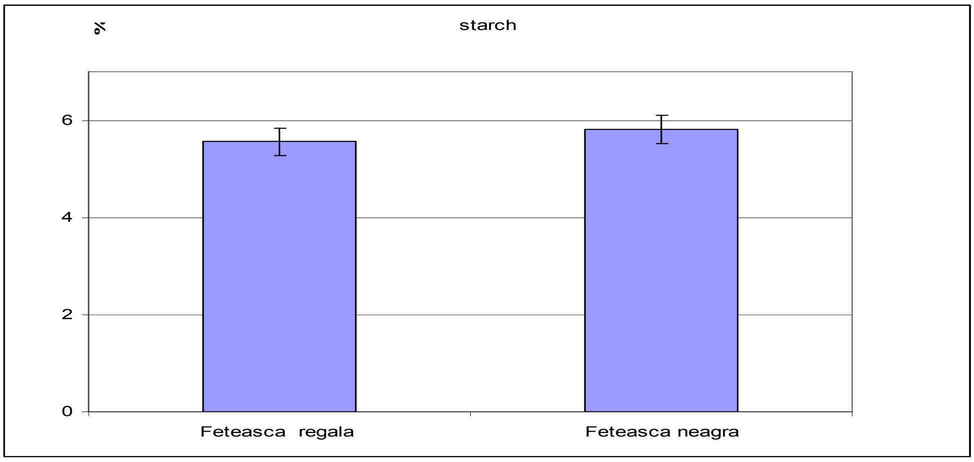


Fig. 6. Comparations for amidon quantities for Feteasca regala si Feteasca neagra

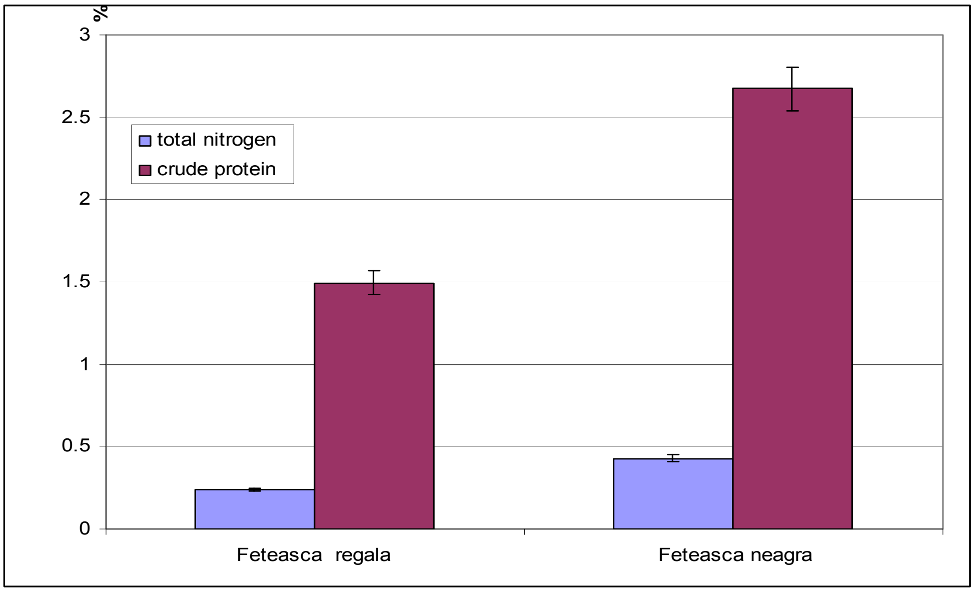


Fig. 7. Comparations for total nitrogen and total protein quantities for Feteasca regala si Feteasca neagra

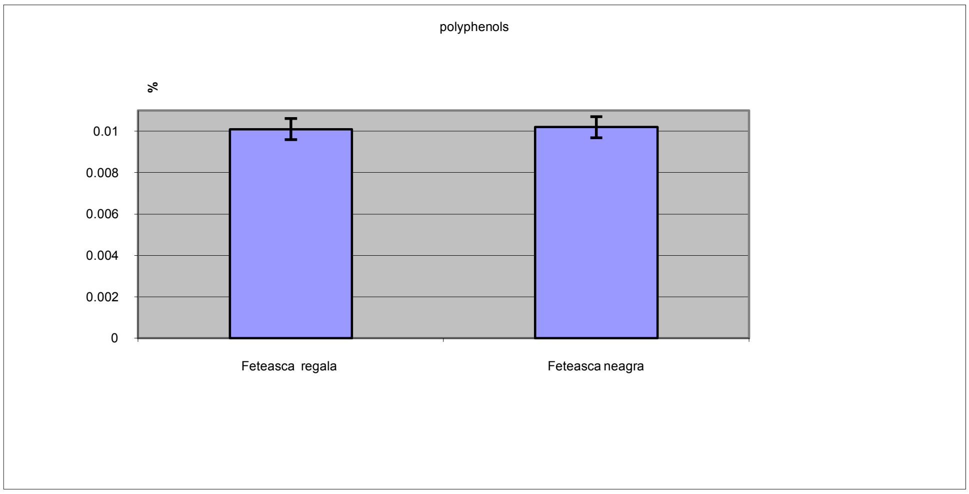


Fig. 8. Comparations for polifenal content for Feteasca regala si Feteasca neagra

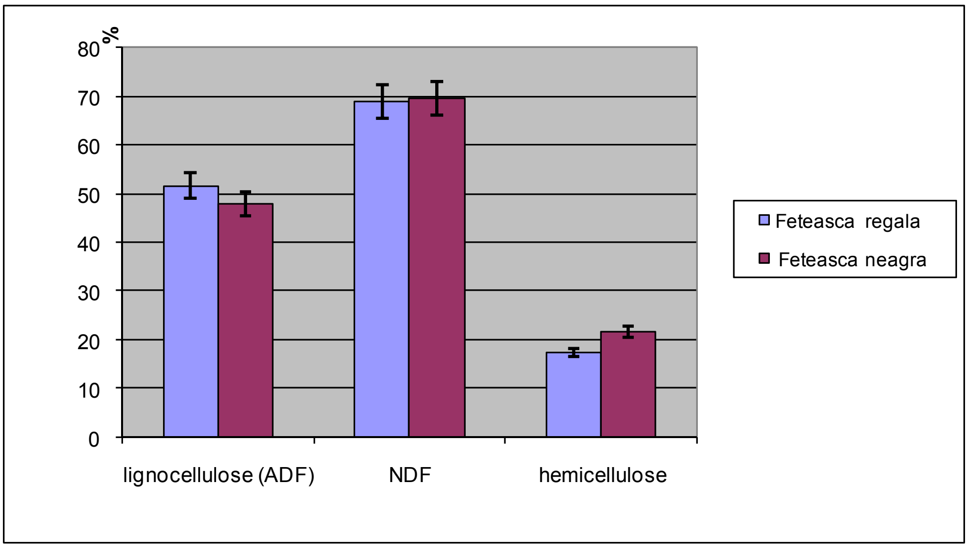


Fig. 9. Comparations for fibre amount from Feteasca regala si Feteasca neagra

Discrimination of Băbească neagră wines from different winegrowing area using electronic nose

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Keywords: sensory analysis, red wine, gas chromatography

ABSTRACT

The methodology for food products discrimination is not very clear definite, priority being sensory analysis. Preoccupations regarding the correlation of tasters responses with data obtained from electronic nose instrumentation demonstrated the necessity of a good repeatability and accuracy of both sets of information. Heracles analyzer (Alpha MOS) provide an unique impress for each product using two different polarity separation columns, which provide a specific response for each wine volatile component, similar to human nose. The instrument is based on ultra-fast gas chromatography and the translation and interpretation process, specific to human olfactory sense, is substituted by powerful software (Alpha Soft ver. 11). The present study presents the assessment of some different discriminating methods of four Băbească neagră wine variants (V3 = selected yeast Lalvin BM 45 + enzyme, V4 = selected yeast Lalvin BM 45 + enzyme Lallzyme OE + chips, V5 = selected yeast Lalvin BM 45+ enzyme Lallzyme OE + tannin Limousine and V6 = selected yeast Lalvin BM 45 + enzyme Lallzyme OE + tannin Tostato) from Odobeşti, Pietroasa and Bucureşti wine-growing area using an electronic nose multiorganoletic analyzer. The applied analysis techniques were Principal Component Analysis (PCA) and Discriminant Function Analysis (DFA). The analyzed wine samples during this study were obtained at USAMV Bucureşti.

INTRODUCTION

In the past decade, electronic nose instrumentation has generated much interest internationally for its potential to solve a wide variety of problems in fragrance and cosmetics production, food and beverages manufacturing, chemical engineering, environmental monitoring, and more recently, medical diagnostics and bioprocesses. An electronic nose is a machine that is designed to detect and discriminate among complex odors using a sensor array. The use of high performance sensors lead to better results in a shorter time but also increase low volatility components discrimination power. Key features include versatility and speed of analysis, giving the product cost and productivity advantages over the more traditional gas chromatographs.

Analytical methods such as gas chromatography-mass spectrometry (GC-MS), or near infrared (NIR) provide the mainstay for measurement of volatile components in food, agricultural, chemical or environmental industries.

This paper presents some preliminary results on the possibility of discriminating red wines depending on winegrowing area, using an apparatus which works on the principle of the electronic nose.

MATERIAL AND METHODS

The HERACLES is a highly selective and sensitive specialty gas chromatograph, capable of performing very fast, low level hydrocarbon measurements in laboratory or field environments. Key features include versatility and speed of analysis, giving the product cost and productivity advantages over the more traditional gas chromatographs. It is a programmed temperature gas chromatograph equipped with specialized devices (Combi PAL Auto-Sampler System for processing multiple groups of samples) using syringe or valve inlets to a flash evaporator, were from the sample is delivered to an adsorbent Tenax trap to concentrate the sample and deliver it to twin capillary columns (GC#1 DB-5, 2m, Apolar/GC#2 DB-1701, 2m, Medium polarity) and flame ionization detectors (FID) simultaneously. The hydrogen used as carrier gas must be FID Grade (Ultra High Purity 99.999%). To start the analysis you must set and verify the method parameters (Table nr. 1). The sample is injected into the hot Injection Port, vaporizes (if necessary) and passes into the ambient temperature trap, hydrogen gas carrier passing through the glass injection port liner. After samples are focused and concentrated onto the trap, internal pressures within the injector/trap assembly equilibrate for a few seconds and then the trap is heated to its appropriate desorbtion temperature. During the analysis time, the instrument injects the sample into the separation columns and the chromatographic separation takes place. At the end of an analysis, all internal instrument components return to their initial temperatures and flow states, and the instrument becomes ready for the next analytical cycle.

An odor stimulus generates a characteristic fingerprint (or smell-print) from the sensor array. Patterns or fingerprints from known odors are used to construct a database and train a pattern recognition system so that unknown odors can subsequently be classified and identified. Thus, electronic nose instruments are comprised of hardware components to collect and transport odors to the sensor array – as well as electronic circuitry to digitize and stored the sensor responses for signal processing.

The analyzed wine samples during this study were obtained at USAMV Bucureşti in four technological variants for each centre (V3 = selected yeast Lalvin BM 45 + enzyme, V4 = selected yeast Lalvin BM 45 + enzyme Lallzyme OE + chips, V5 = selected yeast Lalvin BM 45+ enzyme Lallzyme OE + tannin Limousine, V6 = selected yeast Lalvin BM 45 + enzyme Lallzyme OE + tannin Tostato), with three repetition for each variant. The results were reported as means of all repetitions.

RESULTS AND DISCUSSIONS

After analysing the obtained data the results are presented as chromatograms (Fig. 1), each peak on those chromatograms corresponding to a sample's volatile chemical substance, detected by the instrument's chromatographic columns after a period from sample's injection (retention time). The big number of peaks, correlated with the existence of two chromatographic columns with complementary properties, lead to a big number of *sensors* assuring the instrument a very good sensitivity.

Processing the chromatograms data the instrument software allows the selection of sensors (peaks) with the highest samples discrimination power. The parameter named "discrimination index" establish how good is the obtained discrimination; its value must be positive and high.

The obtained data are processed with the instrument's software (Alpha Soft ver. 11.0) through multivariate statistic methods (PCA – principal component analysis, DFA – discriminant function analysis) leading to graphic representation which allows samples discrimination and identification visualization.

Tabel nr. 2 present the tested technological variants from each wine-growing area.

A first attempt regarded the discrimination of wine samples depending on wine-growing area, ignoring the applied winemaking technology. The software idicated five sensors as adequate to discriminate the three wine groups. The 63 value of discrimination index is considered very good, especially when the analyzed wines are made with different winemaking technologies.

Principal component analysis (PCA) pursue the identification of a smaller number of new variables constituted as linear combinations of initial variables, analytic determined which may explain better the initial experimental data variability. Fig. 2 show that the software has identified a principal component (PC 1) which explain 82,644% from initial data variability and represent a linear combination of the five sensors used. The second principal component, perpendicular on the first one, explains 17,258 % from initial data variability.

Another multivariate statistic method is DFA (discriminant function analysis) which identify those initial data linear combination, named discriminant functions; simplifying the initial set of data this technique assure a better discrimination of analyzed sample groups. Fig. 3 presents the DFA diagram corresponding to the same data and sensors which provided PCA diagram. We can see on the graphic that the three groups of wine are very good separated, although in every group we have different variants of wine. The percentages shown on each of the DFA axes indicate the information provided by those discriminate functions, data used for samples discrimination.

It seems that the differences in the volatile profile of wines induced by the use of different enological materials (enzyme, oak chips, tannins) are not strong enough to overcome the effect of grapes origin place; the electronic nose was able to correctly differentiate the wines based on their place of origin.

A second experiment was made for wine samples discrimination depending on technological variant of each geographical region. In this case the applied method was Discriminant Function Analysis (DFA).

Figure nr. 4 present the discrimination of Băbească neagră wines from Odobeşti winegrowing region. The software indicated a number of five sensors as adequate to discriminate the four analyzed variants. On the grafic it may be seen a very good discrimination of tested samples.

Figure nr. 5 present the Băbească neagră variants from Pietroasa winegrowing region. The instrument was able to make a clear discrimination of studied variants. In this case the number of sensors taken into account was bigger (9 sensors).

To discriminate the Băbească neagră variants from Bucureşti winegrowing region (Fig. 6) was necessary a number of 6 most important sensor. We have also obtained a very good discrimination.

It may be seen that variant number 3, considered as control sample, is very clear separated from the other technological variants.

It established that the use of some enological materials as fermenting enzyme, oak chips, and tannins has a significant influence on aromatic profile of wines, influence that may be determined by using the electronic nose.

Finally, it was tested the instrument ability to discriminate the tested samples, grouped by variants, from all grapes origine place. Figure nr. 7 present the grafic obtained by processing the results through Discriminat Function Analysis (DFA). In this case the instrument and the used technic made a very good discrimination of the four wine groups, although each group contain sapmles from three different winegrowing regions.

This result is very important to bring out into relief the electronic nose ability to correctly discriminate the wines both by applied winemaking technology and grapes origin place.

CONCLUSIONS

Although within the framework of the three winegrowin region were applied different winemaking technologies the Heracles analyzer was able to do a very good discrimination of analyzed samples both by grapes origin place and applied winemaking technology.

The discrimination's degree was such that various applications can be devised for this electronic nose regarding the discrimination of different wine samples.

Summing up the results presented until now we may say that the different winemaking technologies as the origine of grapes were indentified.

Less requirements for sampling, simplicity and speed of analysis gives the electronic nose a big advantage over current methods used for peculation tracking or verify the presence and the concentration of certain substances in food products.

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TABLES AND FIGURES

Table 1

Method parameters

Parameter	Value
Sample volume	4 ml wine
Incubation temperature	60°C
Incubation time	600s
Injection volume	2500µl
Sampling time	20s
Trap temperature	40°C
Trap prepurge time	5s
Other trap parameters	Trap desorbtion temperature 250°C; trap preheat time 20s; incubation time 60s
GC program	Initial temperature 40°C (initial hold time 2s), final temperature 200°C (final hold time 5s), column heating rate 5°/s
Data acquisition time	40s
Injector temperature	200°C
Detector temperature	220°C

Table 2

Băbească neagră tested samples

Wine-growing area	Variant	Type of oenological material	Dosage and time of addition
Odobeşti	BNO3 (r1, r2,r3)	Selected yeast BM45 + enzyme Lallzyme OE	30 g/hl yeast + 2 g/hl enzyme (in the beginning of fermentation)
	BNO4 (r1, r2,r3)	Selected yeast BM45 + enzyme Lallzyme OE + oak chips	30 g/hl yeast + 2 g/hl enzyme + 250 g/hl oak chips (after fermentation, contact 3-5 weeks)
	BNO5 (r1, r2,r3)	Selected yeast BM45 + enzyme Lallzyme OE + tannin Limousine	30 g/hl yeast + 2 g/hl enzyme + 20 g/hl tannin Limousine (after fermentation)
	BNO6 (r1, r2,r3)	Selected yeast BM45 + enzyme Lallzyme OE + tannin Tostato	30 g/hl yeast + 2 g/hl enzyme + 20 g/hl tannin Tostato (after fermentation)
Pietroasa	BNP3 (r1, r2,r3)	Selected yeast BM45 + enzyme Lallzyme OE	30 g/hl yeast + 2 g/hl enzyme (in the beginning of fermentation)
	BNP4 (r1, r2,r3)	Selected yeast BM45 + enzyme Lallzyme OE + oak chips	30 g/hl yeast + 2 g/hl enzyme + 250 g/hl oak chips (after fermentation, contact 3-5 weeks)
	BNP5 (r1, r2,r3)	Selected yeast BM45 + enzyme Lallzyme OE + tannin Limousine	30 g/hl yeast + 2 g/hl enzyme + 20 g/hl tannin Limousine (after fermentation)

	BNP6 (r1, r2,r3)	Selected yeast BM45 + enzyme Lallzyme OE + tannin Tostato	30 g/hl yeast + 2 g/hl enzyme + 20 g/hl tannin Tostato (after fermentation)
Bucureşti	BNB3 (r1, r2,r3)	Selected yeast BM45 + enzyme Lallzyme OE	30 g/hl yeast + 2 g/hl enzyme (in the beginning of fermentation)
	BNB4 (r1, r2,r3)	Selected yeast BM45 + enzyme Lallzyme OE + oak chips	30 g/hl yeast + 2 g/hl enzyme + 250 g/hl oak chips (after fermentation, contact 3-5 weeks)
	BNB5 (r1, r2,r3)	Selected yeast BM45 + enzyme Lallzyme OE + tannin Limousine	30 g/hl yeast + 2 g/hl enzyme + 20 g/hl tannin Limousine (after fermentation)
	BNB6 (r1, r2,r3)	Selected yeast BM45 + enzyme Lallzyme OE + tannin Tostato	30 g/hl yeast + 2 g/hl enzyme + 20 g/hl tannin Tostato (after fermentation)

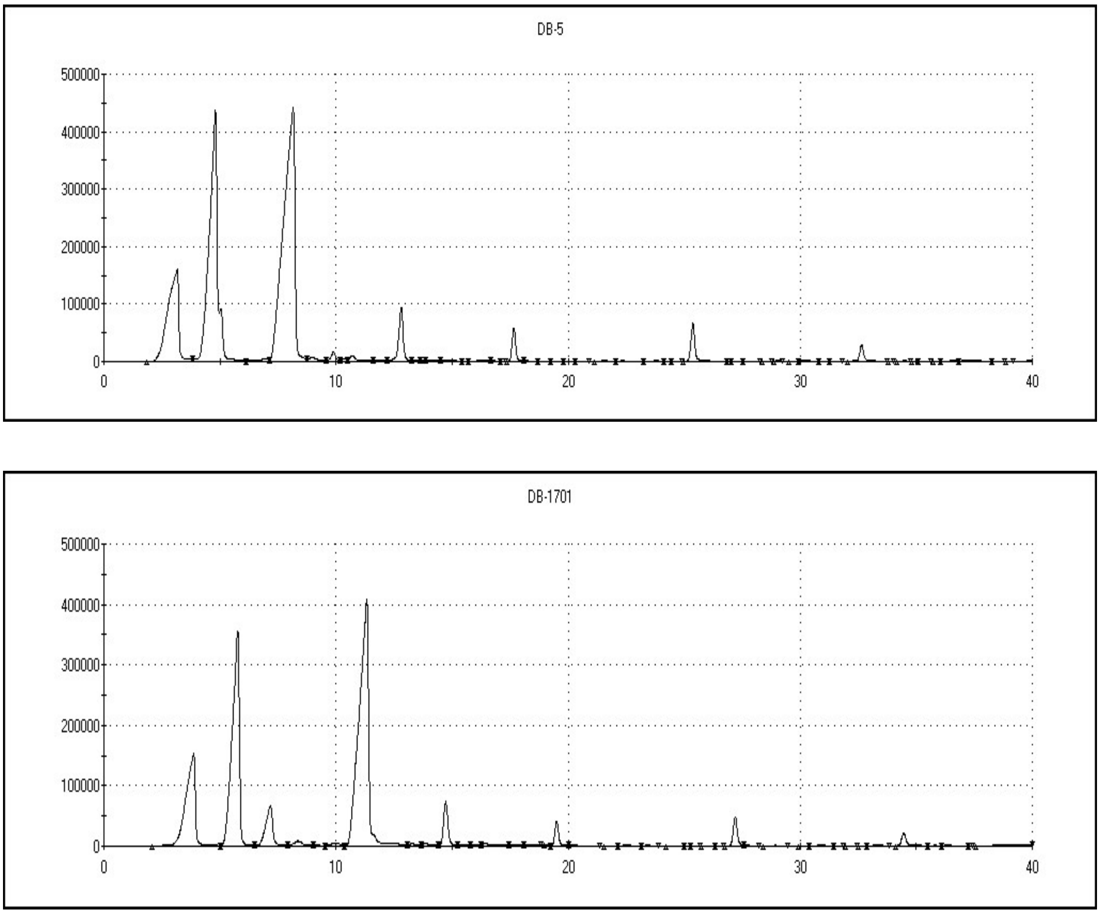

Fig. 1. Examples of chromatograms recorded with the Heracles flash-chromatograph analyzer (equipped with two different columns DB-5 and DB-1701) during the analysis of sample BNB 5_r1

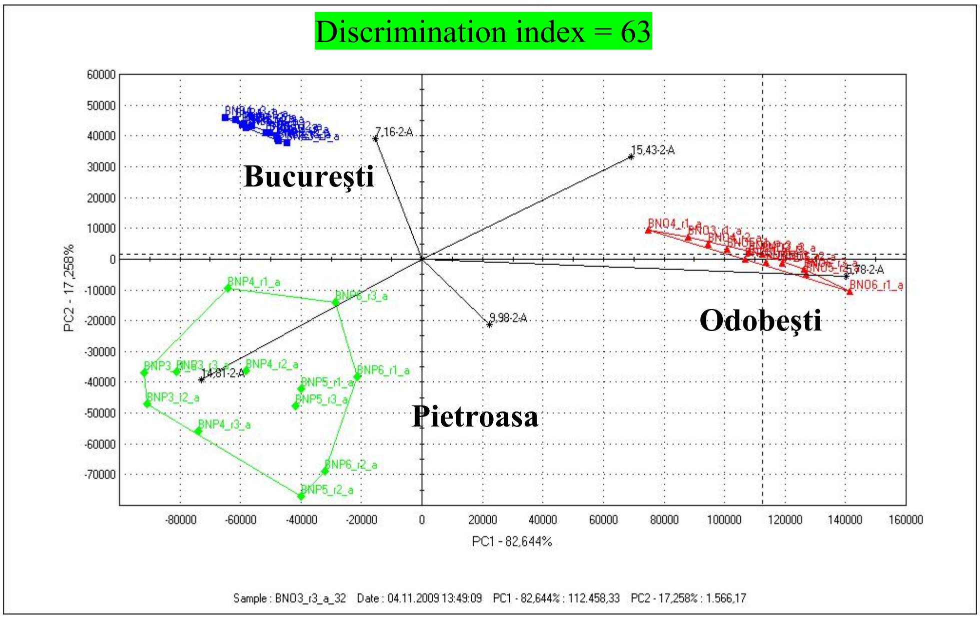

Fig. 2. PCA plot showing the discrimination of Băbească neagră wine groups in accordance with wine-growing area. Discrimination index: 63. PC1-82,644%; PC2-17,258%

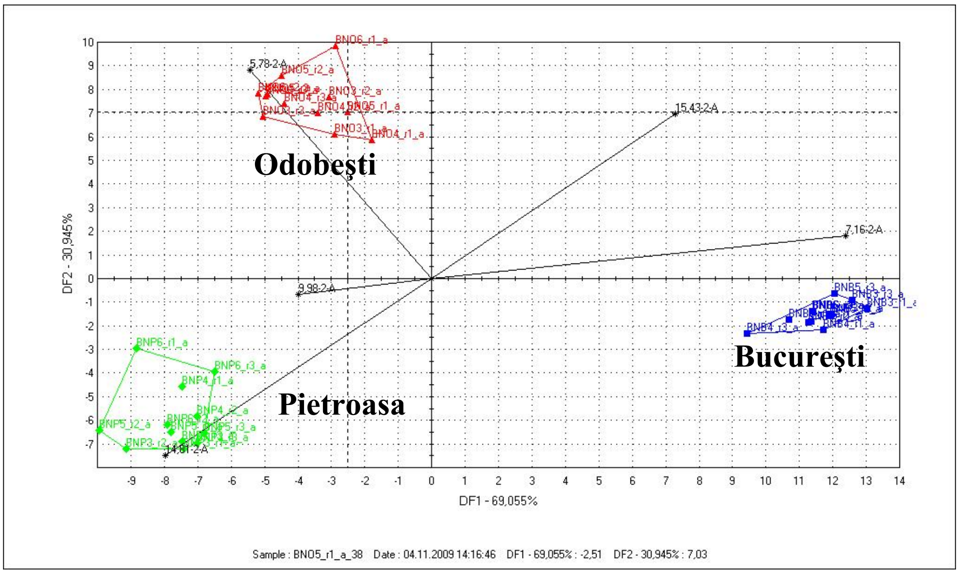

Fig. 3. DFA plot showing the discrimination of Băbească neagră wine groups in accordance with winegrowing area. DFA – 69,055%, DFA – 30,945%. A number of 5 chromatographic peaks (the most significant for discrimination purposes) were taken into account to discriminate the tested samples

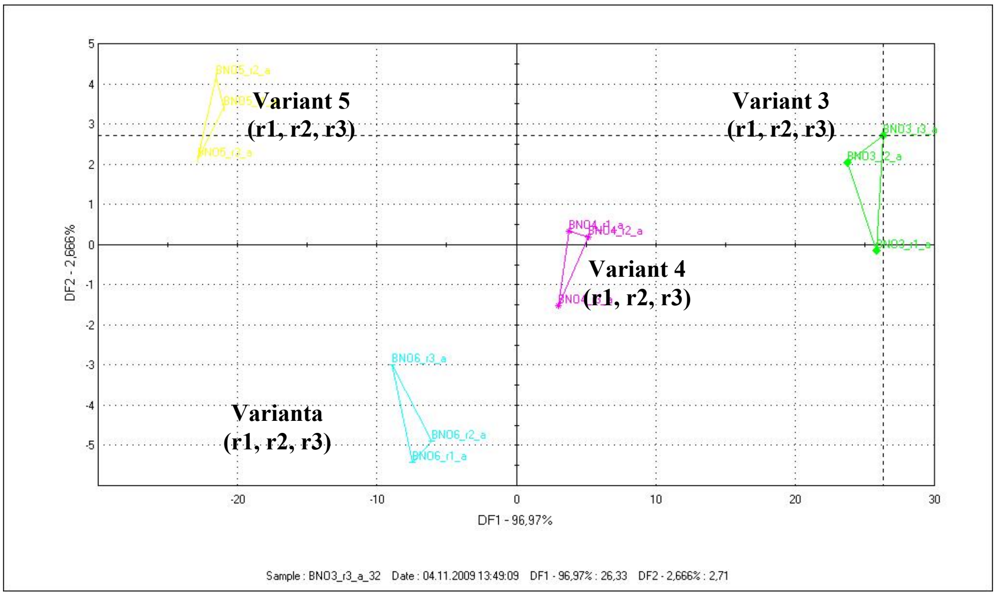

Fig. 4. DFA plot showing the discrimination of Băbească neagră wine variants from Odobeşti winegrowing region. DF1-92,88%; DF2-4,675%. A number of 5 chromatographic peaks (the most significant for discrimination purposes) were taken into account to discriminate the tested samples

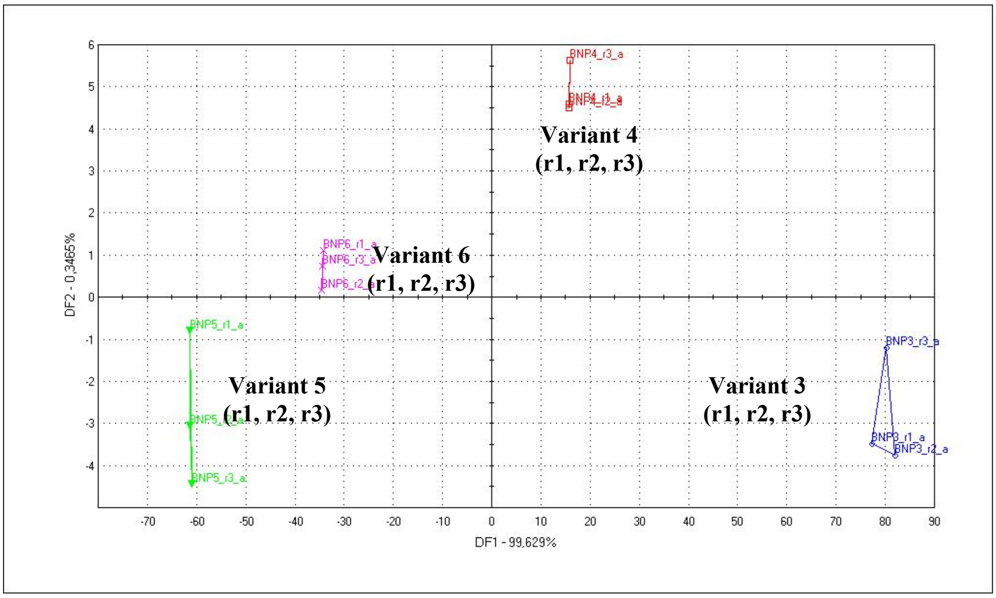

Fig. 5. DFA plot showing the discrimination of Băbească neagră wine variants from Pietroasa winegrowing region. DF1-99,629%; DF2-0,3465%. A number of 9 chromatographic peaks (the most significant for discrimination purposes) were taken into account to discriminate the tested samples

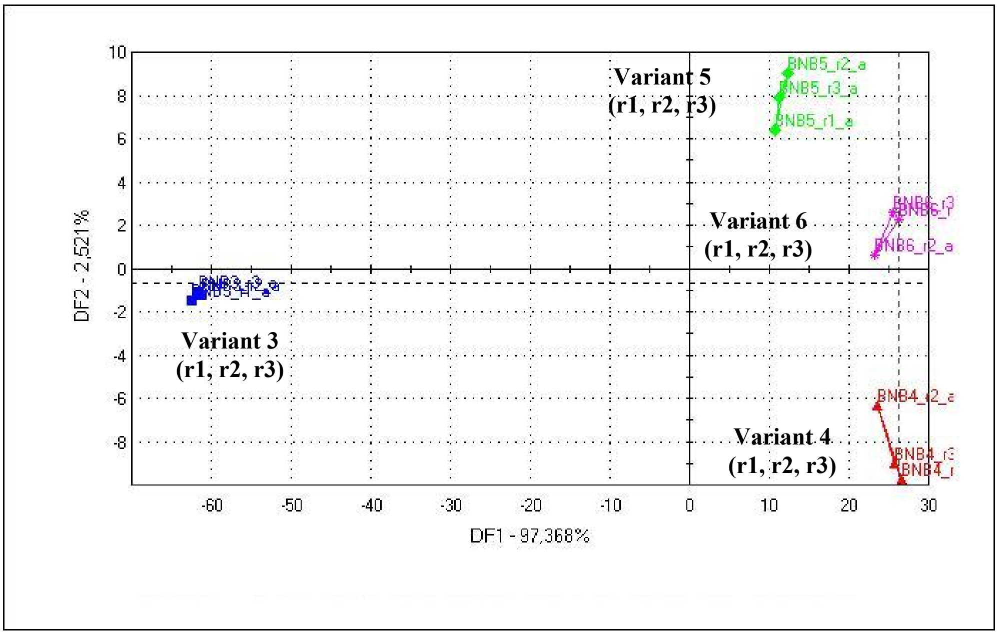

Fig. 6. DFA plot showing the discrimination of Băbească neagră wine variants from Bucureşti winegrowing region. DF1-97,368%; DF2-2,521%. A number of 6 chromatographic peaks (the most significant for discrimination purposes) were taken into account to discriminate the tested samples

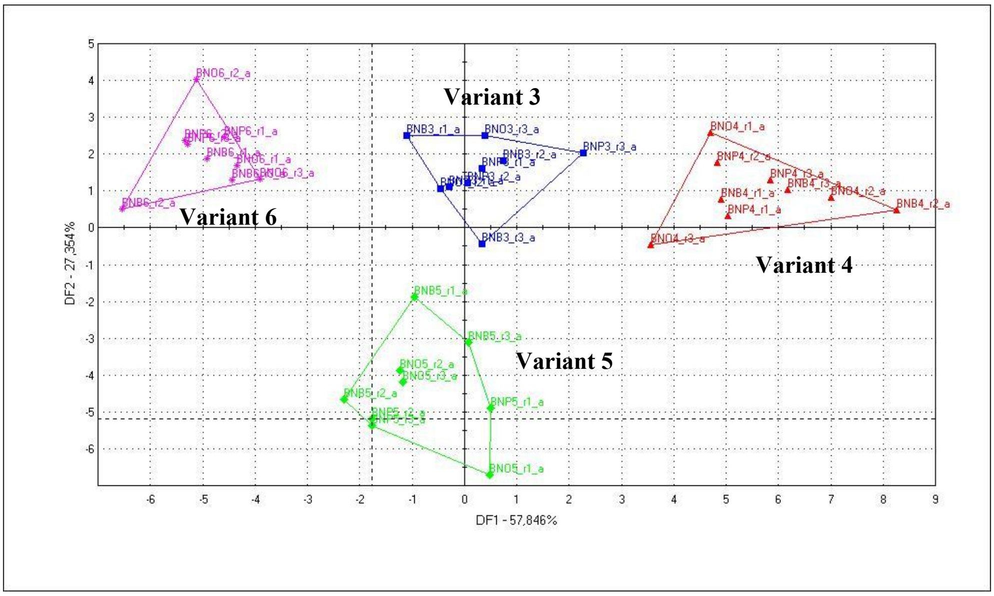

Fig. 7. DFA plot showing the discrimination of Băbească neagră wine variants from the three winegrowing region. DF1-57,846%; DF2-27,354%. A number of 45 chromatographic peaks (the most significant for discrimination purposes) were taken into account to discriminate the tested samples

Strengthening brand „wine of Stefanesti” by extending in culture a new clones: Feteasca alba 97 ST. and Feteasca regala 72 ST. for white wine, and for red wine Feteasca neagra 6 ST.

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ABSTRACT

Entry into the European Union beside main wine countrys, with highly developed viticulture, with technologies and machines for wine-preparation very modern and with a very efficient system capitalization, represents for Romania and separately for each vineyard challenge but also a very difficult barrier to past. Sustainable Development Strategy of Romanian viticulture “ORIZONT 2014” indicates at opportunity penetration in this system qualitatively almost perfect, wine made from traditional Romanian varieties and their clones, with known traceability and authorized from healthy growing plantations, free of major viruses and mycoplasma. To achieve this objective, INCDBH Stefanesti-Arges, created and approved clones of Feteasca regala 72 St. and Feteasca alba 97 St. for quality white wines, and Feteasca neagra 6 St for quality red wines.

INTRODUCTION

Arges lands, vine growing, winemaking and wine trade are dating back to Thracian but first documentary attestation dates from 20 May 1388, time when viticulture was practiced on a much wider area than the hills of Pitesti.

Quality wines produced in hills Pitesti were particularly good, and vineyards of this region were famous not only throughout the country, but abroad as Romanian, justified recognition over time showed the persistence of special interest by monasteries, large Boyar families and especially the rulers.

Until the phylloxera disaster in the Stefanesti vineyard had cultivated only old Romanian varieties, predominantly white wine varieties. The cultivation was "Gordin" with very sweet grapes from which obtain the wine very good, light color. Following "Braghina, variety with relatively early maturing for good wines. Then "Razachia" with fleshy grape berries for good white wine, "Tamaioasa with round grape berry yellow color which ripen early and giving a sweet wine,"Berbecelul" with small grape berries for wines, "Corbul" variety for red wine, strong, "Basicata" which produced a wine but rather weak and sour but grapes are kept well for fresh consumption, "Coarna" good variety for mass and very good for white wine, easy.

After the attack of phylloxera, in Arges vineyards were restored very difficult, especially due to the varieties permeated from Western Europe and HPD, planted by peasant families who do not allow purchase of grafted, even if one of the first five nurseries created in the country to produce grafts, has functioned in this vineyard at Golestii-Badii and was founded in 1929, and first cooperative cellar in the country, at Topoloveni, equipped with superior technique for preparing wine.

In vineyard nurseries from Stefanesti-Arges local varieties were grafted: Cramposie, Gordan, Braghina, Tamaioasa, Coarna, Negru mare, Negru vartos, Tata caprei, Vulpe and foreign varieties Riesling, Semillion, Sauvignon, Muscat Ottonel, Muscat Frontignan, Pinot gris, Pinot noir, Traminer, Gamay blanc.

During the communist period (and now) prevailing culture of grapes varieties for high quality white wines, with which are produced aromatic wines of high quality and wines for distillate at a rate of 8-10% each. White wines, particularly dry, with moderate alcohol content, with special traits of harmony taste, fructuozitatte and suppleness which make them very appreciated. The vineyard central Topoloveni are made higher concentrations of sugars, white wines more alcoholic, more extractive, very nice, but do not have the same suppleness and harmonious taste. Red wines have good color and extracting sufficient. In wine center Valea Mare of Dambovita, are grown varieties for high quality white wines and reds table grapes.

Stefanesti vineyard wines, especially those in Central Stefanesti vineyard, both young and old, have won many awards of national and international competitions. Varieties Sauvignon, Riesling Italian, Feteasca regala and Feteasca alba, are wines that brought many medals but varieties Muscat Ottonel and Tamaioasa roamneasca gave wines have won the most demanding international competitions, and obtaining the champion diploma (Giosanu et al., 1989). These are all reasons to continue this long tradition with even greater intensity.

Entry into the European Union with the main countries with highly developed viticulture, with technologies and machines for wine-preparation very modern, with a very well planned network marketing quality wines, is for Romania and for each vineyard in part challenge and a very difficult barrier to pass. The sustainable development strategy of Romanian viticulture, HORIZON 2014, niche which can penetrate in this quality system almost perfect, represent wines from Romanian traditional varieties made from varieties and clones with known traceability and authorized, free of major viruses and fitoplasme.

To achieve the above objectives, I.N.C.D.B.H. Stefanesti was concerned with the selection and approval of valuable clones of Romanian traditional varieties grown in the vineyard and some clones of foreign varieties, to mark as a new step in the range of varieties that will extend the culture in Stafanesti vineyard. Thus, recently were selected and approved clones Feteasca Alba 97 St., Feteasca regala 72 St., Pinot gris 16 St., Sauvignon 111 St., Muscat Ottonel 10 St. for white wines and Feteasca neagra 6 St., Pinot noir 3 St for red wines. The clones Feteasca regala 72 St., Feteasca alba 97 St., Feteasca neagra 6 St., obtained from traditional Romanian varieties make subject paper listed below.

MATERIAL AND METHODS

Achieving adequate quality demands was a complex objective for all clones obtained, objective inseparable from the achievement of higher productivity indexes. It expresses the nutritional value of grapes, which is determined by content into useful substances: sugar, acidity, aromatic substances, etc., and their organoleptic characteristics harmony and it is, complex genotypic assimilation, variable less influenced by environmental factors (Cazaceanu I. et al., 1982).

As a source of vineyard germplasm to obtain clones were used production vineyards of INCDBH Stefanesti - Arges located in Goleasca and Valeni farms, located on slopes with southern exposition, south-eastern and south-west with a complex soils formed of eutricambisol, typical preluvisol and antrosol.

As a method of improvement for obtaining clones was used clonal selection, which consisted of careful observation over 2-3 years and retain for breeding plants with useful characters desired, multiplied and introduced in the comparative fields of breeding and control. In parallel, candidate clones were subjected to sanitary selection by virologic testing at the major viruses and the healthy have been introduced in insulator nucleus stock. Infected plants were subjected to virus release by thermotherapy and retested. Multiplied propagation material, free of viruses, was introduced in plot verification (field testing of clones) from which, after a comparative study of three years, was chosen final clone which was proposed for homologation in the production and propagation.

Examination methods of quality traits, which shows the specific features depending on the product and its use direction, have resulted in laboratory thorough determinations (mechanical analysis in grapes and chemical analysis in wines), specified in the tables below.

For each clone homologated, was prepared ampelographic and culture sheet where was specified: genealogy, morphological characters, agrobiological and technological characters, main biological events in a certain period of time, main qualities.

At wines obtained by microvinification assessment was made by organoleptic tasting.

RESULTS AND DISSCUTION

From Romanian traditional varieties found in Stefanesti vineyard assortment, for quality white wines were created clones Feteasca alba 97 St. and Feteasca regala 72 St., and for quality red wine was created clone Feteasca neagra 6 St., quantitatively and qualitatively superior clones as described below and the analysis of Tables 1-6.

Characterization of clone Fetească regală 72 St. (Table 1, Table 2**)**

Genealogy. It was obtained by clonal selection of the variety Feteasca regala at I.N.C.D.B.H. Stefanesti and homologated in 2008.

Morphological characters. Adult leaf is medium sized, three-lobed, green-metallic. Grapes are medium-sized (165 g), cylindrical-conical shape, wings. Grape berries is middle-ball (1.8 to 2.0 g), green-yellow, slightly rimed, with obvious point pistilar. The flesh is juicy consistency, with specify taste and aroma.

Agrobiological and technology characterization. Hub vigor is medium. Clone is characterized by high fertility, with fertility coefficient values from 1.70 to 1.86 (C.f.a.) and 1.50 to 1.60 (C.f.r.); clone productivity is high, IPA with values: 250-295 and I.p.r. 235-255. Are obtained 3.0-3.5 kg/hub and 13-16 t/ha.

Ripening grapes, in normal temperature, occurs in the VII age. Accumulate 185-200 g/l sugars and 3.6-4.3 g/l H_2SO_4 acidity. It is used in obtaining DOC wines.

Main phenological phases: starting in vegetation at 10-13.04, blooming into 20-30.05, beginning of ripening grapes 28.07-10.08, full maturity between 10-20.09.

Qualities: - Good resistance at Plasmopara viticola, powdery mildew disease and frost.
- The wood is mature well.
- Is a very productive clone.

Organoleptic apreciation of the wines produced by microvinification

Fetească Regală 72 St. is yellow-green wine, slightly, moderately alcoholic and with a moderately containing in extract, from his personality also helps his acidity easily perceptible. Perfume and flavor, shaped by refinement, suggesting those of honey and hay.

Characterization of clone Feteasca alba 97 St. (Table 3, Table 4**)**

Genealogy. It was obtained by clonal selection of the variety Feteasca alba at I.N.C.D.B.H. Stefanesti and homologated in 2008.

Morphological characters. Leaf is of medium size, five lobed, without hairs and smooth, green light, with petiolar sinus wide open (as bracket). Grapes is cylindrical, uniaxial, mid-sized, 100-120g. Grape berries is spherical, yellow-ruddy, small-medium size (1.3 to 1.5 g), with apparently pistilar point. Flesh is juicy, unflavoured.

Agrobiological and technological characterization. It is a clone with great force. In normal conditions shows a medium tolerance to frost and some fungal diseases (Plasmopara viticola and Botrytis cinerea). Shoots fertility is high (80%) and coefficients of fertility shows values from 1.6 to 1.8 (C.f.a.) and 1.30 to 1.40 (C.f.r.). Productivity indices have values between 180-195 (I.p.a) and 145-160 (I.p.r.). Grape maturation occurs in the V age (September 15 – October 1) in terms of vineyard Stefanesti. Accumulate large amounts of sugars in the must (200-210 g/l), is recommended for obtaining high quality wine. Acidity that register is between 3.0 to 4.0 g/l H_2SO_4. Grape production on the hub, in normal years, reached 4 kg/hub and 14 to 18 tonnes per hectare.

Main phenological phases: starting in vegetation at 8-13.04, blooming into 20-25.05, beginning of ripening grapes 26.07-1.08, full maturity between 10-20.09.

Qualities: - The wood is mature well.

- Is a very productive clone.
- Big grapes.

Organoleptic apreciation of the wines produced by microvinification (Table 4)
Feteasca alba 97 St. has a wine yellow with a green reflections, with a fragrance like vine flowers and a flavor that reminds of a mixture of banana with honey. Wine is entitled to a designation of origin, because it is reflected by the specific vineyard.

Characterization of clone Fetească neagră 6 St. (Table 5, Table 6**)**

Genealogy. It was obtained by clonal selection of the variety Feteasca neagra at I.N.C.D.B.H. Stefanesti and homologated in 2008.

Morphological characters. Mature leaf is wedge-shaped, with terminal lobe spearhead-shaped, light green, without hairs, large or medium, with five lobes. Grapes have cylindrical-conical shape, with two wings, is compact, and are medium to large size with an average weight of 180-220 g. Grape have spherical shape, medium size from 1.6 to 1.8 g, pyelitis is black purple, heavily rimed and the flesh is juicy.

Agrobiological and technological characterization. The hub has a large force, with medium vegetation period, 180-200 days. Shows a medium resistance to cryptogamic diseases. Fertility coefficients, absolute and relative values register between 1.10 to 1.50, CFA and 0.6 to 1.3, c.f.r. Productivity indices fit between values: 180 - 220 for i.p.a. and 100-140 for i.p.r.. Ripening grapes is relatively early, 10 - 20 September. The average fit between 2.2 to 4.0 kg/block and reach 16 tonnes per hectare favorable years. Concentration must be high in sugar, averaging 210-240 g/l, and acidity from 2.3 to 3.5 g/L H_2SO_4.

Main phenological phases: starting in vegetation at 10-15.04, blooming into 25-30.06, beginning of ripening grapes 15-20.07, full maturity between 15-25.09.

Qualities: - Increased ability to supramaturare.

- Big grapes.
- Show high tolerance to frost.
- Are obtained high quality wines from D.O.C. and D.O.C.C. category.

Organoleptic apreciation of the wines produced by microvinification

Fetească Neagră 6 St. is the wine which he managed to gather all the best of variety and from ecologico-geographical conditions of the vineyard. It has a garnet red robe, clear and bright. Parfume and flavor gives an authentic floral note. Well established, pleasant and enough corpulent, the wine is delicious and attractive.

CONCLUSIONS

From assortment of the Romanian traditional varieties at I.N.C.D.B.H. Stefanesti were created clones Feteasca regala 72 St., Feteasca alba 97 St. for quality white wines, and Feteasca neagra 6 St. for quality red wines.This clones are quantitatively and qualitatively superior to varieties of which were created. Feteasca regala 72 St. clone differs from mother variety by higher accumulation in sugars, 200-210g /l in favorable years. Fetească albă 97 St. is a clone distinguished by a higher yield in must in consequence of realization of higher productivity indexes and by wines moore extractive. Feteasca neagra 6 St. clone is distinguished by an early starting in the vegetation, by higher accumulation in sugar, a higer efficienty and a more pronounced intensity coloring.

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TABLES

Table 1

Mechanical analysis of grape at variety Fetească regală (Mt) and clone Fetească regală 72 Şt.

No.	Mechanical characteristics of grapes	Fetească regală (Mt)	Fetească regală 72 Şt.
1	Number of clusters	7	8
2	Clusters weight ((g)	29,5	40
3	Healthy grain weight (g)	668	661
4	Healthy berries weight (g)	950	960
5	Must - volume (ml)	650	700
6	Must - weight (g)	810	760
7	Marc Weight (g)	135	135
8	100 berries weight (g)	183	200
9	Peel weight (g)	10,5	14
10	Number seeds	148	195
11	Seed weight (g)	4,5	6

Table 2

The main physicochemical characteristics of the wine of the variety Fetească regală (Mt) and clone Fetească regală 72 Şt.

No.	Variety/ Clone	Alcohol% vol	Total acidity g/l AT	Reduce extract content	Sugar g/l	Free SO_2/ total	pH	I.C/ T
1	Fetească regală (Mt)	12,2	5,5	19,1	-	5/53	3,25	-
2	Fetească regală 72 Şt.	13,2	5,5	19,1	1,7	6/53	3,29	-

Table 3

Mechanical analysis of grape at variety Fetească albă (Mt) and clone Fetească albă 97 Şt.

No	Mechanical characteristics of grapes	Feteasca alba (Mt)	Feteasca alba 97 Şt.
1	Number of clusters	5	11
2	Clusters weight ((g)	30	41
3	Healthy grain weight (g)	682	808
4	Healthy berries weight (g)	910	940
5	Must - volume (ml)	600	670
6	Must - weight (g)	580	780
7	Marc Weight (g)	140	160
8	100 berries weight (g)	106	126
9	Peel weight (g)	35	14
10	Number seeds	236	171
11	Seed weight (g)	6,5	4,5
12	Anthocyanins	-	-

Table 4

The main physicochemical characteristics of the wine of the variety Fetească albă (Mt) and clone Fetească albă 97 Şt.

No	Variety/ Clone	Alcohol % vol	Total acidity g/l AT	Reduce extract content	Sugar g/l	Free SO_2/ total	pH	I.C/T
1	Fetească albă (Mt)	12,6	4,5	21,4	24,5	9/64	3,97	-
2	Fetească albă 97 Şt.	13,2	4,6	21,75	22,4	5/63	3,46	-

Table 5

Mechanical analysis of grape at variety Feteasca neagra (Mt) and clone Fetească neagră 6 Şt.

No	Mechanical characteristics of grapes	Fetească neagră (Mt)	Fetească neagră 6 Şt.
1	Number of clusters	3	5
2	Clusters weight ((g)	30	32
3	Healthy grain weight (g)	770	777
4	Healthy berries weight (g)	945	960
5	Must - volume (ml)	630	660
6	Must - weight (g)	690	710
7	Marc Weight (g)	160	160
8	100 berries weight (g)	161	213
9	Peel weight (g)	15	12
10	Number seeds	207	175
11	Seed weight (g)	10	7
12	Anthocyanins	1152,6	1380

Table 6

The main physicochemical characteristics of the wine of the variety Feteasca neagra (Mt) and clone Fetească neagră 6 Şt

No	Variety/ Clone	Alcohol % vol	Total acidity g/l AT	Reduce extract content	Sugar g/l	Free SO_2/ total	pH	I.C/T
1	Fetească albă (Mt)	15,6	4,8	25,5	3,0	10/42	4,15	3,96/ 1,09
2	Fetească albă 97 Şt.	16,2	5,0	26,0	2,7	9/39	3,38	4,81/ 1,11

Effect of spraying of *Thompson Seedless* grapevines with hydrogen cyanamide on morphological, biochemical characteristics and mealybug (*Planoccocus ficus)* control

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Keywords: table grapes; subtropical conditions; hydrogen cyanamide

ABSTRACT

Hydrogen cyanamide at 0, 2, 3 and 5% concentration was applied on *Thompson Seedless* grapevines planted at 2 x 2 meter in loamy clay soil on 1, 8 and 15 January. Application with Dormex increased weight of pruning weight kg/vine, while total carbohydrate of canes, meanwhile increased percentage of fruiting buds and yield. All treatments hydrogen cyanamide decreased number of mealy bug on canes. The best results were achieved with 5% in first January.

INTRODUCTION

Botanically, grapevines belong to the genus *Vitis,* in under the family *Vitaceae*, which includes more than 60 species; most of them are used in ornamental purposes and the little produces edible fruits. Grape fruits characterize with the high nutritional value and could be consumed fresh as table grapes, dried to be raisins while the juice may be used in fresh pasteurized form or be fermented to make wine (El-Kassas et al., 1998).

In this respect, spraying hydrogen cyanamide (Dormex) has been used to induce leaf and flower bud break on many deciduous fruit crops around the world in the regions with tropical and subtropical climate. It has been used on fruit crops to replace inadequate or lack of chilling and stimulate uniform bud break. Physiologically, Dormex acts as a plant growth regulator to force the plant to break its dormancy. Dormex causes bud scale removal, terminates rest in grapevines growth, yield and advances maturity (Omran, 2000).

Dormant buds of most deciduous fruit tree species must under go a period of low temperature which is termed the chilling requirement which varies considerably between plant species (Zelleke and Kliewer, 1989).

MATERIALS AND METHODS

This study was executed in 2007 and 2008 seasons on 15 years old *Thompson Seedless* grapevines in a private vineyard in clay soil at El Gharabya Governorate, Egypt. Planted at 2 x 2 meters and head training system was studying the effect of different concentration of the commercial compound (49% hydrogen cyanamide).

The main objectives of the investigation was studying the effects of different concentration of the commercial compound (49% hydrogen cyanamide) applied at different spraying dates yield and fruit quality in terms of berry physical properties and juice chemical constituents on the vines of the studied cultivar. One sixty two *Thompson Seedless* grapevines were chosen as uniform in vigor as possible and devoted to carry out this investigation.

The chosen vines were pruned during the last week of December 2006 and 2007 in the first and second seasons, respectively to leave 60 buds per vines (20 fruiting spurs x 3 buds/ spur) and the suitable replacement spure (2 buds each) were left.

The experiment was set in a complete randomized block design in a split – plot. All vines of the experiment sprayed with 2, 3 and 5% hydrogen cyanamide at first, second and third week of January. Carbohydrate content of canes was estimated during dormant seasons; percentage of bud burst was recorded. At harvest the yield was determined per vine.

In order to study the effects of the treatments of Dormex and different natural compounds on the grape mealybug (*Planococcus ficus*) there were used the following chemicals:
-mineral oil: Masrona oil miscible type, containing 95% paraffinic oil w/w and 5% inert ingredients, unsulfonated residue content reached 92%;
-sulphur (micronized 85% WP);
-Dormex 49% used alone or combined with the previous compounds.
All data were statistically analyzed according to the equation of Henderson and Tilton (1955).

RESULTS AND DISCUSSION

Morphological and biochemical studies

The pruning weight

Concerning the effect of Dormex concentration on pruning weight, the results illustrated in table 1 showed that H_2CN_2 applied at any concentration ranged from 2% to 5%, greatly and significantly increased the valued the weight of pruning in comparison with the control treatment in 2007 and 2008 seasons. Moreover, weight of pruning in *Thompson Seedless* grapevine was increased in proportion to the increase in the applied concentration to reach its highest values with the concentration of 5% in the three experimental seasons. These data are in agreement with El-Sabrout and Sourial et al (1998) on Flame Seedless grapevines, Abd-Elghany et al (2001) on *Thompson Seedless* grapes. They all revealed that, spraying hydrogen cyanamide on grapevines increased the weight of pruning compared to the control.

Carbohydrate content of canes.

The results revealed that the percentage of carbohydrate content of the canes increase with increasing the H_2CN_2 concentration from 0.0% to 5%. This tendency of increment of the carbohydrate content from canes according as the increment of the hydrogen cyanamide concentration that was used on the three moments of application (January 1^{st}, 8^{th} and 15^{th}) Similar results were reported under warm subtropical conditions, by Zanthy et al. (1996) on grapevine, El-Sabrout (1998) on *Flame Seedless* grapevines and Abd-Elghany et al (2001) worked on *Thompson Seedless* grapes, Omran et al. (2005). They all found that, spraying hydrogen cyanamide on grapevines increased carbohydrate content of canes compared to the control.

The percentage of fruit set

These results may be attributed to the enhancement effect of hydrogen cyanamide sprayed on bud break. Such results are in agreement with these obtained by Cheema et al. (1990) on *Thompson Seedless* grapevines, Amed et al. (1995b) on *Roomy Red* grapevines, Turkey et al. (1996) on *Romi Red* grapevines. They found that, sprayed deciduous fruit trees with bud break chemical agents markedly increased fruit set percentage.

Yield

This explanation seemed to be reasonable since the yield per vine by weight is a result of multiplying the number of bunches by their average weight. The variation between all treatments in seasons was in harmony with those obtained by Gomaa-Stino (1990), Esmail et al. (2006) working on figs, Dejeu and Rafik (2008) on *Thompson Seedless* grapevines.

Effect of spraying hydrogen cyanamide treatments on mealybug (*Planococcus ficus)*

Finally can be concluded that the combination between Dormex + oil or micronized sulphur gave the two purpose firstly controlling the mealybug before migration to the grapevine roots and breaks vine bud dormancy, it can advance bud break up to three weeks, that is not a problem in the desert.

CONCLUSIONS

Concerning the morfological and biochemical studies, there were obtained a significant increase of the weight of pruning by used hydrogen cyanamide on vines. The highest values (552 g/vine in 2007 and 553 g/vine in 2008), comparatively with the control (331 g/vine in 2007 and 442 g/vine in 2008) were obtained when Dormex was used at 5 % concentration at 1 January. When applying treatments in the second and third week of January, pruning weight was increased (694 -1297 g/) in all two experimental years.

The percentage of total carbohydrates in the canes increase with increasing the H_2CN_2 from 0.0 % (control) to 5 %. After utilization of treatment with hydrogen cyanamide there were obtained, in every 3 experimental years, significant higher values, comparatively with the control. The highest values were obtained as a result of application of the 5 % concentration of hydrogen cyanamide, in every year on January 1st (14.9, 14.9 and 14.6 %).

In case of H_2CN_2 treatments, the bud break was anticipated with 2 weeks, comparatively with the control. In the same time, the percentage of bud break was increased with increasing the H_2CN_2 concentration from 0.0 (control - 57.8 – 61.2 %) to 5 % (80.2 - 81.3 % in 2006; 76.5 -77.6 % in 2007 and 81.5 - 83.7 % in 2008.

The mixture of mineral oil, or micronized sulphur + Dormex is useful for controlling the mealybug *(Planococcus ficus)* before migration to the grapevine roots and breaks vine bud dormancy.

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TABLES

Table 1

Effect of hydrogen cyanamide on pruning weight, carbohydrate content, percentage of fruit set and yields of *Thompson Seedless* grapevine during 2007 and 2008 seasons

Date of spraying	Dormex conc.(%)	Pruning weight (g/vine)	Carbohydrate content (%)	Percentage of fruit set (%)	Yield (kg/vine)
1/01/2007	0	331.7	13.9	26.5	6.20
	2	337.8	14.1	41.6	9.25
	3	402.8	14.5	42.3	9.70
	5	552.8	14.9	44.7	9.85
	F =	4.21	14.58	-	14.58
	LSD 0.05=	45.78	0.78	-	0.03
8/01/2007	0	331.7	13.9	26.5	620
	2	744.4	14.0	39.8	9.10
	3	769.4	14.4	40.8	9.25
	5	919.4	14.8	43.1	9.60
	F =	29.03	16.24	-	36.26
	LSD 0.05=	51.27	0.14	-	0.08
15/01/2007	0	331.7	13.9	26.5	620
	2	1122.2	13.9	39.0	8.95
	3	1147.2	14.1	39.7	910
	5	1297.2	14.5	42.7	930
	F =	1.71	17.58	2148	11.58
	LSD 0.05=	210.80	0.07	3.48	0.03
1/01/2008	0	422.3	13.6	40.4	7.85
	2	452.8	14.0	45.3	1150
	3	452.8	14.4	45.9	11.85
	5	552.8	14.6	49.0	12.00
	F =	4.94	12.51	-	25.48
	LSD 0.05=	124.28	0.08	-	0.05
8/01/2008	0	422.3	13.6	40.4	7.85
	2	819.4	14.0	44.7	11.45
	3	844.4	14.2	45.0	11.50
	5	919.4	14.5	47.8	11.75
	F =	14.75	26.59	-	25.89
	LSD 0.05=	51.27	0.25	-	0.16
15/01/2008	0	422.3	13.6	40.4	7.85
	2	1197.2	13.9	43.2	11.20
	3	1247.2	14.0	44.2	1145
	5	1297.2	14.2	46.5	11.60
	F =	0.75	33.14	16.59	2.15
	LSD 0.05=	-	0.89	4.51	0.65

Table 2a
Effect of some natural compounds combined with Dormex on grape mealybug, *Planococcus ficus*/trunk during 2007

Treatment	Rate of application	Pre-spraying counts		Post-spraying counts/trunk					
				1st week		2nd week		3rd week	
		A	N	A	N	A	N	A	N
Oil + Dormex	15 + 2 ml/l.	386	455	163	109	175	115	181[c]	129[b]
Sulphur + Dormex	2.5 gm + 2 ml/l.	379	489	176	123	184	134	192[b]	142[b]
Oil + Dormex + Sulphur	15 + 2ml + 2 g/l.	391	454	72	31	79	39	83[d]	44[c]
Control	-	401	502	412	523	424	534	435[a]	538[a]
F								689.3 ***	265.7 ***
LSD								5.88	13.96

Treatment	Rate of application	% reduction of insect and parasitoids at different intervals					
		1st week		2nd week		3rd week	
		A	N	A	N	A	N
Oil + Dormex	15 + 2 ml/l.	58.90	77.01	57.12	76.24	57.33	73.55
Sulphur + Dormex	2.5 g + 2 ml/l.	54.80	75.86	54.08	74.24	53.30	72.90
Oil + Dormex + Sulphur	15 + 2ml + 2 g/l.	82.08	93.45	80.89	91.92	80.43	90.97

A = Adults **N = Nymphs**

Table 2b
Effect of some natural compounds combined with Dormex on grape mealybug, *Planococcus ficus*/trunk during 2008

Treatment	Rate of application	Pre-spraying counts		Post-spraying counts/trunk					
				1st week		2nd week		3rd week	
		A	N	A	N	A	N	A	N
Oil + Dormex	15 + 2 ml/l.	311	410	155	88	163	91	172[b]	98[c]
Sulphur + Dormex	2.5 g + 2 ml/l.	321	434	151	92	156	95	163[c]	101[b]
Oil + Dormex + Sulphur	15 + 2ml + 2 g/l.	323	421	42	34	51	39	56[d]	41[d]
Control	-	395	499	402	511	422	522	429[a]	528 [a]
F								872.1 ***	556.3 ***
LSD								5.52	9.62

Treatment	Rate of application	% reduction of insect and parasitoids at different intervals					
		1st week		2nd week		3rd week	
		A	N	A	N	A	N
Oil + Dormex	15 + 2 ml/l.	51.03	79.04	50.94	78.33	48.23	77.15
Sulphur + Dormex	2.5 g + 2 ml/l.	53.78	79.29	54.51	78.62	52.47	77.75
Oil + Dormex + Sulphur	15 + 2ml + 2 g/l.	87.22	92.11	85.22	90.95	83.77	90.69

A = Adults **N = Nymphs**

Boron application efficiency on horticultural plants on sandy soils in South Oltenia

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Keywords: fertilization, watermelons, peaches, vineyard

ABSTRACT

Additional fertilization with boron-based products contributes to the production and income increases in horticultural plants on sandy soils. In watermelons additional fertilization of boron-based products resulted in a level of profit of 8460 lei/ha and 9910 lei/ha, as against with the control variant, which was fertilized only before planting, and where the profit level was 7876 lei/ha. In the case of the peach culture, using the boron - based fertilizer, determined to achieve a level of profit between 2160 lei/ha and 4360 lei/ha, as compared with 2773 lei/obtained in the case of the foliar unfertilized variant. Vineyard crops with foliar fertilization of boron-based products at two times, contributed to an obtained profit between 431 lei/ha in variant treated with Cupribor, 5 l/ha and 1162 lei/ha in variant treated with boron complex 5 l/ha. Increased foliar treatments number to four moments determined a profit of 1182 lei/ha at variant treated with Folibor standard 5 l/ha, and 1619 lei/ha in variant treated with boron complex 5 l/ha.

INTRODUCTION

Economic efficiency requires finding ways to maximize the production of goods and services.

Production of goods is considered economically efficient when the goods are produced at the lowest possible price (Sullivan and Stevens, 2003).

Proper use of any material resources must bear in mind the principle that a resource is used rationally when using it to obtain an output at least equal value with the unit of resource expenditure applied (Baghinschi, 1979, Nica et al., 1983).

Horticultural plants culture is profitable on sandy soils providing establishment and maintenance of the properly developed technologies (Bushel, in 1983, George et al., 2009, Rato et al., 2009, Thomas, 2001).

In order to determine the profitability of boron fertilizers there were established watermelons, peaches and vineyard culture experiments.

MATERIALS AND METHODS

Experimentation was performed at CCDCPN Dăbuleni, during the period 2005-2006. Three products based on natural organic compounds of boron there were used: Folibor standard, Cupribor and Bor complex, which were applied by spraying the plant. Two and four foliar treatments have been applied. The obtained results have been compared with a foliar unfertilized variant. In all variants the basic fertilization was carried out uniformly, with N 150, P_2O_5 100 and K_2O 100.

Experimental variants were as follows:

V1- Control, foliar unfertilized
V2- Folibor standard, 5 l/ha, 2 treatments
V3- Folibor standard, 5 l/ha, 4 treatments
V4- Cupribor, 5l/ha, 2 treatments
V5- Cupribor, 5l/ha, 4 treatments
V6- Bor complex, 5l/ha, 2 treatments
V7- Bor complex, 5l/ha, 4 treatments

Experiences were set in randomized blocks with four repetitions.

Watermelons – Dulce Dabuleni variety grown by sowing directly in the field, on an area of 720 m^2. Experimental plot area was 18 m^2.

Moments of the foliar fertilizers application:
- treatment I at early haulm formation;
- treatment II- 10 days after the first treatment;
- treatment III- 10 days after the second treatment;
- treatment IV-10 days after the third treatment.

The amount of solution: 600 l/ha.

The basic fertilization was done uniformly with N 100 P 80 K 80.

Peach experimental plot area was 37.5 m^2 and the experience area was 1200 m^2.

Moments of the foliar fertilizers application:
- treatment I at the early intensive growth of shoots;
- treatment II- 14 days after the first treatment;
- treatment III- 15 days after the second treatment;
- treatment IV- 15 days after the third treatment.

Redhaven variety was used.

The basic fertilization was done uniformly with manure - 30 t/ha+ N 100 P 40 K 40.

Vineyard experience was done on Rosioara variety and the experience area was 1440 m^2. Experimental plot area was 45 m^2.

Moments of the foliar fertilizers application:
- treatment I, prior to flowering phase beginning;
- treatment II- after the flowering phase end;
- treatment III- 15 days after the second treatment;
- treatment IV- 15 days after the third treatment.

The basic fertilization was done uniformly with N 100 P 40 K 40.

Determinations regarding the main production have been carried out for all species.

RESULTS AND DISCUSSION

Watermelons culture is one of the most profitable crops for the sandy soil area of our country (Table 1). Fertilization based on boron assures large production increases, costs with fertilization contribute to profit increased.

Expenditure level for 1 ha watermelons culture established by using planting stock and using high productivity hybrids was 6974 lei/ha in the case of the control variant, foliar unfertilized. Boron fertilization from natural fertilizer complex (Folibor) is an effective technological work in both organic and mineral unfertilized crops, especially when boron is applied to the crops which are provided with a rich mineral and organic agro fond.

By applying foliar fertilizer with boron the level of expenditure rose to levels of 7380 lei/ha and 7790 respectively lei/ha in function of the foliar treatments number. Additionally boron-based foliar fertilization increased the production level from 49.5 t/ha, for the control variant, foliar unfertilized to 59 t/ha in variant fertilized with boron complex 5 l/ha, four treatments.

Proportional with watermelons production, income levels have also increased and determined increase profitability up to the level of 8460 lei/ha and 9910 lei/ha, compared with the control, fertilized only at the root system level, where the profit was 7876 lei/ha. Rate of profit achieved at the control was 112.9%, and at variants additional fertilized with boron based products recorded values from 114.6% to 127.2% in the variant fertilized with boron complex 5 l/ha, 4 treatments. Cost was relatively similar varying between 132.03 lei/t in the variant fertilized with boron complex 5 l/ha, four treatments and 140.88 Euro/t in the control variant.

Peach crops, additional foliar fertilization with boron-based products, have contributed to increasing fruit production and increase profit per unit area (Table 2).

Production growth was up to 2.7 t/ha as against to the variant fertilized only at the root system and income levels increased from 11 400 lei/ha in control variant to 12 720 - 14 640 lei/ha in fertilized variants with foliar boron based products.

Although it was also profitable the only root fertilized variant (2773 lei/ha), the profit level increased to 4360 lei/ha in variant fertilized with boron complex 5 l/ha, four treatments, achieving a profit rate of 42 4%. Even if the variant fertilized with Cupribor, 5 l/ha, two treatments, income level was relatively lower, it was realized a profit rate of 44.4% due to lower costs per unit area. The greatest value of profit of 4360 euro/ha was achieved in the variant fertilized with Folibor standard 5 l/ha, four treatments.

Vineyard crops with foliar fertilization of boron-based products contributed to achieving profitable grape production (Table 3).

In the case of the variants based on two foliar applied treatments the obtained profit ranged between 431 lei with a profit rate of 9.3% in variant treated with Cupribor, 5 l/ha and 1162 lei, with a profit rate of 25% when has been used Boron complex, 5 l/ha. In the case of the variants based on four foliar treatments the realized profit was 1182 lei, with a profit rate of 26.1% in the Folibor standard variant treated with 5 l/ha, and 1619 lei, with a profit rate of 32.9% when Boron complex, 5 l/ha has been used.

CONCLUSIONS

1. Fertilization with boron-based fertilizers has contributed to the high production levels and a higher or lower profit depending on which culture it was performed.
2. At watermelons the increase of income level considerably increased the profit of 8460 lei/ha and 9910 lei/ha, compared with the control, fertilized only at the root system level, where the profit was 7876 lei/ha.
3. Peach crops, additional foliar fertilization with boron-based products, revenues have increased the profit level of 8460 lei/ha and 9910 lei/ha, compared with version control, fertilized only root, where the profit was 7876 lei/ha.
4. Vineyard crops foliar fertilization with boron-based products at two times determined the yield ranging between 431 lei, with a profit rate of 9.3% in variant treated with Cupribor, 5 l/ha and 1162 lei with a profit rate of 25% when it has been used Boron complex, 5 l/ha. In the case of four foliar treatments the obtained profit was 1182 lei, with a profit rate of 26.1% in the Folibor standard treated variant with 5 l/ha, and 1619 lei, with a profit rate of 32.9% when it has been used Boron complex, 5 l/ha.

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TABLES

Table 1

Economic efficiency of foliar fertilization with natural organic boron-based products of watermelons culture

Variant	Yield (t/ha)	Production costs (lei /ha)	Income (lei/ha)	Profit (lei/ha)	Profit rate (%)	Cost price (lei/t)
Control, foliar unfertilized	49.5	6974	14850	7876	112.9	140.88
Folibor Standard, 5 l/ha, 2 treatments	53.5	7380	16050	8670	117.4	137.94
Folibor Standard, 5 l/ha, 4 treatments	58.7	7790	17610	9820	126.0	133.12
Cupribor, 5 l/ha, 2 treatments	52.8	7380	15840	8460	114.6	139.77
Cupribor, 5 l/ha, 4 treatments	58.5	7790	17550	9760	125.3	133.16
Bor Complex, 5 l/ha, 2 treatments	55.3	7380	16590	9210	124.5	133.45
Bor Complex, 5 l/ha, 4 treatments	59.0	7790	17700	9910	127.2	132.03

Table 2

Economic efficiency of foliar fertilization with natural organic boron-based products of peach culture

Variant	Fruits yield (Kg/ha)	Production costs (lei /ha)	Income (lei/ha)	Profit (lei ha)	Profit rate (%)	Cost price (lei/t)
Control, foliar unfertilized	9500	8627	11400	2773	32,1	908,10
Folibor Standard, 5 l/ha, 2 treatments	10600	8970	12720	3750	41,8	846,20
Folibor Standard, 5 l/ha, 4 treatments	12200	10280	14640	4360	42,4	842,60
Cupribor, 5 l/ha, 2 treatments	10800	8970	12960	2160	44,4	830,55
Cupribor, 5 l/ha, 4 treatments	10900	10280	13080	2800	27,2	943,11
Bor Complex, 5 l/ha, 2 treatments	11000	8970	13200	4230	47,1	815,45
Bor Complex, 5 l/ha, 4 treatments	11500	10280	14160	3880	37,7	893,91

Table 3

Economic efficiency of foliar fertilization with natural organic boron-based products of vineyard

Variant	Grape yield Kg/ha	Production costs (lei/ha)	Income (lei/ha)	Profit (lei/ha)	Profit rate (%)	Cost price (lei/t)
Control, foliar unfertilized	5260	4050	4208	158	3,9	770
Folibor Standard, 5 l/ha, 2 treatments	6116	4350	4893	563	13,0	710
Folibor Standard, 5 l/ha, 4 treatments	7265	4530	5812	1182	26,1	620
Cupribor, 5 l/ha, 2 treatments	6339	4640	5071	431	9,3	730
Cupribor, 5 l/ha, 4 treatments	8044	4920	6435	1515	30,8	610
Bor Complex, 5 l/ha, 2 treatments	7253	4640	5802	1162	25,0	640
Bor Complex, 5 l/ha, 4 treatments	8174	4920	6539	1619	32,9	600

Qualitative and quantitative performances of some table grape varieties when applying a different of buds/vine

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Key words*:* vineyard, climatical index, table grape varietes, precocity, carpometric parameters

ABSTRACT

Table grape varieties with their characteristics of quality, impressive variability, genetic diversity, appreciation and popularity is very known, offering new ways of study the scientific and practical research. The present study represent a comparative analysis regarding the behavior of some table grapes varieties with different maturation periods, from global range and also Romanian creations – Victoria, Muscat D'Adda, Afuz Ali, Xenia, raised in ecopedoclimatic conditions registred under the vineyard Ostrov, situated in viticultural region Danube Terraces. The experience is concerning the application of different loads of buds/vine and they were made detailed observations and determinations, regarding the agrobiological and technology reaction, but in particular, the production was evaluated in terms of physical and chemical characteristics of grape harvest for marketing. Eco-climatic conditions of Ostrov viticultural center demonstrated that they are very favourables for table grapes varieties growing and they are defining the maximum for grapes maturation precocity, impressing them a plus of organoleptic quality; these conditions are not founded in other viticultural region of our country.

INTRODUCTION

Generally, when we talk about table grapes quality we associate it with grain size and color, but in reality is a complex term, defined from several perspectives: visual, taste, nutrition, health, etc.., measured by the consumer, according to his claims, and if it comes to favorability of a growing area, then it should provide an annual repetitivity regarding product quality. The appreciation and popularity enjoyed by the studied varieties determine the necessity to study and pursue their reactions, leading to new possibilities in ampelographic scientific research by diverse quality production recorded every viticultural year, always surprising. Starting from this consideration, the present study was made to establish if the application of differential loads buds/vine results in an improvement of grape quality both in terms under carpometric characteristics and also under physique – chemical terms.

MATERIAL AND METHODS

To achieve the objective outlined above, the research was conducted in 2008/2009 wine growing year, in an experimental field of Ostrov Vineyard. Varieties subject to these investigations are - Muscat d 'Adda, Afuz ali– from global range and Romanian selections - Victoria, Xenia - varieties highly valued by consumers in terms of visual and taste characteristics. During the experience has been applied a differential load of bud that led to obtaining the following experimental variants (Table 1) with the main aim of determining the optimal number of buts/vine that leads to some great commercial quality grapes.

Varieties were followed throughout the phenological spectrum and at harvest, were made, on a medium sample, the following carpometrical determinations and physico-chemical characteristics: percentage of viable buds/vine (%), percentage of fertile shoots (%),absolute coefficient of fertility, absolute index of productivity (g/shoots), no. grape/vine, the average weight of a grape, the average weight of a grain, production/vine (kg/vine), sugars (g/l), acidity (g/l tartric acid). The obtained results in case of carpometrical parameters were analyzed using one-dimensional indicators- arithmetic mean, maximum, minimum - indicators that can be applied for most quantitative characters, which have the property to be variable in time and space. Those, by their nature, characterize these traits in terms of their level of development (size, number) as well as their frequency of occurrence and trends in the values with typical character for the entire table of values under study.

RESULTS AND DISCUSSIONS

To appreciate the results obtained by these varieties under the conditions of vineyard Centre Ostrov, it is necessary to emphasize that the center enjoys a warm temperate climate, a large amount of solar radiation and high heliothermic resources in conditions of poor rainfall regime, providing conditions very favorable for growth and fructification, on one hand, and secondly, to obtain annual production with high commercial value, regardless of age maturing varieties grown here. Findings eco-climatic favorability of the area for growing grapes varieties is detailed in Table 2 (* Savu, 2004) as part of the Growing Region of the Danube Terraces, which no longer reflect these conditions in other regions of our country.

Application at cutting of a different load of buds/vine at the four studied varieties, lead to a difference of their behavior regarding the aspect of fertility and productivity elements, but also the quality and quantity performances of production, and for being easier the evaluation of the results obtained, data analysis was done for each variety individually analyzing all the carpometric parameters:

Analizing Table 3 we can see that Victoria and Xenia varieties obtained the higest values of viable buds percentage for a load of 10 buds/m^2, the Muscat d'Adda variety has the maximum value for a load of 13 buds/m^2 (34 buds/vine) and Afuz ali variety obtained a maximum of this index for a lod of 16 buds/m^2 (49 buds/vine). The percentage of fertile shoots vary very little, being practical a variety caracteristic, observing that the first three analized varieties obtaine the higest value for a load of 13 buds/m^2 and Xenia variety register the higest value for a lod of 10 buds/m^2, meaning 83.06%, followed decreasing by the other applied load of buds. The values of absolute coeficient of fertility for the four varieties is very constant and approached, registering values which does not exceed the normal limits of it. Regarding the productivity index, its medium values are influenced by medium values of absolute coeficients of fertility and by medium weight of grapes; for the four studied varieties we have the following observation: the Victoria and Afuz ali varieties obtained the higest values for a load of 10 buds/m^2 – 375.55 g/shoots, respectively 417.4 g/ shoots, and for Muscat d'Adda and Xenia varieties the higest value was recorded for a lod of 16 buds/m^2 – 448 g/shoots, respectively 292.32 g/shoots.

In Table 4, it is noted that the Victoria variety, get a load of 10 buts/m^2 (35 buds/vine), the largest number of grapes on the vine (39), the highest average weight of a grain, (6,0g), the largest amount of sugar (155 g/l), with a maximum output of 11,3kg/vine. At a load of 13 buds/m^2 (46buts/vine), record a maximum value, at the three repetitions, regarding the average weight of a grape (352g) and glucose- acidimetry index (42,8) and a load of 16 buts/m^2 (56 buts/vine) has not been any maximum value for any of the repetitions, observing only the minimum values for most carpometrical parameters analyzed.

In case of Muscat d'Adda variety (Table 5) the analysis of the three repetitions of three loads of buds applied, indicates the maximum expression of carpometrical measurements at a load of 13 buds/m^2 (34 buds/vine) as follows: 35 grapes on the vine, with an average weight of a grape with a maximum of 301,5g, with a production of 7,3 kg/vine and a high quantity of sugars (180 g/l). For the other 2 loads, stands a maximum glucose – acidimetry index at a load of 10 buds/m^2 (34 buds/vine) and a minimum value at a load of 16 buds/m^2 (42 buds/vine) in terms of average weight of a grain.

Going on the same principle of data analysis, at the variety Affuz ali (Table 6), we can see that the vast majority of the maximum values are obtained at a load of 13buts/m^2 (40 buts/vine), namely: the grapes have a average weight of 400g, with an average weight of a grain of 4,7 g, a production of 11,2 kg/vine, which recorded a large quantity of sugars, even maximum for this variety (180 g/l). The lowest values of these parameters are at a load of 10 buts/m^2 (31 buts/vine), and if we analyze the behavior of variety when he was a load of 16 buts/m^2 (49 buts/vine), the values are framed in the limits of medium values of the three repetitions.

Xenia variety recorded maximum values in the number of grapes on the vine, (56) to a load of 13 buts/m^2 (49 buts/vine) and a maximum production (14,4 kg/vine) at the same load (Table 7). Applying 10 buts/m^2 (38 buts/vine) maximum values are obtained from parameters - accumulated sugars in beans (170g/l) and glucose -acidimetry index (48.6). At a load of 16 buts/m^2 (60 buts/vine), recorded a maximum value, the average weight of a grape (289g) and average weight of a grain of 5,2 g, practically those parameters which mainly attracts consumers, even before any analysis and gustative appreciation.

CONCLUSIONS

1. For Victoria variety, the best results are obtained at a load of 10 buts/m^2 (35 buts/vine), regarding both the fertility and productivity elements and the carpometric parameters; from the seven carpometric parameters (100%), maximum values were registered in five parameters (production, average weight of a grain, sugar content, numbers of grapes), representing 71,4%.

2. For Muscat d'Adda variety, load 13 buts/m^2 (34 buts/vine), it seems optimal, thus forming large grapes, with large beans, with a great production and a balanced glucose-acidimetry index; in the seven carpometrical parameters (100%), maximum values occurred at six parameters representing 85,71%;

3. For Afuz ali - variety, load of 13 buts/m^2 (40 buts/vine), is the optimal load, the obtained data is significant; from the seven carpometrical parameters (100%), maximum values occurred in five parameters representing 71,4%;

4. For Xenia - variety, the analysis results can draw the conclusion that this variety is almost uniformly for the three loads buds/m^2, specifying that for a minimum load of 10 buds/m2 (32 buds/vine) the fertility elements and quality parameters has maximum values and for a load of 16 buds/m^2 (60 buds/vine), maximum values have three parameters, representing 42.85%, some of whom are most appreciated: the size of grape and grain size.

5. Applying a different load of but on the stock is a very important technological link to culture variety table grape varieties, and the results are always influenced by their vigor, of the mother plant used, the degree of favorability of the area in terms of repetition of the values of environmental factor.

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TABLES

Table 1

Experimental variants

Varieties/ rostocks	Experimental Variants	Distances in planting	Cutting type
Victoria/SO_4	10 buds/m^2 13 buds /m^2 16 buds/m^2	2,5/1,4	Guyot periodically replaced with arms
Muscat d” Adda/ Kober 5 BB	10 buds/m^2 13 buds/m^2 16 buds/m^2	2,2/1,2	Guyot periodically replaced with arms
Afuz ali/ 41B	10 buds/m^2 13 buds/m^2 16 buds/m^2	2,2/1,4	Guyot periodically replaced with arms
Xenia/ SO_4	10 buds/m^2 13 buds/m^2 16 buds/m^2	3,6/1,05	Double Cortina geneveza

Table 2

The wine growing climates of the Growing Region of the Danube Terraces

IS1 IH4 IF4*	***IS1 IH4 IF3***	***IS2 IH4 IF4***	***IS2 IH4 IF3***
climate with moderate drought, warm temperate, with very cold nights, including Greek and Giurgiu centers	climate with moderate drought, warm temperate, with cold nights), wine center Zimnicea	pronounced drought climate, warm temperate, with very cold nights), includes 4 wine centers Island, Baneasa, Oltina, Fetesti	pronounced drought climate, warm temperate, with cold nights), includes wine center Aliman
Growing centers have resources in terms of a heliothermic warm temperate climate (IH4), enjoying a large amount of solar radiation and high heliothermic resources in conditions of poor rainfall regime.			
Today show IF3 and night cooling centers IF4s in all wine growing centers positively influence the region's wine quality attributes of grapes on aroma variety, accumulation of anthocyanic and tannin substances,pattern etc.			
**) rought index - IS heliothermic index - index HI and cooling of the night - RU and has been proposed by Tonietto J., Carbonneau, 2000.			

Table 3

The synthesis of the main fertility elements of varieties study

Experimental variants	% viable buds			% fertile shoots			The fertility coefficients			Productivity index		
	10 buts/m^2	13 buts/m^2	16 buts/m^2	10 buts/m^2	13 buts/m^2	16 buts/m^2	10 buts/m^2	13 buts/m^2	16 buts/m^2	10 buts/m^2	13 buts/m^2	16 buts/m^2
Victoria	98,23	78,53	71,42	64,31	67,27	65,63	1,2	1,19	1,15	375,55	250,44	369,43
Muscat d’Adda	79,48	88,23	53,96	60,79	67,41	57,33	1,21	1,18	1,17	269,03	388,11	448
Afuz ali	22,66	81,66	91,14	30,81	60,58	56,5	1,21	1,19	1,02	417,4	341,8	360,16
Xenia	94,73	90,47	86,11	83,06	60,57	33,42	1,53	1,35	1,11	245,18	276,68	292,32

Table 4

Carpometrical analysis – Victoria variety

Load of buds	No. of grapes	Average weight of grape (g)	Prod. Kg/vine	Average weight of grain (g)	Sugars g/l	Acidity g/l	Glucose-acidimetry index
10 buds/m^2 35 buds/vine	26	300,0	7,8	5,4	155,0	4,3	36,0
	23	325,0	7,5	6,0	145,0	4,3	33,7
	39	290,0	11,3	4,5	137,0	4,0	34,0
13 buds/m^2 46 buds/vine	23	352,0	8,1	5,0	152,0	3,9	38,8
	25	320,3	8,0	4,8	150,0	3,8	39,5
	34	263,0	8,9	3,6	154,0	3,6	42,8
16 buds/m^2 56 buds/vine	38	250,0	9,5	2,9	137,0	4,0	34,1
	19	302,0	5,7	4,0	145,0	4,0	36,3
	34	204,5	7,0	2,8	135,0	4,2	31,9
averages	29,0	289,6	8,2	4,3	145,6	4,0	36,3
maximum	39,0	352,0	11,3	6,0	155,0	4,3	42,8
minimum	19,0	204,5	5,7	2,8	135,0	3,6	31,9

Table 5

Carpometrical analysis – Muscat d'Adda variety

Load of buds	No. of grapes	Average weight of grape (g)	Prod. Kg/vine	Average weight of grain (g)	Sugars g/l	Acidity g/l	Glucose-acidimetry index
10 buds/m^2 35 buds/vine	27	201,0	5,4	4,5	159,0	3,7	43,0
	23	289,0	6,6	4,0	162,2	3,8	42,2
	16	190,0	3,0	4,7	157,0	3,5	45,5
13 buds/m^2 46 buds/vine	35	209,0	7,3	4,8	174,0	4,3	40,9
	14	301,5	4,2	3,8	165,0	3,8	43,4
	24	257,0	6,2	4,0	180,0	4,1	43,9
16 buds/m^2 56 buds/vine	7	269,0	1,9	3,6	163,0	3,7	44,1
	16	300,0	4,8	3,8	164,0	4,0	41,5
	25	252,0	6,3	2,8	162,0	3,8	42,6
averages	20,8	252,1	5,1	4,0	165,1	3,8	43,0
maximum	35,0	301,5	7,3	4,8	180,0	4,3	45,5
minimum	7,0	190,0	1,9	2,8	157,0	3,5	40,9

Table 6

Carpometrical analysis – Afuz ali variety

Load of buds	No. of grapes	Average weight of grape (g)	Prod. Kg/vine	Average weight of grain (g)	Sugars g/l	Acidity g/l	Glucose-acidimetry index
10 buds/m^2 31 buds/vine	10	321	3,2	3,8	136	3,21	42,4
	11	387	4,3	4,0	145,1	3,57	40,6
	14	372	5,2	4,3	151	3,97	38,0
13 buds/m^2 40 buds/vine	24	289	6,9	3,0	137	3,65	37,5
	17	306	5,2	3,1	176	3,2	55,0
	28	400	11,2	4,7	168	3,01	55,8
16 buds/m^2 49 buds/vine	24	311	7,5	4,1	160	4,37	36,6
	36	287	10,33	3,2	158	3,9	40,5
	15	307	4,61	3,9	148	4,2	35,2
averages	19,9	331,1	6,5	3,8	153,2	3,7	42,4
maximum	36,0	400,0	11,2	4,7	176,0	4,4	55,8
minimum	10,0	287,0	3,2	3,0	136,0	3,0	35,2

Table 7

Carpometrical analysis – Xenia variety

Load of buds	No. of grapes	Average weight of grape (g)	Prod. Kg/vine	Average weight of grain (g)	Sugars g/l	Acidity g/l	Glucose-acidimetry index
10 buds/m^2 38 buds/vine	50	225	11,3	3,4	150,5	4,33	34,8
	36	236	8,5	3,6	170	3,5	48,6
	53	245	13,0	4,1	166	4,23	39,2
13 buds/m^2 49 buds/vine	42	255	10,7	5,0	163	3,2	50,9
	17	265	4,5	3,6	152,6	3,6	42,4
	56	258	14,4	5,0	150	3,89	38,6
16 buds/m^2 60 buds/vine	38	238	9,0	4,2	167	4,4	38,0
	36	289	10,4	5,2	144	3,1	46,5
	20	248	4,96	5,0	168	4,35	38,6
averages	38,7	251,0	9,6	4,3	159,0	3,8	41,9
maximum	56	289	14,4	5,2	170	4,4	50,9
minimum	17	225	4,5	3,37	144	3,1	34,8

Comparative study regarding the behaviour of some autochthonous clonal selections of the principal varieties cultivated in viticultural centre Pietroasa, to extend in culture

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Keywords: climatical index, multiplication, vineyard, varieties

ABSTRACT

For harmonious and balanced development of Romanian viticulture and wine-growing industry it impose a modernization stage, which assure a reorganization of varieties sorts, the extending into production of the valuable clones and selections of these varieties, by multiplication of certified biological material and by approaching a complex study on autochthonous clonal germo-plasma fund, in order to diversify the vine-viticulture products and to improve their qualitative performance. The present study is a preliminary indication of the clonal selections of varieties behavior, Grasa de Cotnari, Tamaioasa romaneasca, Fetească neagra, Babeasca neagra, Busuioaca de Bohotin,–varieties extremely valuable in terms of wine quality - in ecopedoclimatic conditions from Pietroasa vineyard. The study will determine the improvement and completion of current range, in terms of quantity and quality, because each clone, by cultural and quality skills for which it was selected (quantity, quality, mixed), contribute in a complementary manner to achieve quality production in order to obtain wines with denomination of origin.The eco-climatic conditions from Pietroasa vineyard have demonstrated that there are favorable for growing these varieties and defining the achievement of a maximum in terms of precocity ripening grapes and bring an organoleptic quality conditions which are not found in any other viticultural area of our country.

INTRODUCTION

The popularity and appreciation enjoyed by the varieties from this study determine new possibilities in scientifical and practical ampelographic research because by the the diversification of wine production recorded every year they always surprise. In this context, the present study is a preliminary indication of the clonal selections of varieties behavior, *Grasa de Cotnari*, *Tamaioasa romaneasca, Feteasca neagră, Busuioaca de Bohotin*, *Babeasca neagra* – in the conditions from Pietroasa vineyard. The experience has been achieved during 2007-2009, having the main purpose to determine the adaptability degree of these clonal selections, in an area characterized with moderate weather conditions, the value and then obtaining and autochthon multiplication of biological material, justifying the need to introduce and expand them in culture.

MATERIAL AND METHODS

In order to reach the proposed goal one has taken into the study the *Grasa de Cotnari* (4 Pt, 45 Pt), *Tamaioasa romaneasca* (36 Pt, 5 Pt), *Babeasca Neagra* (94 Pt), *Busuioaca de Bohotin* (26 Pt). They can be found in the Ampelographic collection of the Pietroasa vineyard center. No matter what the selection was, the type of cutting was Guyot on the semi high, with 28 buds/vine. In order to determine the agro biological and technological potential of the experimental variants taken in the study one has analyzed the following indicators – the percentage of viable buds/vine, the fertility absolute and relative coefficients, the productivity indices (absolute and relative ones), the average weight of a grape, the mass of 100 grapes, the production assessed from a quantitative (kg/vine) point of view and from a qualitative point of view, the sugars concentration (g/l), the contents of total acidity (g/l tartaric acid). The results mentioned above for the proposed preliminary study were analyzed as the average three-years wine.

RESULTS AND DISCUSSIONS

To analyze the behavior of these clonal selections in the vineyard Pietroasa center is needed to assess the climate data were extracted from the database of the Meteorological institute, presented synthetically in Table 1, compared with the average, determined as being the multi annual average.

Under the climate issue, considering only the mean annual air temperature and rainfall amount, the institute is the second moderatly to warm, basically belonging to the second favorable tier as regards the cultivation of vines.

The values of synthetic climatical index recorded in 2006 – 2009 period shows that the vineyard resources heliothermal record high, which correspond to low fluid resources. And allows economic crop varieties with early-ripening middle, and in the terms of the synthetic indicators is

Of the four indicators, is the most sensitive bioclimatic index whose spectrum falls within the limits outlined 7,56-10,4 shwoing that there are favorable conditions to achieve high quality wines.

Average agro biologic skills of clonal selections studied by the force of growth, the percentage of viable buds, the fertility coefficients, the productivity index (Table 2) shows that the studied clone selections have a medium-normal production potential and that the genotype has a direct connection with this index and their average values are also influenced by climatic conditions. The analysis obtained from an output quantity and quality perspective - will be presented on data listed in table 3, taking into account the particularities and skills of each clonal selection.

The clone selections of *Grasa de Cotnari 4 Pt* and *45 Pt* register an average weight of a grape within the normal limits specific for the sort, that is 146 g (4 Pt) and 149 g (45 Pt). Regarding the selections of the *Tamaioasa romaneasca (36 Pt, 5 Pt)* sort some differences were observed among them, differences which will also be felt in the obtained production. Thus the clone *36 Pt* has the average weight of a grape of 124 g and the clone *5 Pt* weights 134 g. the selection of *Feteasca neagra* variety register normal values of this parameter (142g). For the selection *Busuioaca de Bohotin 26 Pt* this parameter registers higher values in 2008 (120) being practically classified within the limits of the sort (104 g). Analyzing the results obtained for the *Babeasca neagra 94 Pt* selections one notes that there are values registered close for the population of the sort, especially in the viticultural year 2007-2008.

The mass of 100 grapes (g). Significant differences in this way were noticed only for *Tamaioasa romaneasca*, and the comparison was possible due to the existence of the two selections (*36 Pt* and *5 Pt*), which suggest their framing in the group of clonal quantity selections. In the case of the other selections one can make the mention they classify within the normal medium limits of the sorts from which they have been selected.

The sugars (g/l). The study selects the particularities of the main parameters which define the quality of the grapes, under the influence of the climate elements as well as the assessment of the qualitative value of the production. The *Tamaioasa romaneasca* variety is recognized from the point of view of its production quality, accumulated great quantities of sugar, ranging from 241 g/l for *36 Pt* and 239 g/l for *5 Pt* accompanied by an medium production, favorable for obtaining white aromatic wines of superior quality. The selection *Busuioaca de Bohotin* obtains 238 g/l and at a very short distance is followed by the selections of the *Grasa de Cotnari* variety, with accumulations of sugar between 237 g/l for *4 Pt* and 238 g/l for *45 Pt*. It is also noticed that the selection of the *Babeasca neagra 94 Pt* variety, has accumulated sugars at the superior limits of the sort, 219 g/l for viticulture year 2007/2008, allowing to obtain a wine with a rather high alcoholic potential.

The acidity (g/l). At a clonal level there are minimum differences between the quantity of sugar and the level of acidity, but in all cases the acidity values are lower than the quantity of sugar accumulated. At the studied experimental variants were minimal differences which did not surpass 0,1 g/l.

The production (kg/ but, t/ha). The grape production was influences by the climate conditions, but also by the productive potential of these cloned species, as well as by the aspect of the health condition. Comparing the medium values one observed differences from one year to another, in 2008 all clonal selections get higher yields compared with 2007, noting that they fall within the normal limits of varieties from which they were selected.

One noticed that at the experiment variants which are very close from the genetically agro biological and technological parameters, posting a selection may be done only by sugar value concentration. Concerning the quality of the production from the point of view of the state of health one notes that the production was healthy 100%, the degree of attack of Botrytis cinerea being equal to zero.

CONCLUSIONS

The Pietroasa viticulture center has high heliothermic resources which correspond to low hydric resources, and in this way allows successfully the cultivation of the quality variety with early-medium and medium maturity, as the selection of varieties made in the study.

The success of integration of the clone selections studied in the ecosystem of the viticulture center of Pietroasa is favored in its entirety by the total of the active thermic balance as well as by the quantities of fallen precipitations which allow the meeting of the main requirements, necessary for obtaining some superior quality wines of the D.O.C type.

The total obtained results from the point of view of the agro biological and technological behavior lead to the idea that the clone selections taken for the study can be multiplied with success in order to obtain an autochthon certified biological material, at the same time justifying the necessity of their introduction and extension in the culture.

ACKNOWLEDGEMENTS

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TABLES

Table 1

The synthesis of climatic elements

Climatic Elements	Multiannual value	The viticulture year 2006-2007	The viticulture year 2007-2008	The viticulture year 2008-2009
Thermal coefficient °C	17,66	17,63	16,59	17,11
Sunstroke coefficient	7,84	8,50	9,94	9,2
Precipitation coefficient	1,73	1,44	1,46	1,45
Helio thermic real index	1,43	1,49	1,13	1,33
Hidro thermic effective index	1,07	0,61	0,88	0,97
Bioclimatic index wine	7,56	10,40	9,02	7,73
Oenoclimatic ability index!	4880	5072	4876	4942
Average yearly temperature °C	11,4	12,2	10,7	11,4

Table 2

The synthesis of the main fertility elements of clone selections study

The viticulture year	Experimental variants (clone selections)	% viable buds	Growth vigor	% Fertile offshoots	The fertility coefficients		Productivity index	
					CFA	CFR	IPA	IPR
2007-2009 (average)	Clones for superior white wines							
	Grasa de Cotnari 4 Pt	81,6	xxx	76	1,0	0,85	165	141
	Grasa de Cotnari 45 Pt	82	xxx	77	1,0	0,9	161	142
	Clones for aromatic wines							
	Tamaioasa romaneasca 36 Pt	83	xxx	71	1,0	0,70	132	84
	Tamaioasa romaneasca 5 Pt	82	xxx	72	1,1	0,72	138	94
	Clones for superior red wines							
	Fetească neagră 10 Pt	86	xxx	76	1,19	0,82	142	92
	Clones for rose wines							
	Busuioaca de Bohotin	82	xxx	71	1,04	0,84	125	101
	Clones for red wines for current consumption							
	Babeasca neagra 94 Pt	77	xxx	73	1,0	0,73	169	123

Table 3

The synthesis regarding the quantitative and qualitative production obtained with the clones selections in the Pietroasa viticulture centre

The viticulture year	Experimental variants	Average weight of grape (g)	Weight of 100 grapes (g)	Sugars g/l	Acidity g/l	Production kg/grape vine	Production t/ ha	The degree of attack (Botrytis cinerea)
	Clones for superior white wines							
2006-2007 2007-2008 2008-2009 * The average of 3 years wine	Grasa de Cotnari 4 Pt	130/165/145 146*	120/270/193 194*	239/238/236 237*	3.44/5.5/4,27 4,38*	0.7/2,4/1,35 1,48*	2.91/8.9/5,7 5,67*	0
	Grasa de Cotnari 45 Pt	140/160/148 149*	125/266/193 194*	237/240/242 239*	3.46/5,4/4,23 4,36*	0.81/2,25/1,33 1,46*	3.37/8,5/5,7 5,86*	0
	Clones for aromatic wines							
	Tamaioasa romaneasca 36 Pt	120/130/123 124*	110/145/125 126*	238/246/240 241*	3.44/5,5/4,27 4.4*	0.70/1,7/1,03 1,16*	3.2/7,2/5,0 5,13*	0
	Tamaioasa romaneasca 5 Pt	133/138/133 134*	115/153/132 133*	237/244/238 239*	3.45/5,5/4,27 4,4*	0.80/1,82/1,11 1,24*	3.33/7,6/5,3 5,5,38*	0
	Clones for superior red wines							
	Fetească neagră 10 Pt	139/142/146 142*	112/110/114 112*	237/242/239 239*	5,4/5,2/5,3 5,3*	2,2/2,4/2,0 2,2*	6,9/8,9/7,2 7,66*	
	Clones for rose wines							
	Busuioaca de Bohotin 26 Pt	90/120/103 104*	80/132/104 105*	234/245/237 238	3.52/5,1/4,11 4,24*	0.60/1,8/1,0 1,13*	2,49/7,5/4,8 4,92*	0
	Clones for read wines for current consumption							
	Babeasca neagra 94 pt	120/169/142 143*	110/165/135 136,*	198/219/206 207*	4.00/5,8/4,7 4.83*	0.88/2,94/1,71 1,84*	2.93/10/7,2 6,71*	0

Quantitative and qualitative influence of Kelpak product, from seaweed, on vine varieties

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Keywords: ecology, grape, medium, Ecklonia maxima, health, Vitis vinifera

ABSTRACT

The study consisted of applying two treatments, during the growing season, with organic product *Kelpak* at five varieties of vine: Perlette, Augusta, Victoria, Chardonnay, Merlot. It was analyzed the influence of environmental product, obtained from seaweed, on sugar and acidity content in grape berries and have determined the average weight of grapes, the mass of 100 berries and vegetative growth. Vine varieties reacted differently: some have recorded growth at weight grapes, mass of 100 grape berries, acidity, length of shoots but a little lower in sugar content; others have recorded higher values regarding acidity, sugars and vegetative growth but in exchange for lower production.

INTRODUCTION

In Romania there is a wide range of organic products which cover several areas, as: agriculture (humificants, improvers, fertilizers, foliar biological treatment, bioprotective), zootechny (treatments for livestock environments, the decomposition of animal carcasses and livestock residues, for biological digestion of animal meal, metabolic stimulator), environment protection (bioremediu oil pollution, solvents), agricultural products (organic treatments for wine, meat products, brine, dairy products).

Due to intense chemicalization modern life – transportation, agriculture and domestic sectors, are eliminated in the environment many residues of mineral products, where, by air, foods and water are placed in bodies generating poisoning caused by environmental pollution.

Excessive use of synthetic chemicals in intensive agriculture led to increased degradation of land fertility either sharp reduction of organic matter and therefore useful microflora, either by promoting erosion surface. Full or partial waiver to pesticides, chemical fertilizers and other substances as stimulator or retarded involves reducing the accumulation in soil and consequently in plants of compounds toxic to humans, helps maintain soil with a normal level of fertility.

Currently, biological products rarely or never apply in vineyards. This is due to the high cost of some products and lack of knowledge of wine-growers. These organic products can provide a qualitative and quantitative production by partial or total replacement of chemicals for disease and pests control and chemical fertilizers.

Organic products offers healthy grapes, superior quality, and, what is also very important, not adversely affect the environment.

Kelpak is made from seaweed that grows in South African waters. Its substances are auxin and cytokinin, natural compounds. Auxin is dominant in *Kelpak*, this product improves the cell growth and the cell elongation. This process is in nearly contact with the development of root. The photosynthesis get better by cytokinin, what enable the development of shoot (Szabó and Hrotkó, 2009). This product was used effectively on wheat (Miers and Perry, 1986; Beckett and van Staden, 1989), on potato (Jenkins and Mahmood, 2003), on pepper (Arthur et al., 2003) and on strawberry (Masny, 2004).

MATERIAL AND METHODS

The experiment was located at I.N.C.D.B.H. Ştefăneşti, on the Goleasca farm characterized by a complex of soils composed of antrosol, eutricambisol, şi tipycal preluvisol. Vineyard is located in the central-southern Muntenia Subcarpathians.

The research was conducted in field and were supplemented by laboratory analysis. They used five varieties of vine: Perlette, Augusta, Victoria, Merlot, Chardonnay. Two treatments were made (June, July) whith *Kelpak* product, which is an organic growth stimulant, a pure concentrated seaweed, natural 100 %. It contains: auxin, citokinine, N, P, K, Na, Ca, B, Cu, Fe, Mg, Mn, Zn and amino-acid. Three measurements were made - first in early June (before starting treatment), second in early July, and the third in late July.

Of each variety were treated three rows, and the fourth was untreated witness. Were marked 12 hubs vines of each variety. At each hub were measured for three times increases vegetative and determined sugar and acidity content in grape berries, average weight of grapes and the mass of 100 berries.

RESULTS AND DISCUSSION

Vine varieties responded differently at application of environmental product *Kelpak*. No variety has not recorded increases at all determinations. The product influenced very much vegetative increases of hubs, acid formation and mass of 100 grape berries in four of the five varieties studied. But the weight of the grapes grown at only three varieties and sugar accumulation recorded increases at only two varieties.

Application influence of Kelpak product on vegetative growth of vine hub.

Vegetative growth of hub were positively influenced of application Kelpack product, these ranging from 16 % at variety Augusta until 49 % at variety Merlot; while the variety Victoria they were not influenced. Wine varieties respond better to product application Kelpack compared with table grape varieties, especially with the Victoria variety (Table 1).

From measurements, 4 of 5 varieties had significant increases thus: Merlot variety had the highest increases, followed by varieties Perlette, Augusta and Chardonnay. Victoria is the only variety which registered vegetative increases higher at untreated variant then treated variant (Fig. 1).

Kelpak product influence on grape production.

Grape harvesting was done in stages depending on the baking times of each variety, in this way: Perlette – 15 August, Augusta – 25 August, Victoria – 2 September, Chardonnay – 22 September, Merlot – 6 October.

After harvesting at each variety were determined the average weight of grapes and the mass of 100 berries. Figure 2 shows that organic product Kelpak produced, at treated variants, the largest increase in weight grapes at Perlette variety and lowest in Merlot. But varieties Augusta and Victoria were not positively influenced by this product, average weight of grapes being higher at untreated variants.

Compared with control plants, vine varieties, treated with the product Kelpak, reacted differently: at Perlette variety was recorded the largest increase at grape berries, this variety was followed by Augusta, Merlot and Chardonnay. At Victoria variety the mass of 100 berries it was higher at the untreated variant (Fig. 3).

Application influence of the Kelpack product on the quality of grape production. To quantify it were determined sugars and acidity. The analysis showed that the ecological product had very little influence or at all in sugar accumulation. Thus, increases in sugar were recorded at Augusta and Victoria varieties. Chardonnay variety had almost the same content in sugars at both variants, and untreated variants of Perlette and Merlot varieties recorded greater increases than treated variants (Fig. 4).

Organic product *Kelpak* influenced the formation of acidity in grapes, thus: the Perlette variety recorded the highest value and Augusta the smallest; Victoria is the only variety that had higher values at untreated variant (Fig. 5).

CONCLUSIONS

Vine varieties respond differently to application *Kelpak* product. It can be applied in vineyards to obtain higher values for acidity and weight of 100 grape berries.Plants have a better vegetative growth, which means an contribution of nutrients so a higher production. Table Grapes, white pyrene, (Augusta şi Victoria) were only which recorded increases in sugars, other varieties (Perlette, Chardonnay, Merlot) recorded a slight decrease in sugars but a higher production.

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TABLE AND FIGURES

Table 1

Vegetative growth of shoots

Variety	Measurements (cm)			Average (cm)	Difference %
	M1	M2	M3		
Perlette - untreated variant	36,31	39,12	39,92	38,45	100
Perlette - treated variant	44,10	55,83	58,88	52,93	138
Augusta -untreated variant	38,16	43,02	44,12	41,76	100
Augusta - treated variant	45,70	49,62	50,39	48,57	116
Victoria - untreated variant	45,15	54,64	58,35	52,71	100
Victoria - treated variant	40,03	43,56	45,43	43,01	82
Chardonnay - untreated variant	24,72	26,08	26,45	25,75	100
Chardonnay - treated variant	28,82	33,29	34,08	32,06	125
Merlot - untreated variant	27,41	31,92	33,56	30,96	100
Merlot - treated variant	41,62	47,25	49,32	46,06	149

M1= first measurement, M2 = second measurement, M3 = the third measurement

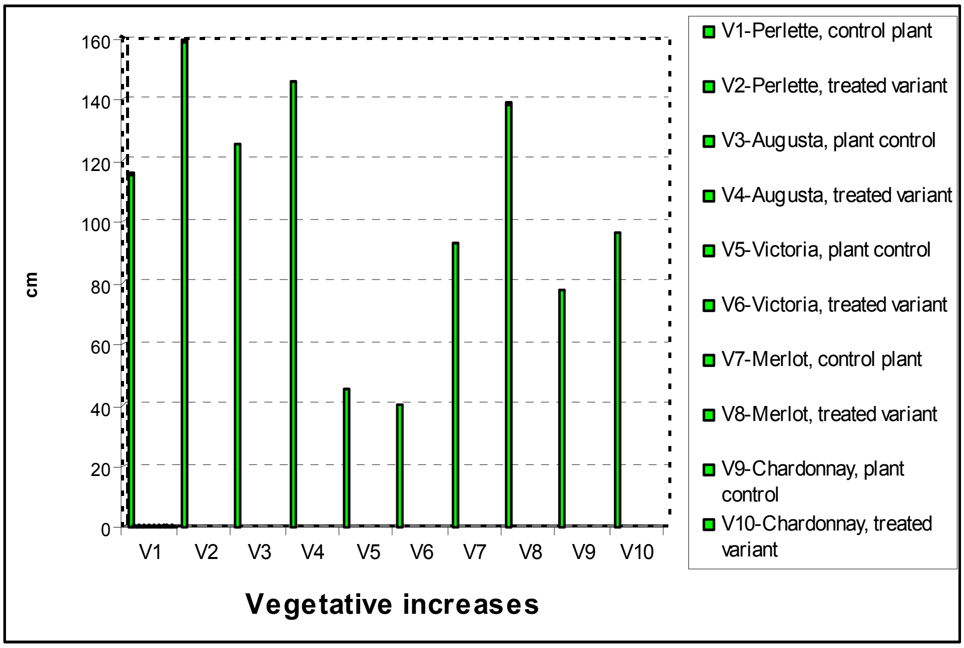

Fig.1. Vegetative increases of shoots treated with *Kelpak*.

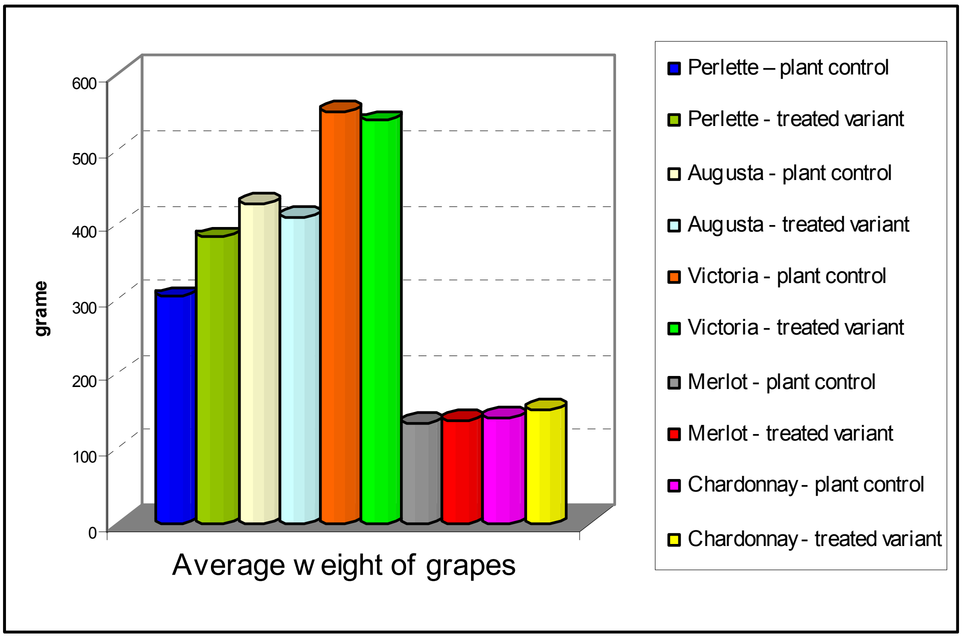

Fig. 2. Kelpak product influence on the average weight of grapes

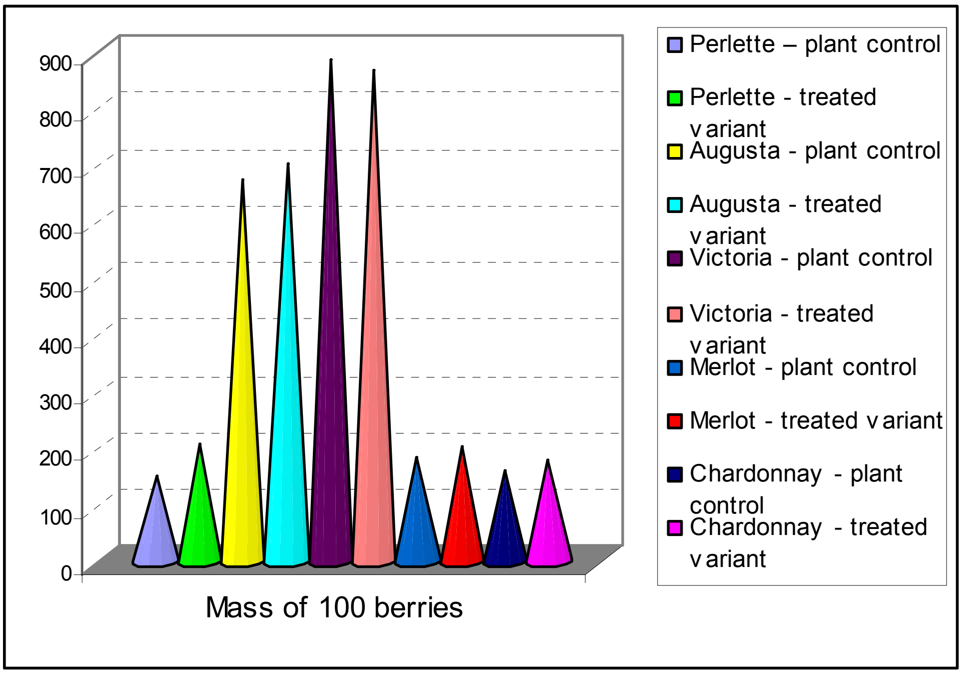

Fig. 3. Influence of Kelpak product on weight grape berries

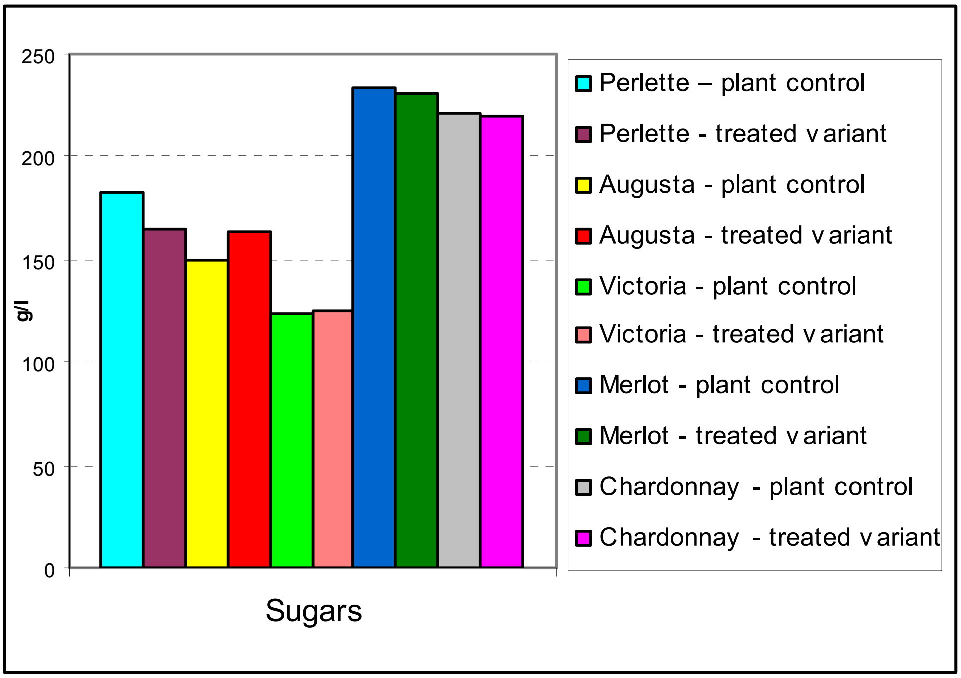

Fig.4. Influence of Kelpak product on the sugar content in grape berries

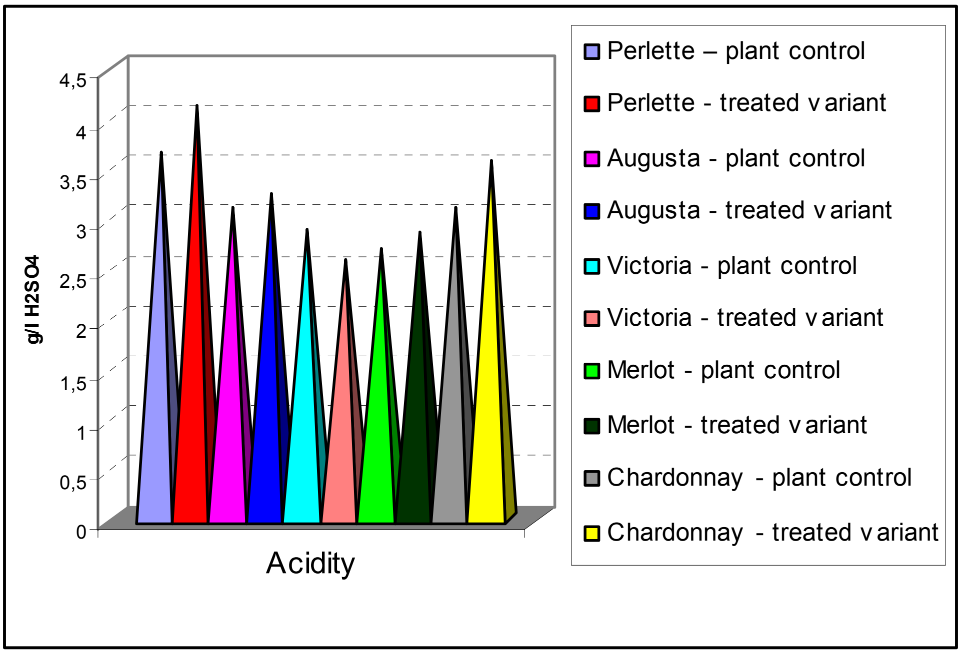

Fig.5. Influence of product application Kelpak on the formation of acidity in grapes

BOTANY & PHYSIOLOGY

Researches concerning the chemical composition of essential oil from *Artemisia austriaca (Asteraceae)* Jacq.

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Keywords: *Artemisia austriaca* Jacq., *Asteraceae***,** essential oil, ecotypes, fresh *herba*

ABSTRACT

Several *Artemisia* species have been or are medicinally use and hence are of more or less commercial value. Analysis of the essential oil extracted by hydrodistillation was performed by GC-MS and emphasized the presence of some major compounds in *Artemisia austriaca* Jacq. The main components of *Artemisia austriaca* Jacq. essential oil are: camphor, eucalyptol, borneol, camphen, myrcen, α-pinene and their quantities depends on the the period of vegetation and the ecotype. Camphor and camphene reached high values at the flowering stage, while α-pinene, myrcene and borneol at the maturation stage. The quantity of eucaliptol (1,8-cineole) depends on environmental conditions, so a dry climate (in Bucharest or Amara-Ialomiţa) decresed 1.2-1.4 times its values comparatively with a wet climate (in Slănic-Prahova or Corbii Mari-Dâmboviţa).

INTRODUCTION

The genus *Artemisia,* which comprises about 400 species, belongs to the Asteraceae family and is the largest of the flowering plants. Several *Artemisia* species have medicinal importance and are used in traditional medicine for the treatment of a variety of diseases and complaints (Demirci et al., 2004). Most representatives are aromatic herbs or shrubs. They are mainly found in the northern hemisphere. Asteraceae is a natural family, with well established limits and a basic uniformity of floral structure, represented in all its members by the common possession of characters such as aggregation of the flowers into capitula and production of achenes (cypselae) as the typical fruits of the family **(**Wright **C.**W., 2002).

The plant (*Artemisia austriaca*) is relatively small, with small leaves, pinnate-sectors, with linear leaflets, the discoid flowers head are almost sessile, arranged in spikes (raceme). Globular shape is ovate. Tubular flowers are yellow.

MATERIAL AND METHODS

The biological material was represented by fresh *herba* - (main and secondary stems, young and mature leaves, flowers) of *Artemisia austriaca* (Figure 1) .The plants were collected from different Romanian areas and were considered as ecotypes: *Artemisia austriaca* from Bucharest (flowering phase), Slănic-Prahova (maturation phase), Amara-Ialomiţa (maturation phase) and Corbii Mari-Dâmboviţa (flowering phase).

The volatile compounds were extracted by hydrodistillation with a Singer-Nickerson apparatus. The separation and identification of components has been carried out using an Agilent gas chromatograph, equipped with quadruple mass spectrometer detector. A capillary column DB-5 (25 m length x 0,25 mm i.d. and 0.25 μm film thickness) and helium as carrier gas were used. The initial oven temperature was 60°C, then rising to 280 °C at a rate of 4°C /min. The NIST spectra bank was used for to identify the volatile compounds, which were verified with the Kovats indices.

RESULTS AND DISCUSSION

The quantities of volatile oil extracted from these *Artemisia austriaca* studied plants are 0,12ml/100 g for Bucharest Ecotype, 0,15ml/100 g for Corbii Mari Ecotype, 0,35ml/100g for Slănic Prahova Ecotype and 0,2ml/100g for Amara Ecotype.

Through described method identified between 32-38 volatile compounds extracted from the studied *Artemisia austriaca*, those represent 90,91% of the total substances extracted from Bucharest Ecotype, 98,18% from Slănic Prahova Ecotype, 96,01% from Amara Ecotype and 98,96% from Corbii Mari –Dâmboviţa Ecotype. Costa et al., (2009) reported only 82.1% identified compounds by GC-FID in volatile oil of *A. austriaca* from Iran (Table 1).

The data analysis suggests that volatile oil from these ecotypes revealed a great plasticity - the main compounds are commonly: camphor, eucalyptol (1,8-cineole), myrcene, camphene, borneol, α-pinene and terpinen-4-ol (Figure 2). Güvenalp et al. (1998) found that the volatile oil of *A. austriaca* from Turkey contained, as main components, camphor (45.5%), 1,8-cineole (30.4%), camphene (6.5%), α-terpineol (3.2%), α-pinene (3.0%) and terpinen-4-ol (2.9%). Our data are almost similarly with Güvenalp's data except some compound like myrcene present in great quantities: 7,92% in fresh *herba* of Bucharest ecotype, 8,38% in Corbii Mari ecotype, 11,71% in Amara ecotype and 12,14% in Slănic Prahova ecotype. This monoterpene was found in plants at maturation phase more than those in flowering phase.

The representative volatile compound of this specie is camphor. High quantities were found in plants from Bucharest (37,17%) and Corbii Mari (35,75%), at flowering stage, while in plant from Slănic Prahova (21,46%) and Amara-Ialomiţa (20,88%), at maturation phase, the quantities were 1,5 times lower. The quantities of its precursor, camphene, varied in the same way: at the flowering stage, in plants from Bucharest and Corbii Mari were 6,56% and 6,11%, while at maturation phase, in plants from Amara and Slănic Prahova the values were 1,5-3 times lower (Table 1).

On the contrary, α-pinene, myrcene and borneol evolution was different: at maturation phase, in plants from Amara and Slănic Prahova the quantities of these volatiles were 1.5 times higher than those, at the flowering stage, in plants from Bucharest and Corbii Mari.

The quantity of eucaliptol (1,8-cineole) depends on environmental conditions, so a dry climate (in Bucharest or Amara-Ialomiţa) decresed 1.2-1.4 times its values comparativelly with a wet climate (in Slănic-Prahova or Corbii Mari-Dâmboviţa).

There were significant differences between the minor volatile compounds of the studied ecotypes: the plants from Bucharest ecotype contain α-felandren, α-campholenal, nonanal and trans-carveol, the plants from Slănic Prahova ecotype contain α-bisabolol and trans-pinocarveol, the plants from Amara-Ialomiţa ecotype contain high quantity of α-borneol, while the plants from Corbii Mari-Dâmboviţa ecotype contain β-eudesmol. The dissociation between different *A. austriaca* ecotypes could be done by the presence of some minor volatiles or their quantities. For exemples, α-terpineol wasn't detected in volatile oil from Bucharest ecotype plants, but its quantity varied in the others: 1,20% (Slănic Prahova ecotype), 0,81% (Corbii Mari-Dâmboviţa ecotype) and 0,58% (Amara-Ialomiţa ecotype).

It is interesting that *Artemisia austriaca* Jacq. does not contain thujona, a toxic volatile compound representative for *Artemisia* genus.

CONCLUSIONS

1. The quantities of volatile oil extracted from these *Artemisia austriaca* studied plants are 0,12ml/100 g for Bucharest Ecotype, 0,15ml/100 g for Corbii Mari Ecotype, 0,35ml/100g for Slănic Prahova Ecotype and 0,2ml/100g for Amara Ecotype

2. Volatile oil (a blue color) composition of *Artemisia austriaca* has been studied for the first time in Romania and varies depending on the ecotype and the period of vegetation.
3. The typical volatile compounds of *Artemisia austriaca* are camphor, eucalyptol (1,8-cineole), myrcene, camphene, borneol, α-pinene and terpinen-4-ol.
4. The representative volatile compound of this specie is camphor. High quantities were found in plants from Bucharest (37,17%) and Corbii Mari (35,75%), at flowering stage, while in plant from Slănic Prahova (21,46%) and Amara-Ialomiţa (20,88%), at maturation phase, the quantities were 1,5 times lower.
5. The quantity of eucaliptol (1,8-cineole) depends on environmental conditions, so a dry climate (in Bucharest or Amara-Ialomiţa) decresed 1.2-1.4 times its values comparativelly with a wet climate (in Slănic-Prahova or Corbii Mari-Dâmboviţa).

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TABLE AND FIGURES

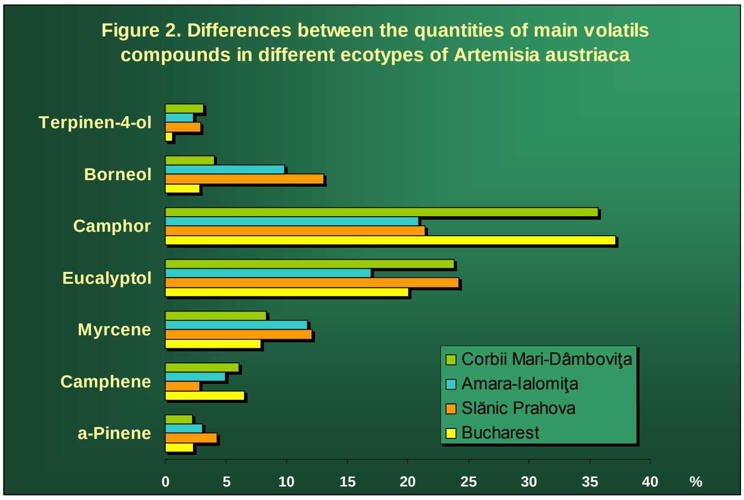
Table 1

The main substance of the volatile oil extracted from *Artemisia austriaca* species (% of total compounds)

Volatile compound	*Ecotype*			
	Bucharest	**Slănic Prahova**	**Amara Ialomiţa**	**Corbii Mari Dâmboviţa**
Methyl ethyl buthan	0.25	nd	nd	nd
Ethyl isovalerate	0.25	nd	nd	nd
Triciclene	0.33	nd	0.20	0.27
α-Pinene	**2.32**	**4.32**	**3.05**	**2.22**
Camphene	**6.56**	**2.83**	**4.96**	**6.11**
β-Pinene	1.20	1.67	1.40	1.36
Myrcene	**7.92**	**12.14**	**11.71**	**8.38**
α-Felandren	0.10	nd	nd	nd
o-Cimol	2.79	nd	nd	nd
α-Terpinene	nd	nd	nd	0.77
o-Cymene	nd	1,05	1.45	1.68
Eucalyptol	**20.08**	**24.23**	**16.99**	**23.84**
γ-Terpinene	0.96	1.10	0.82	0.98
Isopropyl methylbycyclohexen-2-ol	nd	0,34	0.26	0.33
Terpinolene	0.25	0.27	nd	0.41
Nonanal	0.65	nd	nd	nd
Methylbuthyl methylbutirate	nd	0.73	nd	0.56
Amyl-isovalerate	nd	0.60	nd	0.22
Octenyl acetate	0.1 7	nd	nd	nd
Isopropyl methyl cyclohexen-1-ol	nd	0.20	nd	0.26
α-Campholenal	0.28	nd	nd	nd
trans-Pinocarveol	nd	0.73	nd	nd
Camphor	**37.17**	**21.46**	**20.88**	**35.75**
cis-Verbenol	0.61	nd	nd	nd
Borneol	**2.87**	**13.09**	**9.82**	**4.08**

α-Borneol	nd	nd	13.16	nd
Terpinen-4-ol	0.60	2.93	2.36	3.16
α-Terpineol	nd	nd	0.58	0.81
Myrtenol	0.22	nd	0.21	0.15
trans-Carveol	0.20	nd	nd	nd
cis-Carveol	0.16	nd	0.19	0.25
Isobornyl format	nd	nd	0.17	0.25
Carvone	0,18	nd	0.10	0.1 7
Chrysanthenyl acetate	nd	nd	0.72	0.10
trans-Chrysanthenyl acetate	nd	1.33	nd	nd
Bornyl acetate	1.79	2.47	1.45	0.33
Isobornyl propionate	nd	nd	0.06	nd
β-Elemen	0.27	0.49	nd	0.11
Methyl eugenol	0.17	nd	nd	nd
β-Caryophyllene	nd	0.17	0.26	nd
germacren D	0.22	0.73	0.56	0.64
β-Selinen	0.10	0.40	0.26	0.25
GermacreneD	0.59	0.58	0.29	0.32
Nerolidol	nd	nd	0.11	0.10
ent-Spatulenol	0.35	0.41	0.39	0.25
Caryophyllene oxide	0.35	0.22	0.30	0.24
Isoaromadendrene	0.32	0.24	nd	0.15
R-Eudesmol	nd	nd	0.31	0.22
β-Eudesmol	0.66	0.18	0.67	2.68
Total	**90,91%**	**98,18%**	**96,01%**	**98,96**

Fig. 1. *Artemisia austriaca*



The secretory structures and volatile oil composition of *Mentha aquatica* L. from Danube Delta

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Keywords: *Mentha aquatica* L., watermint, *herba*, secretory cells, trichomes, peltate, volatile oil, menthofuran, eucalyptol

ABSTRACT

The soil humidity and temperature influence the morphology, anatomy and chemical composition of volatile oil of *Mentha aquatica* L. This research purposed to study the secretory structures present in stems and leaves of *Mentha aquatica* L., as well as the composition of the essential oils extracted from fresh *herba* of a Romanian watermint from Danube Delta. Both stems and leaves present secretory trichomes, peltate and small capitate trichomes - a plate or shield-shaped cluster of 8 cells attached directly to the surface or borne on a stalk of some kind. The main volatile compounds of fresh *herba* volatile oil are menthofuran (54.95%), β-trans ocimene (6.63%), D-limonene (6.33%), eucalyptol (4.93%), ledol (4.33%) and β-caryophyllene (3.30%).

INTRODUCTION

Mentha aquatica (watermint) is a perennial plant in the *Lamiaceae* native throughout Europe except for the extreme north, and also northwest Africa and southwest Asia (Blamey and Grey-Wilson, 1989; Ciocârlan, 2000). As the name suggests, watermint occurs in the shallow margins and channels of streams, rivers, pools, dikes, ditches, canals, wet meadows, marshes and fens. If the plant grows in the water itself, it rises above the surface of the water (Ciocârlan, 2000).

It hybridizes with *Mentha spicata* (spearmint) to produce *Mentha* × *piperita* (peppermint), a sterile hybrid; with *Mentha suaveolens* (applemint) to produce *Mentha* × *suavis*; with *Mentha arvensis* (cornmint) to produce *Mentha* × *verticillata*; and with both *M. arvensis* and *M. spicata* to give the tri-species hybrid *Mentha* × *smithiana* (Blamey and Grey-Wilson, 1989).

Mentha aquatica L. is an herbaceous rhizomatous perennial plant growing to 90 cm (35 in) tall. The flowers are tiny, densely crowded, purple, tubular, and pinkish to lilac in colour; flowering is from mid to late summer. All parts of the plant have a distinctly minty smell. Hefendehl and Murray (1972) found that the natural strain of *M. aquatica* had 7.7% cineole, 4.9% limonene, a trace of terpinolene and pulegone, 0.1% menthone, 0.2% menthol, 66.4% menthofuran, and 18.9% of 12 different hydrocarbons. The composition of the essential oils from two populations of *Mentha aquatica* ssp. *aquatica* collected in two different habitats in Migliarino-San Rossore-Massaciuccoli Regional Park (Italy) has been determined by GC and GC/MS (Guido et al., 1997). The oils were found to be rich in menthofuran (38.4-55.9%) and 1,8-cineole (11.9-16.3%).

Our study purposed was to found the secretory structures present in stems and leaves of *Mentha aquatica* L., as well as the composition of the essential oils extracted from fresh *herba* of this Romanian ecotype.

MATERIAL AND METHODS

The biological material was represented by fresh *herba* - (main and secondary stems, young and mature leaves, flowers) of *Mentha aquatica* L. The plants were collected from Tulcea county, Plopu village, a wet meadow of Danube Delta. The identity of the plant was confirmed by Vasile Ciocârlan, Systematic Botany Division of Faculty of Horticulture, USAMV Bucharest, with herbarium specimens.

The anatomic study was made to the level of the stem and the leaves (petiole, foliar limb). For this study we used the hand-made sections of fresh material, which were clarifying in chlorine-hydrate and colored with iodine green and carmine-alaunate. The photos and the histo-anatomical observations at the caulinar and foliar levels are made with photonic microscope (ML-4M IOR).

We point out some aspects concerning the non-glandular and glandular hairs, their distribution on the stem and lamina, the epidermic features, the distributions and features of the stomata. Histo-anatomical aspects observed with this method sustain the determinations of volatile oil composition of this specie.

The volatile compounds were extracted by hydrodistillation with a Singer-Nickerson apparatus. The separation and identification of components has been carried out using an Agilent gas chromatograph, equipped with quadruple mass spectrometer detector. A capillary column DB-5 (25 m length x 0.25 mm i.d. and 0.25 µm film thickness) and helium as carrier gas were used. The initial oven temperature was 60°C, then rising to 280 °C at a rate of 4°C /min. The NIST spectra bank was used for to identify the volatile compounds, which were verified with the Kovats indices.

RESULTS AND DISCUSSIONS

Mentha aquatica L. (*Lamiaceae*) have the stems square in cross section, green or purple, and variably hairy to almost hairless, this thing being in relation with pedoclimate specific conditions. Its epidermis has elongated cells, with external thickened walls. In transversal section it is identified a clearly and striated cuticle layer, forming a special relief. Among epidermal cells are protective trichomes with various size and secretory trichomes with a short pedicel and a spherical glands, usually composed by eight secretory cells. The cortex is composed by angular colenchyma, in coast areas, and chlorenchima with visible aeriferous cavities (Figure 1).

The leaves are ovate to ovate-lanceolate, 2 to 6 centimeters long and 1 to 4 centimeters broad, green (sometimes purplish), opposite, toothed, and vary from hairy to nearly hairless. The bifacial lamina presents a dorsal-ventral structure; the adaxial epidermis cells present cells, with irregular wavy shape, without stomata (hypostomatic lamina) (Figure 2). In transversal section it is identified a clearly and smooth cuticle layer and secretory trichomes, peltate and small capitate trichomes, widely described in the literature of *Labiatae* (Giuliano and Maleci Bini, 2008). In cross section, both epidermis present secretory hairs, a common type of trichome as the scale or peltate hair: a plate or shield-shaped cluster of 8 cells attached directly to the surface or borne on a stalk of some kind (Figures 3 a,b).

The quantities of volatile oil extracted from these *Mentha aquatica* L. studied plants was 0,17ml/100 g fresh matter. Through described method identified between 34 volatile compounds, those represent 97.92% of the total substances extracted.

The main volatile compounds of fresh *herba* volatile oil are menthofuran (54.95%), β-trans ocimene (6.63%), D-limonene (6.33%), eucalyptol (4.93%), ledol (4.33%) and β-caryophyllene (3.30%) (Table 1 and Figure 4). Hefendehl and Murray (1972) noticed that *M. aquatica* volatile oil contain 66,4% menthofurane, and Guido et al. (1997) were found between 38.4-55.9% menthofuran and between 11.9-16.3% 1,8-cineole (eucaliptol). This Romanian studied ecotype shows a volatile composition like the Italian ecotypes reported by Guido et al. (1997).

CONCLUSIONS

1. The secretory trichomes from caulinary epidermis present a short pedicel and a spherical gland, usually composed by eight secretory cells.

2. Both epidermis of hypostomatic leaves present secretory hairs, a common type of trichome as the scale or peltate hair: a plate or shield-shaped cluster of 8 cells attached directly to the surface or borne on a stalk of some kind
3. The main volatile compounds of fresh *herba* volatile oil are menthofuran (54.95%), β-trans ocimene (6.63%), D-limonene (6.33%), eucalyptol (4.93%), ledol (4.33%) and β-caryophyllene (3.30%)

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TABLE AND FIGURES

Table 1

The chemical composition of *volatile* oils extracted from fresh herba of *Mentha aquatica* L.

Volatile compound	%	Volatile compound	%
α-pinene	1.03	4 hexen-1ol, 5methyl-2(1methylethenyl)-acetate	1.59
sabinene	1.31	isopulegone	0.22
β-pinene	2.09	α-farnesene	0.16
myrcene	2.30	α-gurjunene	0.30
o-cymene	0.39	β-caryophyllene	3.30
D-limonene	6.33	β- farnesene	0.35
eucaliptol	4.93	α- caryophyllene	0.21
β-trans ocimene	6.63	β- cubebene	1.17
β-cis ocimene	1.77	γ-elemen	0.71
γ-terpinene	0.31	β- cadinene	0.27
terpinolene	0.10	elemol	0.67
2-methylbuthylester	0.35	cubenol	0.73
n amylisovalerate	0.08	caryophyllene oxide	0.18
octatriene	0.15	ledol	4.33
isomenthone	0.29	globulol	0.08
menthofurane	54.95	tau-muurolol	0.11
pulegone	0.31	α-cadinal	0.22
Total = 97.92%			

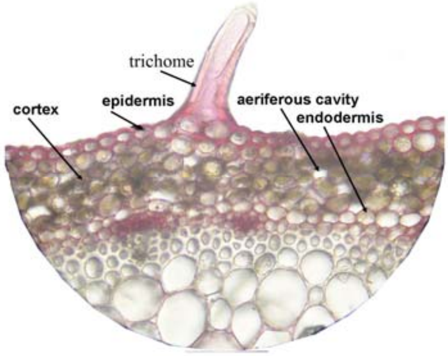

Fig. 1. Transversal structures of Mentha aquatica stem (ob. 25x, oc.12, 5x)

Fig. 2. The abaxial (left) and adaxial (right) epidermis cells of *Mentha aquatica* leaf (ob. 25x, oc.12, 5x)

a b

Fig. 3. Transversal structure of *Mentha aquatica* leaf (ob. 25x, oc.12, 5x)

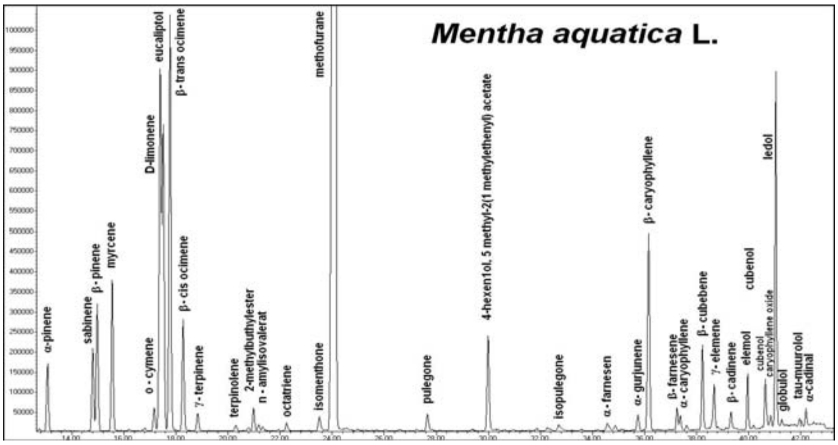

Fig. 4. The chromatogram of essential oil from *Mentha aquatica* L., fresh *herba*, collected from Danube Delta

The composition of volatile oils extracted from *Perovskia atriplicifolia* Benth flowers and leaves

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Keywords: essential oil, leaves, flowers, *Perovskia atriplicifolia,* eucalyptol, tau-cadinol, camphor

ABSTRACT
This studies relieved that volatile oil extracted from *Perovskia atriplicifolia* flowers presented a smaller monoterpenes content (57,71%) and a higher sesquiterpenes content (40,08%), compared with those extracted from leaves (65,59% and 30,63% respectively). Flower extracted volatile oil contained higher quantities of eucalyptol (15,83%), tau-cadinol (14,67%), α-pinene (10,88%), β-caryophyllene (7,99%) and α-caryophyllene (7,99% and 6,96% respectively), and the one extracted from leaves eucalyptol (21,36%) and camphor (14,31%).

INTRODUCTION

Perovskia atriplicifolia is a Lamiaceaes shrub, which is native to central Asia in an area that includes Afghanistan, Iran, Pakistan, and Tibet. It is sometimes called "sage of Afghanistan", "lavender of Afghanistan" or "Russian sage", like other species of the genus *Perovskia.* The intense fragrance of Russian sage is similar to some of the true sages. It was a relatively unknown landscaping plant until the 1990s, in spite of being mentioned by well known landscape authors such as Gertrude Jekyll and Russell Page (Gardner, 1998).

Its average height is about 1 m with lobed, deeply notched silvery-grey leaves, with the glandular trichomes present on leaves and flowers. Their inflorescences at the apical part of the stem are a panicle with tubular blue flowers. Both leaves and flowers are intense perfumed.

Perveen et al. (2006) found that the plants from this specie contain phenolic compounds like isorinic acid and catechol derivates, ferulic and caffeic acid. Iassbi and Ahmad (1999) said that volatile oil extracted from *Perovskia atriplicifolia* contain a high quantity of 1,8-cineole (27,5%), δ-carene (22,3%), β-caryophyllene (10,8%) and α-humulene (5,7). Zamfirache, et al. (2009) sustained that the leaves of this specie contain three types of glandular trichome and the volatile oil had a higher content of limonene (18%), γ-terpinene (16%), β-caryophyllene (13%), α-caryophyllene (12%) and cymene (11%).

MATERIAL AND METHODS

Studies have been performed on *Perovskia atriplicifolia Benth* plants provided by SCDLF Bacău and grown in Botanical Garden of USAMV Bucharest. Analyzed samples, leaves and flowers, have been harvest in the blossoming period at the end of September 2010 (Fig. 1).

The volatile compounds from flowers and leaves were extracted by hydrodistillation with a Liskens-Nickerson apparatus. The separation and identification of components has been carried out using an Agillent gas chromatograph, equipped with quadruple mass spectrometer detector. A capillary column DB-5 (30 m length x 0,25 mm i.d. and 0.25 µm film thickness) and helium as carrier gas were used. The initial oven temperature was 50°C, then rising to 280°C at a rate of 4°C/min. The NIST spectra bank was used for to identify the volatile compounds, which were verified with the Kovats indices.

RESULTS AND DISCUSSIONS

Through the methods that we applied 52 substances where extracted from *Perovskia atriplicifolia* flowers volatile oil, and 66 substances from *Perovskia atriplicifolia* leaves volatile oil, which 42 were identified. Those represent 97.79% of the total substances extracted from flowers and 92.22% of the ones from leaves.

Monoterpenoid hydrocarbons where found in higher quantity in volatile oil extracted from flowers (34.72% from total compounds identified), compared with that extracted from leaves (31.51%). Otherwise, the monoterpenoid alcohol content in the flowers extracted volatile oil was lower (17.82%) compared with that extracted from leaves (24.39%). Volatile ester content presented small differences – 5.12% for flowers and 5.59% for leaves. A similar situation was observed for aldehydes, which had very low, but comparable concentration: 0.05% in flowers and 0.1% in leaves (Figure 2).

Sesquiterpenes where found in smaller quantity then monoterpenes, which represented 40.08% from flowers extracted volatile oil and 30.63% from leaves extracted volatile oil.

The data analysis suggests that volatile oil from both leaves and flowers of *Perovskia atriplicifolia* contains the same compounds except myrtenol, eugenol, α-copaene and α-muurolene which where found in small quantities (Table 1).

Main substances identified in flowers volatile oil are eucalyptol (15.83%), tau-cadinol (14.67%), α-pinene (10.88%), camphor (8.91%), β-caryophyllene (7.99%), α- caryophyllene (6.96%) and 3-carene (4.54%). In leaves volatile oil the proportions changes eucalyptol (21.36%), camphor (14.31%), tau-cadinol (9.63%), β-caryophyllene (5.88%), α-caryophyllene (5.42%) and 3-carene (5.30%). Flowers have a α-pinene and tau-cadinol higher content then leaves, and the leaves have a higher content of eucalyptol and camphor.

Presented results are similar to those obtained by Iassbi and Ahmad (1999), but different from that one obtained by Zamfirache et. al. (2009) who determined high linalool content in the volatile oil obtained from *Perovskia atriplicifolia* leaves.

CONCLUSIONS

In *Perovskia atriplicifolia* extracted volatile oil the presence of 40 compounds was identified. This represent 97.79% of flowers extracted volatile oil total compounds and 92.22% of the one extracted from leaves.

Analyses revealed that *Perovskia atriplicifolia* flowers extracted volatile oil had smaller monoterpenes content (57.71%) and higher sesquiterpenes content (40.08%) compared with the one extracted from leaves (65.59%, 30.63% respectively)

Flowers extracted volatile oil had higher eucalyptol (15.83%), tau-cadinol (14.67%), α-pinene (10.88%) and camphor (8.91%) contents and the one extracted from leaves higher eucalyptol (21.36%), camphor (14.31%) and tau-cadinol (9.63%) contents.

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TABLE AND FIGURES

Table 1

The chemical composition of *volatile* oils extracted from *Perovskia atriplicifolia* leaves and flowers

No.	Substance name	Flowers	Leaves
1	Triciclene	0.15	0.10
2	α-Thujene	0.15	0.07
3	α-Pinene	10.88	3.75
4	Camphene	3.89	3.19
5	β-Pinene	3.49	2.01
6	β-Myrcene	0.72	0.59
7	α-Phelandrene	0.16	0.10
8	3-Carene	4.54	5.30
9	α-Terpinene	0.16	0,10
10	β-Cimene	0.32	0.72
11	Eucaliptol	15.83	21.36
12	γ-Terpinene	0.34	0.24
13	Terpinolene	0.58	0.37
14	Linalool	0.13	0.28
15	Nonanal	0.05	0.10
16	Octyl acetate	0.20	0.17
17	β-Thujone	0.09	0.09
18	Camphor	8.91	14.31
19	Borneole	1.75	2.44
20	Terpinene-4-ol	0.11	0.26
21	α-Terpineole	0.19	0.42
22	Myrtenol	nd	0.05
23	Linalyl acetate	0.13	0.15
24	Bornyl acetate	2.13	1.84
25	Myrtenil acetate	0.13	0.19
26	p-Menthadiene	0.07	0.09
27	α-Terpinyl acetate	2.53	3.24
28	Eugenole	nd	0.06
29	α-Copaene	0.08	nd
30	β-Caryophyllene	7.99	5.88
31	α-Caryophyllene	6.96	5.42
32	Epibiciclosesquiphellandrene	0.64	0.16
33	δ-Cadinene	2.77	1.41
34	γ-Cadinene	0.38	0.32
35	α-Muurolene	0.11	nd
36	Caryophillene oxide	0.73	2.47
37	Cubenol	2.41	1.62
38	γ-Eudesmol	0.36	0.81
39	tau-Cadinol	14.67	9.63
40	α-Eudesmol	1.40	1.19
41	Ledol	1.22	1.19
42	α-Bisabolol	0.44	0.53
Total		**97.79%**	**92.22%**

Figure 1. *Perovskia atriplicifolia* flowers and leaves

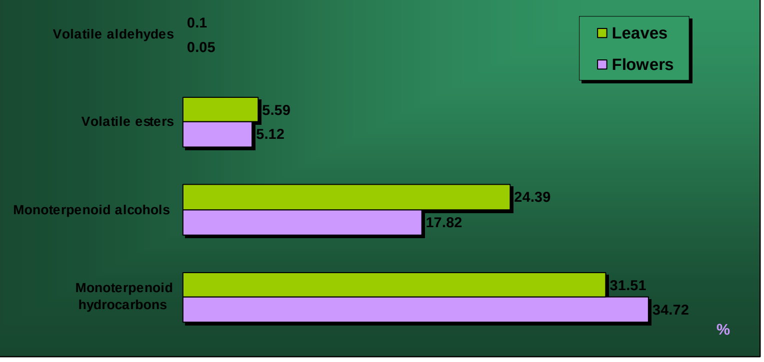

Figure 2. Differences between the quantities of main volatils categories in flowers and leaves of *Perovskia atriplicifolia*

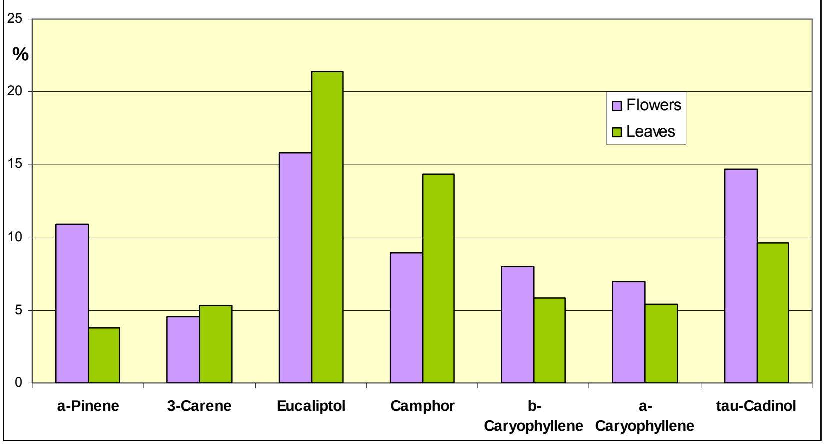

Figure 3. Differences between the quantities of main volatile compounds in flowers and leaves of *Perovskia atriplicifolia*

Effect of applied fertilizer on the chemical composition and quality of potatoes

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Keywords: potato, tubers, starch, soluble solids, minerals, respiration rate, quality, NPK fertilizers, agrofond

ABSTRACT

The cultivar characteristic features, soil humidity and temperature influence increasing the potato yield also the applied fertilization. The potato-studied cultivars accumulate different mineral element amounts in function of the applied fertilizer. Cosmos, Tresor, Bellarosa cvs. accumulate the highest amount of K on Agrofond I: $N_{150}P_{50}K_{50}$. Phosphorous is absorbed and accumulated by all studied cultivars at high NPK concentrations characteristics for Agrofond III: $N_{250}P_{150}K_{150}$. Increasing the NPK doses inhibit absorption and accumulation of Mg in all studied cultivars. Calcium ion is preferentially absorbed and accumulated depending on the applied agrofond. Starch content depends on the cultivar, for the same applied fertilizers. Agrofond II: $N_{200}P_{100}K_{100}$ determined for all the studied cultivar an increasing of starch accumulation, while the Agrofond II: $N_{200}P_{100}K_{100}$ determined for all studied cultivars a decreasing of the soluble solids content. Also Agrofond II: $N_{200}P_{100}K_{100}$ influenced all cultivars by a decreasing of the respiration rate, so, increasing the potato storage capacity.

INTRODUCTION

Potato is cultivated for its tubers, which are used for the culinary purpose, as well as a raw material for the spirits, starch, glucose, and dextrose industry. The cultivar characteristic features, soil humidity and temperature influence increasing the potato yield also the applied fertilization. De la Morena et al. (1994) studied four potato cultivars during the vegetation period and found out that yield varied in function of the steams numbers, tubercles number/steams and tubercles weight. The thermohydric fluctuation for a short interval does not have an influence on the tubercle growing rate because there is not affected the enzymes activity implied to starch accumulation. Some resistant cultivars to the thermohydric stress, as for instance Desire cv. accumulate 4-5 times higher amounts of sucrose, as compared the sensible ones (Basu et Minhas, 1991).

Nitrogen fertilization has a great influence on the vegetative growing, as well as on nitrates accumulation in tubercles, 2-5 times more that the unfertilized control (Carter and Bosma, 1994). Blecharczyk et al. (2008) noticed that combined farmyard manure and NPK treatment had a favourite effect on N, P, K and Mg content in tubers compared to NPK plots, but decreased dry matter, Ca and starch contents. Research performed by Sadej et al. (2007) emphasized that fertilization systems contributed to an increase in nitrate concentrations in potato tubers. The application of mineral fertilizers and farmyard manure resulted in a slight excess of the maximum permissible NO_3^- concentrations in potato tubers.

MATERIAL AND METHODS

The biological material has been represented by 6 potato cultivars: Finka, Bellarosa, Adora, Tresor, Cosmos and Almera, cultivated at the Research and Development Center for the Plant Culture on Sands Soils - Dăbuleni, on Agrofond I : $N_{150}P_{50}K_{50}$; Agrofond II: $N_{200}P_{100}K_{100}$ and Agrofond III: $N_{250}P_{150}K_{150}$.

Using the following parameters it has carried out the qualitative potato tubers characterization: starch and simple sugars content, minerals, soluble solids content and respiration rate. The used methods are those standardized: starch dosage by Nicolet FT-IR spectrometry; minerals by Thermo spectrometry ICP-AES; soluble solids by refractometry and respiration rate using a RIKEN infrared CO_2 analyzer.

RESULTS AND DISCUTIONS

On the world level there are many concerns to increase and diversify the legumes yield, with a better reliance of the locally ecological and soil climatic conditions in order to respond to qualitatively imposed exigencies which are nowadays higher. There are created cultivars and hybrids with higher agroproductive characteristics and commercially quality, but these are influenced by the environmental factors: temperature, humidity, technological factors, as well as theirs interactions.

Generally, legume importance and especially potato tubers the absorbed minerals also justify their importance; those are indispensable for a healthy organism. By analyzed data (Table 1) it can be noticed that for all the studied cultivars there are present minerals as: K, P, Mg, Ca, Na, Fe, B, Mn, Cr, Cu, Al, and Zn. These minerals accumulation is different from one to other cultivars in function of the applied agrofond.

Potassium is accumulated 1.6 times at Agrofond I cultivars compared with those of Agrofond II and Agrofond III. In the case of Agrofond I the highest K accumulation is registered at Cosmos cv., followed by Tresor, Bellarosa and Finka cvs. It can be appreciated that the K accumulation is proportionally opposite with K level administration, presumably the ammonium ion inhibited K ion absorption (Burzo and Dobrescu 2005).

Phosphorous is present in high amount at all cultivars Agrofond III. The P accumulation being 1.3-2 times higher as compared those determined at Agrofond I. In the case of Agrofond III, the highest value was registered at Finka cv. and the lower one at Bellarosa cv., intermediary values being determined at Tresor, Cosmos, Almera, and Adora. All these data are correlated with ash content (Table 3). The phosphorous accumulation in potato tubers can be explained by the synergic relation of this mineral element with nitrogen, respectively the optimum nitrogen quantity favors phosphorous absorption, also its translocation from leaves to tubers (Dobrescu, 2007).

As regard as the Mg, this has been determined at all studied cultivars. The highest accumulation has been noticed also for Agrofond I and there was registered a steeply decreasing and differently in function of cultivar from Agrofond II to Agrofond III, with a rate of 1.6-2.3 times. Therefore, increasing NPK doses has a negatively impact on the absorption process and respectively Mg accumulation in the case of the studied cultivars, the explanation can be the antagonistic relations between N and Mg.

Calcium are also accumulated in the most of studied cultivars for Agrofond I with small differences between Finka and Bellarosa (6.278-6.272 mg/100 edible F.W.) and between Cosmos and Almera (5.617-5.593 mg/100 edible F.W.) and the lower values has been determined at Tresor 2.979 mg/100 edible F.W. In this case Agrofond II application stimulated calcium accumulation by 2.73 times as against the Agrofond I, following a decreasing by 1.3 times in the case of Agrofond III. It can be appreciated that Ca^{2+} is preferentially absorbed and accumulated depending on the cultivar for each applied Agrofond.

Natrium potato content registered high values following Agrofond I and III application and the concentrations are lower in the case of the Agrofond II. The highest values have been registered at Finka, Bellarosa, Cosmos in the case of Agrofond I and Agrofond III. It can be remarked that for these cultivars and in the same fertilization conditions, also K ion was determined in a high amount, so it can be considered that those two ions step in to regulate the cellular osmotic potential and control plant resistance against the thermohidric stress.

Boron is the element implicated in the tuberisation process in relation with its implication in sugars translocation registered an approximately constant concentration (0.636-0.672 mg/100 edible F.W.) for all variants, without considerably variation between the studied cultivars.

Research performed indicated Mn, Cr, and Cu accumulation as being cultivar dependent, concentrations varied in large limits, being higher in the case of the cultivars grown on Agrofond I. As for instance Mn presents a concentration ranging between 0.001-0.110 mg/100 edible F.W., with the highest values for Tresor, Cr content varied between 0.020-0.052 mg/100 edible F.W. with the highest value at Cosmos and for Cu limits content were between 0.112-0.185, with higher value at Adore cv.

As regard as Al and Zn amounts it can be noticed that in the case of aluminum the highest concentration has been registered on Agrofond I for all studied cultivars, while Zn accumulation has been proportionally with the increasing the administrated NPK concentrations. It must be remarked that those two elements are in a small concentration the maximum admitted limit of 10 mg/100 edible F.W according with OMS 975/1998 (Gherghi et al., 2001).

Analyzing the obtained results regarding the starch accumulation and soluble solids content (Table 3) it was emphasized the difference between the studied cultivars in relation with NPK concentration. The highest value was determined at Finka cv. (14.58%), when there was applied the fertilization with $N_{200}P_{100}K_{100}$ and the lower value was registered at Tresor cv. (10.94%) with the fertilization with $N_{150}P_{50}K_{50}$.

Data presented in Table 2 as regard as the starch and soluble solids contents indicate different values depend on the studied cultivar and the used Agrofond. Agrofond I determined the highest starch contents at Bellarosa (13.39%). The highest starch accumulation (14.58%) has been registered at Finka under Agrofond II, following Almera cv. (13.98%) on Agrofond III. Relatively low values there were registered at Tresor and Cosmos, with small variations: 0.45-0.17 from one Agrofond to another Agrofond.

Concerning soluble solids content it was noticed that at a high NPK concentration, Agrofond III favours the increasing of the soluble solids content at Almera 7.7% and Tresor 6.9%. It can be remarked that for all cultivars Agrofond II induced a decreasing of soluble solids concentration.

Crop quality is also appreciated by the respiration rate evolution (Burzo et al. 2004). It is known that the respiration rate is high after the tuberisation process is finished and decreases about 10 times during tubers maturation phase. After the harvesting moment the respiration rate is reduced, to surpass the tubers qualitatively depreciation. Following these researches there was demonstrated that the respiration intensity registered higher values at all fertilization variants, but the higher NPK concentrations determined at Cosmos cv. a decreasing of the respiration rate. For Tresor and Almera respiration intensity increased proportionally with the NPK concentrations, so, in the case of Agrofond III the respiration rate was highest. The respiration rate values are correlated with dry matter (Table 3), part of substances being degraded in this process.

Analyzing the Figure 1 it can be observed that at Agrofond II for all the studied cultivars there were determined low values for the respiration rate. So, it can be recommended to apply Agrofond II with a view to maintain the respiration rate at reduced values, correlating this fertilization with an increasing of the starch accumulation too, for the used cultivars, taking into consideration that those two physiological and biochemical parameters assure potato quality.

CONCLUSIONS

1. The potato-studied cultivars accumulate different minerals depends on the applied fertilizer.
2. Cosmos, Tresor, Bellarosa cvs. accumulate the highest amount of K on Agrofond I: $N_{150}P_{50}K_{50}$;
3. Phosphorous is absorbed and accumulated by all studied cultivars at high NPK concentrations characteristics for Agrofond III: $N_{250}P_{150}K_{150}$

4. Increasing the NPK doses inhibit absorption and accumulation of Mg in all studied cultivars.
5. Calcium ion is preferentially absorbed and accumulated depending on the applied Agrofond.
6. Starch content differs in function of cultivar, in the case of the same Agrofond. Agrofond II: $N_{200}P_{100}K_{100}$ determined for all the studied cultivar an increasing of starch accumulation.
7. Agrofond II: $N_{200}P_{100}K_{100}$ determined for all studied cultivars a decreasing of the soluble solids content.
8. Agrofond II: $N_{200}P_{100}K_{100}$ influenced all cultivars by a decreasing of the respiration rate, so, increasing the potato storage capacity.

Acknowledgements

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TABLES AND FIGURE

Table1

The mineral content of potato tubers depends on the applied NPK fertilization

Cultivar	**K**			**P**			**Mg**		
	Agrofond			*Agrofond*			*Agrofond*		
	I	**II**	**III**	**I**	**II**	**III**	**I**	**II**	**III**
Finka	247.206	181.789	145.228	70.527	102.640	130.536	18.750	10.953	7.954
Bellarosa	245.608	142.967	151.013	80.066	95.342	107.411	21.421	13.192	12.789
Adora	186.469	154.832	116.176	75.771	92.063	111.187	16.246	11.798	8.756
Tresor	249.734	207.343	144.830	64.089	94.521	121.789	20.242	15.769	8.472
Cosmos	301.707	186.156	152.274	57.431	107.876	120.006	22.413	10.873	9.411
Almera	215.537	183.649	175.780	82.329	89.614	117.487	19.275	11.694	11.541
Cultivar	**Ca**			**Na**			**Fe**		
	Agrofond			*Agrofond*			*Agrofond*		
	I	**II**	**III**	**I**	**II**	**III**	**I**	**II**	**III**
Finka	6.278	4.528	4.458	4.679	1.982	4.206	0.948	0.727	0.484
Bellarosa	6.272	4.011	3.257	3.922	1.671	3.196	0.778	0.427	*0.658*
Adora	4.762	*6.092*	4.973	2.630	1.977	3.762	0.762	0.526	0.338
Tresor	3.979	*10.898*	7.957	2.710	1.881	3.645	0.668	*0.772*	0.435
Cosmos	5.617	4.388	4.141	4.166	2.125	3.815	0.954	0.942	0.458
Almera	5.593	4.615	4.411	3.712	1.899	2.647	0.941	0.555	*0.706*
Cultivar	**B**			**Mn**			**Cr**		
	Agrofond			*Agrofond*			*Agrofond*		
	I	**II**	**III**	**I**	**II**	**III**	**I**	**II**	**III**
Finka	0.663	0.654	0.641	0.045	0.017	0.015	0.041	0.038	0.044
Bellarosa	0.666	0.663	0.654	0.090	0.056	0.006	0.047	0.055	0.033
Adora	0.651	0.656	0.636	0.043	0.056	0.060	0.020	0.037	0.039
Tresor	0.669	0.659	0.642	0.044	0.110	0.101	0.043	0.028	0.044
Cosmos	0.672	0.650	0.643	0.103	0.001	0.008	0.052	0.033	0.033
Almera	0.657	0.662	0.653	0.051	0.005	0.030	0.027	0.040	0.035
Cultivar	**Cu**			**Al**			**Zn**		
	Agrofond			*Agrofond*			*Agrofond*		
	I	**II**	**III**	**I**	**II**	**III**	**I**	**II**	**III**
Finka	0.181	0.127	0.003	1.808	1.352	1.220	0.558	1.829	1.907
Bellarosa	0.154	0.126	0.114	1.572	0.785	1.666	0.886	1.685	1.709
Adora	0.135	0.185	0.122	1.702	1.331	0.799	1.225	1.662	2.132
Tresor	0.147	0.134	0.119	2.402	1.999	1.029	0.625	1.632	2.051
Cosmos	0.177	0.123	0.016	2.118	2.828	1.192	0.438	1.639	1.893
Almera	0.133	0.112	0.112	1.902	1.625	1.972	1.125	1.418	1.557

Table 2

The starch and soluble solids content of potato tubers depends on the applied NPK fertilization

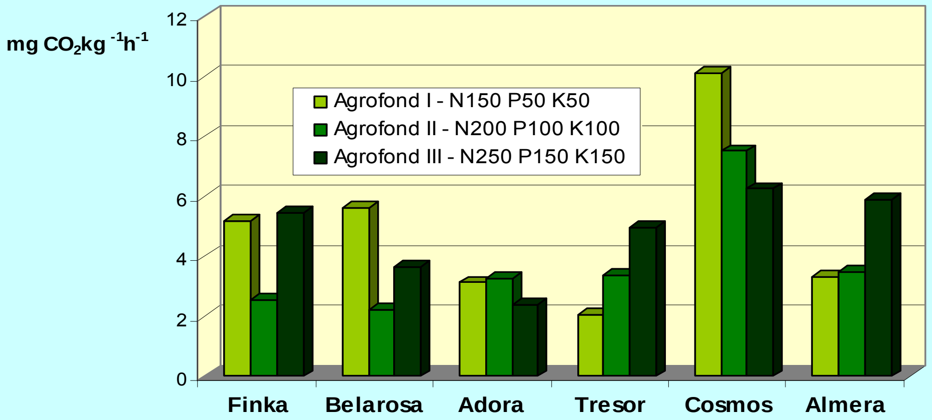
Cultivars	**Starch %**			**Soluble solids %**		
	Agrofond I	**Agrofond II**	**Agrofond III**	**Agrofond I**	**Agrofond II**	**Agrofond III**
	$N_{150}P_{50}K_{50}$	$N_{200}P_{100}K_{100}$	$N_{250}P_{150}K_{150}$	$N_{150}P_{50}K_{50}$	$N_{200}P_{100}K_{100}$	$N_{250}P_{150}K_{150}$
Finka	11.52	**14.58**	13.84	5.0	4.0	**6.1**
Bellarosa	**13.39**	12.76	13.44	5.7	5.9	*3.7*
Adora	12.13	11.59	10.99	4.7	4.3	**6.9**
Tresor	*10.65*	11.11	10.94	5.3	4.0	5.6
Cosmos	12.77	12.22	12.82	6.0	4.4	**7.7**
Almera	13.22	13.27	**13.98**	5.9	5.2	5.7

Table 3

The water, dry matter and ash contents of potato tubers depends on the applied NPK fertilization

Cultivar	Water %			Dry matter %			Ash %		
	Agrofond I	Agrofond II	Agrofond III	Agrofond I	Agrofond II	Agrofond III	Agrofond I	Agrofond II	Agrofond III
	$N_{150}P_{50}K_{50}$	$N_{200}P_{100}K_{100}$	$N_{250}P_{150}K_{150}$	$N_{150}P_{50}K_{50}$	$N_{200}P_{100}K_{100}$	$N_{250}P_{150}K_{150}$	$N_{150}P_{50}K_{50}$	$N_{200}P_{100}K_{100}$	$N_{250}P_{150}K_{150}$
Finka	81.30	80.20	81.03	18.70	19.80	18.97	*0.66*	0.80	**0.90**
Bellarosa	82.00	*79.09*	79.95	18.00	**20.91**	20.05	0.73	0.69	0.85
Adora	80.27	82.70	80.98	19.73	17.30	19.02	0.68	*0.66*	0.75
Tresor	80.03	80.82	81.42	19.97	19.18	18.58	0.79	0.77	0.88
Cosmos	*79.54*	80.99	82.83	**20.46**	19.01	17.17	0.81	0.80	0.88
Almera	83.69	**85.55**	**84.75**	16.31	*14.45*	15.25	0.72	0.70	**0.96**

Figure 1. The respiration rate of potato tubers depends on the NPK fertilization



Contribution to knowledge the volatile oil from *Paeonia officinalis* L. flowers

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Keywords: Paeonia officinalis, volatile oil, floral scent, parfume.

ABSTRACT

***Paeonia officinalis* flowers have a weak scent, which contains a high quantity of terpenes. From these substances, monoterpenes are in majority, such: β-citronelol (22.24%), and eucalyptol (6.22%) and sesquiterpenes: β-cariophyllene (13.36%), dihydro-trans-farnesole (11.31%) and trans-farnesole (7.41% from the total content of the determined components). There were also quantified high quantities of hydrocarbons (25.70%).**

INTRODUCTION

Paeonia officinalis is a herbaceous perennial plant, with white, red, pink, or krimson petals, native to Central and South-East Europe. Its flowers are often fragrant or have no any parfume (Carter, 2007).

Until now the studies were carried out on the chemical components of the roots from diferent species of *Paeonia*. Yu Jin et al (1985) determined monoterpenic glucozides (paeoniflorin) which had sedative, antispasmodic and anti-inflamatory effects, and cetonic compounds (paeonol) and their glicozides (paeonoside, paeonol) which had been shown to be antibacterial, antifungal, analgesic, sedative and anti-spasmodic.

Researches concerning the floral scent of Paeonia officinalis flowers were carried out by Burzo and Mihăescu (2003). They established that citronellol and geraniol were the main components.

MATERIALS AND METHODS

The investigations were carried out with on *Paeonia officinalis* flowers, from a private garden. Volatile oil has been extracted from flowers by hidrodistilation, using for this purpose a device type Siger Nikerson.

Separation of the components was performed with an AGILENT gaschromatograph, with a masspectrometric detector with quadrupol. It was used a capillary column type DB5 having a length 30 m and diameter of 0,25 mm, with helium as carried gas. The initial temperature of the oven was 50 ^{o}C, isothermal 4 minutes and increased to 280 ^{o}C, with a gradient 4 ^{o}C/ minute.

To confirm the exact position of the peaks in chromatogram, there were also used the Kovats retention index and a series of n-alkanes as references.

RESULTS AND DISCUSSIONS

The components of volatile oil from *Paeonia* flowers are presented in figure 1 and their concentration, in table 1.

The data showed that floral scent of *Paeonia* flowers had a greate amount of mono and sesquiterpenes. From the total content of compounds, □-citronellol which is aciclic monoterpenic alcohol, represented 22.24%, and eucalyptol wich is biciclic monoterpenic alcohol, represented 6.22%. A small quantity of monoterpenes was determined in the case of citronellil acetate (0,98%), nerol (0,82%), terpinene-4-ol (0,5%) and linalool (0,43%).

In the case of sesquiterpenes, three components were determined in higher quantities: α-cariophyllene (13.36%), dihydro-trans-farnesole (11,31%) and trans-farnesole (7.41%).

From the total components, hydrocarbons represented 25.70% and were represented by: tricosane (10.03%), heneicosane (7.17%), pentacosane (4.00%), docosane (1.64%), tetracosane (0.94%), heptacosane (0.81%), nonadecane (0.69%) and eicosane (0.42%).

The presented results confirmed those that had been obtained by Burzo and Mihaescu (2003), concerning α-citronellol which had been determined in high quantity in volatile oil from Paeonia flowers, but were different regarding the hydrocarbons content.

CONCLUSONS

Paeonia officinalis flowers have a low content of volatile substances; this was the reason for using the hexan as capture.

In Paeonia flowers perfume there were determined high quantities of terpenes: monoterpenes were in majority, such: α-citronelol (22.24%), and eucalyptol (6.22%) and sesquiterpenes: α-cariophyllene (13.36%), dihydro-trans-farnesole (11.31%) and trans-farnesole (7.41% from the total content of the determined components).

There was also determined a high quantity of hydrocarbons (25.70%).

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TABLE AND FIGURE

Table 1

The main components from volatile oil of *Paeonia officinalis* flowers

No.	Retention time	Name of substance	% of total identified compounds
1	10,866	Dimethyl heptadiene	1,41
2	17,469	Eucalyptol	6,22
3	20,729	Linalool	0,43
4	24,667	Terpinen-4-ol	0,50
5	26,483	Dimethyl benzofuran	0,57
6	27,344	β-Citronellol	22,24
7	28,385	Nerol	0,82
8	33,010	Citronellyl acetate	0,98
9	36,415	β–Caryophyillene	13,36
10	37,541	α-Caryophyillene	2,18
11	40,323	trans-Nerolidole	0,45
12	40,999	Caryophyillene oxid	1,70
13	42,036	trans-Longipinocarveole	1,29
14	42,831	Dihydro-trans farnesole	11,31
15	43,338	trans-Farnesole	7,41
16	43,637	Farnesole	0,22
17	44,975	Hexahydrofarnesylacetone	0,70
18	45,614	Nonadecane	0,69
19	45,909	Methyl palmitate	0,38
20	46,717	Eicosane	0,42
21	47,748	Heneicosane	7,17
22	48,645	Docosane	1,64
23	49,536	Tricosane	10,03
24	50,312	Tetracosane	0,94
25	51,126	Pentacosane	4,00
26	52,843	Heptacosane	0,81

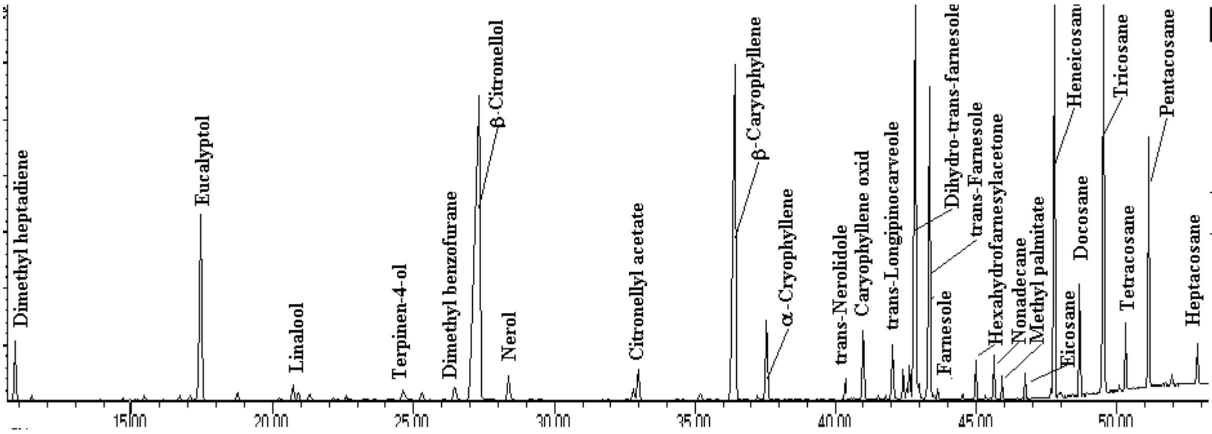

Fig. 1. The chromatogramof volatil oil extracted from *Paeonia officinalis L.* flowers

Ruderal vegetation, between option and necessity

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Keywords: ruderal vegetation, an alternative, aesthetic recovery, reduced management, avant-garde

ABSTRACT

The article argues in favour of spontaneous vegetation in urban areas that can be a viable alternative, even in relation to aesthetics, of traditional landscape facilities, taking advantage of its high adaptability to the specific environmental factors in the city, its reduced maintenance costs and superior margin of success. It is discussed in terms of both botanical, respectively phytosociological, and landscape.

INTRODUCTION

Ruderal vegetation is a result of human activity (it forms with the vegetal ones the anthropophilous vegetation), installed on the "territories inhabited by people" (C. Chirila, 2001): on trodden field, in manure storage places, on roadside, or vacant, degraded or abandoned lands, at the crops edge, etc.

In urban areas, the human contribution to shaping the landscape is essential; vegetation, in turn, obeying these rules, has become predominantly anthropogenic.

Bucharest, in particular, is up to the end of the nineteenth century "a city dominated by vegetation more than buildings" (Ioana Tudora, 2009). Starting from the example of the "garden path", Romanian invariant, unlike the French one, that appears even if "not always drawn geometrically", "well defined and separated," has "valued the path invasion by plants on the side, her loss under the pile of leaves, grass growth among the stones, in short, the strength and wildness of free nature" (Dolores Toma, 2001).

The twentieth century modernization of the city has imposed a "radical shift in the predominance of gardens" (Ioana Tudora, 2009). The forced systematization, practiced during the communist era, led to the creation of green areas that should contribute to the improvement of sanitary conditions imposed by the development of large architectural ensembles" (M. Preda, L. Palade, 1973).

Today, another disturbing factor is exerted on the vegetation in cities: climate changes. For the situation, somewhat overly predictable, the current environment continues to change and provide adverse conditions for cultivated plants, a new approach can be expected from ruderal plants, spring and developed spontaneously in the landscape, that they can be appreciated aesthetically and providing solutions for the future landscape arrangements.

In time, a question will appear: "The use of the ruderal plants in landscape aesthetic décor is a choice or a necessity?"

Some benefits are clear:

1. The characteristic adaptability to severe and changing environmental conditions of the ruderal species facilitates, for this kind of landscape, establishment and maintenance low costs.
2. The emergence of such vegetation in places totally inaccessible for the establishment of traditional arrangements.
3. Development of plants in places with adverse conditions (sun exposure, insufficient water, human presence like a disturbing factor).
4. The recovery, according to new trends in urban development, of the spontaneous vegetation, relying on its versatility, by creating “wilderness” urban areas or by accepting or even by creating of wastelands – a widespread tendency among the vanguard landscapers.

MATERIALS AND METHODS

Various urban areas have been observed to illustrate this subject and were tacked photos with a DCM-LZ7 Panasonic digital camera type.

RESULTS AND DISCUSSION

In the cities, the ruderal vegetation can be found installed in the cracks of sidewalks (Fig. 1), on roadside (Fig. 2), inside the abandoned buildings (Fig. 3), climbed on the ruins, roofs or old balconies (Fig. 4, 5, 6), around the street alignment trees (Fig. 7), in green spaces more (Fig. 8) or less maintained (Fig. 9), on vacant lands (Fig. 10), or as a pretext for landscape (Fig. 11, 12).

Ruderal species are generally pioneer plants, resistant or tolerant to drought and sun exposure (V. Cristea, 2004). They have a higher growth rate than the species found in compact clusters and they are the selection subject of the local ecological factors rather than surrounding species (V. Cristea, 2004). They may be herbaceous or woody plants. Of herbaceous plants, annual species predominate (eg: *Amaranthus retroflexus, Senecio vernalis, Polygonum aviculare, Epilobium* sp. *Solanum nigrum, Sonchus oleraceus, Matricaria recutita, Xanthium italicum, Chenopodium hibridum, Ballota nigra, Veronica* sp. etc.) (Fig. 13). Woody species - trees, shrubs or lianas, are drought, smoke or pollution-resistant plants, adapted to the conditions around human dwellings, with a high capacity propagation by seed or by vegetative organs (eg *Ailanthus altissima, Ulmus minor, Morus* sp., *Populus* sp. *Prunus cerasifera, Parthenocissus* sp. etc.) (Fig. 14).

The floral composition of plant association from urban space, unlike that of the crop edge, consisting usually of weed species from surrounding area, provide a characteristic feature: the presence of the ornamental species "dropped from the culture" or due to intense tourist traffic (Negrean, 1998) (Fig. 15, 16).

In the context of supporting the recovery potential of ruderal plants discussed in the introduction, we can make these options:

- To have something **where** you can't plant anything;
- To still have something **when** you don't have anything planted.

We declare horrified by the savagery with which nature seizes zones and urban areas – roofs, abandoned buildings, peripheral streets, etc. Is this vegetation really inappropriate and subject to an attitude of total non-acceptance? What attitude should / can be taken by the offensive against spontaneous vegetation in urban areas more or less industrialized? It must be aggressively destroyed using different toxic substances or even organic methods or it may be adopted a balanced approach to discover the aesthetic and ecological valences of their presence in places totally inappropriate plantings?

In urban areas ruderal vegetation could be used with the same success, for aesthetically or ecologically purposes, as many ornamental plants, in landscape. There are, indeed, situations in which spontaneous vegetation is incompatible with some structures (bridges, buildings, etc.) (Fig. 17, 18); despite this, there are areas free of buildings spontaneous "arranged" by nature that can compete with human landscape (Fig. 19, 20).

Today, there is a trend of building expansion at the expense of landscaped areas; the deliberate cover of unpretentious vegetation of some buildings could provide a welcome solution in urban areas, increasing the area of green space per capita. It is already known that the presence of plants on the roof reduces inside temperature of buildings during summer, improve conditions for soundproofing and reduces the amount of pollutants in their area (Fig. 21). The choice of species for such arrangements must be made based on several criteria, including frost resistance, drought tolerance, achieving a compact vegetation cover, the ability to restore the areas affected by adverse conditions (guidelines, 2008). An alternative may be offered by ruderal species.

In addition to aesthetic valences, vegetal cover consists of ruderal plants may perform other functions such as interception of precipitation and fluid adjustment, soil protection, surface leak proof or wind speed attenuation.

Finally it should be noted that these trends have occurred in countries that have already gone through all the canons of aesthetic landscape approaching and have found this new approach as a different view of the vegetation natural potential.

CONCLUSIONS

Ruderal vegetation is a characteristic presence in urban environment by setting up in unconventional spaces, being adapted to extreme conditions: heat-stroke, water shortages and pollution. This may be the option for future landscape developments under climate changes. Ruderal species allow the employment in the avant-garde arrangements, such as urban "wilderness" areas or those of "wastelands", and their adaptation to specific town conditions allowed their use to achieve "green roofs". Finally, installing ruderal vegetation in urban areas provide important ecological functions.

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FIGURES

Fig. 1

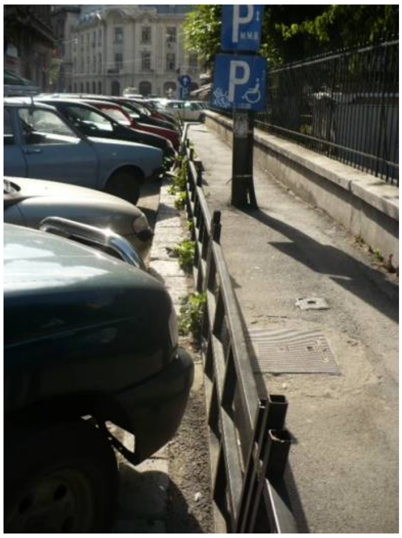

Fig. 2

Fig. 3

Fig. 4. Lipscani street


Fig. 5


Fig. 6


Fig. 7


Fig. 8


Fig. 9 Church „Cu Sfinţi”

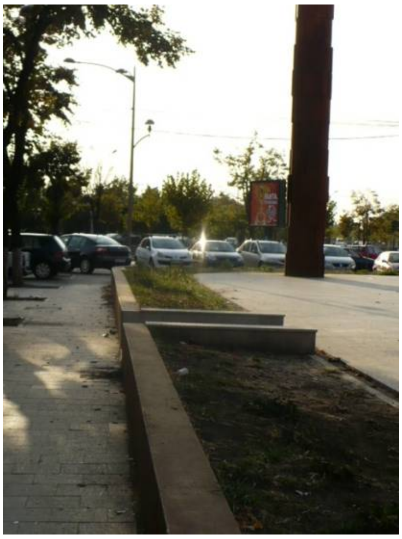
Fig. 11 Holocaust Monument


Fig. 10


Fig. 12 Holocaust Monument

Fig. 13. *Senecio vernalis*

Fig. 16 *Viola wittrochiana*

Fig. 14. *Ailanthus altissima*

Fig. 15. *Persica vulgaris*

Fig. 17 „Izvor” Bridge

Fig. 18 „Izvor” Bridge

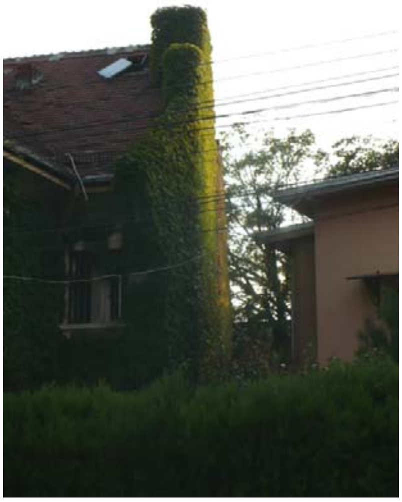
Fig. 21


Fig. 20


Fig. 19

Steviol glycosides: pharmacological effects and radical scavenging activity

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Keywords: ROS scavenging, hydroxyl radicals, steviol glycosides, steviol glucuronide, pharmacological effects

ABSTRACT

Steviol glycosides are sweeteners of *Stevia rebaudiana* Bertoni. Besides sweetening properties, they also possess interesting pharmacological effects such as lowering hypertension, lowering blood glucose in type 2 diabetes, anti-inflammatory as well as anti-carcinogenic and anti-atherosclerotic activities. A radical scavenging activity for hydroxyl radicals of steviol glycosides and steviol glucuronide has now been demonstrated *in vitro*. The activity was measured by the decrease of the fluorescence of hydroxyterephthalate that is formed from terephthalate in the presence of hydroxyl radicals (excitation at 315 nm, emission at 420 nm). Stevioside, rebaudioside A and rubusoside have about the same scavenging activity and were much better (20 x) than glucose or sucrose. It was demonstrated that steviol glucuronide, the excretion product in urine, also has strong ROS ($^{\bullet}OH$) scavenging activity (14 x better than sugar). This activity might explain most of the beneficial pharmacological effects of oral stevioside on ROS related diseases, such as high blood pressure, type 2 diabetes, insulin resistance, atherosleroris, inflammation and certain forms of cancer, as well as certain brain diseases like Parkinson or Alzheimer. More research is still required on this interesting topic.

Abbreviations: Using SV for steviol, allows the use of the following abbreviations: SVgly: steviol glycosides; SVglu: steviol glucuronide; SM: steviol monoside; SVE: steviol 19-ester; SVglu: steviol glucuronide; ST: stevioside, RebA - G: rebaudioside A – G; SB: steviolbioside; DulA: dulcoside A; Rub: rubusoside.

INTRODUCTION

The many pharmacological effects of steviol glycosides have already been discussed (Geuns 2008 a, b; Geeraert et al., 2010). Reactive oxygen species (ROS) are formed, e.g., in organelles with a high metabolic activity like mitochondria (respiration), microbodies and chloroplasts (photosynthesis, typical for plants). Organisms have to deal with these ROS and several mechanisms have been developed to keep these ROS in balance. Stress also induces the production of ROS (Mittler *et al.*, 2004; Mantena *et al.*, 2008).

ROS are, as opposed to molecular oxygen, partly reduced or activated oxygen derivatives. They possess an unpaired electron in the outer orbital which makes these compounds very reactive and toxic and they can lead to oxidative cell death. ROS can attack amino acid residues in proteins, mainly tyrosine, phenylalanine, tryptophane, methionine and cystein, and they can form carbonyl derivatives. ROS also provoke intra- and intermolecular cross-linking such as S-S bonds and protein fragmentation. These modifications mark proteins for degradation. ROS also damage membranes (Shen *et al.*, 1997).

Recently, it was shown that during evolution organisms began using ROS to control and regulate different biological processes, e.g., growth, cell cycle, hormone signalling and apoptosis (Neill *et al.*, 2002; Ballinger, 2005; Jin *et al.*, 2010). In spite of this adaptation, organisms must possess ROS scavenging mechanisms to survive and to control the amount of ROS. These mechanisms can convert ROS into non-radical forms or into less oxidizing radicals. In the body, there are different ROS scavenging enzyme systems like superoxide dismutases (SOD), catalase, glutathione peroxidase, ascorbic acid peroxidase and peroxiredoxine. These, together with antioxidants such as, e.g., glutathione, uric acid and ascorbic acid, are able to detoxify the cells very efficiently (Mittler *et al.*, 2004). In this way, superoxides are converted into H_2O_2 by SODs and then degraded to water by ascorbic acid peroxidases. However, these enzyme systems can only degrade H_2O_2 and convert superoxide. Hydroxyl radicals cannot be degraded (Shen *et al.*, 1997).

Kroyer (1999, 2010) reported that stevioside significantly reduced the breakdown of ascorbic acid (Vitamin C) when a water solution containing both substances was heated at 80 °C for up to 4 h, suggesting a radical scavenging activity. In *Stevia* leaves, some compounds, other than steviol glycosides, have ROS scavenging activity. Ghanta *et al.* (2007) reported an antioxidant potential of crude ethyl acetate extract obtained from the crude 85% methanol extract of *Stevia rebaudiana* leaves. The extract exhibited a preventive activity against DNA strand scission by hydroxyl radicals generated in Fenton's reaction on pBluescript II SK (-)DNA. Its efficacy was better than that of quercetin. The radical scavenging activity was also tested in the 2,2-diphenyl-1-picrylhydrazyl (DPPH) assay, the 2,2'-azinobis-(3-ethyl-benzothiazoline-6-sulfonic acid) (ABTS) assay, the deoxyribose assay for $^{\bullet}OH$, and the anti-lipoperoxidant activity assay by the thiobarbituric acid (TBA) reactive substances reaction. All these assays demonstrated ROS scavenging activity of this relatively apolar fraction, containing the following flavonoids: quercetin-3-O-arabinoside, quercitrin, apigenin, apigenin-4-O-glucoside, luteolin and kaempferol-3-O-rhamnoside. Shukla *et al.* (2009) tested a crude ethanolic extract (possibly containing steviol glycosides too, note from the present author) in different ROS scavenging assays and found ROS significant scavenging in the DPPH assay and in the assays for hydroxyl radicals, nitric oxide and superoxide anions. However, the activity was less than that of ascorbic acid.

The aim of this investigation was to study the possible ROS scavenging activity of steviol glycosides. As the hydroxyl radicals are the most destructive, it was decided to develop an assay to measure the effects of steviol glycosides on $^{\bullet}OH$ scavenging. It is known that steviol glycosides are not absorbed by the intestines (Koyama *et al.*, 2003; Geuns *et al.*, 2003). They are degraded by the bacteria of the colon into steviol, which is easily absorbed and transformed in the liver into steviol glucuronide. This steviol glucuronide can be found in the peripheral blood and it is filtered out by the kidneys and excreted in the urine (Figure 1; Geuns *et al.*, 2006; 2007). Steviol glucuronide was the only compound found in the blood and was suggested as the active principle provoking some pharmacological effects when stevioside is administered in large amounts (up to 1500 mg/d; Geuns 2008a, 2010). Therefore, we also studied the radical scavenging activity of steviol glucuronide.

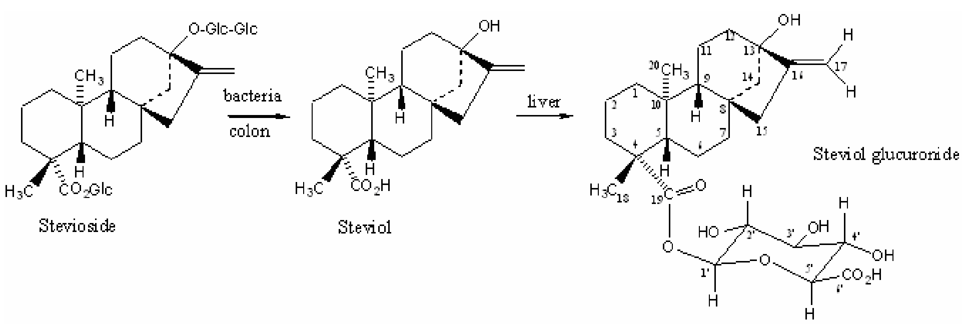

Fig. 1. Hypothetical route from dietary stevioside to steviol glucuronide in human urine

METHODS AND MATERIAL

To study the ROS ($^{\bullet}OH$) scavenging activity, a modified protocol of Linxiang *et al.* (2004) was used. It is an *in vitro* protocol that is very sensitive and reproducible. Terephthalic acid (TPA) is used as a radical scavenger (Figure 2). After contact with hydroxyl radicals, 2-hydroxy-terephthalic acid (HTPA) is formed as a stable end product. TPA itself is barely fluorescent, but the HTPA has a strong fluorescence (excitation at 315 nm, emission at 420 nm; Šnyrychová and Hideg, 2007).

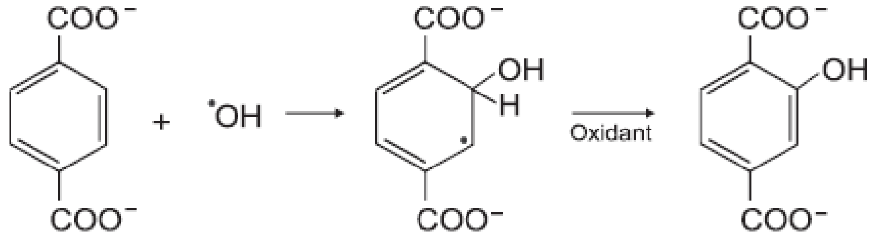

Fig. 2. Formation of the fluorescing hydroxyterephthalate by hydroxyl radicals. Terephthalate itself is barely fluorescent

The radical scavenging activity of compounds can be measured *in vitro* by the decrease of fluorescence due to a decrease of hydroxyterephthalate formation by a reaction mixture containing terephthalate and a production system of $^\bullet OH$. Figure 2 shows the formation of hydroxyterephthalate under influence of $^\bullet OH$.

Hydroxyl radicals were produced by the Fenton, or Haber-Weiss-reaction:

$Fe^{2+} + H_2O_2 \rightarrow Fe^{3+} + {}^\bullet OH + OH^-$
$Fe^{2+} + {}^\bullet OH \rightarrow Fe^{3+} + OH^-$
$H_2O_2 + {}^\bullet OH \rightarrow HOO^\bullet + H_2O$
$TPA + {}^\bullet OH \rightarrow [TPA\text{-}OH]^\bullet$

TPA detects hydroxyl radicals very sensitively, but it is almost unreactive to H_2O_2, superoxide radicals or singlet oxygen (Šnyrychová and Hideg, 2007).

When TPA is added to the solution, there is a competition between TPA, Fe^{2+} and H_2O_2. The product formed can react to HTPA.

$[TPA\text{-}OH]^\bullet + {}^\bullet OH \rightarrow HTPA + H_2O$ (1)
$[TPA\text{-}OH]^\bullet + \text{oxidant} \rightarrow [TPA\text{-}OH]^+$ (2)
$[TPA\text{-}OH]^+ \rightarrow HTPA + H^+$ (3)
$[TPA\text{-}OH]^+ + ½\, H_2O_2 \rightarrow HTPA + H_2O$ (4)

The next reaction from $[TPA\text{-}OH]^\bullet$ is the removal of the hydrogen radical (1). Another possible reaction pathway may be the oxidation-deprotonation of the adduct [(2) and (3)] to provide HTPA, which may be done using H_2O_2 (4).

The reaction mixture (2.5 mL) had the following composition: 500 µM TPA; 10 µM EDTA; 10 µM $FeSO_4$; 100 µM ascorbic acid; different concentrations of scavenger (between 0.25 and 10 mM); 100 µM H_2O_2.

All solutions were made in potassium phosphate buffer (50 mM, pH 7.2). Stevioside, rebaudioside A and rubusoside were purified and crystallized to a purity of over 99% (Struyf *et al*., 2008). The sample of steviol glucuronide was prepared from urine, which might contain a small percentage of impurities, collected from volunteers who consumed 750 mg ST about 3 h before the start of the 24 h urine collection period. Glucose and sucrose were of PA quality of Merck.

To measure the fluorescence of the HTPA formed, a HPLC with a fluorescence detector was used. The HPLC column was substituted for by an empty tube of about 1 m length. The solvent used was water of HPLC quality at a flow rate of 1mL/min. Each run takes about 0.3 min, allowing an injection every 0.5 min. As the HTPA formation progresses for several hours, and as the HTPA formed is very stable, the reaction product was measured after about 16 h at room temperature.

The activity was measured by the areas of the fluorescence peaks of hydroxyterephthalate that is formed from terephthalate by the presence of hydroxyl radicals (excitation at 315 nm, emission at 420 nm). In the presence of ROS scavengers, fewer radicals are formed and hence the fluorescence is less. Figure 3 shows the signal that is obtained from the fluorescence detector. The traces were superimposed to show better the inhibition of fluorescence by increasing concentrations of scavenger (Rub in Figure 3).

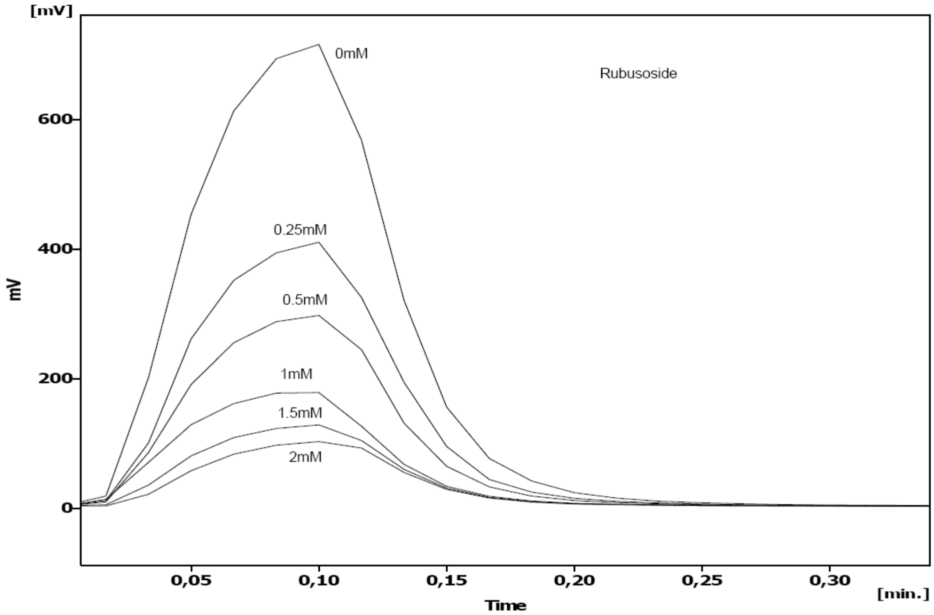

Fig. 3. Example of an overlay of the signals of the fluorescence detector for rubusoside. From top to bottom: 0, 0.25, 0.5, 1, 1.5 and 2 mM rubusoside.

RESULTS AND DISCUSSION

ST, rebA, rub and steviol glucuronide have about the same scavenging activity (Figure 4). Very similar HPLC traces were obtained as the one shown in Figure 3.

Figure 4 shows the decrease of fluorescence by ST, rebA, rub and SVglu plotted against the concentration of scavenger added. Stevioside, rebaudioside A and rubusoside are about equally active. Steviol glucuronide has about the same scavenging activity. The small difference might be due to a small percentage of impurities occurring in the steviol glucuronide.

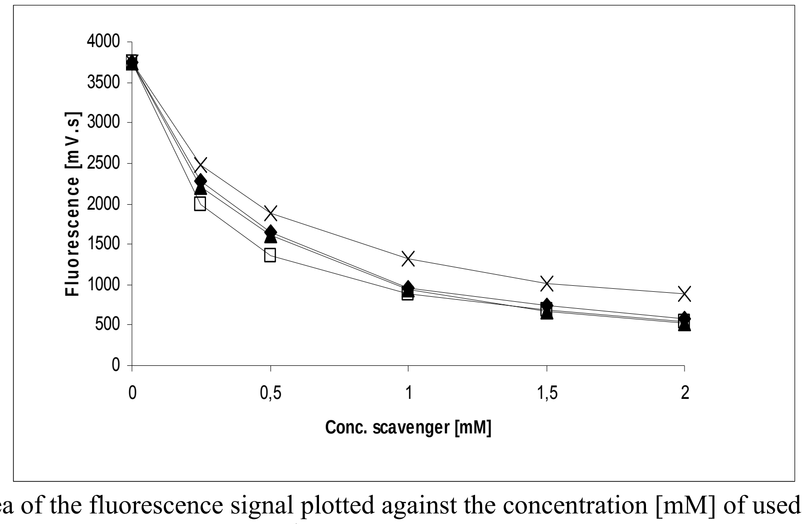

Fig. 4. Area of the fluorescence signal plotted against the concentration [mM] of used scavengers (□ ST, ◆ Reb A, ▲ Rub, ✕ SVGlu)

Sucrose and glucose are known radical scavengers, but are less efficient as a scavenger (greater mM concentrations needed than for SVgly) (Figure 5; Table 1).

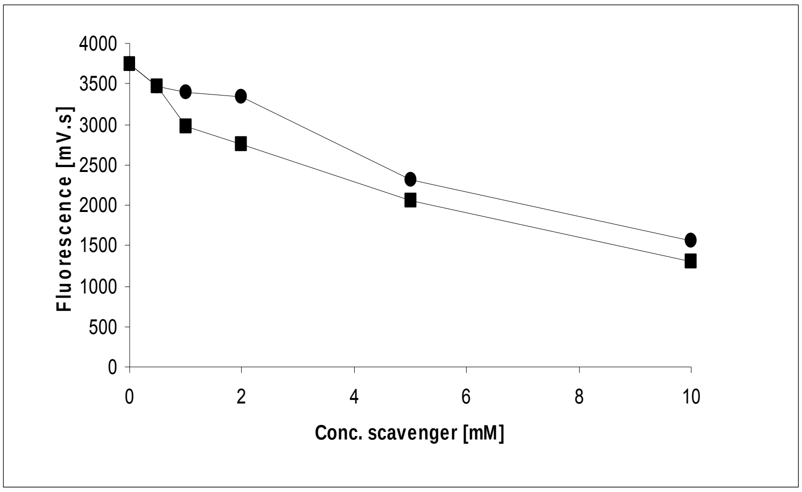

Fig. 5. Area of the fluorescence signal plotted against the concentration [mM] of used scavengers (● Gluc, ■ Sucr)

Plotting the values of Figures 4 and 5 as log (F^0/F -1) against log (concentration of scavenger) produces straight lines, proving that the HTPA inhibition, as a function of scavenger concentration, is a first order exponential function (Figure 6). In this formula, F^0 is the fluorescence of the reaction mixture without scavenger, whereas F is the fluorescence of the mixture after the addition of scavenger.

From the log-log plots of Figure 6, the half-inhibitory concentration of scavenger ($IC_{50}{}^{\bullet}OH$) can be calculated when y = 0 or when log (F^0/F -1) = 0, i.e., when the fluorescence value of F equals half the fluorescence of F^0. It follows then that log (1/0.5 – 1) = log (2 – 1) = 0 (Table 1).

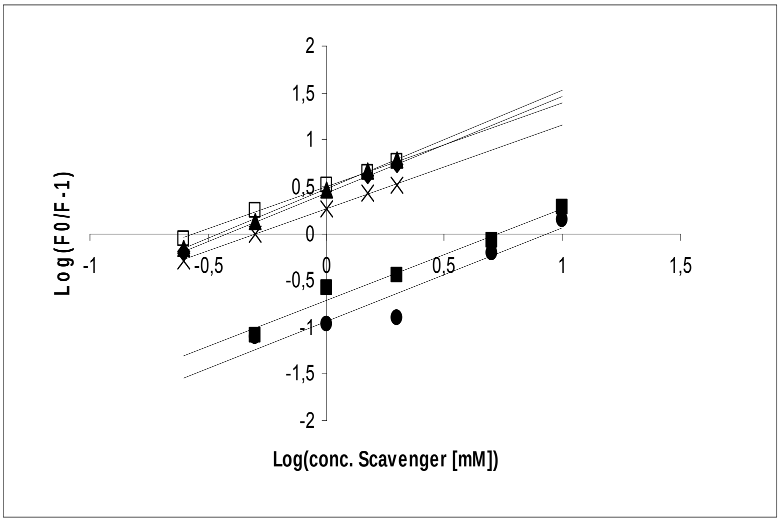

Fig. 6. Log-log plot of the inhibition of HTPA formation by different scavengers (□ ST, ◆ Reb A, ▲ Rub, × SVGlu, ● Gluc, ■ Sucr)

Table 1 gives the equations of the different log-log curves, their correlation coefficients (as r^2), $IC_{50}{}^{\bullet}OH$ and the number of sugar units per molecule.

With y = 0 or (log ((F^0/F) - 1) = 0), the calculation for e.g., stevioside becomes: 0 = 1.0321 x + 0.4304, or x = - 0.4304/1.0321 = - 0.417. The half-inhibitory concentration is obtained as follows: $IC_{50} = 10^{-0.417}$ = 0.383 mM.

Table 1

Half-inhibitory concentrations (IC_{50}-$^{\bullet}$OH) for hydroxyterephthalate formation of the different scavengers

scavenger	Equation	r^2	IC_{50}- OH in mM	# sugar units
ST	y = 0.8996x + 0.5008	0.9987	0.383	3
RebA	y = 1.0321x + 0.4304	1	0.360	4
Rub	y = 1.0557x + 0,4678	0.9986	0.278	2
SVglu	y = 0.8946x + 0.2591	0.9984	0.514	1
Glucose	y = 1.003 x – 0.9466	0.9153	8.913	1
Sucrose	y = 0.9974 x – 0.7176	0.9476	5.303	2

The half-inhibitory concentrations for SVgly (average 0.34 ± 0.055 mM) are about 20 x less than those for sucrose and glucose. Even the value for SVglu is about 14 x less than that of the sugars.

The last column of Table 1 shows the number of sugar units incorporated in each molecule. There is no relationship between the number of sugar units attached, or with the number of OH groups, although a strong correlation was found between the hydroxyl scavenging activity and the number of alcoholic hydroxyl groups of "true" sugars (glucose, fructose, deoxyribose, sucrose, maltose; Morelli *et al.*, 2003).

SVgly and SVglu possess a high ROS ($^{\bullet}$OH) scavenging activity. So what? SVgly is not absorbed by the intestines. The only possible beneficial effect of SVgly is the protection of food components against ROS, as, e.g., demonstrated in the stability study of stevioside by Kroyer (1999, 2010) wherein the degradation of Vitamin C was significantly reduced. An additional beneficial effect might be a protection against radical attack of the walls of the digestive tract. However, the most interesting result is the ROS scavenging activity of SVglu, which, after daily administration of 750 mg stevioside, occurs in the peripheral blood in concentrations up to 21.3 µg SVeq/mL or 67 µM SVglu (Geuns *et al*., 2007).

Before extending the discussion, let us first consider the overwhelming list of beneficial pharmacological effects of high doses of oral stevioside and steviol (reviews: Geuns, 2008a; Geuns, 2010). It is uncertain if rebA provokes similar effects due to a possible difference in the rate of degradation in the colon, as its degradation was slower *in vitro* (Gardana *et al*., 2003; Geuns, 2008b). The pharmacological effects of stevioside and steviol have at least been confirmed in animal models and in isolated organ and/or cell cultures and in some human studies. These very diverse effects induced by just one substance led to an atmosphere of disbelief, certainly in the medical world, such as "too good to be true". A selection of the beneficial effects are: lowering of blood pressure in case of hypertension, without effect on persons with normal or hypotension; lowering of blood glucose in type 2 diabetes, without effects on basal glucose levels; enhancement of insulin secretion and enhancement of insulin sensitivity, effects on blood glucose in a glucose concentration dependent manner, reduction of inflammation, reduction of skin cancers and prevention of atherosclerosis (Geuns 2008b; Geeraert *et al.*, 2010).

Mitochondria form ATP *via* the electron transport chain or the oxidative phosphorylation system. The terminal electron acceptor is molecular oxygen. The oxidative phosphorylation is also responsible for the production of ROS as a by-product. These ROS can damage proteins and lipids as well as the mitochondrial DNA. Mutations of mitochondrial

DNA (mtDNA) can lead to changes in the respiratory chain, which leads to a reduction of its efficiency and thus the production of still more ROS, creating a vicious circle leading to apoptosis of cells, e.g., in specific brain regions, skeletal muscles, optic nerve, liver... . Much of the clinical variability of diseases caused by specific mtDNA mutations appears to result from: (1) the severity of the mtDNA mutation, (2) its tissue distribution, (3) the percentage mutant present in each tissue (heteroplasmy), (4) tissue energetic thresholds, (5) age of the individual (somatic mtDNA mutations accumulate with age, further compromising mitochondrial function), and (6) individual predisposition in terms of genetic and environmental factors associated with disease (Ballinger, 2005).

Mutations within the mitochondrial genome accumulate with age and in common neurodegenerative diseases such as Parkinson's and Alzheimer's disease (Lin and Beal, 2006; Lambert and Brand, 2007; Reeve *et al*., 2008). The proteins associated with familial Parkinson's disease are either mitochondrial proteins or are associated with mitochondria, and all interface with the pathways of oxidative stress and free radical damage (Schapira 2008). Ballinger (2005) reviewed the literature about the relationship between the altered levels of oxidative and nitro-oxidative stress within the cardiovascular environment and the development of cardiovascular disease (CVD). Mitochondria not only appear susceptible to damage by oxidative and nitro-oxidative stress, but also play a significant role in the regulation of cardiovascular cell function. One of the important risk factors for CVD is increased mitochondrial damage and dysfunction. Atherosclerosis is the leading cause of CVD-related mortality, accounting for 3/4 of all deaths from heart disease. Free-radical mediated changes within the cardiovascular milieu are most popular suspects for CVD, as exemplified by the cytotoxic and atherogenic properties of oxidised Low Density Lipoprotein cholesterol (oxLDL cholesterol), which can be formed *via* several pathways involving oxidative and/or nitro-oxidative stress (Ref. in Ballinger, 2005). Recently, Hulsmans and Holvoet (2010) described the roles of ROS and oxidised lipoproteins in the activation of inflammatory cells and inducing signalling pathways related to cell death and apoptosis. They also presented evidence that the vicious circle between oxidative stress and inflammation does not only occur in the diseased arterial wall, but also in adipose tissues. There, oxidative stress and inflammation impair adipocyte maturation resulting in defective insulin action and adipocytokine signalling. The last is associated with increased infiltration of inflammatory cells, loss of anti-oxidant protection and cell death in the arterial wall. Diabetes increases vascular oxidative stress, including increased $O_2^{\bullet-}$ production, lipid peroxides, isoprostanes, 3-nitrotyrosine levels and DNA damage (Ballinger, 2005; Fridlyand and Philipson, 2006). Hyperglycaemia induces $O_2^{\bullet-}$ generation in the endothelial cells *in vitro*, most of the radicals being produced by the mitochondria. This might happen by an increase of the inner membrane proton gradient resulting from an overproduction of electron donors (NADH, FADH2) by the tricarboxylic acid cycle giving an overproduction of $O_2^{\bullet-}$.

Fatty liver disease can be associated with chronic high alcohol consumption or with obesity/type 2 diabetes (Mantena *et al*., 2008). The start of this disease is the accumulation of triglycerides in hepatocytes, a process called steatosis. This condition sensitises the liver to progress to more severe liver pathologies when individuals are exposed to additional metabolic (hyperglycaemia, hypertriglyceridaemia, hypercholesterolaemia) or environmental stresses (cigarette smoke, pollutants) or when there are genetic risk factors. Oxidative stress, disrupted nitric oxide (NO) signalling and mitochondrial dysfunction leading to ROS in the liver, are the key molecular events that accelerate or worsen steatosis and initiate progression to steatohepatitis, fibrosis and cirrhosis (Mantena *et al*., 2008).

To explain the myriad of beneficial effects of SV and SVgly, and to convince the medical world of the interesting healing effects of stevioside, a common trigger had to be found that was influenced by the administration of stevioside or steviol. This study makes radicals and the ROS scavenging activity of SVglu the possible common trigger involved, as SVglu can be found in the peripheral blood at concentrations up to 67 μM. SVglu has very strong ROS scavenging activity and it can be transported all over the body. By its ROS scavenging, it can positively influence the above cited diseases, as these are in some way related to excess of radicals. Too much blood glucose, e.g., leads to excess of radicals that cannot be detoxified by the body and which damage the insulin signalling pathway, whereas low blood glucose does not lead to excess of radicals, and hence there is no effect of SVglu. In the same way, in other processes too, the occurrence or lack of effects of stevioside might be related to the production of an excess of radicals, or lack of overproduction, respectively. It is known that by their ability to decrease oxidative stress in tissues, antioxidants can improve or prevent diseases, e.g., the serum liver enzymes are improved by α-tocopherol (vitamin E; Mantena *et al.*, 2008). Due to its potent anti-inflammatory activity, γ-tocopherol was more effective than α-tocopherol in treating diseases involving oxidant stress and inflammation (Devaraj *et al*., 2005).

In this study, only hydroxyl radicals were considered. In the near future, the scavenging effects for the other radicals will be studied (H_2O_2, superoxide, singlet oxygen). More research is still required on this interesting new topic.

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Contributions regarding the biometrics and several biochemical aspects of two Salix species from Prahova river meadow (Pucheni)

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Keywords: willow, leaf, shape index, salicylic acid

ABSTRACT

For *Salix alba*, in April, leaf 4, located on the shoot, was characterized by the highest values of weight, length and width. In May, leaf no 6 had the highest values of weight, length and width and in June leaf no 5 had the highest values of weight, length and width. The foliar limb width was comprised between 11 and 18.5 mm and the shape index (the length/width quotient) was found within the range 2.81-7.81, with an average value of 5.31. The foliar surface was comprised between 148 and 1365 mm^2 . For *Salix fragilis*, in April, leaf 4, located on the shoot, was characterized by the highest values of weight, length and width. In May, leaf no 4 had the highest values of weight, length and width and in June leaf no 6 had the highest values of weight, length and width.

INTRODUCTION

The study aimed at following the evolution of the foliar surface of two Salix species, frequently encountered on Prahova river meadow. The main criterion on which the study is based was the rapid growth of the foliar parenchyma, and, subsidiary, the growth of primary wood.

Two biochemical indicators, intrinsically related to the leaf growth and leaf development phenophase were also followed. The importance of this study lies in soil stabilization, in case of river flow variation.

MATERIALS AND METHOD

Two willow species were followed: Salix alba and Salix fragilis. Shafts and biennial branches were analysed, and the following biometrical measurements were performed: shaft length (mm), leaf length (mm), petiole length (mm), petiole width (mm), foliar surface (mm^2), leaf weight (g) and limb weight (g).

The acidity expressed as salicylic acid (known as the main acid of this species) and the reducing sugars level (as glucose, evaluated by Schoorle method) were also assessed.

The statistical treatment of the data was performed by the ANOVA test and the obtained mean values were used in specific correlations.

RESULTS AND DISCUSSIONS

For ***Salix alba***, the biometrical variation of the leaves on the shoot was followed, in three different moments (April, May, June). The number of leaves varies from 6 to 8 and 14, respectively. The position of the leaves on the shoot can be correlated to leaf weight, leaf length and leaf width.

The correlations of the position of the leaves, to their mass, length and width are described in figure 1 (a,b,c). After solving the regression equations, the following conclusions can be drawn: in April, leaf no 4 is characterized by the highest values of weight, length and width. In May, leaf no 6 has the greatest values of weight, length and width and in June, leaf no 5 shows the greatest values of weight, length and width.

The characteristics of the foliar limb (area, length, width) are described in figure 2, where it can be noticed that, depending on the leaf position, the foliar surface growth has the highest values and it can be very significantly correlated (r = 0.974***) to the leaf position, following the equation: y = 60.911 x + 145.32.

The maximum limb length reaches actually 111 mm, exceeding the threshold value of 100 mm, as mentioned by Beldie Al. 1953; Săvulescu 1953; Ivănescu et al. 1979; Dămăceanu 1994; Beldie 1996; Milescu et al. 1997; Pârvu 2006; the value is situated within the range obtained in previously published studies (Stănescu 1979), which mention 140 mm as maximum value of the limb length. The limb width of 11-18.5 mm confirms the data published by the same authors: 10-20 mm. The shape index (defined as the length/width quotient) varies between 2.81 and 7.81. The average of 5.31 confirms, the results obtained by Ocskay et al., 1973. The foliar surface varies between 148 and 1365 mm^2, meaning 70.9% of a quadrilateral area.

The acidity of the foliar mesophyll, expressed as salicylic acid, is relatively low compared to other species, namely 0.502%. The direct reducing sugars level is the most elevated, namely 4.26%.

The growths in length and diameter, as a function of the branch age, are described in figure 3, the evolution of the length being much more enhanced.

For ***Salix fragilis***, the biometrical variation of the leaves on the shoot was followed, in three different moments (April, May, June). The number of leaves varies from 8, to 8 and 9 respectively. The position of the leaves on the shoot can be correlated to leaf weight, leaf length and leaf width.

The correlations of the position of the leaves, to their mass, length and width are described in figure 4 (a,b,c). After solving the regression equations, the following conclusions can be drawn: in April, leaf no 4 is characterized by the highest values of weight, length and width. In May, leaf no 4 has the greatest values of weight, length and width and in June, leaf no 6 shows the greatest values of weight, length and width.

The acidity of the foliar mesophyll, expressed as salicylic acid is 2.76%. The direct reducing sugars level is 3.82%.

CONCLUSIONS

For *Salix alba* and *Salix fragilis*, the 76 chromosomes karyotype is responsible for the height of these species, whereas for *Salix triandra* and *Salix purpurea*, the 38 chromosomes karyotype can explain the smaller (bushlike) size.

The foliar mesophyll acidity (as salicylic acid) is relatively small (0.502%) for *Salix alba*, compared to other species.

The reducing sugars level for *Salix alba* is the greatest, 4.26%, when compared to the value obtained for *Salix fragilis*, namely 3.82%.

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FIGURES

Fig. 1a. Leaf variation on shoot S. alba

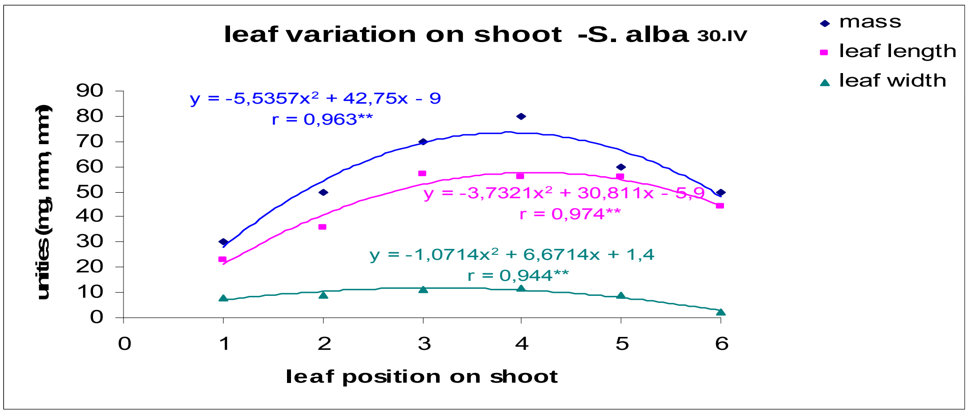


Fig. 1b. Leaf variation on shoot S. alba

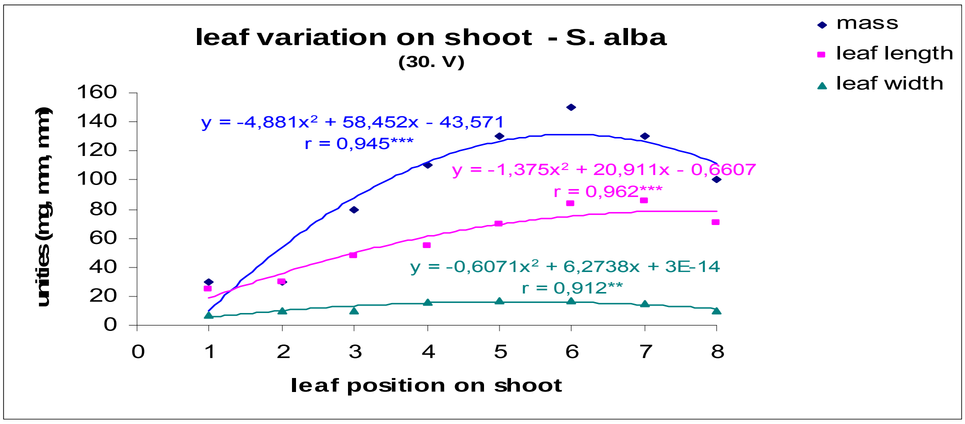


Fig. 1c. Leaf variation on shoot S. alba

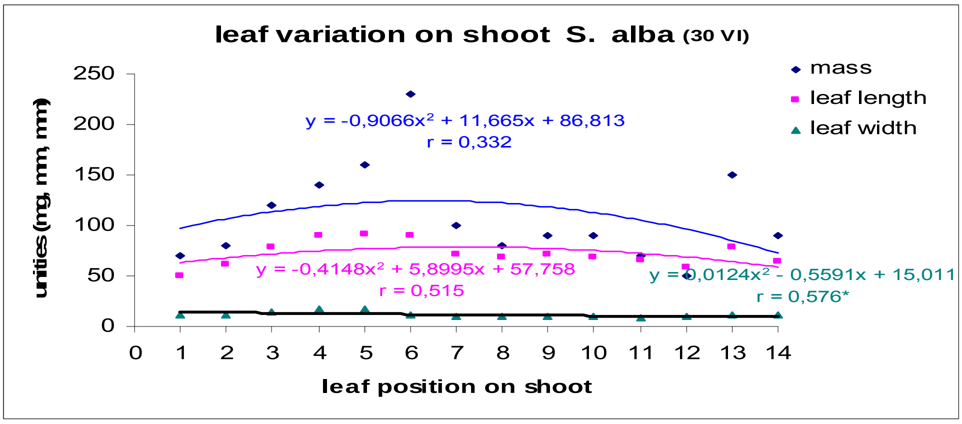


Fig. 2. The evolution of the biometrical parameters

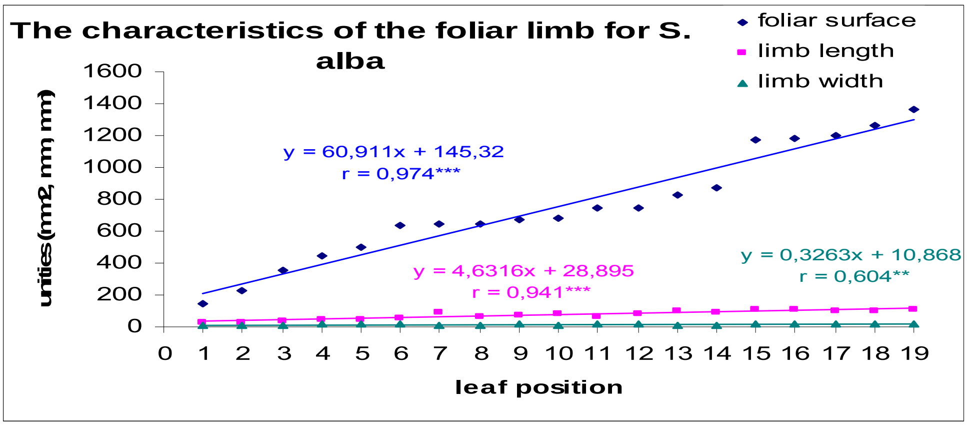


Fig. 3. The growth of the diameter of the branches

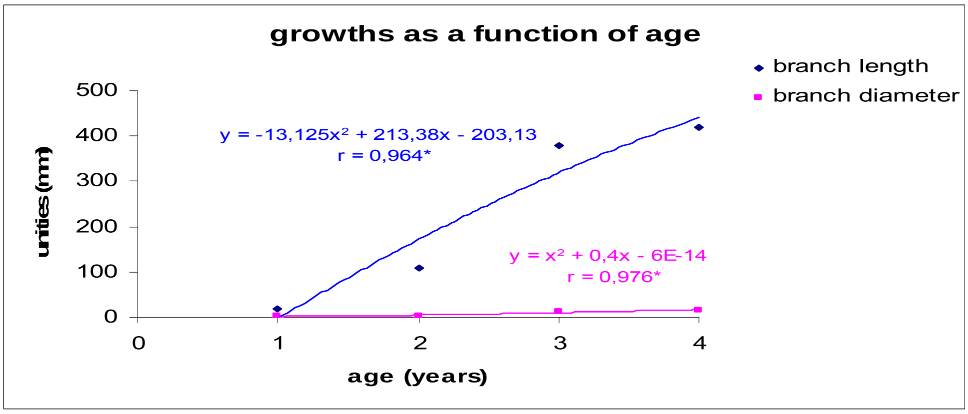


Fig. 4a. The variation of the leaves on the shoot

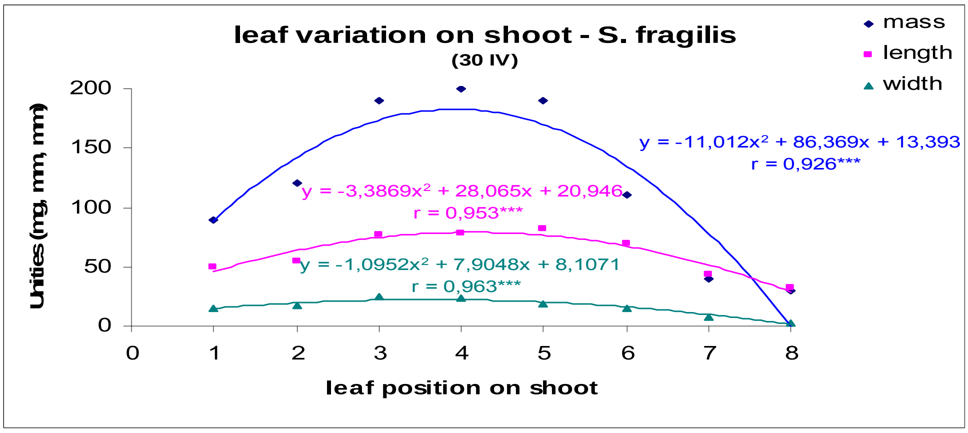


Fig. 4b. The variation of the leaves on the shoot

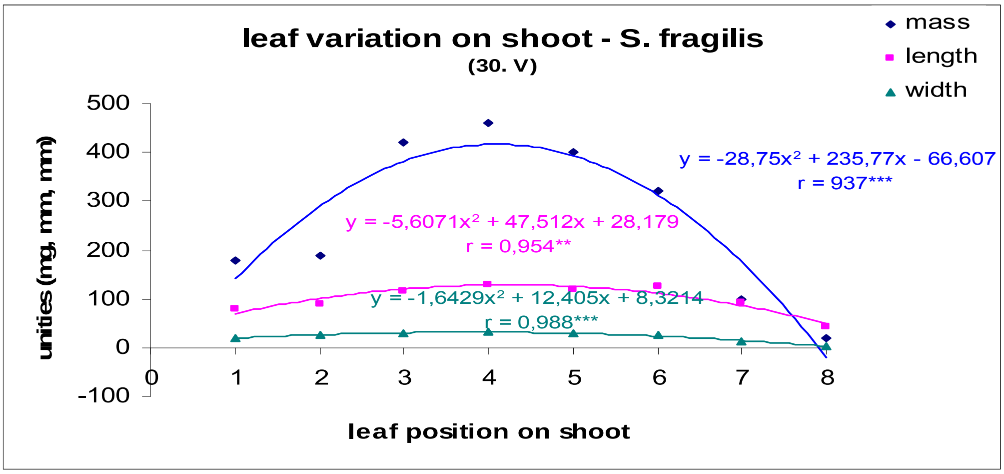


Fig. 4c. The variation of the leaves on the shoot

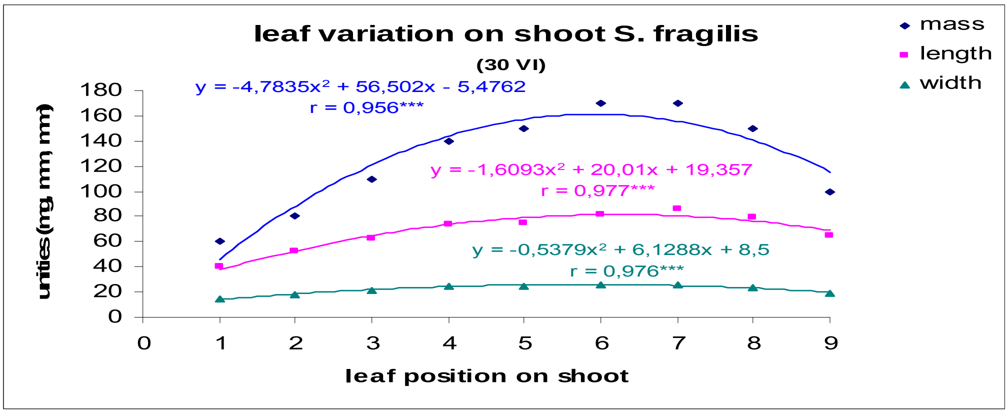


Fig. 5. The characteristics of the foliar limb

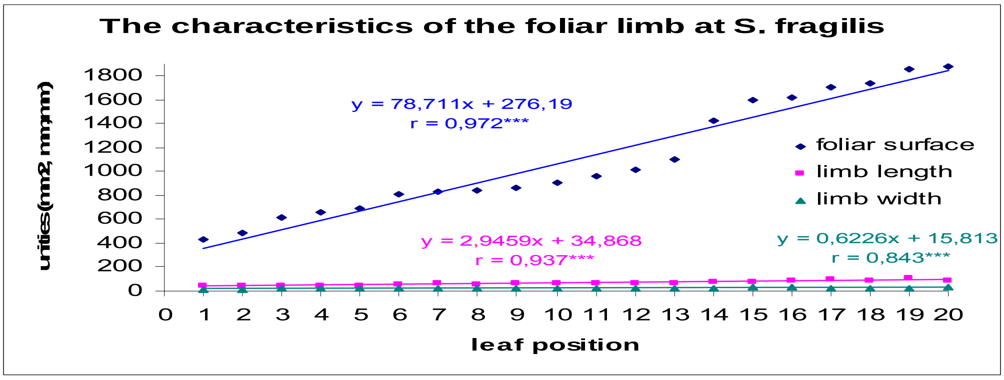
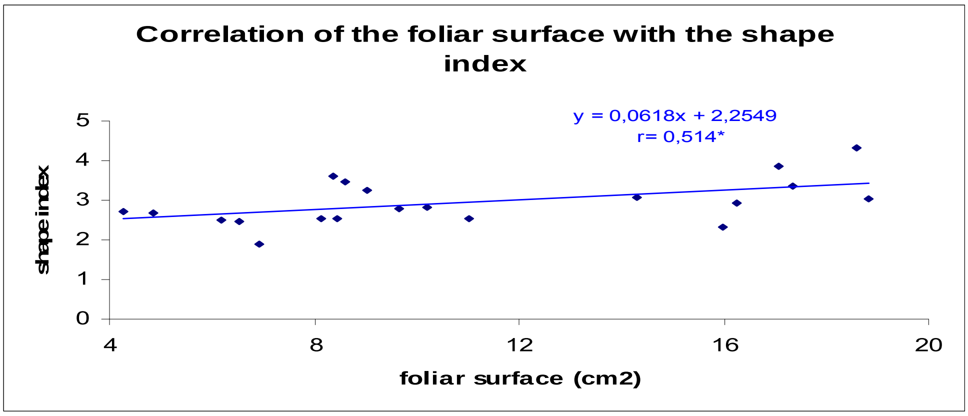


Fig. 6. Correlative features of the leaves



Biometrical and biochemical aspects of Salix triandra and Salix purpurea species, found on Prahova river meadow (Pucheni)

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Keywords: salix, annual branches, shape index, correlations

ABSTRACT

The maximum limb length reaches actually 110 mm, being comprised within the range 50-100 mm. For *Salix purpurea*, the biometrical variation of the leaves on the shoot was followed, in three different moments (April, May, June). The number of leaves varies from 15 to 13 and 9, respectively. The position of the leaves can be correlated to leaf weight, leaf length and leaf width. The foliar surface is found within the range 128-217 mm^2, representing aproximately 70.45% of a quadrilateral area.

INTRODUCTION

Willow is an important species, found in plain and hill areas. It is prevalently encountered in wet areas and always accompanies the water streams. It always supported the fields partially or thoroughly exposed to flooding, which were hence protected from water anger. Fields unsuited for other cultivations or wood species are successfully used by Salix species. Willow has an enhanced growth rate and multiple purposes, including decorating uses. Salix triandra and Salix fragilis can be encountered in association with other willow and poplar species.

MATERIALS AND METHOD

The biological material consisted in two *Salix* species, found alonside Prahova river. Both *Salix* species were studied for several years, following the treetop growth rate, the rate of development of the shoots at the treetop periphery, the shape of the leaves, the rate of dynamic development of the diameter of annual and multiannual branches.

The measurements were performed on field and were completed by physical and chemical laboratory experiments.

RESULTS AND DISCUSSIONS:

For ***Salix triandra***, the biometrical variation of the leaves on the shoot was followed, in three different moments (April, May, June). The number of leaves varies from 8 to 7, and 19 respectively. The position of the leaves on the shoot can be correlated to leaf weight, leaf length and leaf width.

The correlations of the position of the leaves, to their mass, length and width are described in figure 1 (a,b,c). After solving the regression equations, the following conclusions can be drawn: in April, leaf no 6 is characterized by the highest values of weight, length and width. In May, leaf no 6 has the greatest values of weight, length and width and in June, leaf no 8 shows the greatest values of weight, length and width.

The characteristics of the foliar limb (area, length, width) are described in figure 2, where it can be noticed that, depending on the leaf position, the foliar surface growth has the highest values and it can be very significantly correlated ($r = 0.974^{***}$) to the leaf position, following the equation: $y = 110.63 x + 636.3$.

The maximum limb length reaches actually 110 mm, being comprised within the range 50-100 mm, as mentioned by Beldie Al. 1953; Săvulescu 1953; Ivănescu et al. 1979; Dămăceanu 1994; Stănescu şi colab. 1997; Şofletea şi colab. 2001; the limb width of 12-27 mm confirms the data published by Ivănescu et al. 1979; Ciocârlan, 1990. The shape index (defined as the length/width quotient) varies between 3.62 and 5.68. The average of 4.33 confirms the results obtained Beldie, 1979. The foliar surface varies between 550 and 1983 mm^2, meaning 70.5% of a quadrilateral area.

The acidity of the foliar mesophyll, expressed as salicylic acid, is 1.756%. The direct reducing sugars level is 2.72%.

For ***S. purpurea***, the biometrical variation of the leaves on the shoot was followed, in theree diffent moments (April, May, June). The number of leaves varies from 15 to 13, and 9 respectively. The position of the leaves on the shoot can be correlated to leaf weight, leaf length and leaf width.

The correlations of the position of the leaves, to their mass, length and width are described in figure 3 (a,b,c). After solving the regression equations, the following conclusions can be drawn: in April, leaf no 8 is characterized by the highest values of weight, length and width. In May, leaf no 9 has the greatest values of weight, length and width and in June, leaf no 5 shows the greatest values of weight, length and width. The graph shown a Gaussian-like dependence.

The characteristics of the foliar limb (area, length, width) are described in figure 4, where it can be noticed that, depending on the leaf position, the foliar surface growth has the highest values and it can be very significantly correlated (r = 0.974***) to the leaf position, following the equation: y = 9.46069 x + 130.07.

The maximum limb length reaches actually 36 mm, being comprised within the range 30-36 mm, being situated at the lower limit of the results, as mentioned by Beldie Al. 1953; Stănescu et al. 1997. The limb width of 6-9 mm does not confirm the data published by Săvulescu, 1953. The shape index (defined as the length/width quotient) varies between 3.66 and 5.66. The average of 4.30 indicates a developing leaf, being, with respect to the biometrical data, inferior to mature leaves indicated in literature. The foliar surface varies between 128 and 217 mm^2, meaning 70.45% of a quadrilateral area.

The acidity of the foliar mesophyll, expressed as salicylic acid, is 3.51% (being the most elevated among the studied four species). The direct reducing sugars level is 3.55%.

CONCLUSIONS

For *Salix triandra*, the growth of the foliar surface is the greatest, being significantly correlated to the leaf position, following the equation: y = 110.63 x + 636.3.

The acidity of the foliar mesophyll is 1.756%, as salicylic acid, and the reducing sugar level is 2.72%.

The foliar surface varies for *Salix purpurea* between 128 and 217 mm^2, meaning 70.45% of a quadrilateral area.

The number of leaves varies from 15, to 13 and 9 respectively, for Salix purpurea and the leaf position on the shoot can be correlated to leaf weight, length and width.

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FIGURES

Fig. 1a. The variation of the leaves on the shoot

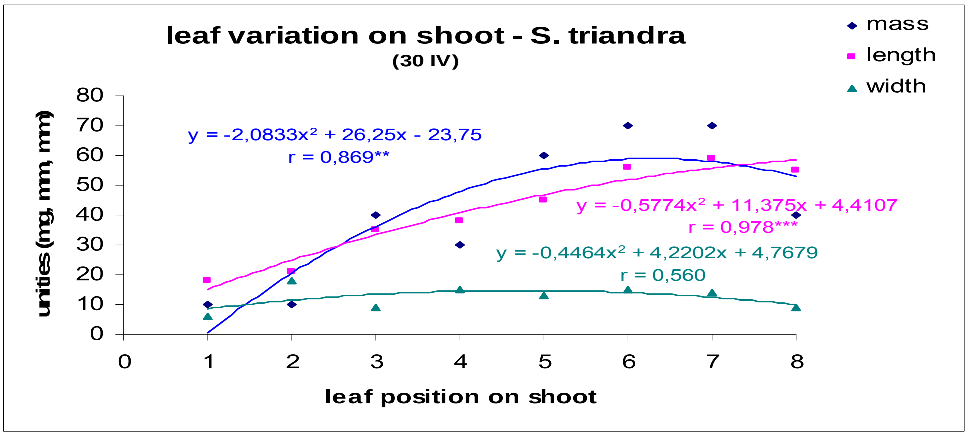


Fig. 1b. The variation of the leaves on the shoot

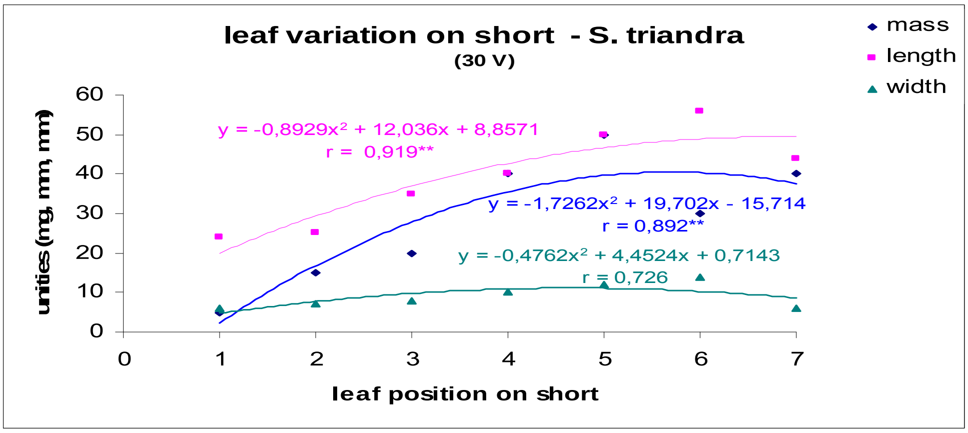


Fig. 1c. The variation of the leaves on the shoot

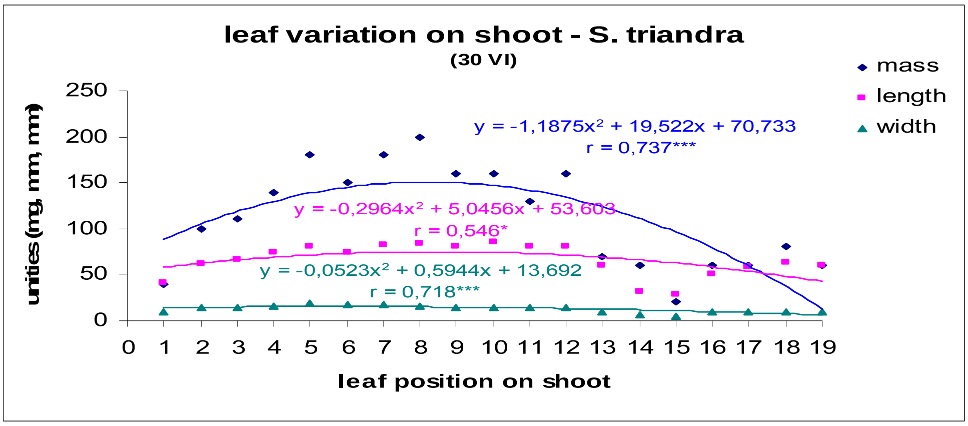


Fig. 2. The characteristics of the foliar limb

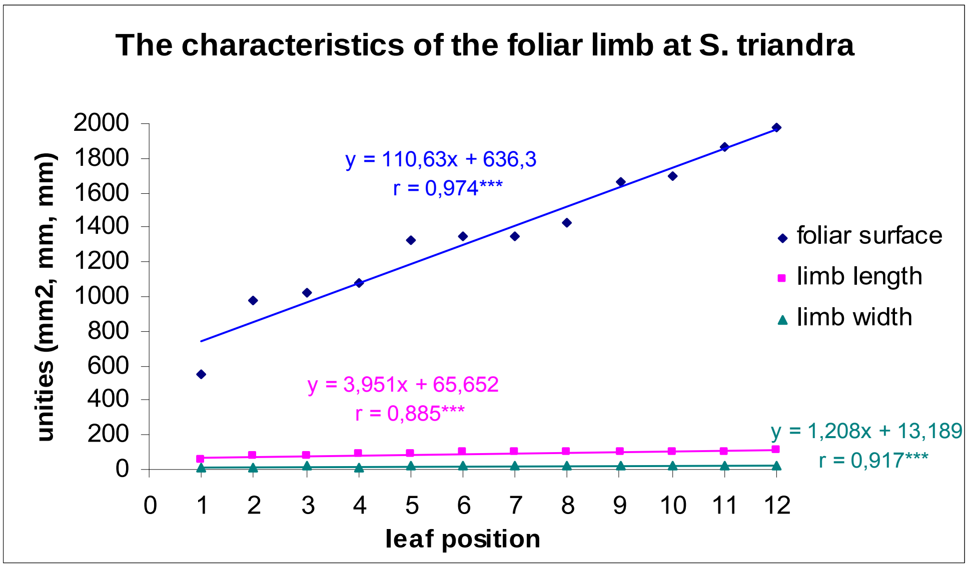


Fig. 3a. The variation of the leaves on the shoot

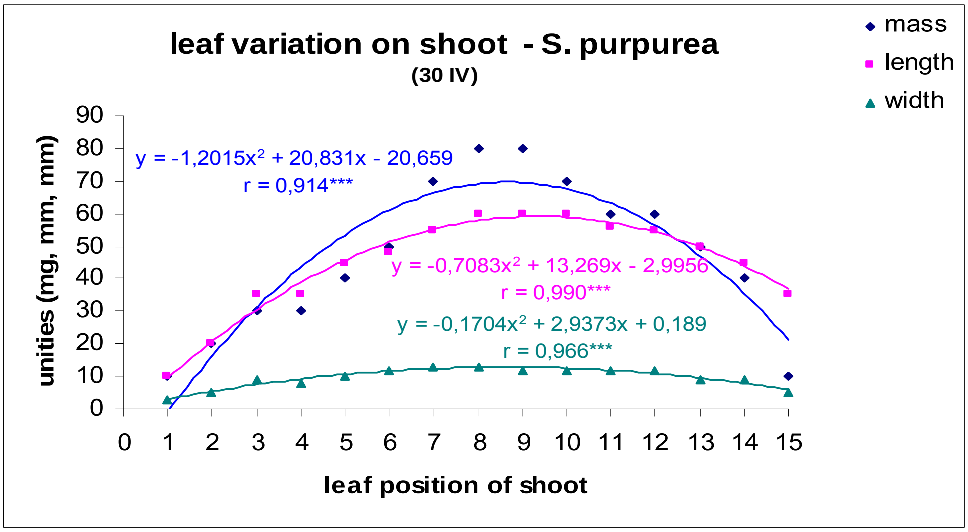


Fig. 3b. The variation of the leaves on the shoot

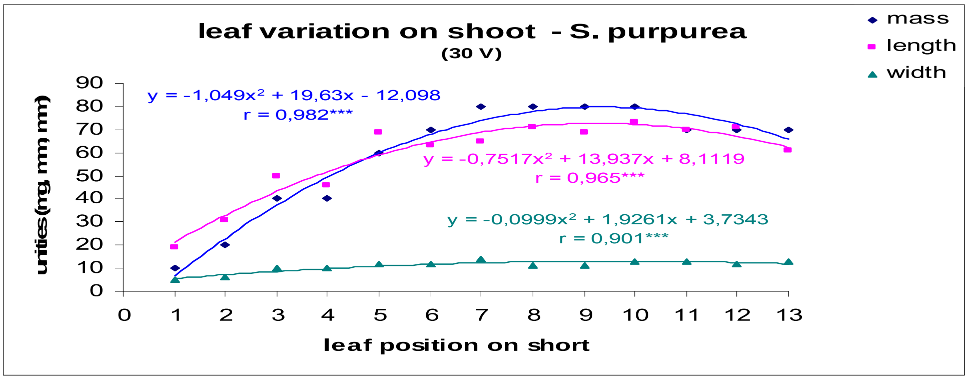


Fig. 3c. The variation of the leaves on the shoot

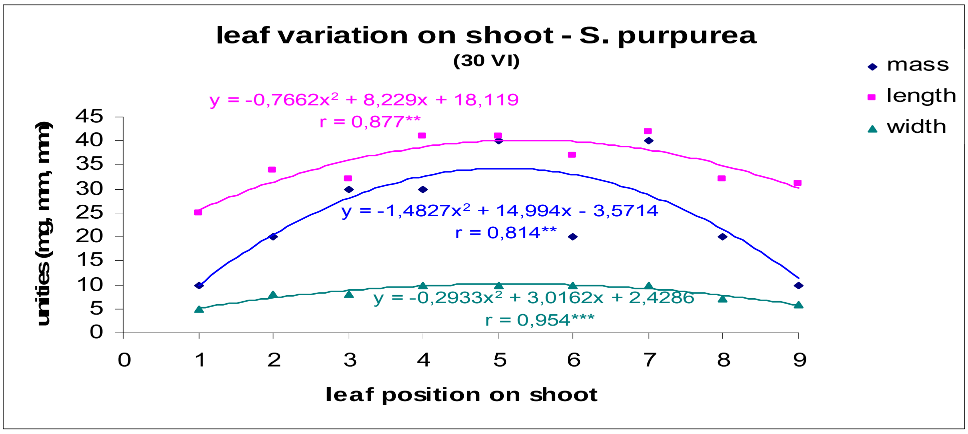


Fig. 4. The characteristics of the foliar limb

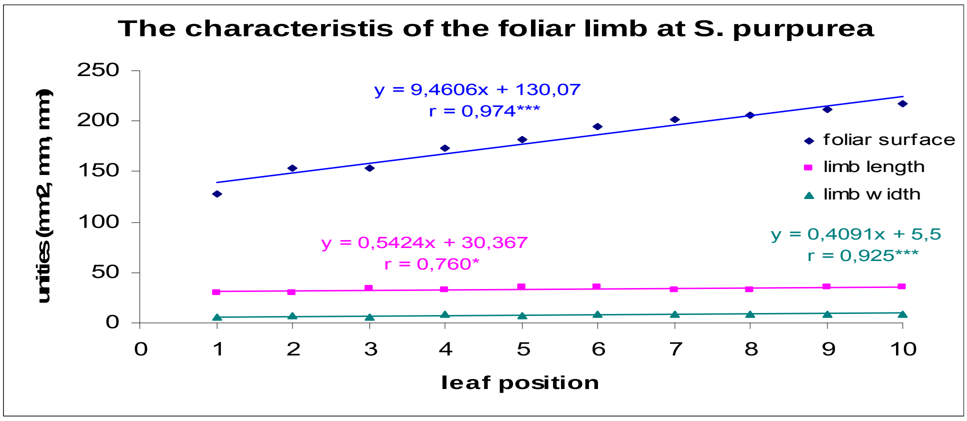
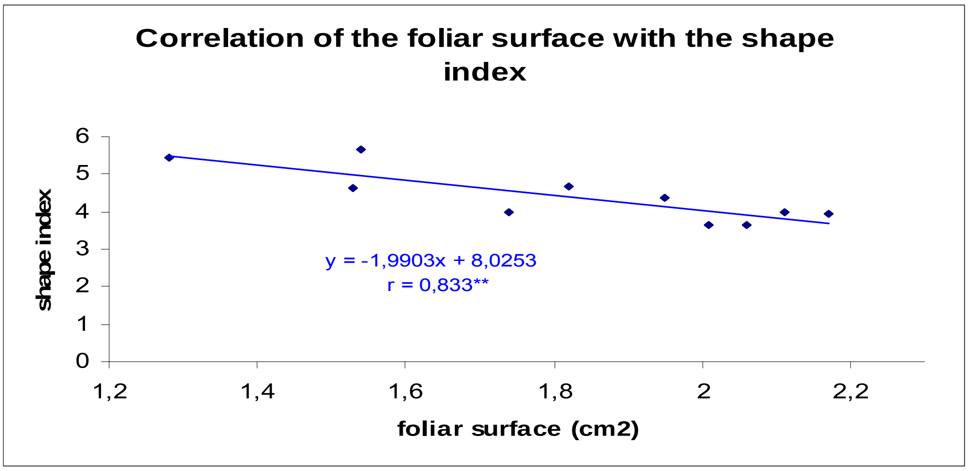


Fig. 5. Correlative features of the leaves



Influence of alternative technologies for maintenance of soil on the vine hydric regime

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Keywords: soil management, soil moisture, transpiration rate, relative water content

ABSTRACT

Viticulture is a highly intensive, using technique with a high potential pollutant. Irrational use of resources can contribute to increased erosion on soil physical and chemical degradation through misuse or abuse of fertilizers and irrigation, pollution phenomena intense because of the use of pesticides widely. Under current conditions of great interest is the formation of a new thinking and action to prevent occurrence of serious ecological imbalances. The paper shows the advantages of using alternative systems of maintenance of soil on soil moisture, and the rate of transpiration and relative water content of vine leaves.

INTRODUCTION

This paper aims at studying the influence of soil maintenance alternatives, based on organic fertilization on the vine hydric regime. Research topics covered in the contract research partnerships in priority areas 51009/2007.

In agriculture, maintaining soil quality is the main purpose for sustainable use of land in crop production. In general, losses of soil organic matter is the most important factor leading to soil degradation, affecting physical, chemical and biological soil (Gregorich et al., 1994; Rivero et al., 2004).

Consequently, one of the most important goals of sustainable agriculture is to maintain and improve the stock of organic matter in soil by adding organic matter as plant residues, different types of manure or compost, sludge resulting from purge, or indirectly by cultivating perennial plants. Long-term effects of organic amendments on soil physical and chemical characteristics are well documented; they imply an increase in organic carbon and organic nitrogen, the stock of nutrients, improving soil structure, reducing susceptibility to erosion (Bossuyt et al., 2001; Crecchio et al., 2001; Dhillion, 1997; Dominy and Haynes, 2002; Konopka and Turco, 1991).

An addition of organic matter in soil used in agriculture is an important source of energy, carbon and nutrients for soil microorganisms. An increase in biomass (organic carbon) and a stimulation of soil enzymatic activity was observed Houot and Chaussod (1995), Dhillion (1997), Badick and Dick (1999), Kandeler et al. (1999), Albianch et al. (2000), Crecchio et al. (2001), Debosz et al. (2002).

Grass cover has been introduced in vineyards to overcome problems of environmental impacts on cropping systems, vine vigour and product quality. Cover cropping limits erosion (Klik, 1994; Battany and Grismer, 2000), which can be severe in vineyards (Le Bissonais et al., 2001). Grass cover limits the impact of rainfall (Stocking, 1988) and improves the soil surface structure (Ballif, 1999). Cover cropping also increases the soil organic matter content (Masson and Bertoni, 1996). Cover cropping reduces weed development (Porqueddu et al., 2000). These effects of cover cropping on vines and their environment vary depending on the characteristics of the grass cover and its period of activity during the vine cycle.

Lejon D. et al. (2007) published results obtained by studying the effects of different soil management, comparing the following: straw mulch, compost with pine, pine nuts, spread of grass, clover and fescue, in a clayey soil, and incorporation of vine roots with single or double dose of manure or manure from farm for mushrooms in a limestone-sandy soil. The amount of carbon incorporated into biomass derived microorganisms is negatively correlated with the ratio C / N, showing the influence of organic soil management type on the rate of microbial processes.

MATERIALS AND METHODS

Experiments were conducted in a private vineyard plantation in Ștefănești, Argeș County, Aligote cultivar. Organizing the experimental field is presented in Table 1.

For monitoring moisture during the growing season were collected soil samples at regular intervals, in three repetitions, the depth of 0-10 cm and 10-20 cm, 20-40 cm, 40-60 cm, 60-80 cm, each variant Experimental. Samples were weighed directly in the field.

To determine the rate of transpiration to carry out repeated weighing the plant material, using the torsion balance.

Determination of relative water content was performed after re-examined method of Barr and Weatherley (1962).

All results were represented graphically using Microsoft Excel and interpreted statistically using SPSS 16.0 for Windows (Duncan test for multiple comparisons).

RESULTS AND DISCUSSION

A key role on plant growth and development and especially those such as perennial and vine is the evolution of soil moisture and soil moisture during the growing season.

Figure 1 is the results, determining soil moisture, the depth of 0-10 cm. The depth of 0-10 cm, the highest moisture was determined for variant V6: 26.62%. Variations are represented by green fertilizer use also increased (23.90% - V5, 22.104% - V4). Growing grass (clover, *Lolium* and *Sorghum*), and leaving them as cutting the mulch has helped maintain a high humidity of 0-10 cm soil depth. By applying Duncan test for multiple comparisons are found between the three variants are significant differences ($p<0.05$). Somewhat lower values were recorded for variant V3, V7, V8 and V2, between 20.38% and 21.68%.

Figure 2 is the results obtained by determining the depth of 10-20 cm soil moisture. High value determined for the V6 is maintained at this depth: 24.48%. Value is significantly higher than all other variants ($p<0.05$). The mulch represented stalks and straw keep moisture increased to maintenance options as black field. V9 variant was determined the lowest amount of soil moisture, maintain soil as black field, with work to raise the soil causes water loss significantly higher than that of other variants ($p<0.05$).

Figure 3 is the results obtained by determining the depth of 20-40 cm soil moisture. If the V6 variant soil moisture is highest (22.70%), followed in order V4 (21.78%) and V5 (21.65%).

And 40-60 cm depth increased humidity levels be kept for permanent perennial herbs variants with green fertilization. Values recorded for V4 and V6 are significantly higher than other variants ($p<0.05$).

Figure 5 is the results of soil moisture at a depth of 60-80 cm. Highest value at that depth was recorded for variant V4: 21.21%, significantly different value for the other variants ($p<0.05$).

CONCLUSIONS

Analysis of changes in soil moisture experiment shows the influence of each technological option applied technologies, especially those where soil water evaporation is prevented. Variants that has been made mulch straw and plant debris, soil moisture depths from 0 to 10 cm, 1 to 20 cm, 20-40 cm, 40-60 cm and 60-80 cm is relatively common.

Application of manure and its incorporation leads to improvement of soil physical properties, which have influence on maintaining ground water. The black field maintenance that leads to water loss from soil surface and soil profile in relation to climatic conditions.

Green fertilizers incorporated into soil and maintained at the soil surface after mowing, ensure better protection of soil and maintaining the surface water layer and the soil profile. Incorporated into the soil, green fertilizers contribute to improved physical and hydro-physical indices of soil improvement reflected the soil moisture.

The lowest intensity of transpiration and relative water content of leaves was found in soil conditions as field maintenance, black, and most intense in terms of using perennial grasses on the range.

Cover crops are an alternative to maintain the ecological and economic soil for organic vineyards (known as maintenance of soil biological system), aiming to form a balance between the physical, chemical and biological weapons that take place between soil and plant executed to maintain and enhance soil fertility and healthier damaged or diseased.

Soil fertilization with green fertilizers and mulch helped to preserve soil moisture by slowing evaporation of soil water, with direct influence on the fluid regime vines.

I believe that the combination of cover crops in the vineyard ecosystem has a major influence on the fluid system of the vine, and research can be pursued to determine the interactions between water content in soil, root system distribution of the species involved, the absorption capacity water and, ultimately, productivity.

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TABLE AND FIGURES

Table 1

Experimental variants

Current no.	Experimental variants
1.	Black field, unfertilized + Herbicide
2.	Permanent mulch + Digging turns
3.	Permanent mulch + Herbicide
4.	Green fertilizers + Mulch
5.	Green fertilizers + Herbicide
6.	Permanent green cover
7.	Black field + 40 t manure/ha Herbicide
8.	Experimental variants
9.	Black field, unfertilized + Herbicide

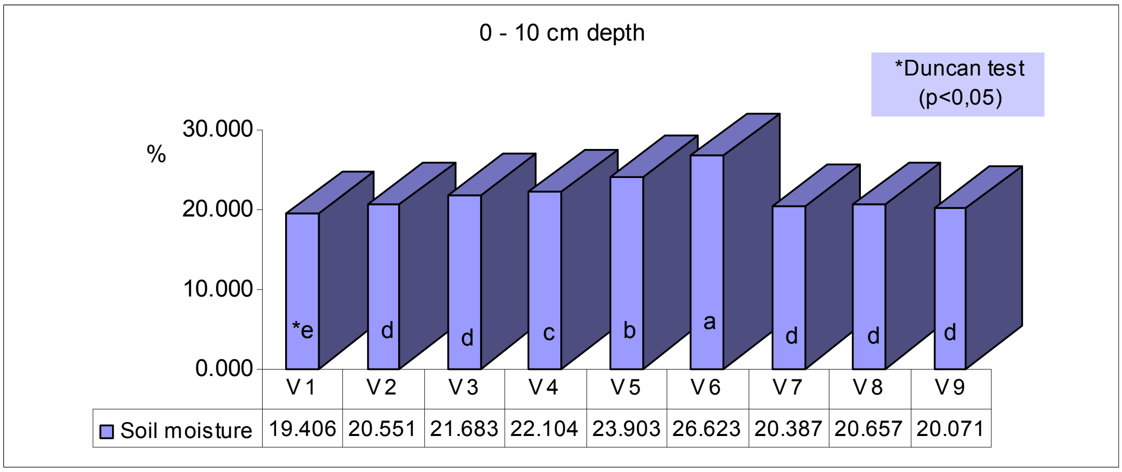

Fig.1. Determination of soil moisture 0-10 cm depth

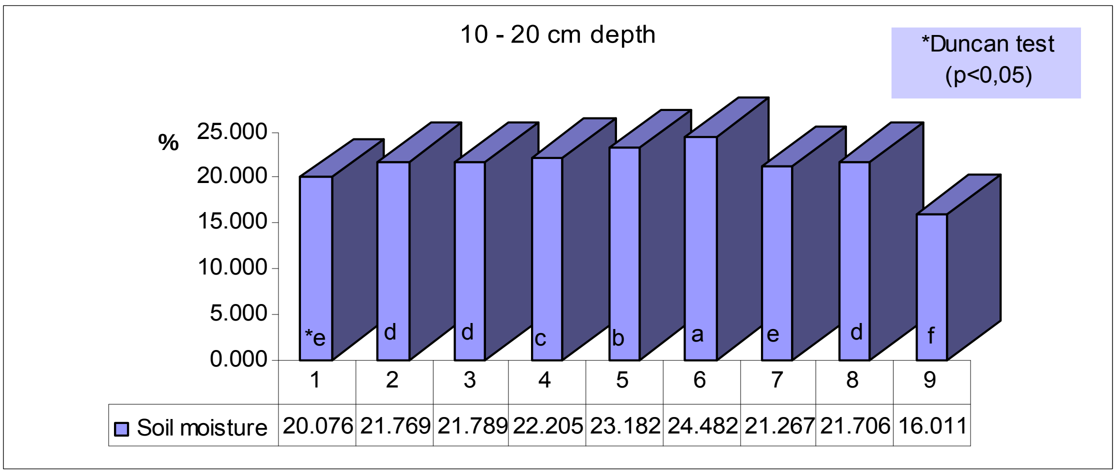

Fig. 2. Determination of soil moisture 10-20 cm depth

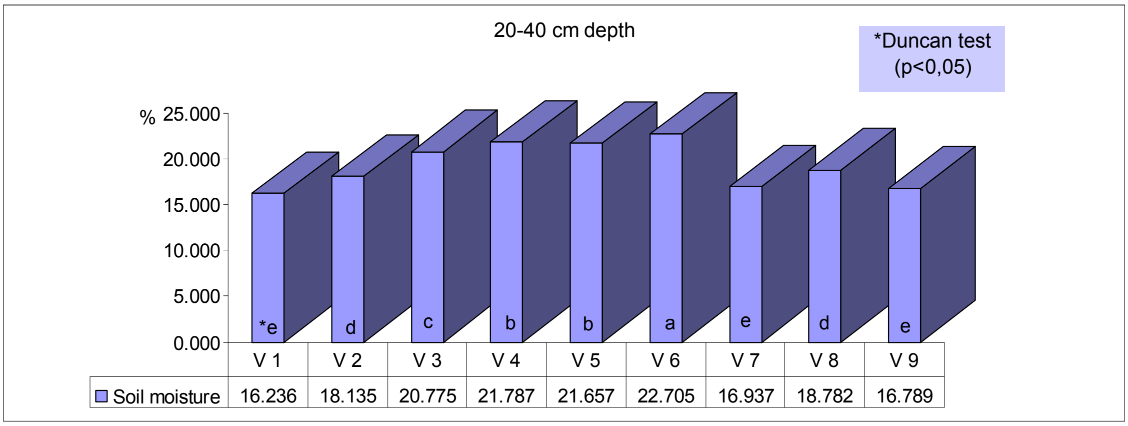

Fig. 3. Determination of soil moisture 20-30 cm depth

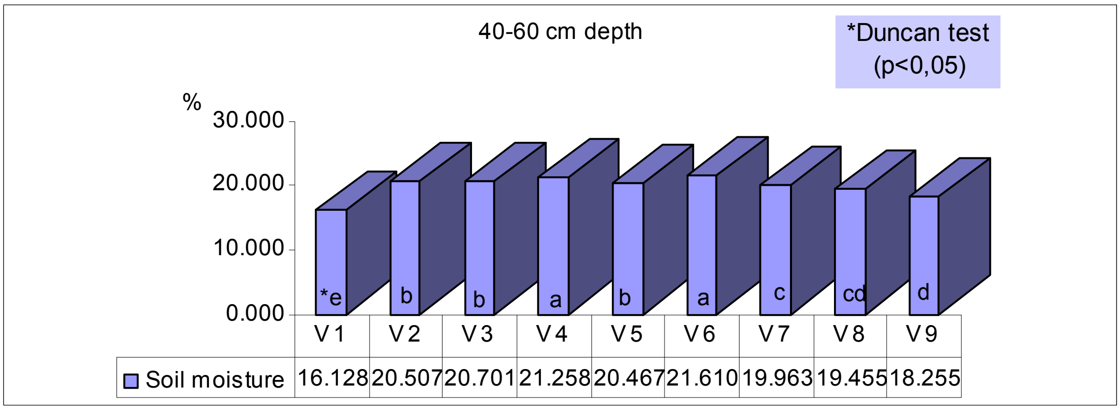

Fig. 4. Determination of soil moisture 30-40 cm depth

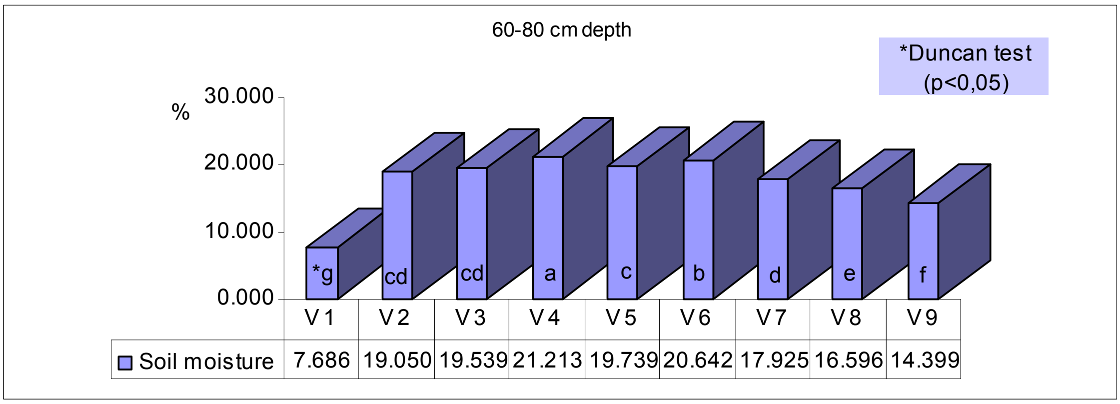

Fig. 5. Determination of soil moisture 40-50 cm depth

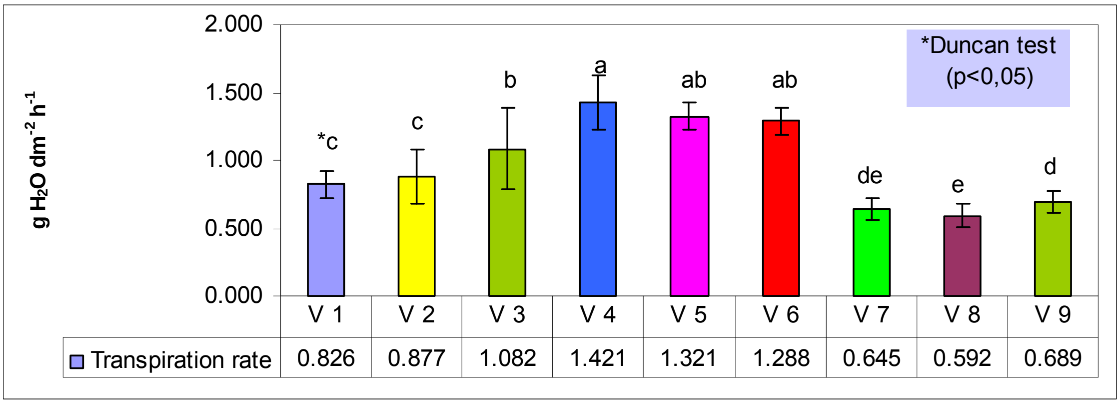

Fig. 6. Determination of transpiration rate

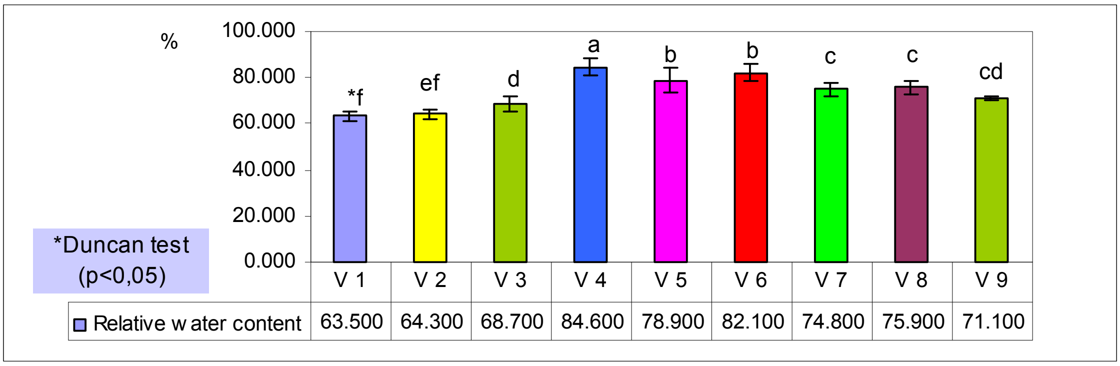

Fig. 7. Determination of relative water content

Investigation on suitability for modified atmosphere packaging storage of excelsior apricot cultivar

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Keywords: modified atmosphere packaging, *Prunus armeniaca L.*, post-harvest, color, ethylene

ABSTRACT

Apricots are climacteric highly perishable fruit and their short postharvest life is a problem for marketing. Extending of stone fruits shelf-life is very important for prolonged consumption period. MAP is an available technique for the improvement shelf-life and maintaining of apricot quality.

The objective of this study was to evaluate the suitability of two films packaging and low temperature storage for quality maintaining of Excelsior apricot variety and establish optimum storage time. Acoustic firmness, color (L*, a*, b*), dry matter, SSC/acidity ratio, weight were assessed for quality fruit at harvest and weekly during 15 days of storage. Physiological determinations (respiratory intensity and ethylene production) were also recorded. The results of this experiment indicated that Excelsior cultivar presents a good storability special through used unperforated films, and the end of storage (15 days) this cultivar having a pleasant commercial appearance.

INTRODUCTION

Apricot ripen and senescence rapidly at ambient temperature and require careful and rapid handling after harvest to avoid serious losses. Their short storage life is often limited by high respiration rate and pronounced ethylene production and a rapid ripening process (Chambroy et al., 1995; Fan et al., 2000) .

The time period from commercial ripening to degradation process characteristics of senescence, ranges between 3 and 5 days, depending on the variety (Pretel et al., 2000). This aspect forces harvesting of the apricot fruit in at pre climacteric stage which does not permit acquisition of quality characteristics demanded by the consumer during storage and marketing.

In order to achieve fruits of good quality, they must be harvested at optimum stage of maturity and adequate techniques that monitor quality must be used. An important factor in maintaining quality and extending the self-life of fruit after harvest is temperature. Metabolic processes including respiration, ethylene production and ripening are particularly temperature dependent (Tano et al., 2007).

Modifying the atmosphere surrounding the fruits may decrease the respiration rate and extend self-life for some fruit. Creating and maintaining the optimal atmosphere to achieve this benefit is based on packaging with plastic films known as modified atmosphere packaging (MAP)(Pala et al.,1994; Lee et al., 1995; Irtwage, 2006; Tano et al., 2007) .

Therefore, the objective of this study was to evaluate the suitability of two films packaging and low temperature storage for quality maintaining of Excelsior apricot cultivar originated from Romania and establish optimum storage time.

MATERIAL AND METHODS

The apricot cultivar used in the present study was 'Excelsior' originated from Romania, developed by Research Station for Pomiculture, Baneasa orchard. The fruits were harvested from experimental orchard, located in south of Romania, during two consecutive seasons. After harvesting, the fruits were rapidly transported to the laboratory under refrigeration conditions, where they were washed and rinsed with tap water, drained and used for experiment.

The fruits were harvest by hand, from five trees take in study from all three levels of tree canopy is being an average sample. The samples were analyzed at five days intervals during storage, fifteen days.

Storage conditions

The fruits were randomly divided into three groups, one for each storage conditions. Fruits were packed on the same day of harvest in low density polyetylene film of 35 μm thick. Two storage technologies of fruits were tested:

♦ refrigeration at 1º C and 90% relative humidity and normal atmospheric conditions without film (V1)

♦ MAP in perfored films with refrigeration at 1º C (V2)

♦ MAP in perfored films with refrigeration at 1º C (V3)

The film used to package apricot fruits was polypropylene P-Plus 35PA160. Each bag was sealed without gas packaging, so the modified atmosphere was established passively. A sample of three bags per storage conditions was removed every 5 days and evaluated in order to provide quality parameters of apricot fruit until the samples were not fit for consumption. Each parameter analysis was performed in triplicate in each bag.

Some physical and biochemical analyses such as weight loss, respiration rate, titratable acidity, soluble solids content, fruit colour, acoustic firmness, ethylene production, were conducted on samples which were taken at certain intervals during storage periods. Specific methods for each compound have been used.

Weight loss (%) was also determined during the storage by monitoring the weight of each fruit at harvest and during storage. Weight loss was expressed as the percentage of the loss of weight with respect to the initial weight and was determined in triplicate.

Dry matter concentration was measured by drying some slices from each side of equatorial part of fruits to a constant weight in an oven at 105° C. The results were expressed in percent (w/w).

Soluble solids content (SSC) were determinate by using an Atago refractometer at 20°C from juice extracted from the fruits and values were expressed in °Brix. Titratable acidity (TA) was quantified in juice by titration with 0.1N NaOH up to pH 8.1. TA is expressed as percent of malic acid which is the predominant acid in this species mg acid malic /100g fresh weight. The ratio between the SSC/TA, which reflects the fruit taste feature, has been determinated.

Acoustic firmness of fruits was measured at the equator of the unpeeled fruit in two repetitions using an AWETA Acoustic Firmness Sensor. In this device, an acoustic signal is generated by means of gentle impact on the equator of the fruit. This signal is processed and transformed to obtain a peak of natural frequency, which is used to calculate the stiffness factor as f^2x $m^{2/3}$, where f represents this frequency and m is the fruit mass.

Color was measured with HunterLab MiniScan XE Plus spectrophotometer on the basis of the CIELAB color system .In this system L*, a* and b*, describe a three dimensional space, where L* is the vertical axis and its value varies from 100 for perfect white, to zero for black. Values a* and b* specify the red-green and blue-yellow axis, respectively ranging from -60 to + 60 or from –a (green) to +a (red) and from –b (blue) to + b (yellow).

C* and h° values are calculed based on a* and b* values according to the following equation: $h^o = tg^{-1} \frac{b*}{a*}$ and $C* = \sqrt{a*^2 + b*^2}$.

The spectrophotometer was calibred with the white pattern during each sampling time. Each fruit was analyzed on both sides (the more colored side and the less colored side); the final result for the color parameters was obtained by averaging the whole samples' content.

The measurement of physiological parameters (respiratory activity and C_2H_4 concentration) was carried out following the closed-system method at 20°C (Chambroy et al., 1995). Apricots were placed in hermetic glass containers (1500mL) equipped with rubber sampling ports. Three replicates were prepared from each maturity stage.

Concentration of CO_2 produced in respiration time of apricot were determinated using an IR-RIKEN analyzer. Respiratory intensity of fruit were expressed in mg CO_2 $kg^{-1}h^{-1}$.

Concentration of C_2H_4 was determined using a Fisons GC 9000 series gas chromatograph with a flame ionization detector EL980 and a Chrompack CP-Carboplot P7 column (inside diameter 0.53mm, length 10 m). The temperature of the oven was 60° C and the detector temperature was 100° C. The carrier gas used was H_2. The values were expressed in µl C_2H_4 $kg^{-1}h^{-1}$.

RESULTS AND DISCUSSIONS

The development of fruit color increase during apricot storage. The manner of color development was similar for all three variants but more intensely for V1 (without film) and less intensely for V3 (with unperforated film).

In case of Excelsior cultivar the L* value decreased with time of storage (darker fruit) for all three variants studied. A significant increase in color a* value was observed after 15 days storage in all three variants (figure 1). The b* value changes poorly during storage, even some time remain steadly. Apricots sealed in plastic films V2 and V3 changed color more slowly.

The weight loss depends to type of films used and storage time. The postharvest modification of weight is because of the loss of water through transpiration. The decrease of apricot weight during storage was aproximatively liniar for all three variants studied (table 1).

While the control (unpacked apricot) lost during the storage more than 70%; MAP fruits of different physiological stages at the same period (10 days) show less than 10% of weight loss. Thus we observed that fruit kept in perforated and unperforated films show the lowest weight loss during the storage period for both cultivars studied.

A decrease of dry matter content was more or less proportional to the quality of storage condition (table 1).The decrease, illustrated by the date from table 1 was fluctuant in the case of unpacked, whereas the changes in the V2 or V3 were more gradual. In the V2 variant fruit sealed with perforated films average dry matter content at the time of harvest was15.4% and it was reduced to 11.26% after 15 days of storage. In the V3 the dry matter content at the harvest time was15.8% and it was reduced to12.4% after 15 days of storage.

Storage conditions were also very decisive for the decrease of fruit firmness for apricot cultivar studied. A critical level of 0.5 of the acoustic firmness index, which is considered unacceptable fruit quality of the cultivar, was reached after about 15 days in unpacked apricot (V1), when the fruit were already too soft.

In the case of V2 and V3, the decrease of fruit firmness was very low and the critical level was never reached in storage (figure 2). Reduction in loss of apricot firmness with MAP has been reported and from other researcher (Agar and Polat, 1997; Aubert and Chanforan, 2007; Gouble et al., 2006).

Ethylene concentration determinated is quantitatively low, but the quantity of exogene ethylene recording a constantly increase for fruits of all variants studied. We observed that fruits of V1 (without film) registered small value of ethylene concentration than other two variants because difusion of ethylene around fruit in storage space, autocatalitic stimulating of biosynthesis is more little (figure 3).

Excelsior cultivar presents a dynamics of respiration rate during storage different (figure 4). Thus V1 and V2 present an upward dynamics of respiratory intensity, without clearly climacteric maxim and with constantly value after 10 days of storage. The variants of fruit storage at low temperature and covered with unperforated and perforated films presents in general reduced values of respiratory intensity and ethylene concentration what highlight delaying of maturation process and increses storage time.

We observed that SSC decrease during apricot storage for all three variants studied. The decrease of SSC was more rapid in the control (unpackaged apricot) than the fruits sealed with different packaging films (V2 and V3). TA declined as the storage period prolonged in close limits. During apricot storage the acidity decrease but some fruit did not reached acidity of fruit harvest at ripe stage (table 1).

These results are in accordance with that of (Agar&Polat, 1995; Znidarcic, 2006) which, maintain that acidity decreased with evolution of ripening because the acids are substrates for respiration process. However this result are in contradiction with data obtained from Jay et al., (2006) on three apricot cultivars which SSC and TA does not change very much during storage.

The SSC/TA ratio indicates apricot fruit taste and flavour. Fruit storage in unperforated films has a good taste and flavour. Non significant variation in SSC/TA was observed with respect to all variants stored 15 days.

CONCLUSIONS

Apricot sealed in plastic plastic films at low temperature had an extended marketable life more than three weeks. This length in time is based first on external appearance and second on quality attributes.

Our results indicate a delays the onset of the climacteric increase in ethylene production and respiration rate. This delay is sufficient to extend storage life by delaying loss of firmness and titratable acidity as well as color changes associated with ripening.

This study shows that MA packing is a promising alternative approach to prolong postharvest life of apricot cultivars studied at low temperatures.

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Table 1

Evolution of some quality parameters of Excelsior apricot variety during storage in MAP at 1°C

Variety	Storage period (days)		Dry matter %	Weight loss %	SSC °Brix	Titratable acidity mg ac. malic%
Excelsior	0 (harvest)		15.4	68	14.5	1.08
	5	V1	13.74	10.2	13	1
		V2	12.42	11.7	12	1.05
		V3	10.68	10.2	9	0.95
	10	V1	14.07	26.4	13.5	0.98
		V2	12.45	19.1	12	0.95
		V3	13.09	20.5	9.5	0.9
	15	V1	15.36	30.8	15	0.95
		V2	11.26	22	14	0.93
		V3	12.4	23.5	12	0.95

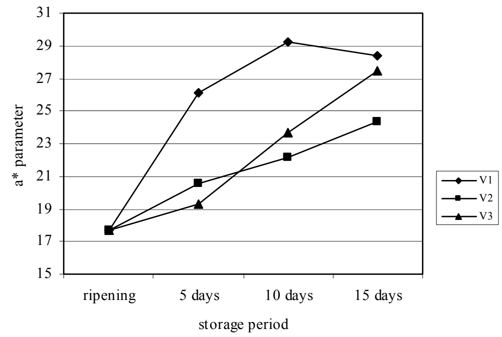

Fig. 1 Color parameter a* changes of Excelsior apricots sealed within different packaging films during storage period at 1°C

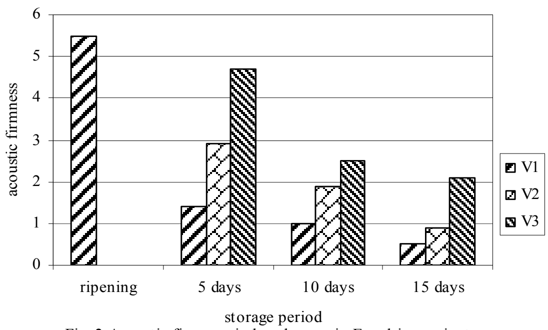

Fig. 2 Acoustic firmness index changes in Excelsior apricots sealed with different packaging films during storage period at 1°C

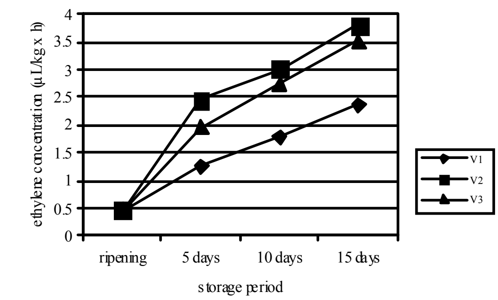

Fig. 3 Variation of ethylene concentration of Excelsior apricots sealed with different packaging films during storage period at 1°C

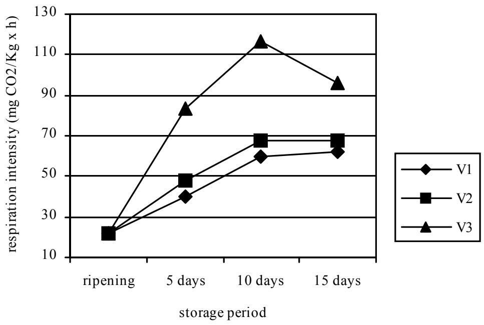

Fig. 4 Variation of respiration intensity of Excelsior apricots sealed with different packaging films during storage period at 1°C

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The influence of environmental anthropic conditions on Non-Photochemical Quenching (NPQ) indicators of chlorophyll fluorescence at some of the most important synanthropic plant species in Piteşti, Mărăcineni and Mioveni

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Keywords: thermic dissipation, photoprotection, photoinhibition, photodamage

ABSTRACT

Chlorophyll fluorescence represents an indicator of the energy conversion in the photosynthesis process, offering information regarding the photosystem II (PS II) efficiency. Functioning of PS II is the most sensitive indicator of environmental stress in plants. Changes in PS II activity can be assayed rapidly and non-destructively by measurement of chlorophyll fluorescence. NPQ test was applied to the synanthropic plants analyzed, in order to highlight the photoprotection processes as a result of plant exposure to light excess. Thirteen indicators were calculated and interrelations were stated amomg. The experiments were carried out in 2009 for six dominant species on the wastelands around the cities Pitesti, Mioveni and Maracineni: *Cichorium intybus L.*, *Conyza canadensis (L.) Cronq.*, *Erigeron annuus L. (Pers.)*, *Lactuca serriola Torn.*, *Polygonum aviculare L.* and *Echinochloa crus-galli (L.) Beauv.*, by the use of FluorPen FP 100 fluorometer. The highest values of F_0 (210), F_M (756) şi NPQ_Lss (1.97) were registered at *Erigeron annuus L. (Pers.)*. The lowest values of NPQ_D_3 (0.06), QP_Ls (1.09) and R_{df} (0.66) were registered at *Echinochloa crus-galli (L.) Beauv.*, which having a low NPQ is not affected by the light excess. The highest rate of QY_Lss (0.30) was determinated at *Conyza canadensis (L.) Cronq.*.

INTRODUCTION

Maxwell şi Johnson (2000) show that PS II is the most vulnerable component of the photosynthetic apparatus to light excess exposure. Damages at PS II level often represents the incipient manifestation of stress to which the leaf/plant is subject to. Thus, chlorophyll fluorescence may offer information about the ability of the plants to cope with the environmental stress and about the way this stress can damage the photosynthetic system. NPQ (Non-Photochemical Quenching) varies linearly depending on the heat dissipation on a scale from 0 to infinite. In plants, the values of NPQ are generally between 0,5 and 3,5, in saturation light. The changes of NPQ reflect the efficiency of thermal dissipation. A rise can occur as a result of the processes which protect the leaf against the damages induced by light excess. (Maxwell şi Johnson, 2000).

According to Manual of Opti-Sciences, the parametres of the quenching allow the cuantification of the photochemical state PS II regarding the fraction of PS II centers which remain open or oxidized at every moment as well as the mechanisms photosyntetic non-photochemical involved in photoprotection, quenching phenomena related to the transitions of the state 1 and state 2, photoinhibition and photodamage. In the model of separate units for PS II, every reaction center owns an independent system of aerials. In the ”lake” model for PS II, the reaction centers are connected by a mutual aerial. The ”lake” model has proved to be more realistic in the case of terrestrial plants. Some parameters of the quenching in the model of separate units are abhorrent to those of the ”lake” model (Kramer, Johnson, Kiirats şi Edwards, 2004, quoted in Manual of Opti-Sciences).

NPQ test includes five measurements in actinic light and three measurements while dark adaptation (Figure 1). The leaf is prior dark adapted. The testul starts at F_0 or minimum flourescence, measured in the absence of actinic light. Then a pulse of saturation occurs, which causes a total closure of the receivers in PS II by completly reducing the PS II, the result being maximum fluorescence F_M. The pulse of saturation is followed by the activation of an actinic light and once the fixation of CO_2 b begins the fluorescent signal fades to an equilibrium state. Photochemical quenching is a measure of the open centres of PS II, of the non-photochemical quenching photoprotection and of others mechanisms of thermal dissipation which may occur.

The flash of saturation occuring during the equillibrium state produces F_M' – maximum fluorescence, in this situation NPQ being ballanced with photochemistry. F_s represent the fluorescence related to the present level of the photochemical balance. From the point where the actinic light is cut off, a source of far-red light is turned on to facilitate the rapid transfer of electrons to reduce PS I and subsequently FS II re-oxidization. F_0' stands for this value of the non-relaxed non-photochemical quenching.

The rising of the rates of the saturation flashes after the actinic light has just been cut off represents the relaxation of NPQ in time. NPQ has more components (parameters), (according Manual of Opti-Sciences) and is a measure of heat dissipation, a combination for photoprotective mechanisms, for the quenching phenomena of the transition in stage 1 and stage 2, photoinhibition and photodamage: NPQ=qE+qT+qI. A portion of NPQ, qE or Y(NPQ) in the ”lake” model represents the pH and the xanthophyll cycle – a mechanism of photoprotection in the thylakoid lumen. The remainder of NPQ represents qT and qI (or Y(N0) in the ”lake” model). qT stands for the quenching due to the transitions of the state 1 and state 2 and is negligible in higher plants. qI stands for photoinhibition and photodamage.

NPQ is influenced to a greater extent by the non-photochemical quenching compared to heat dissipation of excitation energy in the aerials and can be considered as an indicator of excitation energy excess. NPQ is relatively insensitive to the part of non-photochemical quenching associated with qN values lower than 0.6. This range of qN is affected by ΔpH of the thylakoid lumen which is an important aspect of photosynthetic regulation. (Bilger şi Björkman, 1990, citaţi în Manual of Opti-Sciences).

The research on maize conducted by Ming and his team (2006) proved that there was marked difference in the photosynthetic rate (Pn), but no difference existed between different parameters such Fv/Fm, qP şi ǿp, while apparent difference existed in the NPQ and its characteristics, such as TNPQ, $TNPQ_{max}$, RNPQ şi $RNPQ_{max}$ for different genotypes of maize. These authors showed that TNPQ and NPQ_{max} were significantly correlated to Pn, which meant that not only NPQ but also its characteristics such as TNPQ and NPQmax, especially TNPQ might be good index for selecting the high photosynthesis genotype in maize.

MATERIAL AND METHODS

The index of NPQ was studied and registered for the following species: *Conyza canadensis* (L.) Cronq., *Erigeron annuus* L. (Pers.), *Lactuca serriola* Torn., *Polygonum aviculare* L., *Echinochloa crus-galli* (L.) Beauv., *Sonchus oleraceus* L., *Taraxacum officinale* Weber ex Wiggers, *Amaranthus retroflexus* L. and *Ambrosia artemisiifolia* L., under the specific environmental conditions of Piteşti, Mioveni şi Mărăcineni, between June and August 2009. The parametrers of the chlorophyll fluorescence, registered by using the OJIP test – (Chlorophyll Fluorescence Induction Kinetics) and NPQ test – (Non-photochemical Quenching), were measured by the use of FluorPen FP 100 fluorometer. The following parameters regarding the NPQ rates were analysed:

- F_0 (the dark adapted initial minimum fluorescence when Q_A is oxidized (q_P=1) and the non-photochemical quenching is relaxed (NPQ=0);
- F_M (maximal fluorescence after dark adaptation when Q_A is reduced (q_P=0) and the non-photochemical quenching is relaxed (NPQ=0);
- F_P (the peak of fluorescence during the incipient phase of Kautsky effect (Kautsky effect is related to complex dynamics of the chlorophyll fluorescence emission as well as to photochemical productions during the transition from dark to light (Kautsky and Hirsch,

1931, Govindjee, 1995), when a local maximum of F occurs by rapid reduction of the amount of plastoquinone (PQ) and the slight stimulation of redox mechanisms and non-photochemical quenching

- F_M_Lss (steady-state maximum fluorescence in light, when Q_A is reduced and the non-photochemical quenching is at maximum (NPQ=1);

NPQ_Lss (steady-state non-photochemical quenching in light)

Q_P_Lss (steady-state photochemical quenching parameter estimated as fraction of open PS II reaction centers: $PSII_{open}/PSII_{open}+PSII_{closed}$)

- R_{fd} (steady-state fluorescence decline ratio, parameter used to assess plant vitality $R_{fd}=(F_P-F_t/F_P)$;
- NPQ_D_3 (non-photochemical quenching during dark relaxation) NPQ_$D_3=(F_M-F_M_D_3)/F_M_D_3)$;
- Q_P_D_3 (parameter of photochemical quenching during dark relaxation when the reaction centers of PSII are open, estimate of the fraction of open PS II reaction centers) $PSII_{open}/PSII_{open}+PSII_{closed}$)
- QY_max (PS II maximum yield during dark adaptation = F_V/F_M)
- QY_Lss (photochemical production of FS II during the steady-state, in light QY_Lss=(F_M_Lss-F_t_Lss)/F_M_Lss)
- QY_D_3 (FS II production during dark relaxation QY_$D_3=F_{M'_D3}-F_{t_D3}/F_{M'_D3}$).

The statistic method used to process the experimental data was polifactorial experiments variance analysis, and the test used to establish the statistic significance was DUNCAN multiple range test for a confidence level of α=0,05. Statistical analysis were computed using SPSS 14 for Windows.

RESULTS AND DISCUSSION

The 30 values of the test specimen represent the total number of determinations for the following parameters: F_0, F_M, F_P, F_M_Lss, NPQ_Lss, Q_P_Lss, R_{fd}, NPQ_D_3, Q_P_D_3, QY_max, QY_Lss şi QY_D_3. The statistics of NPQ indicators is illustrated in table 1. The average data are representative for the test specimen if normality is accepted, normality being tested by using Shapiro-Wilk test. Significant correlations and discrete significant positive and negative ones were proved to be established among the analysed parameters. On the one hand F_0 correlates with F_M, F_P, F_M_Lss and Q_P_D_3, and on the other hand, a positive correlation between F_M and all the parameters except for NPQ_Lss and Qp_D_3 was found (table 2).

The variation of F_0, F_M, F_P şi F_M_Lss. parameters, for different species, is illustrated in figure no. 2.

The highest value of F_0 was determined at *Erigeron annuus* (210), which means that, in the case of this species, the photochemical reactions yield was lower probably due to an unappropriate dark adaptation, while in the case of *Cichorium intybus, Polygonum aviculare* şi *Echinochloa crus-galli*, which form a unitary group in relation with the rates of F_0 (they own more open reaction centers and the primary acceptor of quinona type, Q_A, more oxidizing) (Figure 2). It is considered that the changes of F_V/F_M and F_0 can be used as indicators of photoinhibition (He and colab, 1996, Valladares and Pearcy, 1997, quoted by Maxwell şi Johnson, 2000). A decrease of F_V/F_M, in the dark and an increase of F_0, indicate the fact that a photoinhibition process appears to avoid damages, as a reaction to high temperatures (Gamon and Pearcy, 1989, quoted by Maxwell and Johnson, 2000), low temperatures (Groom and Baker, 1992, mentioned by Maxwell and Johnson, 2000), PFD excess (Ögren and Sjöström, 1990, mentioned by Maxwell and Johnson, 2000) and hydric stress (Epron and colab., 1992, mentioned by Maxwell and Johnson, 2000).

The highest value of F_M (756) was registered at the same above mentioned species, which best reacted to an intense pulse light exposure. In this case the plastoquinone pool and the primary acceptor Q_A decrease occurs as well as the saturation of the electron-transport chain which lead to the stage when the reaction centers are closed. The lowest value of F_M (560) was determined at a *Echinochloa crus-galli* (because only a smaller number of reaction centers were closed)(Figure 2).

F_P is reached in the first second of the dark to actinic light fluorescence transition when the plastoquinone pool is highly reduced by the pulse of electrons (from PS II activity) while neither of the mechanisms of photoprotective quenching and CO_2 assimilation are yet activated. Later, the fluorescency begins to decrease (reaching F_t_Lss when the strady-state is aquired) due to the oxidization of the plastoquinone pool. In parallel with the electrons transportation, the decrease of the fluorescency is still amplified by photoprotective non-photochemical quenching, which diminishes maximum fluorescence from F_M, reached under dark adaptation conditions, to a lower - F_M_Lss or maximum fluorescence at steady-stage in light. Refering to F_P and F_M_Lss, it was determined that among the seven analysed species there are no stated statistic differences for neither of the two parameters, the species acting unitarily under actinic light conditions (Figure 2).

Analyzing figure no. 3, it can be stated that there were no statistically significan differences concerning F_0, F_M, F_P şi F_M_Lss, based on the substratum.

Species dependence of NPQ_Lss, NPQ_D_3, Q_P_Lss, Q_P_D_3, R_{df} is illustrated in figure no. 4. *Erigeron annuus* (1,97) and *Cichorium intybus* (1.89), ranged in a first cathegory concerning the values NPQ_Lss due to the fact that the heat dissipation, as a photoprotective mechanism, is more pronounced, whereas at la *Conyza canadensis, Polygonum aviculare* and *Echinochloa crus-galli*, the values of non-photochemical quenching during the strady-state are lower, which proves that these species were less affected by exess light exposure (low non-photochemical reactions). Concerning NPQ_D_3, it was found that non-photochemical relaxation in the dark occurs more rapidly in the case of *Echinochloa crus-galli* (0.06) comparing the other analysed species (Figure 4). Analysing Q_P_Lss, it was stated that in the case of *Echinochloa crus-galli* the photochemical quenching index during steady-state is small, which means that the ratio of open centers is small compared with the ratio calculated in the case of *Erigeron annuus, Conyza canadensis* and *Cichorium intybus* (Figure 4). By calculating the photochemical quenching index during dark relaxation, Q_P_D_3, it was shown that for all the analysed species the photochemical reactions relax relatively rapidly after the inhibition produced by the light excess exposure stress, by re-opening the reaction centers of PS II (Figure 4).

The smallest decline ratio of instantaneous fluorescence (R_{fd}) was calculated for *Echinochloa crus-galli* (0.66), which having a low NPQ, is not affected by intense light, being adapted to high light intensities (C_4–type plant) (Figure 4).

The analysis applied to NPQ_Lss, NPQ_D_3, Q_P_Lss, Q_P_D_3, R_{df}, based on substratum, showed that there were no statistically significant differences for none of these parameters.

Species dependence of QY_max, QY_Lss şi QY_D_3, is illustrated in figure no. 5. As regarding the maximum production of PS II as a result of dark exposure, it was found that there were no differences among the analyzed species, which was also found in the case of PS II production while dark relaxation. The statistic differences occur among the analysed species in connection with QY_Lss, which expresses the PS II production during the steady-state, in the light, when *Conyza canadensis* (0,38) ranged in the first class of values, the differences being significant only in the case of *Echinochloa crus-galli,* which, after being exposed to actinic light, registered a reduced photochemical production of PS II (Figure 5).

The analysis of the QY_max, QY_Lss and QY_D_3, based on substratratum, showed that statistically significant differences occur only in the case of QY_max – maximum production of PS II, which registered smaller values in the case of those plants which grow in the rifts created in the asphalt, regardless the species (Figure 6).

CONCLUSIONS

NPQ test was applied to study the synanthropic plants in order to mark out the photoprotection processes as a result of plant exposure to light exess. Thirteen indicators were calculated and interrelations were stated amomg.

- F_0 (initial fluorescence) had the lowest value for *Cichorium intybus, Polygonum aviculare* şi *Echinochloa crus-galli,* which stands for the biggest number of open reaction centers due to a proper dark adaptation;

- F_M registered high values at all species, except for *Echinochloa crus-galli*, in which case during the exposure to the first saturation pulse of light, after dark adaptation, only a smaller number of reaction centers are closed.

- as concerning F_P (reached in the first second of the transition of fluorescence to light) and F_M_Lss (maximum fluorescence during the steady-state, in light) there are no statistically significant differences among the analysed species;

- non-photosynthetic thermal dissipation, as a photoprotective mechanism, was less emphasised at *Conyza canadensis, Polygonum aviculare* and *Echinochloa crus-galli,* which stands for the fact that these species are less affected by light excess exposure (NPQ registers low values);

- photochemical reactionns relax relatively soon after the inhibition due to the light excess in the case of all the above mentioned species;

- among the analysed species there are no statistically significant differences regarding the maximum production of PS II, subsequent the light exposure (QY_max) or during the relaxation in the dark (QY_D_3), whereas the value of QY_Lss places *Conyza canadensis* on the first position;

- the decline ratio of fluorescence during the steady-state (R_{fd}) registered the lowest value in the case of *Echinochloa crus-galli* (0.66).

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TABLES AND FIGURES

Table 1

NPQ parameters statistics
a. Calculated by class distribution; b. There is multiple model.
The lowest value is presented

		Fo	F_M	Fp	F_M_Lss	NPQ_Lss	Q_p_Lss	Rfd	NPQ_D3	Q_p_D3	QY_max	QY_Lss	QY_D3
N	Valid	30	30	30	30	30	30	30	30	30	30	30	30
	Missing	0	0	0	0	0	0	0	0	0	0	0	0
Mean		181.43	675.40	617.37	272.13	1.54	0.96900	0.70533	0.22367	0.9337	0.7213	0.3377	0.6360
standard error of the mean		4.999	24.878	26.154	12.712	0.078	0.175018	0.010567	0.019893	0.01233	0.01108	0.01469	0.01021
Mediana		176.00(a)	706.00(a)	626.00(a)	258.00(a)	1.59(a)	1.17500(a)	0.72000(a)	0.23333(a)	0.9400(a)	0.7300(a)	0.3540(a)	0.6533(a)
Module		164(b)	746	566(b)	320	1	0.930(b)	0.750	0.220	0.94(b)	0.72	0.39	0.66
Standard drift		27.382	136.264	143.251	69.625	0.429	0.958614	0.057878	0.108960	0.06754	0.06067	0.08046	0.05593
Variaţion		749.771	18567.903	20520.792	4847.637	0.184	0.919	0.003	0.012	0.005	0.004	0.006	0.003
Asymetrie coefficient		0.837	-0.369	-0.215	0.704	-0.592	-2.774	-1.052	-0.489	0.012	-1.092	-1.704	-1.644
Standard drift of asymetrie coefficient		0.427	0.427	0.427	0.427	0.427	0.427	0.427	0.427	0.427	0.427	0.427	0.427
Excess (Vaulting)		0.337	-0.293	-0.408	1.006	0.250	7.947	0.791	1.526	-0.137	1.472	2.861	3.961
Standard drift of excess (vaulting)		0.833	0.833	0.833	0.833	0.833	0.833	0.833	0.833	0.833	0.833	0.833	0.833
Maximum amplitude of variation		113	561	586	312	2	4.670	0.230	0.530	0.27	0.26	0.34	0.27
Minimum		134	365	321	148	0	-2.670	0.550	-0,060	0,80	0,56	0,11	0,44
Maximum		247	926	907	460	2	2.000	0.780	0.470	1.07	0.82	0,45	0,71
Sum		5443	20262	18521	8164	46	29.070	21.160	6.710	28.01	21.64	10,13	19,08

Table 2

Corelations matrix (Pearson coefficient)
****Corelation is significant when p<1%; Corelation is significant when p<5%**

	Fo	F_M	F_P	F_M_Lss	NPQ_Lss	Q_P_Lss	Rfd	NPQ_D3	Q_P_D3	QY_max	QY_Lss	QY_D3
Fo	1	0.469(**)	0.517(**)	0.384(*)	0.020	0.087	0.192	-0.163	0.514(**)	-0.168	0.107	0.266
F_M	0.469(**)	1	0.952(**)	0.624(**)	0,239	0,529(**)	0,682(**)	0,503(**)	0,035	0,764(**)	0,632(**)	0,641(**)
F_P	0.517(**)	0.952(**)	1	0.695(**)	0.119	0.439(*)	0.668(**)	0.316	0.161	0.669(**)	0.568(**)	0.706(**)
F_M_Lss	0.384(*)	0.624(**)	0.695(**)	1	-0,587(**)	0,386(*)	0.033	0.171	0.117	0.471(**)	0.712(**)	0.502(**)
NPQ_Lss	0.020	0.239	0.119	-0,587(**)	1	0.017	0.653(**)	0.271	-0,067	0.179	-0.286	0.060
Q_P_Lss	0,087	0.529(**)	0.439(*)	0.386(*)	0.017	1	0.392(*)	0.487(**)	-0.223	0.649(**)	0.708(**)	0.301
Rfd	0.192	0.682(**)	0.668(**)	0.033	0.653(**)	0.392(*)	1	0.375(*)	0.103	0.607(**)	0.342	0.579(**)
NPQ_D_3	-0.163	0.503(**)	0.316	0.171	0.271	0.487(**)	0.375(*)	1	-0.376(*)	0.696(**)	0.558(**)	0.106
Qp_D_3	0.514(**)	0.035	0,161	0,117	-0,067	-0,223	0,103	-0,376(*)	1	-0,319	-0.068	0.595(**)
QY_max	-0.168	0.764(**)	0.669(**)	0.471(**)	0.179	0.649(**)	0.607(**)	0.696(**)	-0.319	1	0.740(**)	0.543(**)
QY_Lss	0.107	0.632(**)	0.568(**)	0.712(**)	-0.286	0.708(**)	0.342	0.558(**)	-0.068	0.740(**)	1	0.495(**)
QY_D_3	0.266	0.641(**)	0.706(**)	0.502(**)	0.060	0.301	0.579(**)	0.106	0.595(**)	0.543(**)	0.495(**)	1

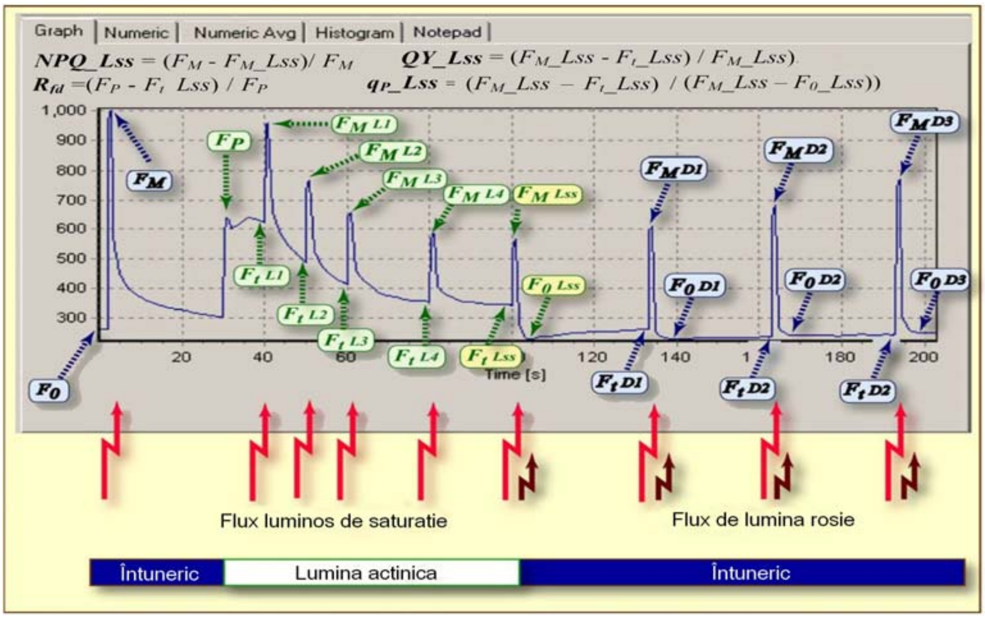
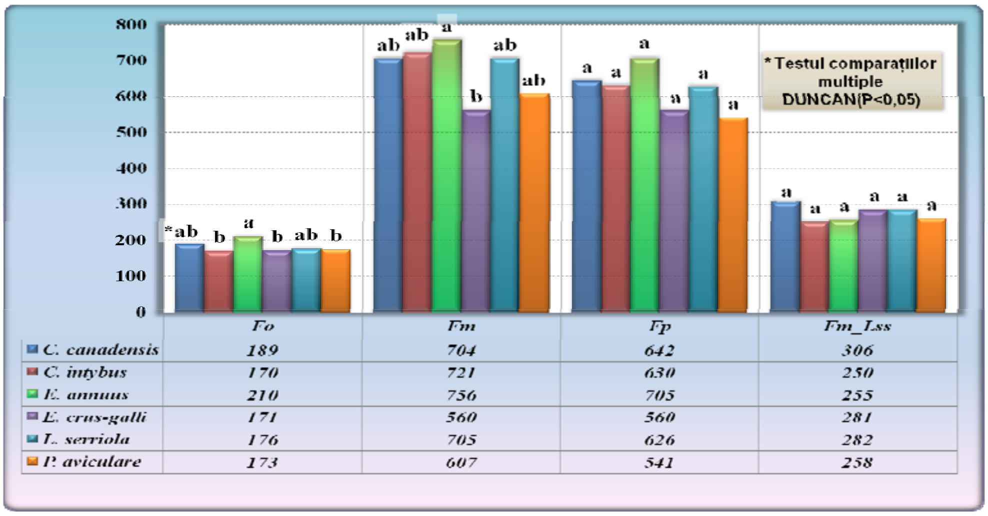
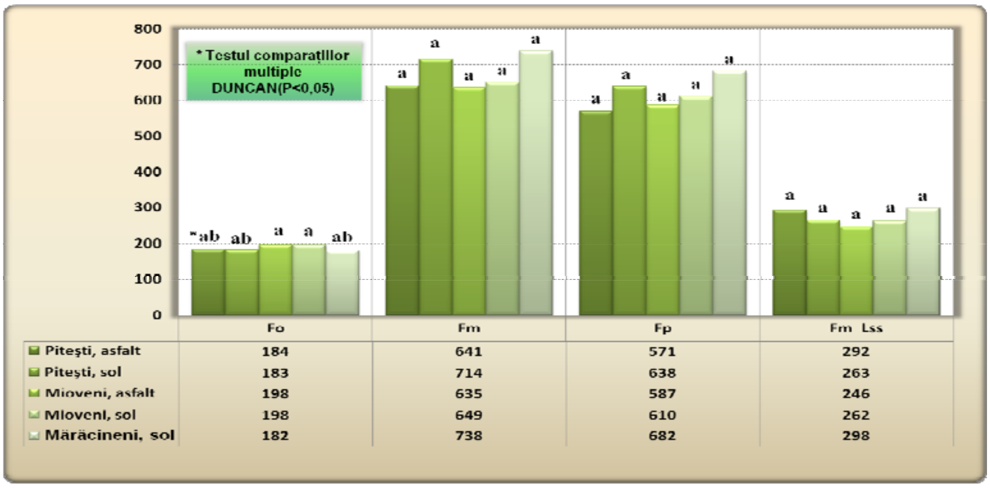


Fig. 1. NPQ test (according to FluorCam_Operation_Manual.pdf, 2008)



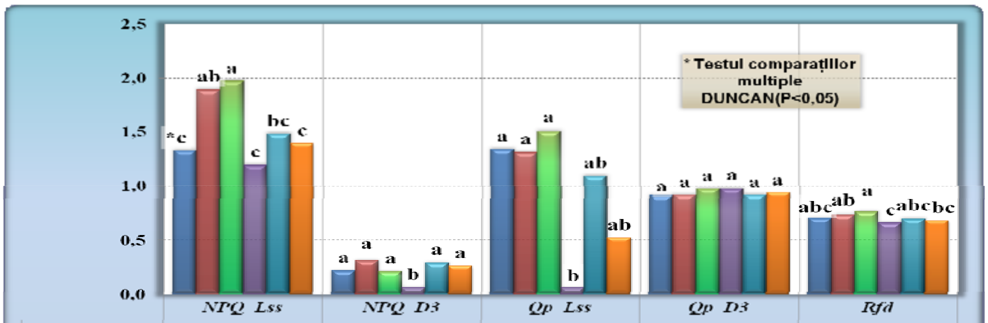
	Fo	Fm	Fp	Fm_Lss
C. canadensis	189	704	642	306
C. intybus	170	721	630	250
E. annuus	210	756	705	255
E. crus-galli	171	560	560	281
L. serriola	176	705	626	282
P. aviculare	173	607	541	258

Fig. 2. Species dependence of F_0, F_M, F_P şi F_M_Lss



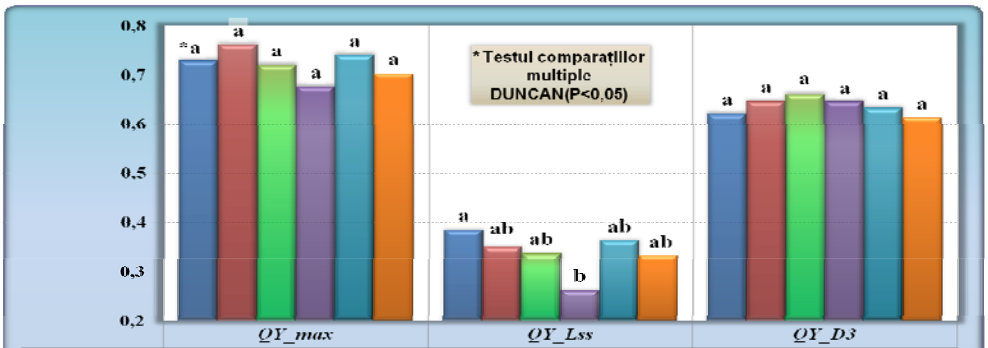
	Fo	Fm	Fp	Fm_Lss
Piteşti, asfalt	184	641	571	292
Piteşti, sol	183	714	638	263
Mioveni, asfalt	198	635	587	246
Mioveni, sol	198	649	610	262
Mărăcineni, sol	182	738	682	298

Fig. 3. Substratum dependence of F_0, F_M, F_P şi F_M_Lss



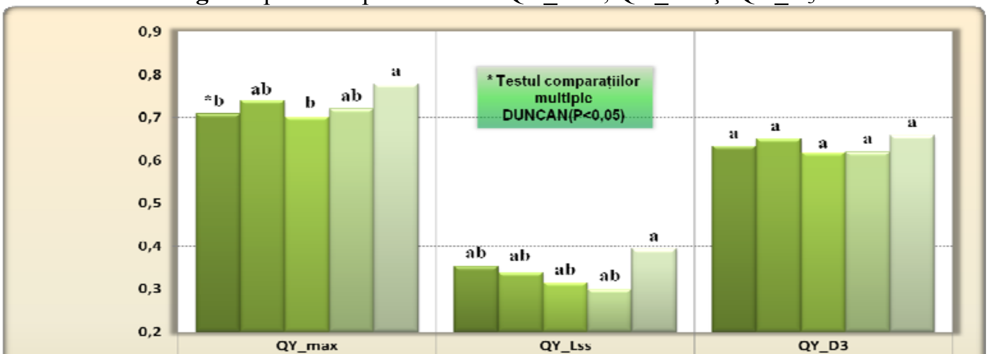
	NPQ_Lss	NPQ_D3	Qp_Lss	Qp_D3	Rfd
C. canadensis	1,33	0,22	1,34	0,91	0,71
C. intybus	1,89	0,31	1,31	0,91	0,73
E. annuus	1,97	0,21	1,50	0,97	0,76
E. crus-galli	1,19	0,06	0,06	0,97	0,66
L. serriola	1,48	0,29	1,09	0,91	0,70
P. aviculare	1,39	0,26	0,52	0,93	0,68

Fig. 4. Species dependence of NPQ_Lss, NPQ_D_3, Q_P_Lss, Q_P_D_3 şi R_{df}



	QY_max	QY_Lss	QY_D3
C. canadensis	0,73	0,38	0,62
C. intybus	0,76	0,35	0,65
E. annuus	0,72	0,34	0,66
E. crus-galli	0,68	0,26	0,65
L. serriola	0,74	0,36	0,63
P. aviculare	0,70	0,33	0,61

Fig. 5. Species dependence of QY_max, QY_Lss şi QY_D_3



	QY_max	QY_Lss	QY_D3
Piteşti, asfalt	0,71	0,35	0,63
Piteşti, sol	0,74	0,34	0,65
Mioveni, asfalt	0,70	0,32	0,62
Mioveni, sol	0,72	0,30	0,62
Mărăcineni, sol	0,78	0,39	0,66

Fig. 6. Substratum dependence of QY_max, QY_Lss şi QY_D_3

Anatomical changes of *Fraxinus excelsior* L. leaf exposed to urban traffic pollution

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Keywords: ash, epidermis, collenchyma, parenchyma, stomata, mesophyll

ABSTRACT

Urban traffic pollution differentially affects some plants species. Among them, *Fraxinus excelsior* is also included. From this species, leaves samples were collected from polluted and unpolluted trees, samples prepared as petiole, blade rachides and leaflets. Microscopic observations and measurements revealed many anatomical changes induced by the urban traffic pollution. Petiole and leaf epidermis recorded higher values in the case of pollutes samples, as against the unpolluted ones. Petiole tissues, excepting epidermal area, emphasized much lower values in polluted samples, compared with unpolluted ones. The average number of stomata per mm^2 was higher in unpolluted, compared with polluted samples. Leaf mesophyll significantly declined quantitatively at polluted sample, compared with unpolluted ones. The mesophyll leaf tissue has been affected by pollution: in most areas palisadic tissue was monolayer organized and at the lacunar tissue cells were disrupted, and resulted many collapsed cells.

INTRODUCTION

Plants are exposed to many abiotic and biotic stress factors that affect their health, even if they are field grown, indoor plants or live in gardens, landscapes and forests (Delian, 2006).

Air pollution, although known for centuries, has become today a major concern, not only because it affects human health, but also is harmful to plants and animals.

Road traffic emission have emerged as the major cause of urban poor air quality and as regarding their effects on plants, nitric oxide (NO) and nitrogen dioxide (NO_2) are the most important phytotoxic pollutants, associated with road transport (Bigmal et. al., 2004). There have been reported in a number of studies changes in plant community composition with increasing proximity to road sides, positive relationships between traffic density and some physiological features, anatomical changes or as regard as stomata structure (Delian et.al., 1996; Ungurean et.al., 1996; Gratani et.al, 2000; Viskari et.al., 2000; Bernhardt-Romermann et al., 2006, Savulescu et.al., 2008).

Using plants as a mean to control air pollution may occur if we will have a wide range of resistant and adapted plants to different climatic and soil conditions of the concerned area. This requires knowledge of the mechanisms of plant responses to air pollutants in order to select resistant species (Bennett et al., 1991). As Aksoy and Demirezen (2006) shown, *Fraxinus excelsior* is a useful biomonitor of the determined heavy metals, as a main cause of traffic emission.

MATERIAL AND METHODS

The used biological material was represented by leaves of *Fraxinus excelsior*, from species grown in the Botanical Garden of U.S.A.M.V. Bucharest and from the street alignment (trees located along the urban traffic road), intensively polluted with cars gases emissions.

Samples have been collected from five trees, using 50 leaves with completed growth from the periphery of the lower part of the tree-head. Observations and determination have been performed on July beginning, 2009-2010.

Cross sections were carried out in the leaf petiole, in its rachides and the middle part of the leaflets. Sections were cleared in chloral hydrate and colored with carmine alaunate and iodine green, known as classical methods described elsewhere (Georgescu et. al., 2003).

On the obtained sections the microscopic measurements were performed as regard as: tissues size, both for samples collected from the polluted and unpolluted areas.

On the exfoliated epidermis (using solution of collodium), it was determined the medium stomata number (stomata mm^{-2}) and their size were registered. Examination of leaf structure, measurements and photographs were carried out under the optical microscope, using the objectives 20 x 40 x and 10x eyepiece.

RESULTS AND DISCUSSIONS

After analyzing the *Fraxinus excelsior* leaves structure, in terms of polluted and unpolluted samples, there have been noticed cytohystological changes, especially from the quantitative point of view.

As regard as the petiole structure, the outline cross section is circular, showing from the outside to the inside the followings components: epidermis, cortex and central cylinder (Fig. 1).

Petiole tissues were registered lower values for polluted samples, compared with unpolluted ones, similar to the literature data (Radoukova, 2009).

In the case of epidermis it was registered an average thickness of 16.5 μm at pollutes samples, being covered by a thick cuticle with an average of 4.8 μm, compared with unpolluted samples, where the epidermis had an average thickness of 14.4 μm, being covered with a cuticle with an average thickness of 4.2 μm.

Collenchyma consisted of 2-3 rows of cells at polluted samples and recorded an average thickness average of 56.7 μm, and at the unpolluted samples there were noticed 4-5 rows of cells, with an average thickness of 72.9 μm.

Fundamental parenchyma, consisting of 4-5 rows of cells on the polluted samples had an average of 121.5 μm and at unpolluted 226.8 μm, with 5-7 rows of cells. In some parenchyma cells there were observed calcium oxalate crystals in the form of rafidia.

Central cylinder was bounded by a sclerified pericycle forming a ring, consisting in 2-4 rows of cells with an average thickness of 28.5 μm, at the pollutes samples (Fig.2), being thicker, with 3-7 rows of cells and fragmented at the unpolluted samples (Fig.3) with an average thickness of 62.3μm.

In the central cylinder there were observed many collaterally fascicle, very close to each other, disposed in a circle and separated by clarified medullar rays. Phloem had an average thickness of 40.5 μm for the polluted samples, and 57.4 μm at the unpolluted ones, as compared to xylem that has recorded an average thickness of 105 μm at polluted and 174.5 μm at unpolluted samples.

Medullary parenchyma is a meatic type composed of cells with thin walls recorded an average thickness of 195 μm at polluted and 320 μm at unpolluted samples.

Rachis transverse section is also circular, modified by two converged adaxiale wings, which delineates a very deep ditch. It has the same structure as the petiole and each wing is characterized by the presence of 4-5 smaller vascular bundles (Fig. 4).

Analyzing the leaf leaflet structure, it can be noticed that the epidermis seen from the front is composed of cells with irregular shape, with laterally side walls, corrugated. As is known foliar limb is hipostomatic (fig. 5) with anomocitic - type stomata (Cotthem, 1970; Esau, 1977; Andrei, 1978; Toma and Rugina, 1998). The polluted samples have been characterized by an average number of 276.4 stomata mm^{-2}, as against with the unpolluted samples where there was counted 390.5 stomata mm^{-2}. It is interesting to note that the stomata density results are opposed to those reported by other authors (Ninova, 1970). For instance, stomata recorded relatively larger size at the polluted samples an average length 24.5 mμ and a width of 19.7 µm, as compared with the unpolluted samples: an average length of 23 µm and an average width of 18.8µm.

In both epidermises, the multicellular secretory hairs are present, with octocelularr secreting gland, consisting of eight cells disposed in a circle.

In cross section, the median nervure is very prominent on the abaxial leaf blade, with a similar structure as petiole (Figure 6).

Values obtained for the leaflets blade (table 1) are very close to those of the literature (Bennett et. al., 1991; Radoukova, 2009).

The both epidermis cells were elongated, the upper with an average thickness of 16.8 µm at polluted and 14.2 µm at unpolluted samples, covered by a thin cuticle, averaging 3.5 µm (polluted) and 3.2 µm (unpolluted). Lower epidermis has been characterized by average values of 14.5 µm (polluted) and 12.5 µm (unpolluted), with a thin cuticle too (an average of 3.2 µm).

As it is known leaf mesophyll is of bifacial type, consisting by bistratified palisadic tissue under the upper epidermis and lacunar tissue under the lower epidermis, composed by of three to four rows of isodiametrically shaped cells.

Leaf mesophyll was very affected at the polluted samples, the palisade tissue showed an average thickness of 78.2 µm, being composed of 1-2 rows of cells and lacunar tissue had an average 54.4. µm, compared with unpolluted samples where leaf mesophyll was almost double, the palisade tissue consisting of two rows of cells, which registered an average thickness of 110.5 µm, and the lacunar tissue had 102.2 µm. At the lacunar tissue level cell damage was observed and resulted many gaps (Fig. 7).

It can be mentioned that in the case of both leaves mesophyll samples were observed many libero-ligneous fascicles, surrounded by sclerenchima cordon.

CONCLUSIONS

Epidermis thickness of the leaf petiole and blade at the polluted had higher values compared with unpolluted samples.

Petiole epidermis was covered with a thicker cuticle to the polluted, compared with unpolluted samples.

The petiole structurally tissues, excepting the epidermis were significantly affected by traffic pollution, recording much lower values as compared with unpolluted samples.

The average number of stomata polluted leaves was much lower than in unpolluted samples.

At the polluted samples larger stomata were recorded, compared with unpolluted samples.

Leaf mesophyll was changed at the polluted samples, recording much lower values compared with unpolluted samples.

At the lacunar tissue level, many cells were damaged, and resulted many gaps.

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TABLE AND FIGURES

Table 1

***Fraxinus excelsior* leaf structure characteristic feature variation**

Variant	Upper epidermis			Mesophyll		Lower epidermis			Stomata	
	Cuticle µm	Upper epidermis µm	Stomata number mm^{-2}	Palisadic tissue µm	Lacunar tissue µm	Cuticle µm	Lower epidermis µm	Stomata number mm^{-2}	Length µm	Width µm
Polluted	3.8	16.8	0	78.2	56.4	3.2	12.5	276.4	24.5	19.7
Unpolluted	3.2	14.2	0	110.5	102.2	3.2	14.5	390.5	23	18.8

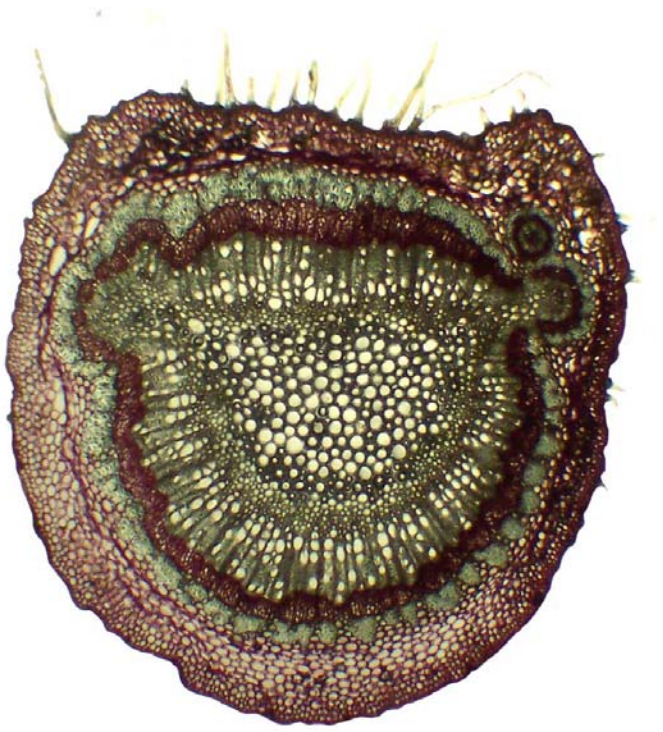

Fig. 1. Transversal section on *Fraxinus excelsior* leaf petiole

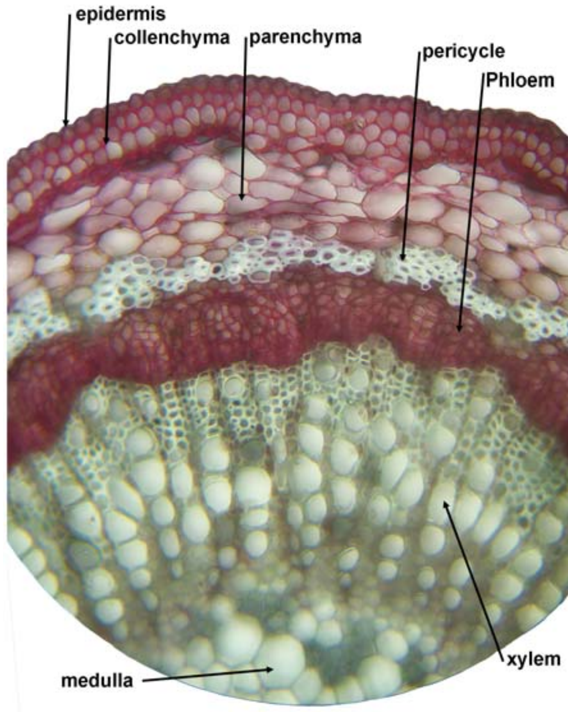

Fig. 2. *Fraxinus excelsior* - detail of petiole structure, polluted sample

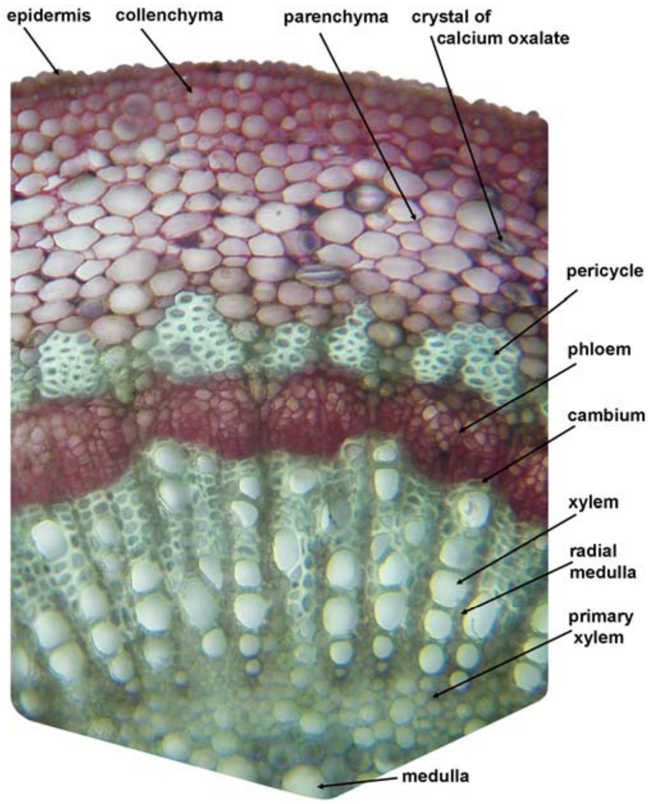

Fig. 3. *Fraxinus excelsior* - detail of petiole structure, unpolluted sample

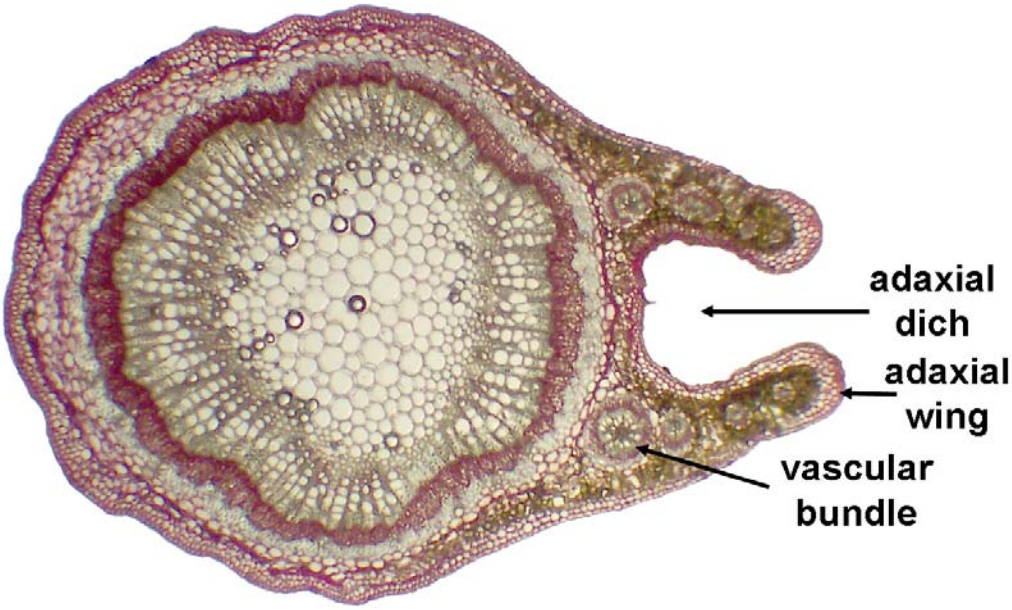

Fig. 4. *Fraxinus excelsior* - transverse section in leaf blade rachis

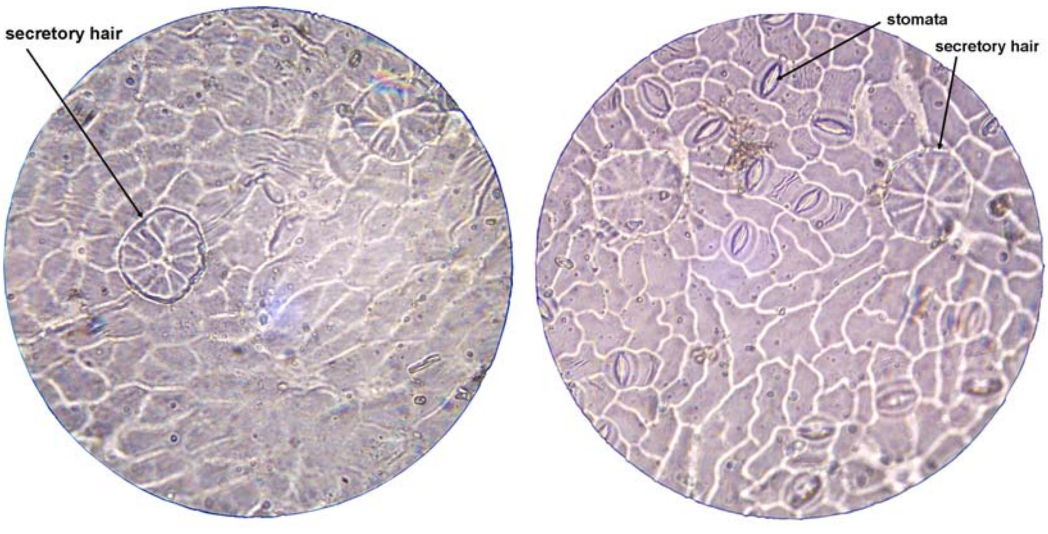

Fig. 5. *Fraxinus excelsior* - epidermis of leaf (left - upper epidermis; right - lower epidermis

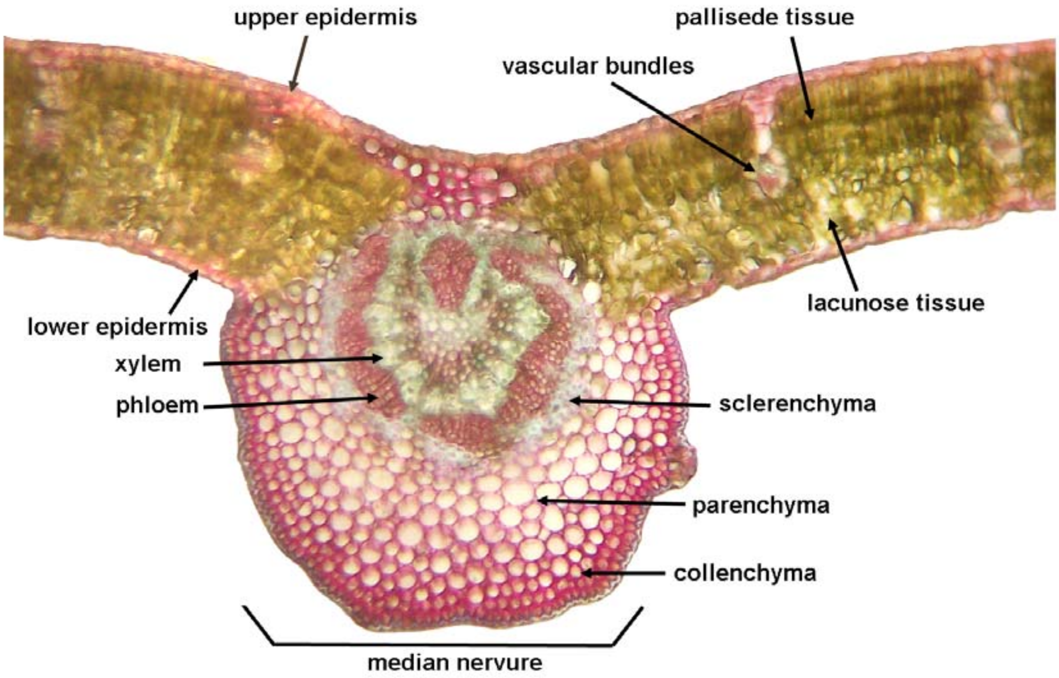

Fig. 6. *Fraxinus excelsior* - cross section of leaf blade, unpolluted

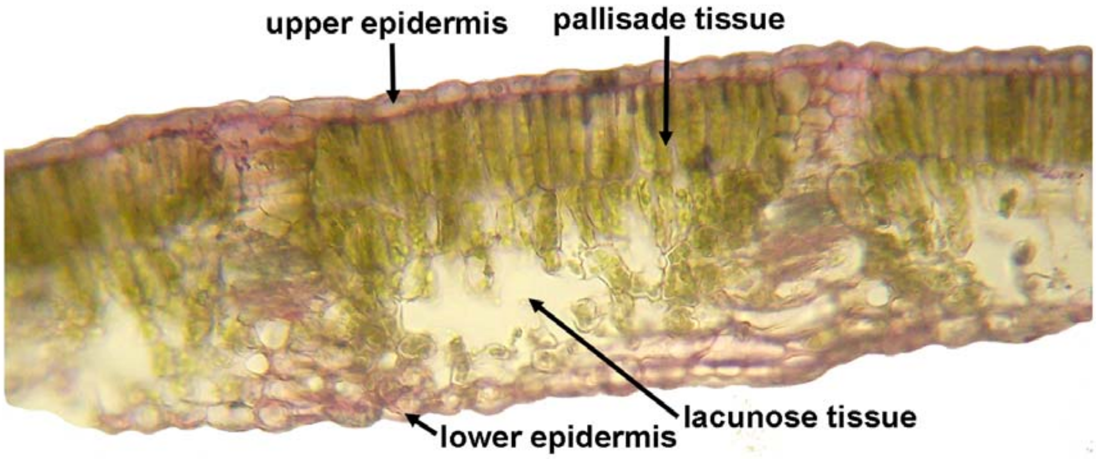

Fig. 7. *Fraxinus excelsior* - cross section of leaf blade, polluted

Research results regarding the anatomy of *Momordica charanthia* L. specie

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Keywords: epidermis, collenchyma, parenchyma, bicollateral vascular bundle, stomata

ABSTRACT

The anatomical observations were made in the stems and leaves of *Momordica charantia* grown in the greenhouse. The anatomy of the *Momordica charanthia* specie is similar of the Cucurbitaceae family. The contour of the stem in a transversal section is polygonal with numerous tectorial and multicellular secretory hairs on the epidermis. There are 10 vascular bundles bicollateral opened in the fundamental parenchyma. The petiole is elliptic-semicircular with two protuberant wings, separated by a deep groove in transversal section. In the epidermis of leaf there are tectorial and secretory multicellular hairs. In the petiole there are 7 vascular bundles bicollateral opened disposed in an arc, with the same structure like in the stem and two lower vascular bundles in the both wings. The leaf blade is amphystomatic, with anomocitic stomata type. The number of stomata per square millimeter is much higher in the lower epidermis than upper epidermis. In the both leaf epidermis there are multicellular tectorial and secretory hairs. In the median nervure of the leaf blade there is only one vascular bundles bicollateral opened. The mesophyll type of leaf blade is bifacial.

INTRODUCTION

The Momordica genus from the Cucurbitaceae family coming across from the tropical and subtropical regions and includes 45 annual and perennial species (Aguoru, 2008).

The *Momordica charantia* is an annual plant, little known in Romania. It is named bitter cucumber in Romania and karela, bitter melon, bitter pear and bitter gourd in other world regions. Its stem has 5 edges, creeping and climbing with simple tendrils and hairs cover it. The alternate leaves are deeply palmately with five to seven lobes, covered by hairs and with a characteristic odor. The flowers are yellow colored, solitary and unisexual-monoecious, with vanilla smell. The flowers are approx. 2.2 cm, with the gamosepal calyx and rotated corolla. Melonide fruits are oblong-ovoid, yellow-orange, high rough-tubers of 7-25 cm long. The fruits break at maturity bursting open along the 3 irregular valves (Jeffrey, 1980).

Momordica species are plants with enormous potentials both as sources of foods and drugs (Stoian, 2001). The aim of this study therefore is to present the morphological characters that could be used for the systematic characterization of this specie and explain the physiological and medicinal properties of the plant (Beloin, 2005).

MATERIALS AND METHODS

The plants of *Momordica charantia* were cropped in greenhouse of University of Agricultural Sciences and Veterinary Medicines, Bucharest.

In June, the stems and leaves were use in assessment. Transversal sections were made using common technique. The anatomical sections were clarified 24 hours using chloral hydrate and after that there was washed and fixed into the gelatinous glycerin.

The number of stomata per square millimeter was observed in both leaf epidermises. The observations and measurements were made with the optical microscope.

RESULTS AND DISCUSSIONS

The anatomy of *Momordica charantia* stem and leaf are similar with the species of Cucurbitaceae family, with some differences (Andrei, 1978; Dickison, 2000; Toma, 1998; Zanoschi, 1985).

Stem anatomy

The contour of stem is polygonal with the ribs in cross section with the epidermis, cortex and central cylinder from outside to inside (figure 1). The epidermis is monolayer made up of izodiametric cells with external wall slightly thickened than the internal wall, covered by a thin cuticle.

In the epidermis are present the stomata and numerous tectorial and secretory multicellular hairs with a terminal multicellular capitate gland.

In the cortex there are belts of angular collenchyma, wider in front of ribs (7-10 cells rows) and thinner between the ribs (2-3 cells rows) alternated with the belts of assimilator parenchyma.

The central cylinder is limited at the outside by the sclerenchyma pericicle shape in a ring with 3-4 cells rows with the walls thickened with lignin.

In the fundamental parenchyma, the central cylinder there are 10 vascular bundles bicollateral opened with 5 external, smaller in front of the ribs and 5 internal bigger between ribs, all separated by parenchymatous medullary rays. In the center of the central cylinder, the parenchyma cells are disorganized resulting medullary lacuna.

We can see in figure 2, the structure of vascular bundles bicollateral opened composed by the external and internal phloem tissues accompanied by annex cells and parenchymatous phloem. Between the both phloem tissues there is xylem tissue with the metaxylem looked by parenchymatous xylem disposed external and protoxylem internal disposed.

Cambium is present between xylem and external phloem as a strip of intra-fascicular meristematic tissue.

Leaf Anatomy

In cross section the petiole has a semicircular-elliptical shape with attenuated ribs and with two clear wings, separated by a deep groove (figure 3). The petiole structure is similar with the stem composed by epidermis, angular collenchyma and fundamental parenchyma.

The epidermis has isodiametric cells with the external walls covered by a thin cuticle. In the epidermis there are stomata and multicellular tectorial and secretory hairs. Under epidermis is angular collenchyma with 2-3 cell rows.

There are 7 vascular bundles bicollateral opened in the fundamental parenchyma disposed an arch with the same structure like in the stem and two smaller vascular bundle in the each wings.

In the epidermis of limb there are polygonal unregulated cells with the strong undulated lateral walls. Stomata are in the both epidermis and the leaf is called amphistomatic with anomocytic stomata and multicellular tectorial and secretory hairs (figure 4, 5).

The median nervure in cross section is more protuberant on the lower epidermis, with the same structure like petiole: epidermis, collenchyma, and fundamental parenchyma and only one vascular bundles bicollateral opened. The both epidermis have elongated cells with thin walls.

The leaf blade mesophyll is bifacial with palisade tissue under upper epidermis and lacunose tissue under lower epidermis. The palisade tissue has 1-2 cell rows slightly elongated and the lacunose tissue has 4-5 isodiametric cells rows (figure. 6).

The average number of the stomata in upper epidermis is 30.2 per square millimeter, opposite to lower epidermis with a lot of stomata, 345.4 per square millimeter.

CONCLUSIONS

These data from the vegetative morphology of the *Momordica charantia* specie investigated present some important characters that could be exploited in improving the characterization and physiological properties and some are actually reported for the first time.

On the epidermis of stem and leaves there are many tectorial and secretor hairs.

The vascular bundles in the stem and leaf are bicollateral opened.

The leaf is amphistomatic with anomocytic stomata.

The average number of stomata/square millimeter in the lower epidermis is 10 times higher than the upper epidermis.

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FIGURES

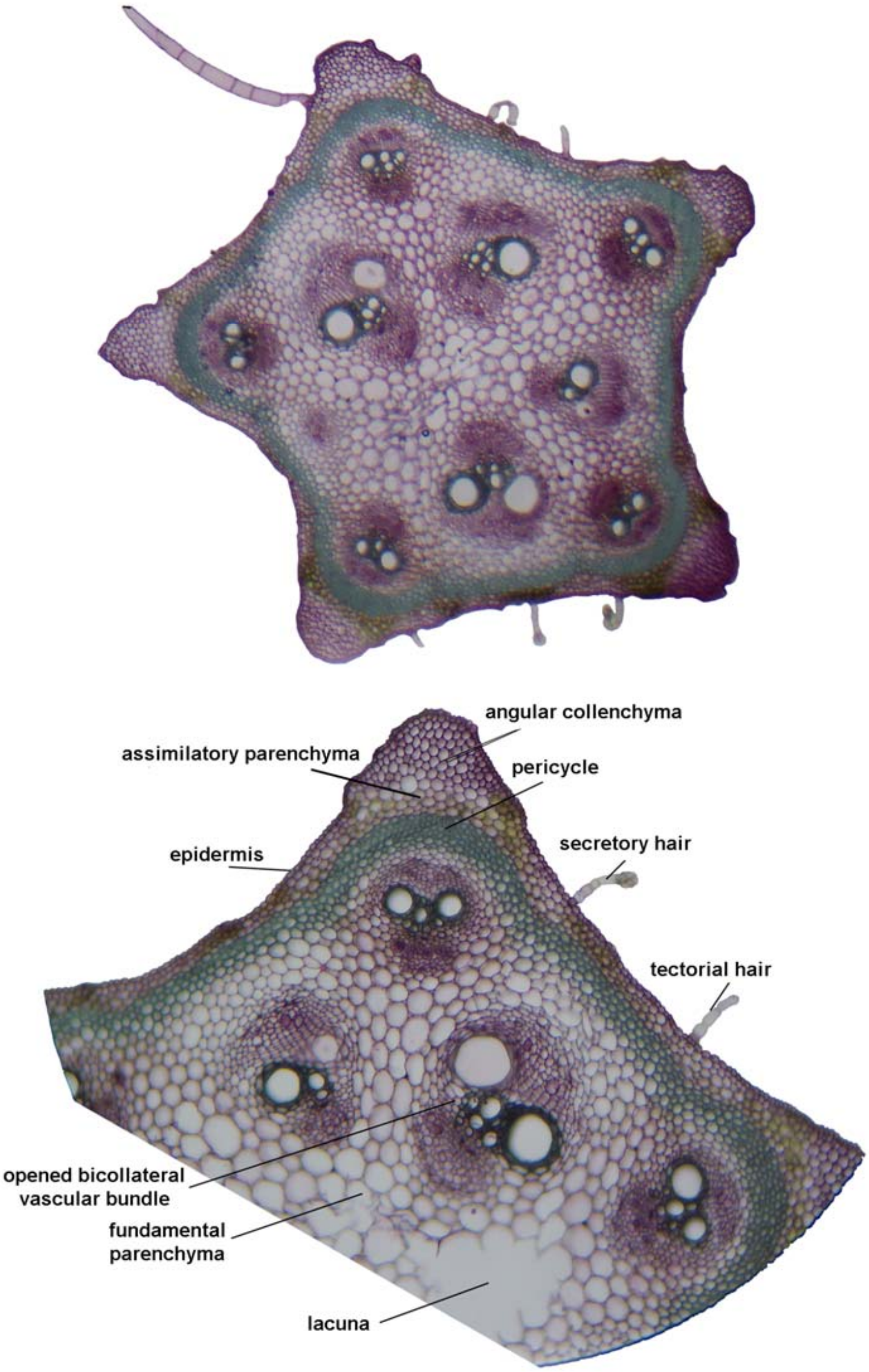

Fig. 1. Cross section in the *Momordica charantia stem*, ob. 20 x.

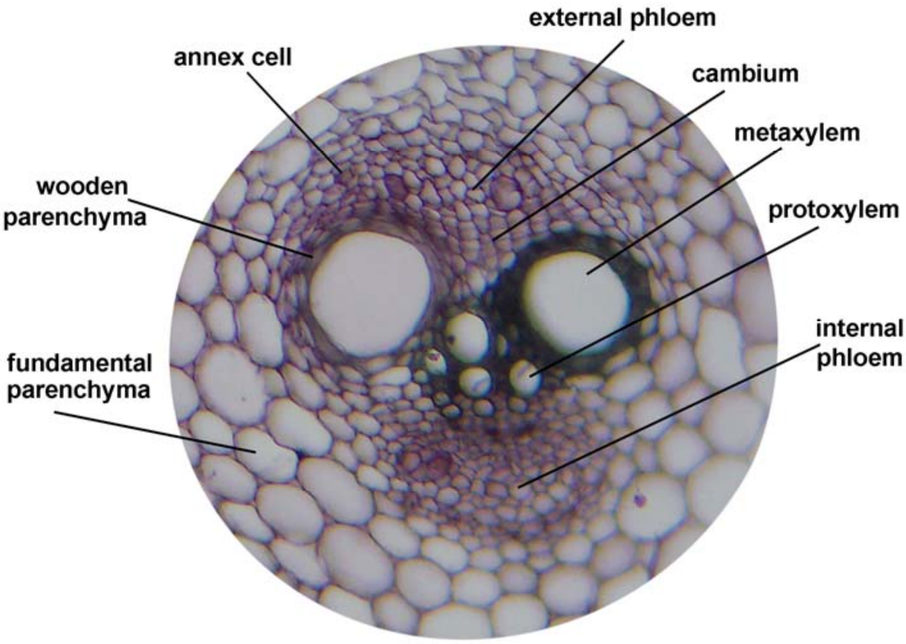

Fig. 2. Cross section in vascular bundle bicollateral opened of *Momordica charantia* ob. 40 x.

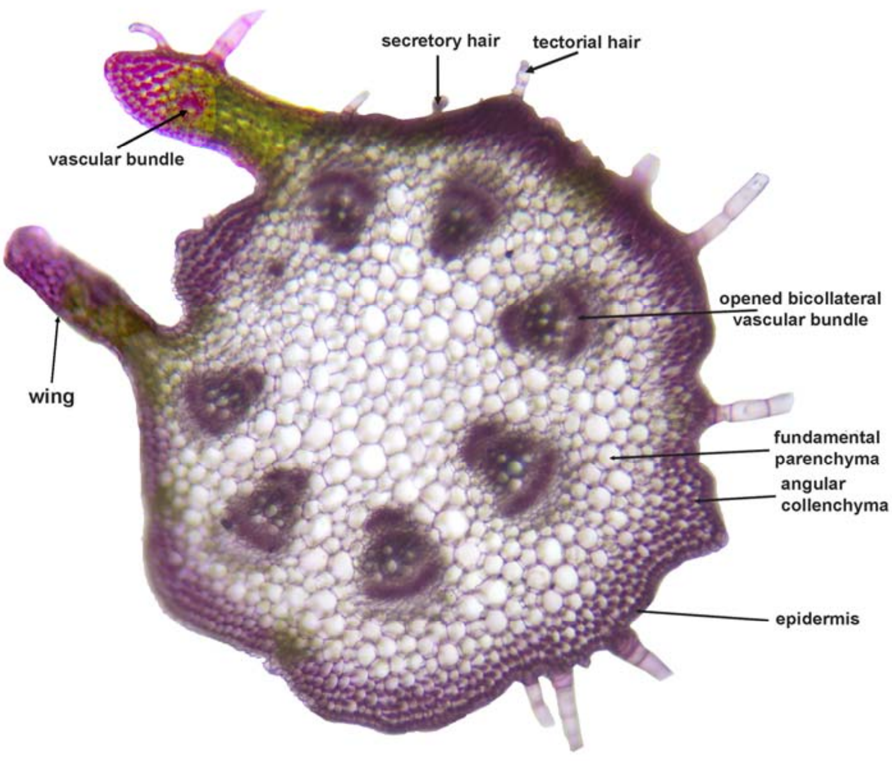

Fig. 3. Cross section in *Momordica charantia* petiol ob. 20 x.

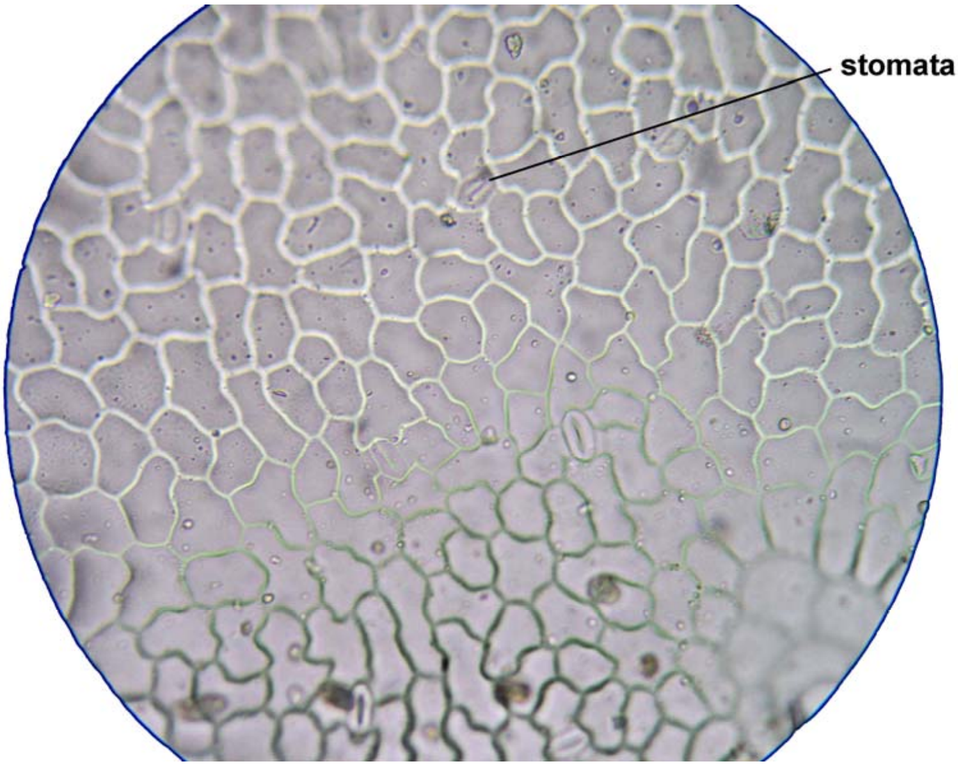

Fig. 4. Upper epidermis of *Momordica charantia* leaf ob. 20 x.

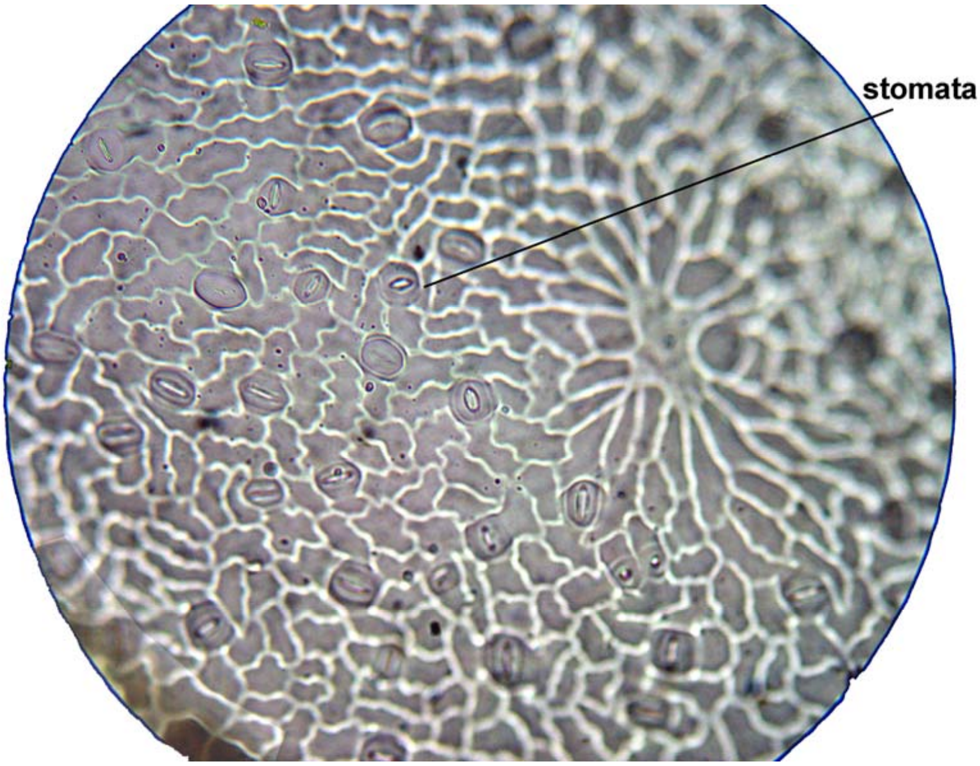

Fig. 5. Lower epidermis of *Momordica charantia* leaf ob. 20 x.

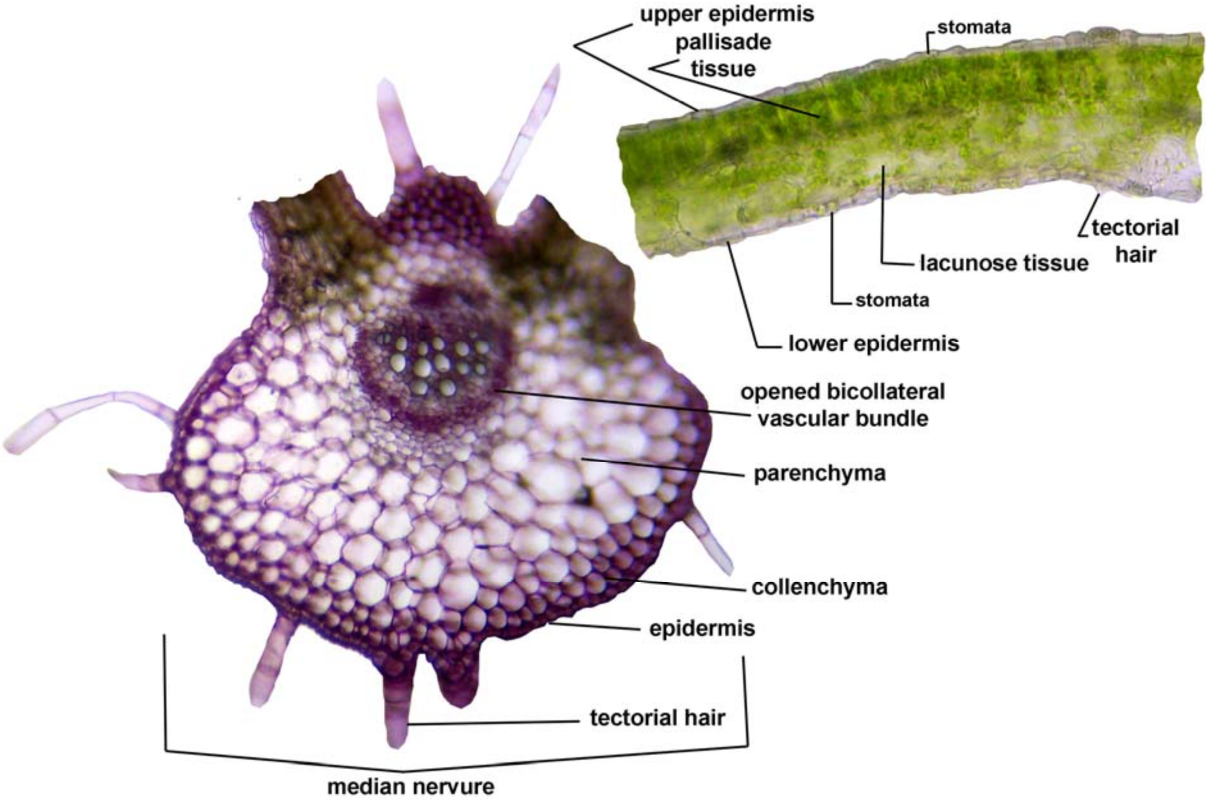

Fig. 6. Cross section in the leaf blade of *Momordica charantia* ob 20 x

Research on trace elements and heavy metal accumulation in eggplant organs depending on the applied technology

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Keywords: *Solanum melongena*, heavy metal, fruits

ABSTRACT

Vegetables represent a potential source of important nutrients and constitute important functional food. Nowadays, there are many research preoccupations for eggplant new cultivation methods, as for instance using of biodegradable plastic mulch. The purpose of the present study was to characterize the distribution of mineral elements between the different plant organs of cultivated eggplants, after a clean technology - with the sheet of biodegradable mulch - and to monitor the content of heavy metals in fruit. Mn, Fe and Na accumulated in roots and mature leaves. B, Ba and Cr accumulated in leaves, fruits and flowers. Their absorption has been dependent on the used technology, excepting Fe and Ba. The fruit content of the determined heavy metals (Al, Cu, Pb and Zn) was below the maximum limits allowed for vegetables. Aluminum and zinc accumulated mainly in roots, lead in aerial organs and copper distribution was relatively uniform among plant organs. Analyzing in terms of eggplant fruits quality, this clean technology using biodegradable film reduced or eliminated weeds, also there was obtained yields with a high content of mineral nutrients and low in heavy metals, under the maximum limits allowed.

INTRODUCTION

Vegetables occupy an important place in rational human's diet. In addition to a potential source of important nutrients, vegetable constitute important functional food component by protein, vitamins, iron and calcium which have marked health effects (Arai, 2002). Eggplants play also an important role in human nutrition. Nowadays, there are many research preoccupation for eggplant new cultivation methods (including our country too) (Maniutiu and Sima, 2010), using the compost of municipal solid waste (Topcuǒglu and Önal, 2007), or under waste water irrigation (Bigdeli and Seilsepour, 2008). Also, researchers have been looking for degradable plastic mulch for decades. The purpose of the present study was to characterize the distribution of mineral elements between the different plant organs of cultivated eggplants, after a clean technology - with the sheet of biodegradable mulch - and to monitor the content of heavy metals in fruit.

MATERIALS AND METHODS

The studied biological material was represented by the Raven eggplant variety, a semi-early variety, very productive, with oval-round fruit (12 x 15 cm), dark purple color, which may be approximately 500 g weight.

Specific technology applied experience

Experience has been carried out in the greenhouse conditions to produce seedlings. These were planted on April 5 in boxes using peat as substrata, and then transplanted on April 25 in plastic pots filled with peat „biolan".

Planting in the greenhouse was performed on June 5 at a distance of 80 cm between rows and 40 cm between plants in the row, and on June 10 there was mounted mulching films and the established studied variants are presented in Table 1. Culture was weekly irrigated, without any chemical fertilization. The following determinations have been performed: water and dry matter accumulation by gravimetric method (%) and mineral elements content (mg 100 g^{-1} DM.) (Mn, Fe, Na, B, Ba, Cr, Cu, Pb, Zn and Al).

RESULTS AND DISCUSSION

Manganese is one of the essential trace elements of the photosynthesis process, being involved in water photolysis and oxygen production. It has a role in the processes of synthesis of chlorophyll and ascorbic acid, and the accumulation of copper, magnesium (Gherghi et.al. 2001). Experimental obtained data regarding manganese accumulation in eggplants roots and mature leaves pointed out that its accumulation is generally stimulated by the use of mulch (Figure 1). Thus, the highest amount of Mn was determined in plant roots V2 (0.569 mg 100 g^{-1} DM), V1 (0.552 mg 100 g^{-1} DM) and V5 (0.447 mg 100 g^{-1} DM).

Iron, found in plants as organo mineral compounds is required for chlorophyll biosynthesis and oxidation-reduction processes. Translocation of iron is reduced and its storage in leaves is a complex form: fitoferitină (Burzo et. al, 2004). Analytical data particularly highlights the iron accumulation in roots; its concentration is approximately 3-6 times higher than in the plant organs (Figure 2), which shows a reduced transport to plants' aerial organs. A high iron content was determined in mature leaves, ranging between 2.07 mg 100 g^{-1} DM (V3) and 4.86 mg 100 g^{-1} DM(V4), through its role in the process of photosynthesis.

Sodium is an essential element for higher plants; accumulate in the vacuole, cell wall apoplast and very little in cytoplasm. Experimental data obtained show the accumulation of sodium in the roots of eggplant plants, accumulation depending on the used technology (Figure 3). Thus, if the witness uncovered sodium concentration is reduced in all plant organs except for flowers, unlike the variants covered with non-degradable mulch CERTEX or biodegradable mulch, black and white 2. In fruit there were determined very low sodium concentrations ranging from 0.49 mg 100 g^{-1} DM (control) and 1.92 mg 100 g^{-1} DM (V5).

Boron is an element that usually accumulates in roots and leaves and during senescence period is retranslocated in a very small proportion (Burzo et. al., 2004). Boron deficiency generally occurs in the case of alkaline soils, where this element becomes inaccessible to roots system. Analytical data emphasized a boron transport mainly by leaves, fruits and flowers, which eliminate the hypothesis of a deficiency in this element (Table 1). Also, at the roots there were determined low boron concentrations, ranging from 0.888 mg 100 g^{-1} DM (V4) and 0.992 mg 100 g^{-1} DM (V1). The highest boron amount was determined in flowers – control variant (1531 mg 100 g^{-1} DM).

Barium has a definite physiological role in higher plants and is generally accumulated in roots. Eggplant farming technology used in this experiment stimulated the absorption of barium mulched plants, most likely due to lack of competition between crop and weeds (table 2).

Chromium is found in very small quantities in plant organs, being present in large amounts in organs with higher metabolic rates: young leaves, fruits and flowers. The concentration of chromium in eggplant plants organs ranged from 0.030 mg 100 g^{-1} DM (witness the strain) and 0.183 mg 100 g^{-1} DM (the flowers to V4), being influenced by the cultivation technology (Table 1).

Heavy metals can accumulate in plants causing disturbances of metabolic processes, particularly as equally harmful for consumers. Accumulation of heavy metals is selective and varies depending on the species and soil pH, being more intense in the case of acidic soils. In terms of specific body storage of heavy metals it was observed a variation depending on the species: in branches, leaves or senescence roots (Burzo et al., 2004). Heavy metal toxicity is primarily due to their ability to influence the redox processes, free to react with groups of enzymes and inactivate them, to precipitate the protein or to alter membrane permeability, in some cases causing chromosomal aberrations (lead).

Copper in small concentrations is very useful plant trace elements involved in the synthesis of chlorophyll, ascorbic acid, catalyze redox reactions, and stimulates the activity of enzymes. In high concentrations it is considered a heavy metal, harmful, which currently has its maximum concentration in the vegetables for 5 mg kg^{-1} FW. Experimental obtained data showed a relatively constant concentration and a relatively uniform distribution of this element in plant organs of eggplant, ranging between 0.56 mg 100 g^{-1} DM (the flowers of witness) and 0.80 mg 100 g^{-1} DM (the flowers V4). The fruits of eggplant variation of copper content is between 0.67 and 0.80 mg 100 g^{-1} DM, which corresponds to a concentration of 0.97 mg kg^{-1} FW and 1 05 mg kg^{-1} FW .

Lead reduces the intensity of photosynthesis and respiration process. In some cases, it causes chromosome aberrations, due to changes in membrane permeability, which reacts with some free radicals in proteins, causing different changes: conformational, stability and functioning (Burzo et al., 2004). The experimental data showed a very high mobility of lead in vegetative organs. We have found accumulations of lead in leaves and flowers, in particular, and only in high concentrations in the V2 variant which shows an intense absorption and transport to the aerial organs (Figure 5). The highest concentrations of lead were determined at V1 mature leaves (0.81 mg 100 g^{-1} DM), young leaves from V2 (0.75 mg 100 g^{-1} DM) and flowers to V5 (0.60 mg 100 g^{-1} DM). The eggplant fruit variation of lead content was between 0.02 and 0.30 mg 100 g^{-1} DM, which corresponds to a concentration of 0.02 mg kg^{-1} FW and 0.46 mg kg^{-1} FW, placing the maximum permissible limits of 0.5 mg kg^{-1} FW.

Yilmaz et al. (2009) studied lead (Pb) accumulation and distribution, and its effects on growth and nutrient content of *S. melongena* seedling growth in pot and noticed that exposure to excess P caused accumulation of Pb in roots, shoots and leaves. At the higher Pb concentrations, roots accumulated 6-fold more Pb than shoot and 4-fold more than leaves. The highest level of Pb, generally inhibited the uptake of all mineral elements.

Zinc is a trace element, at low concentrations in higher plants and is particularly useful due to its role as activator of many enzymes. It also regulates metabolism of carbohydrates, proteins and tryptophan. In high concentrations it cause disorders of metabolic processes, therefore the maximum permissible concentration in vegetables is 5 mg kg^{-1} FW (Gherghi et al., 2001). Analytical data show zinc accumulation in roots and stems in most variants, absorption and its transport to organs being stimulated by mulching soil air. Note that if the mulch bare witness, because competition between plant roots and roots grown weed, zinc content is very low (below 0.3 mg 100 g^{-1} DM). The fruit concentration of zinc varies between 0.14 and 0.48 mg 100 g^{-1} DM, which corresponds to a concentration of 0.21 mg kg^{-1} FW and 0.72 mg kg^{-1} FW, ranging thus the maximum limits of 5 mg kg^{-1} FW.

Aluminum is found in leaves and is generally considered an essential element for higher plants (Burzo et al., 2004). It accumulates in the leaves or senescent roots. Effects of excess aluminum on acid soils occur at the root, which reduces their growth and meristematic activity is irregular. Also, aluminum inhibits calcium absorption, favoring symptoms of deficiency in calcium. Experimental obtained data show the accumulation of aluminum in plant roots eggplant in all studied variants, a technology-dependent process- the concentration of aluminum at mulched plants was 2-4 times higher, than control plants. High concentrations of aluminum were determined in mature leaves, and fruit variation limits ranged from 0.37 mg 100 g^{-1} DM and 1.85 mg 100 g^{-1} DM, which corresponds to a concentration of 0.56 mg kg^{-1} FW.

It can be mentioned that there are many preoccupation for new cultivation methods as for example eggplants cultivation in containers fillet with limited volume of substrata and the possibility of applying only organic fertilizers in order to reduce the cultivation costs and to decrease the risk of nitrates accumulation in fruits over the accepted limits (Maniutiu and Sima, 2010). Phytotoxic metal limits are defined by Kabata-Pendis (2002) cited by Topcuoğlu and Önal (2007) and the experiment performed emphasized that fruit tissue of eggplant contained higher metal concentration than that of leaf. Also, Bigdeli and Seilsepour (2008) researched heavy metal accumulation in some vegetables under waste water irrigation and noticed that the lead concentration in all vegetables samples was more than maximum permitted concentration, while Cd pollution was observed in eggplant. For eggplant, the followings value expressed as mg kg^{-1} were determined (Cd-0.13; Pb-1.43; Mn-40.55; Fe-176.50; B-20.25; Zn-116.50; Cu-27.53; Ni-0.00; Co- 0.00). Growing some vegetables in industrially polluted region emphasized that the accumulated quantities of heavy metals were concentrated in different parts of each one of the crop: in roots for tomato, in fruit-set for pepper and in leaves for eggplant. In the case of eggplant, Shilev and Babrikov (2005) found the followings value for Pb, Cd, Zn and Cu as mg kg^{-1} DW (roots: 42.3; 13; 241.55; 34.76; steams: 23.6;12; 219; 18.3; leaves: 155; 14.1; 216; 40.4; fruit-set: 42.1;8.2;145.8; 39.4). Regular monitoring of heavy metal in plant tissue is essential in order to prevent excessive build up of these metals in the human food chain (Jawad, 2010).

Analyzing in terms of quality of eggplant fruits studied variants, we conclude that using this clean technology to reduce or eliminate weeds by mulching with biodegradable film yields were obtained with a high content of mineral nutrients and low in heavy metals, below the maximum limits allowed.

CONCLUSIONS

Based on these results conclusions can be drawn on the quality of original and valuable recommendations made by the eggplant clean technology biodegradable mulching films, with the established culture at the greenhouse of University of Agronomical Sciences and Veterinary Medicine Bucharest.

• Of the trace elements examined, Mn, Fe and Na accumulated in roots and mature leaves, in contrast B, Ba and Cr accumulates in the leaves, fruits and flowers; their absorption is dependent on the used technology, excepting Fe and Ba.

• The content of heavy metals (Al, Cu, Pb and Zn) were determined in fruit below the maximum allowed for vegetables; aluminum and zinc accumulate mainly in roots, lead in aerial organs and copper distribution is relatively uniform among plant organs.

• Analyzing in terms of quality of eggplant fruits obtained from the studied variants, we conclude that using this clean technology to reduce or eliminate weeds by mulching with biodegradable film, yields were obtained with a high content of mineral nutrients and low in heavy metals, under the maximum allowed.

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TABLES AND FIGURES

Table 1

Experimental variants

Experimental variants	Features cover
Control	Control - uncovered
V1	Non-degradable mulch CERTEX
V2	Biodegradable mulch white 1
V3	Biodegradable mulch white 2
V4	Biodegradable mulch black 1
V5	Biodegradable mulch black 2

Table 2

Minerals content in plant organs of eggplant (%)

		Root	Stem	Mature leaf	Young leaf	Fruit	Flower
B	Control	0,960	0,952	1,053	1,006	1,043	1,531
	V1	0,992	0,964	1,041	1,120	1,050	1,095
	V2	0,976	0,990	1,070	1,053	1,063	1,400
	V3	0,969	0,947	1,026	0,999	1,104	0,972
	V4	0,888	0,907	1,011	1,014	0,975	1,321
	V5	0,899	0,869	0,949	0,888	0,996	0,959
		Root	Stem	Mature leaf	Young leaf	Fruit	Flower
Ba	Control	0,797	0,816	0,833	0,766	0,761	0,560
	V1	0,991	0,815	0,864	0,729	0,769	0,779
	V2	0,888	0,803	0,840	0,925	0,755	0,606
	V3	0,858	0,840	0,989	0,886	0,917	0,858
	V4	0,937	0,877	0,818	0,890	0,836	0,760
	V5	0,994	0,983	0,920	0,793	0,834	0,860
		Root	Stem	Mature leaf	Young leaf	Fruit	Flower
Cr	Control	0,037	0,030	0,035	0,047	0,050	0,129
	V1	0,047	0,035	0,034	0,069	0,054	0,067
	V2	0,051	0,043	0,050	0,076	0,059	0,122
	V3	0,050	0,044	0,074	0,100	0,129	0,079
	V4	0,068	0,062	0,084	0,104	0,098	0,183
	V5	0,068	0,045	0,054	0,055	0,096	0,078

Fig. 1. The content of manganese in the organs of eggplant plants

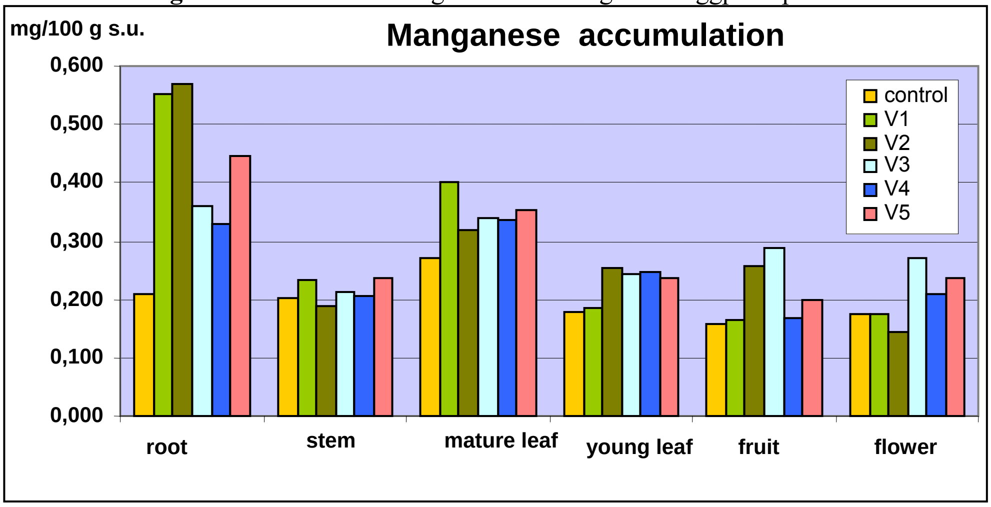


Fig. 2. Iron content of plant organs of eggplant

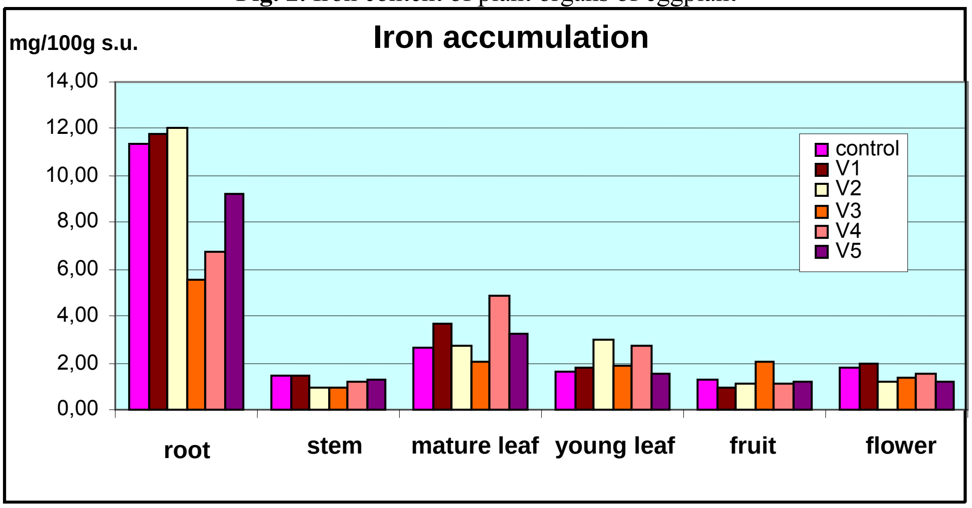


Fig. 3. Sodium content in plant organs of eggplant

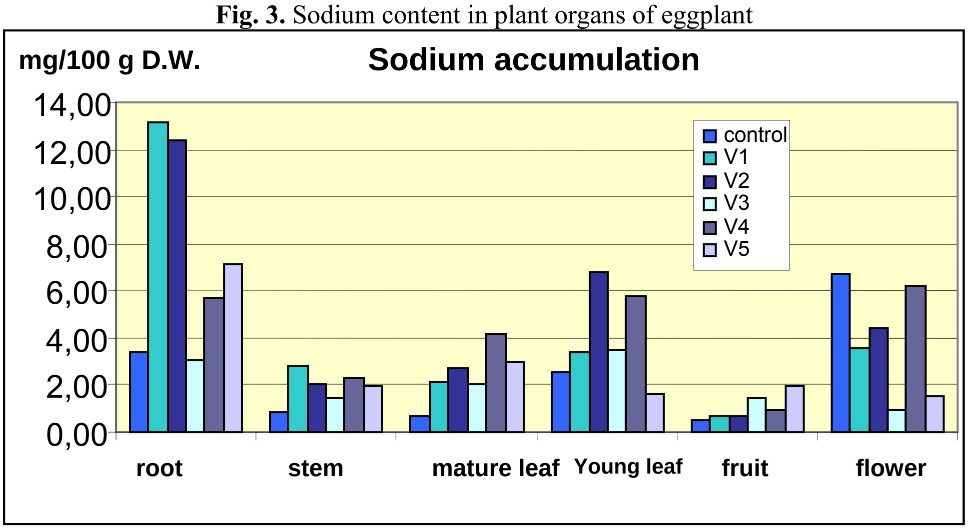


Fig. 4. The content of copper in plant organs of eggplant

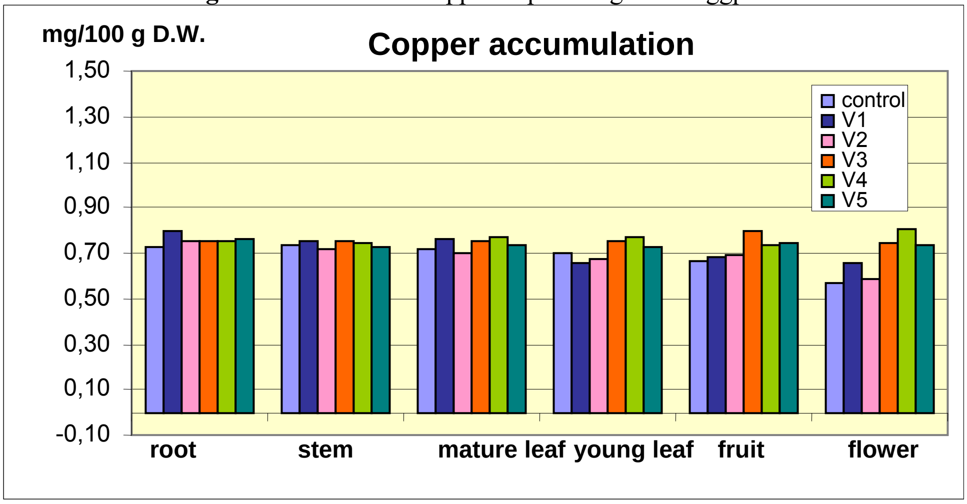


Fig. 5. The lead content in plant organs of eggplant

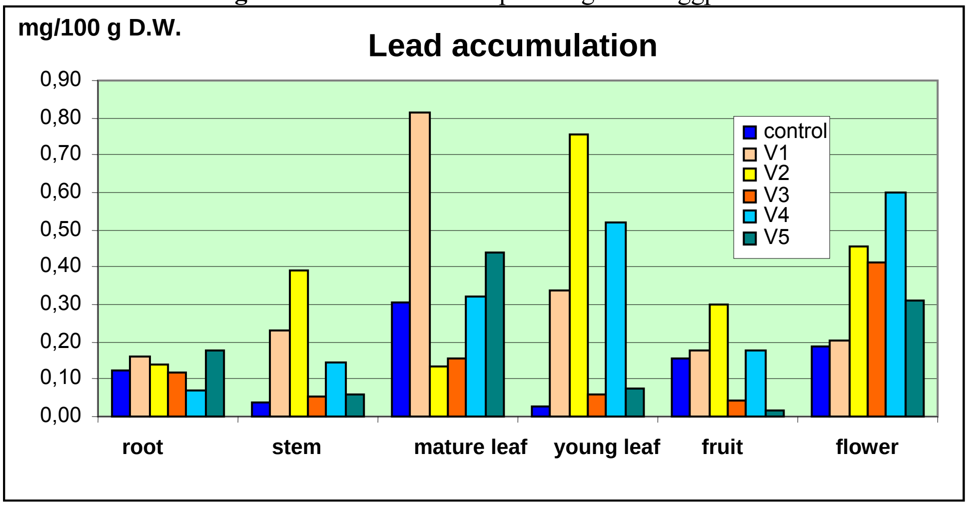


Fig. 6. The zinc content of plant organs Eggplant

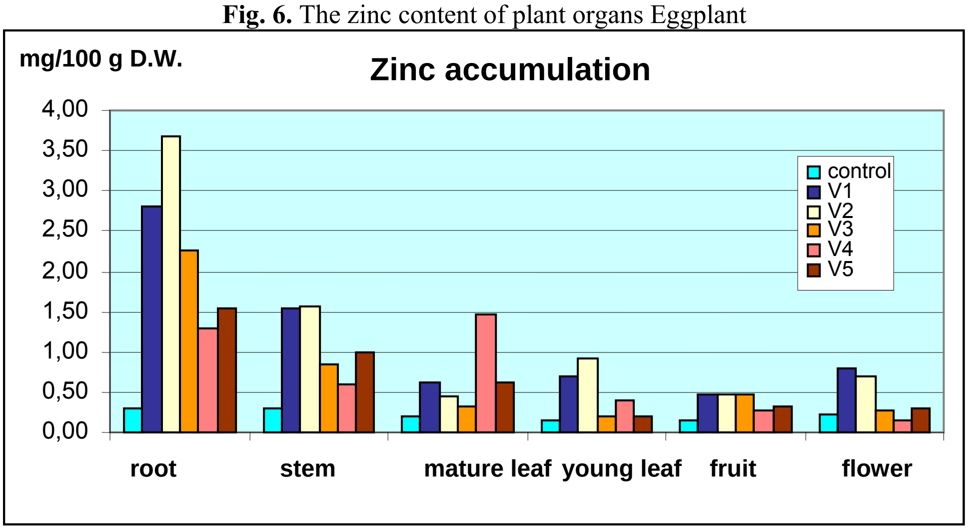
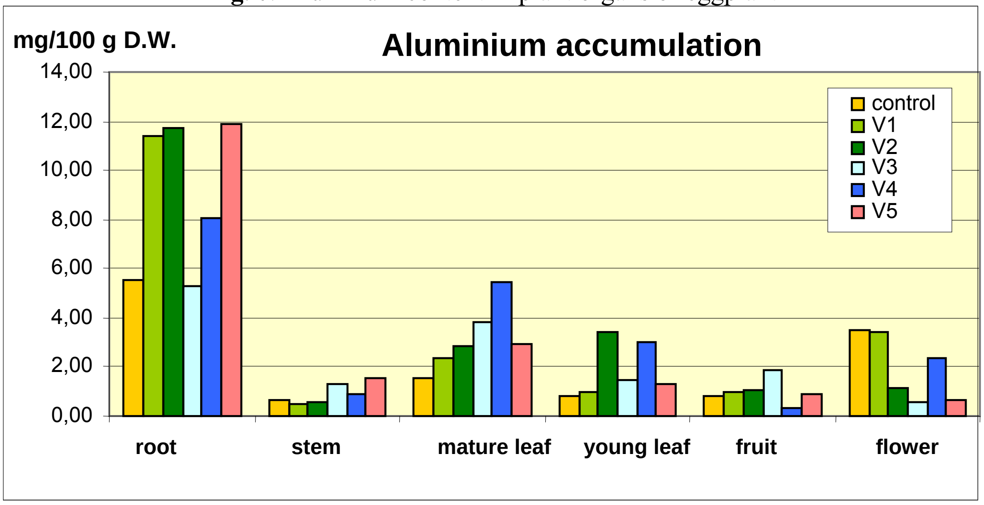


Fig. 7. Aluminum content in plant organs of eggplant



Research on the accumulation of macro elements in eggplant plant organs depending on the applied technology

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Keywords: *Solanum melongena*, macroelements, mulch

ABSTRACT

Examining the five variants covered with mulch (V1 - Mulch non-degradable CERTEX; V2- Mulch biodegradable white 1; V3- Mulch biodegradable white 2; V4- Mulch biodegradable black 1; V5- Mulch biodegradable black 2) compared with the control it was found that the black film 2 recorded the highest accumulation of dry matter: 22.35% in roots, 25.65% in the stem, 22.29% in mature leaves, 21.06% and 15.27% in young leaves, and flower, respectively. A high mineral content was determined in roots and mature leaves (2.71%; 2.38% mature leaves and roots - V5; V2), and the lowest in flowers (eg 0.39% in control). Comparing the distribution of potassium between the different organs of plants, depending on the culture technology, it highlights the fact that potassium is a mobile ion and is generally present in tissues resulting in a higher content of water (the flower - control, V2 ,V4 of the root - the control and V1). Also, mature leaves have a high potassium content, which confers resistance to dehydration. The highest amount of calcium was determined in plant roots variants V2 (219.86 mg 100 g $^{-1}$ DW) and V3 (208.54 mg 100 g $^{-1}$ DW), and mature leaves from plants of variants V2 (212.66 mg 100 g $^{-1}$ DW) and, V1 and V4 (202.4 mg 100 g $^{-1}$ DW).The experimental data obtained in this experiment shows that phosphorus is transported rapidly by shoot organs and is generally accumulated in flowers, fruits and leaves. Distribution of magnesium is relatively uniform, being generally dependent on the mulch type used to cover the ground. There is a positive influence on the absorption of magnesium in plants at variants V3 and V2. The highest concentration of magnesium was recorded in flowers- V3 (35.98 mg 100 g $^{-1}$ DW).

INTRODUCTION

Eggplant (*Solanum melongena* L.) is not only a kind of tasty food, but also with underlying medicinal use (Konczak et al., 2004). Eggplant fruits are valuable dietetically due to their low caloricity along with rich and varied mineral composition.

There are many research studies to implement new horticultural plants technology, including that of mulching. The use of plastic material for mulching is a very common practice for vegetable crops, also experimented for eggplants, next to others living mulch (Adamczewska-Sowińska and Kołota, 2009).

Black polyethylene is the most widely used due to its excellent properties and low cost. Petrolium based plastic mulching films are used to suppress weeds, to reduce the loss of moisture from the soil, and to protect the plants and their edible products from the soil-borne diseases and from the dirt. The world consumption of plastic mulching film made mainly with low density polyethylene (LDPE) in horticulture is around 700.000 tonnes per year (Espi et al., 2006). Moreover, Immirzi et.al. (2009) studied the mechanical properties, the radiometric properties and biodegradable tests of an innovative biodegradable coating that can be sprayed. This was tested as suitable alternative to low density polyethylene film for soil mulching in horticulture.

Use of biodegradable plastic materials for mulching may be an alternative to polyethylene film because biodegradable mulching fulfill successfully all the functions of the traditional plastic mulches (Morene and Moreno, 2008).

The purpose of this study was to characterize the distribution of some macroelements between different organs of eggplant plants cultivated as a clean technology - with biodegradable film mulching.

MATERIALS AND METHODS

The studied biological material was represented by the Raven eggplant variety, a semi-early variety, very productive, with oval-round fruit (12 x 15 cm), dark purple color, which may be approximately 500 g weight.

Specific technology applied experience

Experience has been carried out in the greenhouse conditions to produce seedlings. These were planted on April 5 in boxes using peat as substrata, and then transplanted on April 25 in plastic pots filled with peat „biolan".

Planting in the greenhouse was performed on June 5 at a distance of 80 cm between rows and 40 cm between plants in the row, and on June 10 there was mounted mulching films and the established studied variants are presented in Table 1. Culture was weekly irrigated, without any chemical fertilization. The following determinations have been performed: water and dry matter accumulation by gravimetric method (%) and mineral elements content (mg 100 g^{-1} DM.) (K, Ca, P and Mg).

RESULTS AND DISCUSSION

Water and minerals are essential for plant growth, with severe repercussions on production and quality. Data from the literature (Souci et. al., 1981) show that the fruits of eggplants have a water content ranging from 92 to 93.4% and a mineral content of about 0.5%. The experimental data obtained in this experiment demonstrates that a water content less fruit than the literature, ranging between 84.85% (V2) and 89.69% (V3). Fruit mineral content varies very broad ranging from 0.46% (V4) and 1.55% (control).

A comparative analysis (Table 2), the variants, the water content of plant organs can be appreciated that the limit of variation is between 74.35% (strain V5) and 93.53% (V4 flower and blank). In general, young leaves, fruits and flowers have the highest water content due to intense metabolism and growth process. A high mineral content (expressed as total ash of fresh substance) was determined in roots and mature leaves (ex. 2.71% 2.38% mature leaves and roots V5 V2), and lowest in flowers (ex. 0.39% in control). Mineral accumulation in roots is due to their functions - to absorb water and minerals and detoxification, was arrested at their ions like aluminum, barium, sodium, zinc, etc.. High content of nutrients in the mature leaves is mainly due to accumulation of calcium - ion found in large amounts in building this body of vegetation.

Accumulation of dry matter in plant organs is largely due to the efficiency of photosynthesis and distribution assimilates in function of the needs of each organ.

Examining the five variants covered with mulch compared to bare witness V5 variant record shows that the largest accumulations: 22.35% in roots, 25.65% in the stem, 22.29% in mature leaves, 21.06% in leaves Young and 15.27% in bloom. These experimental data show that plants of this variant is in an advanced state of maturity. High dry matter accumulation, higher than if the witness were recorded in roots and stems of plants variant V3, and V1 variant plant stems and leaves. The lower accumulation of dry matter were recorded in variants V4 and control flowers (6.47%) and V2 (8.19%), which was predictable because their development phase (most flowers open), compared with other variants that also contained buds (Figure 1).

The dry matter content of fruits ranged from 10.31% eggplant (V3) and 15.15% (V2), being dependent on the rate of accumulation of organic matter contributing to the value of their dietary and food, and stage of development and hence water content. Black biodegradable film 2 as organic mulch stimulated mineral elements accumulation in all plant organs.

Distribution of mineral elements in plant organs

Potassium is an ion present in all vegetables having a role in the activation of enzymes involved in phosphorus metabolism in the process of respiration, having influence at the cellular level installation turgidity. The presence of potassium favors water penetration and retention in cells, reducing the intensity of transpiration and plant resistance to drought (Gherghi et al., 2001). Eggplants have a high demand and the harvested fruit removes a large amount of K from the soil (Wuzhong, 2002). Comparing the K accumulation in eggplant fruit is found that this process is stimulated by culture technology applied, respectively mulching with biodegradable film results are about 30-40% higher than if the witness or mulching with non-biodegradable foil (Figure 2). Comparing the distribution of potassium between the different organs of plants, depending on culture technology, it highlights the fact that it is a mobile ion, generally being present in tissues resulting in a higher content of water (the flower - control, V2, V4, the root - the control and V1). In the case of fertilization experiments potassium content ranged from 23.4 to 35.1 g kg^{-1} DM (and being easier transported in plants its higher concentration was also found in generative parts (Michalojć and Buczkowska, 2009). Also, mature leaves have a high potassium content, which confers resistance to dehydration.

Calcium is found in the middle lamella as calcium pectates, where it causes tissue firmness, or in the cell wall, vacuole and endoplasmic reticulum where it regulates cell permeability and cellular homeostasis (Burzo et al., 2004).Comparing the 5 different experimental mulching variant it was generally found that calcium absorption was stimulated by the technological means, whether biodegradable films or non-biodegradable films CERTEX were used, (Figure 3).

From literature data it is known that this ion generally accumulates in roots and mature leaves, as demonstrated in this experiment. Thus the largest amount of calcium was determined in plant roots variants V2 (219.86 mg 100 g^{-1} DW) and V3 (208.54 mg 100 g^{-1} DW), and mature leaves from plants of variants V2 (212.66 mg 100 g^{-1} DW) and V1 and V4 (202.4 mg 100 g^{-1} DW). Fruits of eggplant can be a source of calcium, achieving an accumulation of this ion between 87.89 mg 100 g^{-1} DW (M) and 109.69 mg 100 g^{-1} DW(V2). Michalojć and Buczkowska (2009) determined in eggplants fruit a calcium concentration ranging from 1.2 to 1.9 g kg^{-1} DW.

Phosphorus is present in vegetables as organic and inorganic form, performing energetic role in the processes of phosphorylation, redox and respiratory systems (Burzo et al., 2004). It is a very mobile ion and is generally located in tissues with intense metabolism and the respiration intensity is very high. The experimental data obtained in this experiment shows that phosphorus is transported rapidly by shoot organs, is generally accumulated in flowers, fruits and young leaves (Figure 4). The highest amount of phosphorus was determined in flowers at the variant V2 (90.01 mg 100 g^{-1} DW), this variant generally having greater P accumulation than the control of all plant organs. Comparing the five variants of mulching is was found that phosphorus accumulation in fruit is stimulated by the use of biodegradable films white 1, black 2 and white 2 and non-biodegradable film CERTEX. The V4 variant is considered that plants have a phosphorus deficiency, which explains the low ion content in roots, stems and fruits, this being mainly transported to flowers. After Michalojć and Buczkowska (2009) phosphorous concentration in eggplants fruits ranged from 2.5 to 3.0 g kg^{-1} DW, with no significantly influence of the fertilization factor on its accumulation in fruits.

Magnesium contained in chlorophyll and phytin being present especially in the green plants tissues. It is estimated that it has a role in the phosphorus uptake and transport, affect the enzymes activity during the respiration, carbohydrate metabolism and photosynthesis process. It is estimated that during the growing season magnesium level remained constant and only at the mature phase it is accumulated in fruits as phytin (Gherghi et al., 2001). Experimental obtained data show that the accumulation of magnesium in plant organs of eggplant is in most cases similar as in the case of phosphorus accumulation (Figures 4 and 5), which suggests the involvement of magnesium phosphorous absorption and transport in plant. As with phosphorus, the V4 variant is considered to be with magnesium deficiency, manifested especially in the fruit (4.04 mg 100 g^{-1} DW). Michalojć and Buczkowska (2009) found in eggplant fruit a magnesium level ranging from 1.0 to 1.4 g kg^{-1} DW. The content of magnesium in eggplants fruits depended on the type of mulch (polyethylene black foil or non-woven polypropylene agrotxtil) and term of living mulches sowing, and in the case of potassium on the species used as living mulch (perennial ryegrass and white clover) (Adamczewska-Sowińska and Kołota, 2010).

CONCLUSIONS

Based on these results conclusions can be drawn on the quality of original and valuable recommendations made by the eggplant clean technology with biodegradable mulching films with the established culture of the University of Agronomical Sciences and Veterinare Medicine Bucharest, Romania.

• Examining the five variants covered with mulch, compared with the control it was found that the black film 2 (V5) recorded the highest accumulation of dry matter: 22.35% in roots, 25.65% in the stem, 22.29% in mature leaves, 21.06% and 15.27% in young leaves, and flower, respectively.

• A high mineral content (expressed as total ash from fresh biological material) was determined in roots and mature leaves (2.71%; 2.38% mature leaves and roots - V5; V2), and the lowest in flowers (eg 0.39% in control).

• Comparing the distribution of potassium between the different organs of plants, depending on the culture technology, it highlights the fact that potassium is a mobile ion and is generally present in tissues resulting in a higher content of water (the flower - control, V2 ,V4 of the root - the control and V1). Also, mature leaves have a high potassium content, which confers resistance to dehydration.

• The highest amount of calcium was determined in plant roots variants V2 (219.86 mg 100 g^{-1} DW) and V3 (208.54 mg 100 g^{-1} DW), and mature leaves from plants of variants V2 (212.66 mg 100 g^{-1} DW) and, V1 and V4 (202.4 mg 100 g^{-1} DW).

• The experimental data obtained in this experiment shows that phosphorus is transported rapidly by shoot organs and is generally accumulated in flowers, fruits and leaves.

• Distribution of magnesium is relatively uniform, being generally dependent on the mulch type used to cover the ground. There is a positive influence on the absorption of magnesium in plants at variants V3 and V2. The highest concentration of magnesium was recorded in flowers- V3 (35.98 mg 100 g^{-1} DW).

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TABLES AND FIGURES

Table 1

Experimental variants

Experimental variants	Features cover
Control	**Control - uncovered**
V1	Mulch non-degradable CERTEX
V2	Mulch biodegradable white 1
V3	Mulch biodegradable white 2
V4	Mulch biodegradable black 1
V5	Mulch biodegradable black 2

Table 2

Water and mineral content in plant organs of eggplant

		Root	Stem	Mature leaf	Young leaf	Fruit	Flower
Water (%)	**Witness**	81,30	79,62	82,68	83,97	85,44	93,53
	V1	81,74	78,87	79,87	87,03	84,89	86,80
	V2	80,44	81,60	84,10	89,18	84,85	91,81
	V3	80,19	78,07	84,14	87,95	89,69	85,24
	V4	81,01	81,42	85,13	88,30	87,25	93,53
	V5	77,65	74,35	77,71	78,94	87,47	84,73
		Root	**Stem**	**Mature leaf**	**Young leaf**	**Fruit**	**Flower**
Ash (minerals elements) (%)	**Witness**	1,79	1,67	2,42	1,29	1,55	0,39
	V1	1,79	1,48	2,71	1,05	1,38	1,44
	V2	2,34	1,38	2,02	0,93	1,42	0,57
	V3	2,04	1,42	2,23	1,06	0,74	1,36
	V4	2,14	1,38	2,55	1,60	0,46	0,56
	V5	2,38	1,35	2,41	1,60	0,99	1,27

Fig. 1. Dry matter content in plant organs of eggplant

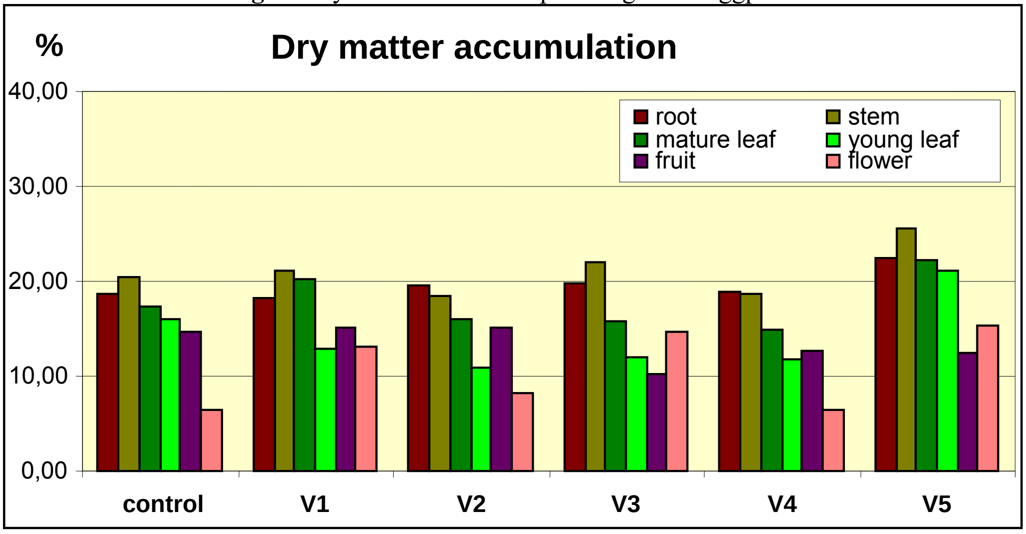


Fig. 2. The potassium content in plant organs of eggplant.

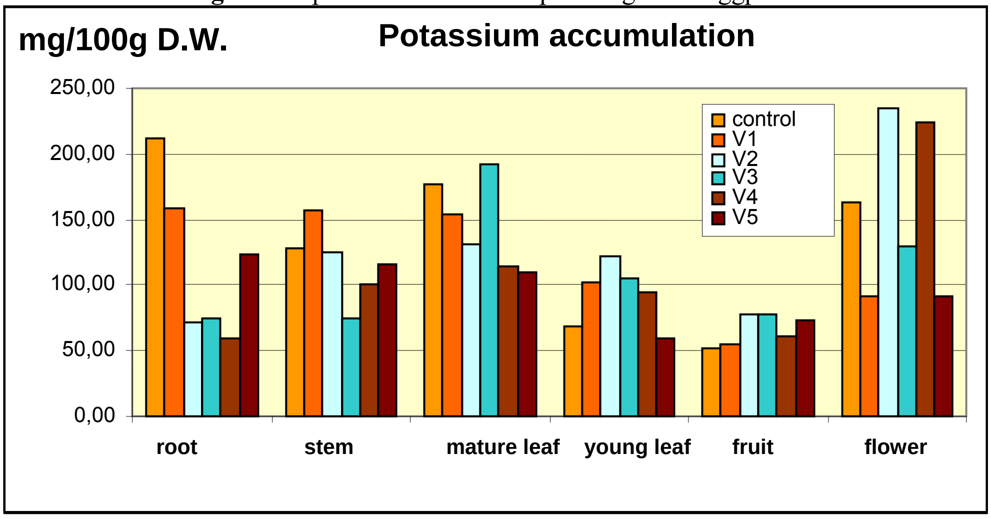


Fig. 3. The calcium content of plant organs of eggplant.

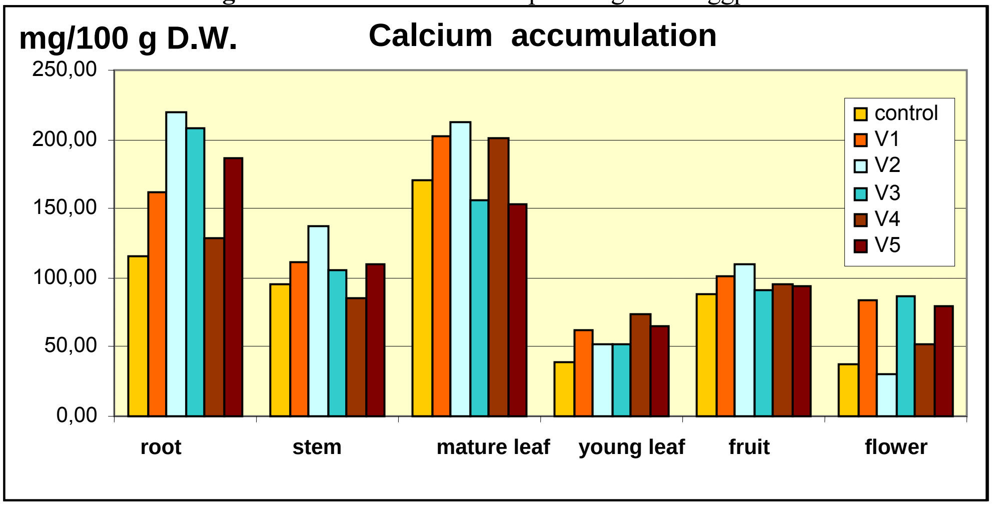


Figure 4. The phosphorus content of plant organs of eggplant.

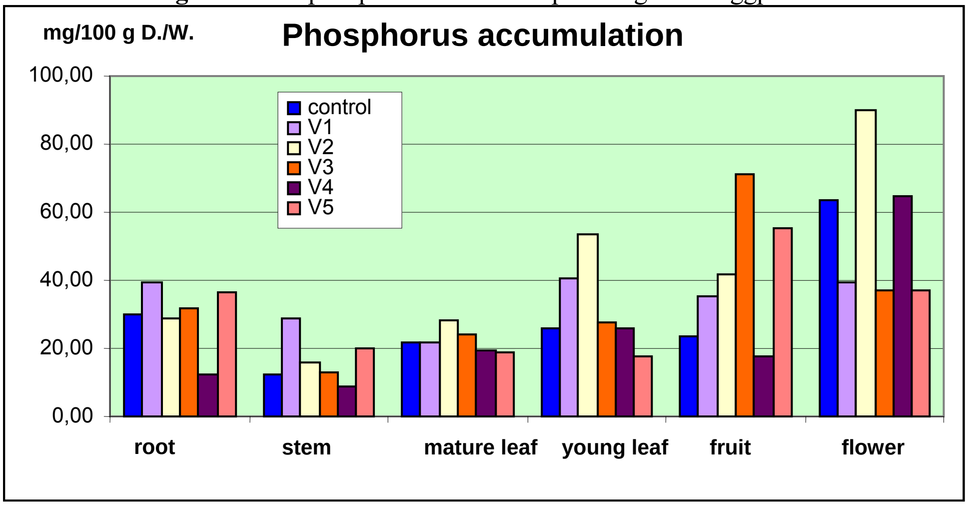
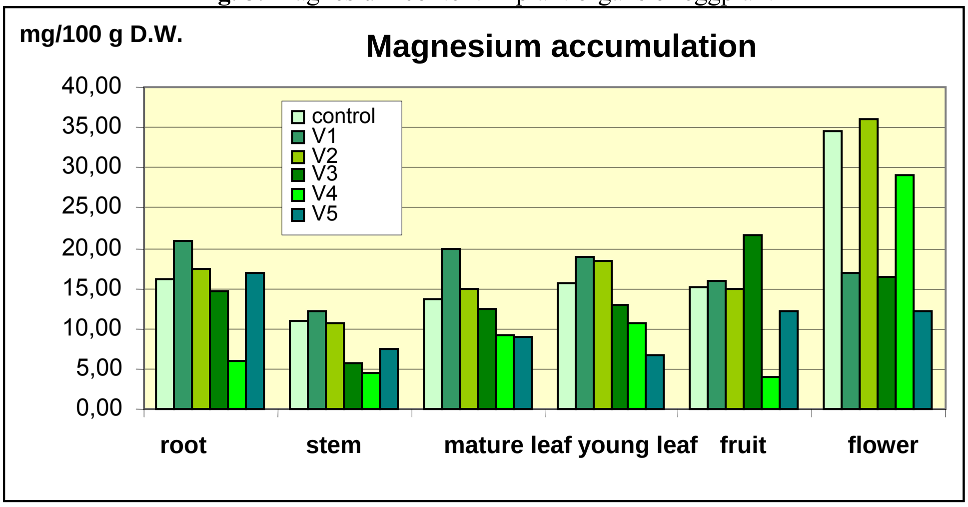


Fig. 5. Magnesium content in plant organs of eggplant



Researches about the biochemical and physiological changes on the apricot, under the *Stigmina carpophila* Lev. M.B. Ellis pathogen agent's influence

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Keywords: the leaves' perforation, apricot, physiological and biochemical parameters

ABSTRACT

It is well known the fact that under the pathogen agent's action, which induces the fungal piercing of apricots, the entire metabolism of the plant is disturbed. This is the reason for which, in this present study we decided to discover in what way the biochemical processes -which take place inside healthy plants, in comparison with sick plants- are influenced. The analyses have been made on apricot fruits, healthy but also unhealthy, because on this species the symptoms on the fruits' levels were the most frequent, in comparison with other tree species. The results obtained are presented here, and they concern the respiration intensity, the amount of ascorbic acid (vitamin C), the ethylene emission, the amount of carbohydrates (glucose, fructose, sucrose) and the amount of total dry and soluble substance, the established acidity, the dosage of carotene and the anthocyans, also some mineral element content.

INTRODUCTION

Coryneum blight, also known as shothole blight is a fungal disease that can cause damage on peach, nectarine, apricot, almonds and to a lesser degree, cherries. It is cause by the fungal pathogen *Wilsonomyces carpophylus*. Changes in fungal taxonomy explain the pathogen name. In the past it was known as *Stigmina carpophila* or *Coryneum beijerinki* (Evans et al., 2008). *Wilsonomyces carpophyllus* is one of the principal pests considered also by the guideline of Normes OEPP-EPPO Standards (2004).

The climatic conditions of the South-East area of Romania are extremely favorable for the apricot tree cultivation and researchers are interested to this culture. Recently, Neamtu et al. (2009) developed an integrated management system of the apricot tree based on few numbers of elements: cultivation of varieties that are resistant/tolerant to the main diseases of the apricot tree; prognosis for phytosanitary risks and forecasting treatments, regarding the integrated management of the phytosanitary risks and their efficiency in the apricot trees plantations.

From the biochemical view point Balan et al. (1999) started in 1995 studies regarding the biochemical changes of the volatile and partly volatile organic components from the apricot branches of some phenotypes that were inoculated by *Cytospora cincta* Sacc., and from the skin of fruits that were infected by *Stigmina carpophila* Lev. M.B. Ellis, regarding to flavonoid components, with a purpose to reveal the biochemical markers involved in the apricot disease resistance.

The Research Station for Fruit Tree Growing - Băneasa is a principal research centre which conceived and implemented a research program on genetic resistance to apricot diseases (1980 – 1997). In 1997, this centre began a system of integrated cropping management for the apricot, its main focus being the introduction of biological materials resistant to the pathogenic fungi *Monilinia laxa* (Aderh et Ruhl), *Stigmina carpophila* (Lev.) M.B.Ellis, *Cytospora cincta* Sacc. and *Alternaria tenuissima*, as well as the *Plum Pox* virus, that is particularly damaging in Romania (Balan et al., 2000).

In the present paper there are presented results as regard as some physiological and biochemical parameters of healthy and unhealthy apricot fruits (affected by the fungus *Stigmina carpophila*).

MATERIALS AND METHODS

The biological material was represented by apricot healthy and affected maturated apricot fruits and the followings physiological and biochemical parameters have been determined: respiration rate; ascorbic acid (vitamin C) content; carbohydrates content (glucose, fructose, sucrose); dry matter and soluble solid content; titratable acidity; carotene and anthocyans content; ethylene emission by fruits; total minerals and mineral composition. For some indicators methods described by Bădulescu (2003), Delian et al. (2010), Cristea et al. (2005) were used.

Respiration rate have been established using the IR-RIKEN analyser to quantify CO_2 production and results were expressed as mg CO_2 $kg^{-1}h^{-1}$.

Sugars (glucose, fructose, and sucrose) were determined by HPLC chromatography using the Agilent 1200 HPLC equipment, coupled with refractive index detector (RID). Results were expressed in mg 100 g^{-1} fresh weight. Ascorbic acid was determined also by HPLC chromatography using the Agilent 1200 HPLC equipment, equipped wired a diode array detector (DAD). Results were expressed as mg 100 g^{-1} fresh weight

Carotene and anthocyans content have been quantified by a spectrometric method. Results were expressed as mg 100 g^{-1} fresh weight.

Ethylene emission was evaluated by gas chromatography, using a FISION GC, equipped with a flam ionisation detector (FID), as it can be read elsewhere. Results were expressed as µl kg^{-1} h^{-1}.

The determination of total dry matter substance was carried out by weighing the fresh vegetal material, drying it for 24 hours at 105˚C, cooling it outside and then weighing again the dry vegetal material. The results obtained were expressed in percentage (%). The determination of soluble dry substance was carried out refractometrically, the results being expressed in percents (%).

Minerals total content (ash) has been established after biological material burning in an oven at 560˚C, and afterwards it was cool in an exicator and in the end, ash was weighed. The obtained results were expressed in the form of percentage (%).

In order to determine the mineral elements composition, ash was dissolved in concentrated nitric acid and then double distilled water was add. The obtained solution was analysed to the inductively coupled spectroscopy (ICP-AES). Results were expressed as mg 100 g^{-1}F.W.

RESULTS AND DISCUSSION

Carbohydrates and ascorbic acid content data are presented in table 1. It can be observed that as regard as total carbohydrate content, there are not remarkable differences between the healthy samples and those affected (7.19%, as against 6.74). Glucose content was higher with 27.3% on healthy fruits, in comparison with the affected fruits. Fructose content was higher with 5.0% on healthy fruits, in comparison with unhealthy fruits, while sucrose content was lower with 49.04% on healthy fruits, in comparison with affected fruits. The vitamin C content was higher with 30.3% on healthy fruits, in comparison with unhealthy fruits.

As we can see from the information presented in table 2, the respiration rate on perforated fruit, of 59.39 mg CO_2 $kg^{-1}h^{-1}$, was approximately 40.0% higher than the one of healthy fruits (35.66 mg CO_2 $kg^{-1}h^{-1}$). This respiration increasing rate is a consequence of the plant's reaction, along with the pathogen respiration adding.

The respiration rate enhancement on fruits affected by the *Stigmina carpophila* fungus has repercussions also upon the total carbohydrates content (as a respiratory substratum) which is more reduced, than in the case of healthy fruits. This reduction can be observed especially in the glucose's case. The glucose's concentration in affected fruits was of 3.46 mg

100 g^{-1} fresh weight, in comparison with 4.76 mg 100 g^{-1} fresh weight on healthy ones. The trees' fruits respiration rate- due to the fact that they have been perforated and attacked by the fungus- is superior to the healthy trees' fruits. It can also mean that the unhealthy trees' energy losses are higher. Unhealthy trees are forced to fight back against the pathogen agent.

Also, the vitamin C content was diminished in affected fruits. This is because it fights back against the pathogen agent's attack.

Regarding water content, dry substance and mineral substances (ashes), a small dehydration was noticed in the case of unhealthy fruits, which determined a sort of growth of K, P, Ca, Mg, Fe, Al and Zn content, on 100 grams of edible product (consumable pulp).

Regarding the soluble dry substance quantity and determined acidity (the two components which form the fruit's taste), we have noticed higher values on healthy fruits, in comparison with fruits affected by the fungus.

Caroten content was with 2.5 higher in healthy fruits, in comparison with affected fruits, while the anthocyanic pigments content was with 1.33 higher on healthy fruits.

From data presented in table 3, we can observed that almost all macroelements (potasium, phosphorus, calcium and magnesium), except for sodium, can all be found in larger quantities in attacked fruits, in comparison with healthy fruits (where smaller quantities are present). As regard as the content which includes oligoelements (iron, aluminum, zinc and barium), we had a situation which is very similar with the one that concerns the macroelements content, the exception being made by Boron, whose content was constant in the case of both variants, represented by healthy and also affected fruits.

The higher content value of mineral elements in the case of attacked fruits, in comparison with the healthy fruits, could be explained as follows: in their desperate attempt to resist against the attack, the infected trees'' have the capacity to try to fight back against the fungus" attack, so they try to concentrate certain chemical elements, which could give the tree some type of resistance, while fighting with the stressful pathogen agent. In our case, we refer to the pathogen agent *Stigmina carpophila*.

Ethylene emission was two time higher in the case of the affected fruits (from 0.10 µl kg^{-1} h^{-1} –healthy fruits, to 0.20 µl kg^{-1} h^{-1} – unhealthy fruits). Ethylene is a plant hormone which promote a number of events in the fruit development, including apricot as a climacteric fruit (Chahine et al., 1999; Gherghi et al., 2001) and also is a stress hormone with many singular or hormonal cross-talking implications in plant-pathogen interactions (Delian, 2006).

CONCLUSIONS

Healthy apricot fruits have a higher glucose, fructose and vitamin C content, than the fruits with typical symptoms of perforation, due to the fungus' attack.

The increase of the affected fruits' respiration rate and ethylene emission are normally response reaction of the fruits to the pathogen incidence.

Except total minerals content and dry matter content, all other determined parameters (carotene, anthocyans, titratable acidity, soluble dry matter, water) had higher values in the case of healthy fruits as against the affected ones.

Almost all macroelements, except for sodium, was found in larger quantities in attacked fruits, in comparison with healthy fruits. The same trend was registered for microelements, the exception being made by Boron, whose content was constant in the case of both variants, represented by healthy and affected fruits.

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TABLES

Table 1

Carbohydrates and vitamin C content variation on apricot fruits

Variant	Parameter				
	Carbohydrates (mg 100 g^{-1} F.W.)				Vitamin C (mg 100 g^{-1})
	Total	**Glucose**	**Fructose**	**Sucrose**	
Healthy fruits	*7,19*	4,76	1,80	0,80	0,33
Unhealthy fruits	*6,74*	3,46	1,71	1,57	0,23

Table 2

Some physiological and biochemical parameters of apricot fruits

Variant / Parameter	Healthy fruits	Affected fruits
Respiration rate (mg CO_2 kg^{-1})	35,66	59,39
Ethylene emission (µl kg^{-1} h^{-1})	0,10	0,20
Caroten (mg 100 g^{-1} F.W.)	5,39	2,14
Anthocyans (mg 100 g^{-1} F.W.)	4,53	3,40
Titratable acidity (mg 100 g $^{-1}$ F.W.)	0,71	0,40
Soluble dry substance (%)	17,5	16,2
Water (%)	81,17	75,10
Dry matter (%)	18,83	24,90
Mineral substances (%)	1,14	2,04

Table 3

Mineral composition of apricot fruits

Mineral Element (mg 100 g $^{-1}$ F.W.)	Variant	
	Healthy Fruits	Affected Fruits
K	157,90	200,04
P	14,05	15,58
Ca	15,61	25,19
Mg	11,80	13,37
Na	2,39	1,23
Fe	0,41	1,66
Al	0,60	1,93
B	0,40	0,40
Ba	0,02	0,03
Zn	0,02	0,11

OTHER FIELDS

The study of lumbricidae fauna in three terrestrial ecosystems of Cândești Piedmont, Argeș County (Romania)

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Keywords: lumbricid, terrestrial, diversity, frequency, dominance

ABSTRACT

The work aims to study the lumbricid fauna in three terrestrial ecosystems of Candesti Piedmont, in the county of Arges (Romania). In the three studied ecosystems (deciduous forest, spruce forest and grassland), specific diversity is composed of 11 species of lumbricidae. The dominant species in three ecosystems are *Octolasion lacteum, Aporectodea rosea rosea* (Savigny1826) *Allolobophora caliginosa caliginosa* (Savigny1826) and *Dendrobaena Byblica* (Rosa, 1893). In terms of frequency and constancy of species in the ecosystems studied, the above mentioned species proved to be constant, the other species being accidental. The highest densities in the three stations (Ruginoasa - deciduous forest, Cetate - spruce forest and Cetate - grassland) were recorded by the species *Allolobophora caliginosa caliginosa* (Savigny, 1826), *Aporectodea rosea rosea* (Savigny, 1826) and *Octolasion lacteum* (Örley, 1881). The highest relative abundance is represented by the species *Octolasion lacteum* (Örley, 1881) with 74.44%, followed by *Aporectodea rosea rosea* (Savigny, 1826) with 70.97% and *Allolobophora caliginosa caliginosa* (Savigny, 1826) with 50%. Relative humidity values in soil levels remain approximately equal in Ruginoasa and Cetate – spruce stations and slightly higher in Cetate – grassland station.

INTRODUCTION

The study of lumbricidae populations in deciduous forest, coniferae and grassland ecosystems, of Candesti Piedmont, Arges, is less developed and contributes to environmental research conducted in this area. The present work is a study on three ecosystems of lumbricidae fauna located in the village Dobresti, Arges County (Candesti Piedmont). The deciduous forest ecosystem (Ruginoasa) is situated on a slope with an average inclination of 20° and a sunny S-E exhibition, the spruce forest ecosystem (Cetate - spruce) is on a slope with an inclination of 20° and N-W shaded exhibition, and the third is a grassland ecosystem (Cetate - grassland) on the base of the slope with spruce forest and has an inclination of 10° and N-E exhibition.

MATERIALS AND METHODS

The three ecosystems were separated by 50/50m2 areas where samples were extracted. The lumbricidae fauna was collected monthly in March, April, May and June of 2008 by making 10 holes in each stationary, using a metal frame 25/25 cm. Samples were taken from each hole on soil levels from 10 to 10 cm to 40 cm deep. Worms were collected from soil samples by hand and immediately placed in 90° alcohol containers. Soil moisture was determined using a soil hydrometer and the recorded values were presented as monthly averages from March to June 2008. Specific diversity was determined for each station with the following ecological indices: density, relative abundance, frequency, Mc Naughton-Wolf dominance index, soil relative humidity.

RESULTS AND DISCUSSION

Specific diversity of the lumbricidae identified in the three stations studied from March to June 2008 includes the following species present in table 1.

Of the 11 species identified in the three stations, 100% were identified in Cetate – grassland station, 90% in Ruginoasa station and 60% in Cetate-spruce station (fig.1). The largest number of individuals in the four months was collected in Cetate-grassland station (334), Rugionasa station (218) and Cetate – Spruce (135). The number of species common to the three ecosystems is 6 (fig.2).

Relative humidity values (fig. 3-5) of soil in the three stations are not very different, being lower in the litter and increasing as the soil level deepens. The highest moisture is recorded in June in Cetate - grassland station at 40 cm (51.2%). In Ruginoasa and Cetate - spruce station the relative humidity values are approximately the same at all levels of soil research.

Depending on soil moisture, the relative abundance of earthworms in any given ecosystem can vary greatly from year to year or month to month. The highest densities in the three stations (fig.6-8) were recorded by *Allolobophora caliginosa caliginosa, Aporectodea rosea rosea* and *Octolasion lacteum* species. *Allolobophora caliginosa caliginosa* species has the same value of the index (4.96) in April in Ruginoasa and Cetate – grassland stations with very low levels in Cetate –spruce station. *Aporectodea rosea rosea* species reaches values of 4.48 in May in Ruginoasa station, 4.32 in March, 3.52 in May and 3.04 in June in Cetate – spruce station, this species recording low values in the grassland. The highest density values are recorded by *Octolasion lacteum* in all three stations with the highest density in grassland in May (10.7) being present in all soil levels, 8.96 in June and 8 in March. Because plant species differ both in waste production and quality, they may have significant effects on soil fauna and soil processes (Wardle et al. 2004).

The highest relative abundance (fig.9-11) is recorded by *Octolasion lacteum* species with 74.44% in May in Cetate –grassland station, with a relative abundance of 54.24% in Ruginoasa station, and a low relative abundance in Cetate -spruce station. *Aporectodea rosea rosea* species is most abundant in Cetate –spruce station, where it has primacy in all months, with the highest abundance value in May (70.97%). Only in Ruginoasa station *Allolobophora caliginosa caliginosa* species reaches a relative abundance value of 50% in April. In the same month it has a relative abundance value of 37.35% in Cetate –grassland station with low values for the rest.

Mc Naughton and Wolf dominance index was calculated taking into account the first two species with the highest relative abundances in each station (table 2).

Earthworms can significantly influence grassland ecosystems through their effects on soil nutrient and carbon (C) cycling, soil aggregation and porosity, decomposition and plant productivity (Sánchez-de León and Johnson-Maynard, 2009).

Thus, *Octolasion lacteum* and *Aporectodea rosea rosea* species are dominant in Ruginoasa station with a rate of 54.48%, *Aporectodea rosea rosea* and *Dendrobaena byblica* species are dominant in Cetate – spruce station with a rate of 71.13%, while *Octolasion lacteum* and *Allolobophora caliginosa caliginosa* are dominant in Cetate-spruce station in proportion of 74.55%. Frequency and consistency showed these species as constant and the other species as accidental.

CONCLUSIONS

Cetate-grassland station is the richest in species but also individuals; we find here 11 species reported in all the three ecosystems studied. Density is achieved mainly on account of *Octolasion lacteum* species representing more than half of the existing species at that station. The slope inclination of this station is small compared with the other two stations, relative humidity of soil is higher and vegetation on the soil surface is continuous, which influences the vertical distribution of lumbricidae in soil. In Ruginoasa station were identified 90% of all species with a smaller number of individuals compared with Cetate–grassland station, but larger compared with Cetate–spruce station. Density was established on account of *Allolobophora caliginosa caliginosa*, *Aporectodea rosea rosea, Octolasion lacteum*, and the other species having low densities. *Aporrectodea* and *Octolasion* generally prefer food from organic matter-rich soils (Bernier, 1998; Hendrix et al. 1999).

Cetate - spruce station comprises a smaller number of species identified (60%) of all species, compared with the other two stations. Density was mainly achieved on account of *Aporectodea rosea rosea* species that had significantly higher values compared with other existing species at that station in all four months. The small number of species found in this station could be explained by the shaded exhibition of the slope and by the fact that vegetation is much poorer in comparison with the other two stations.

Relative humidity values in soil layers remain approximately equal in Ruginoasa and Cetate-spruce stations and slightly higher in Cetate – grassland station. Soil moisture regime in the microclimate space depends on the heat received by the active surface in the form of radiative balance - heat, rainfall, nature of soil and water balance. Although the amount of water fallen in the area was the same, because of foliar interception and slope inclination in deciduous and spruce ecosystem, the soil moisture was lower than in the grassland. High soil moisture in the forest is due to low evaporation, soil keeping higher moisture in depth. The higher soil moisture in grassland is due to the brook nearby and to groundwater layer at a lower depth.

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TABLES AND FIGURES

Table1

The specific diversity of lumbricidae species in the three stations

No.	SPECIES	RUGINOASA (deciduous station)	CETATE (spruce station)	CETATE (grassland station)
1.	*Allolobophora caliginosa caliginosa* (Savigny),1826	+	+	+
2.	*Allolobophora chlorotica* (Savigny),1826	+	-	+
3.	*Allolobophora dacica* (Pop),1938	+	-	+
4.	*Allolobophora léoni* (Michaelsen), 1891	+	-	+
5.	*Aporectodea rosea rosea* (Savigny),1826	+	+	+
6.	*Dendrobaena byblica* (Rosa), 1893	+	+	+
7.	*Dendrodrilus rubidus rubidus* (Savigny),1826	-	-	+
8.	*Lumbricus rubellus rubellus* (Hoffmeister), 1843	+	+	+
9.	*Lumbricus terrestris linnaeus* (Savigny), 1758	+	-	+
10.	*Octodrilus lissaensis* (Michaelsen), 1891	+	+	+
11.	*Octolasion lacteum* (Örley), 1881	+	+	+

Table 2

Mc Naughton and Wolf dominance index

SPECIES	RUGINOASA STATION	CETATE SPRUCE STATION	CETATE GRASSLAND STATION
Octolasion lacteum	1,08	0,65	0,79
Aporectodea rosea rosea	0,78	1,75	0,19

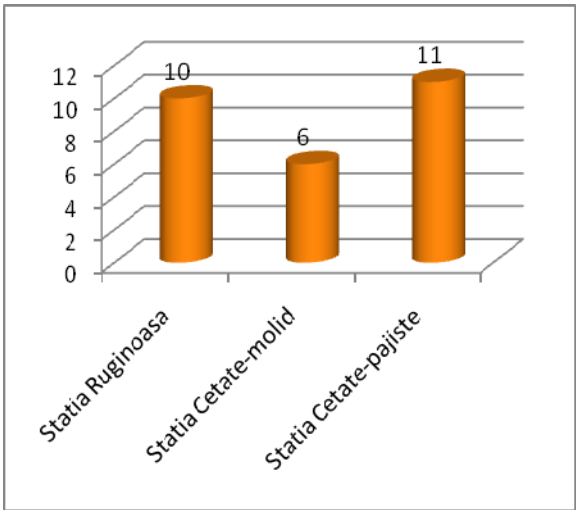

Fig. 1. The total number of species in the four month

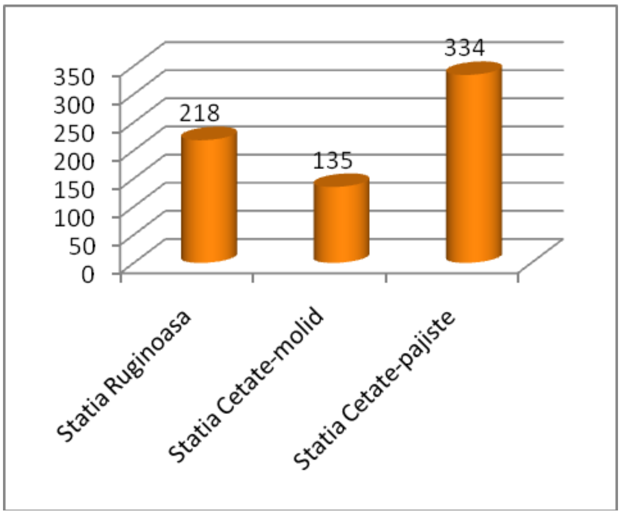

Fig. 2. The total number of individuals in the four month

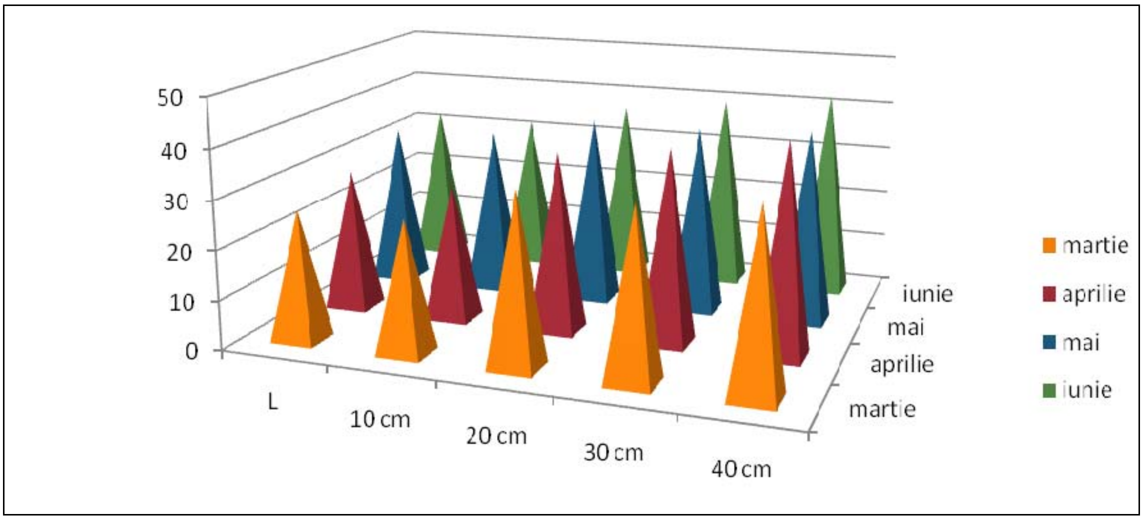

Fig. 3. Monthly dynamics of relative humidity on the ground level of Ruginoasa station during March-June 2008

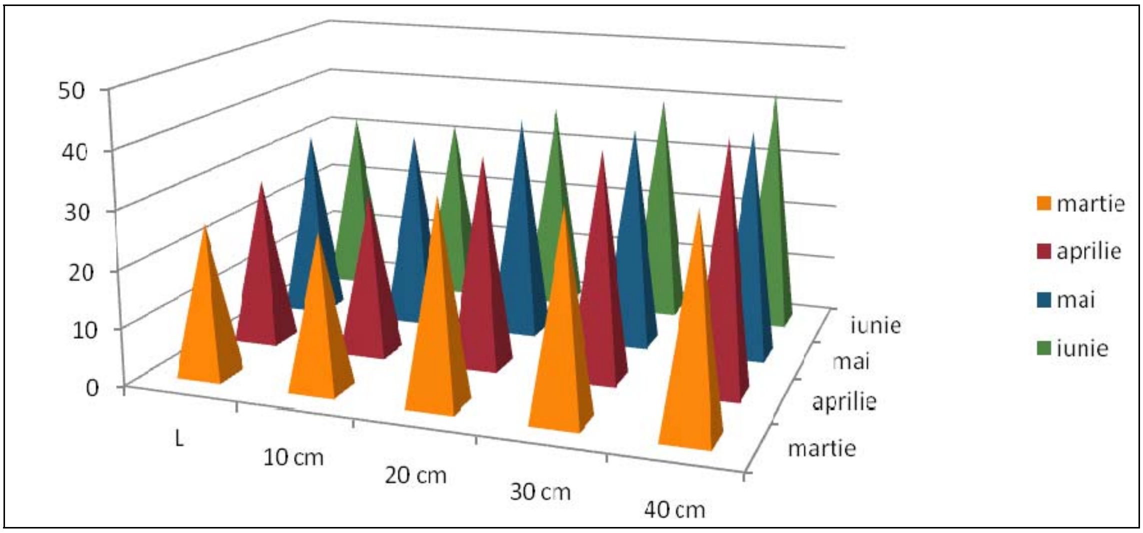

Fig. 4. Monthly dynamics of relative humidity on the ground level
of the Cetate-spruce station during March-June 2008

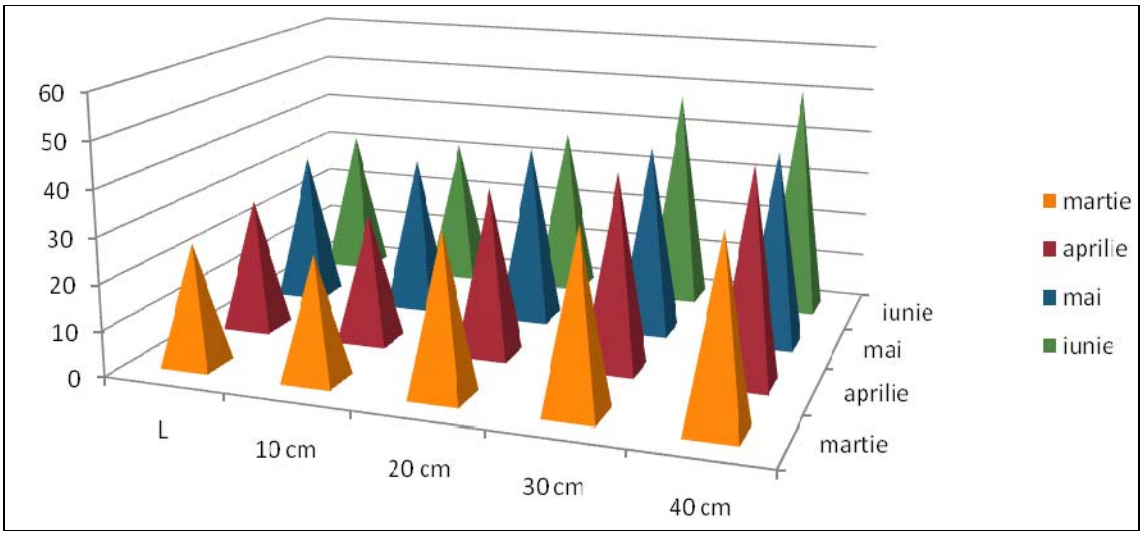

Fig. 5. Monthly dynamics of relative humidity on the ground level
of the Cetate-grassland station during March-June 2008

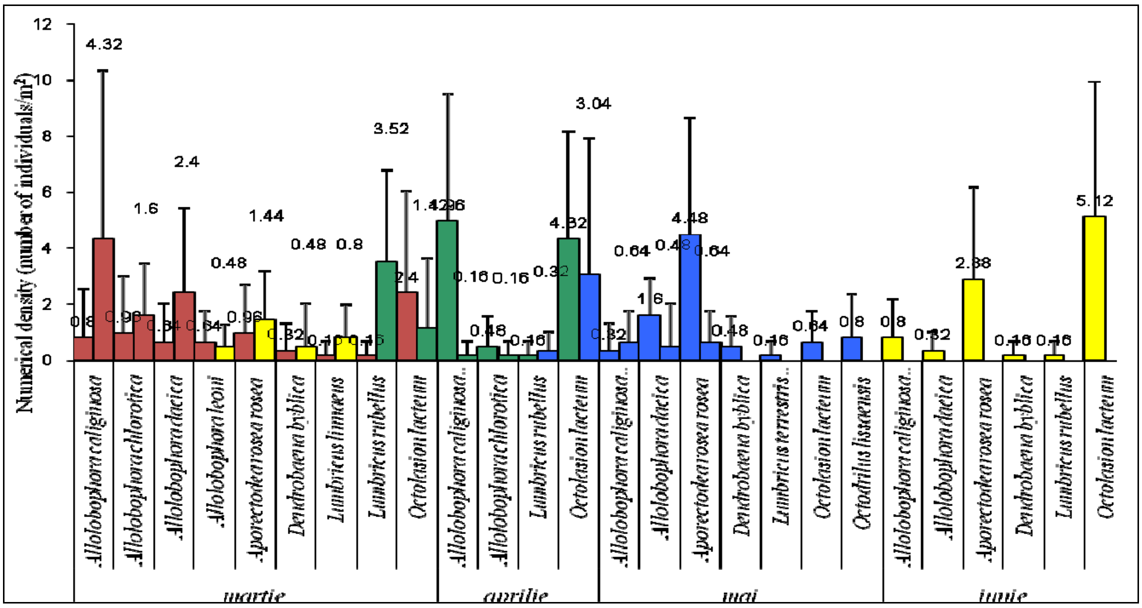

Fig. 6. Numerical density of lumbricidae in Ruginoasa station (March-June 2008)

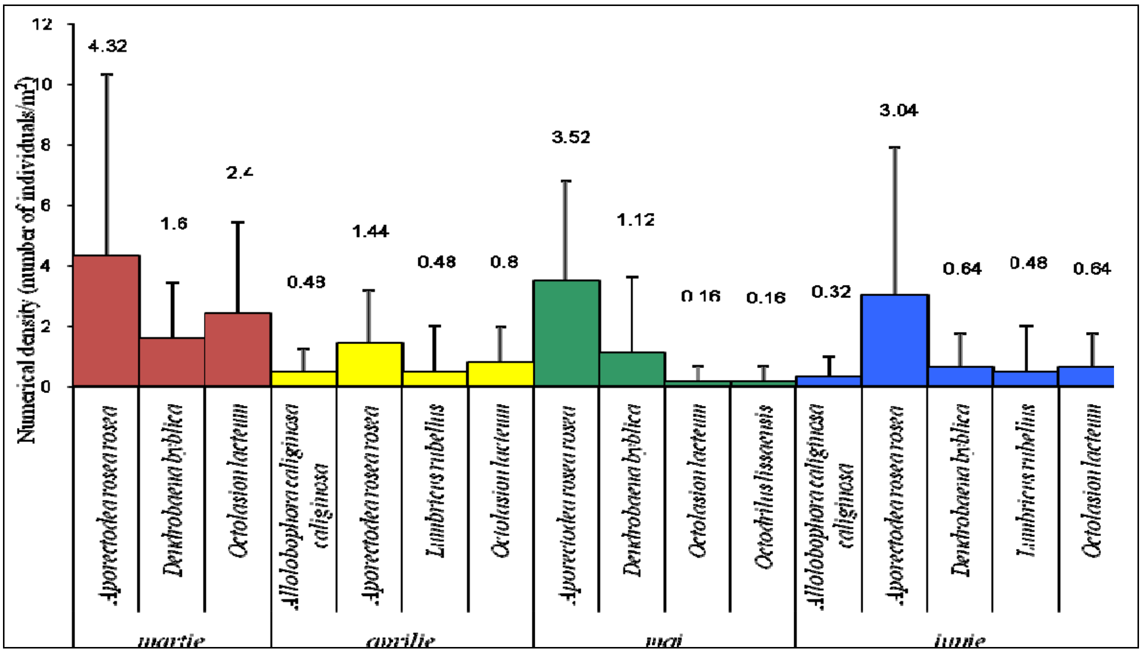

Fig. 7. Numerical density of lumbricidae in Cetate-spruce station (March-June 2008)

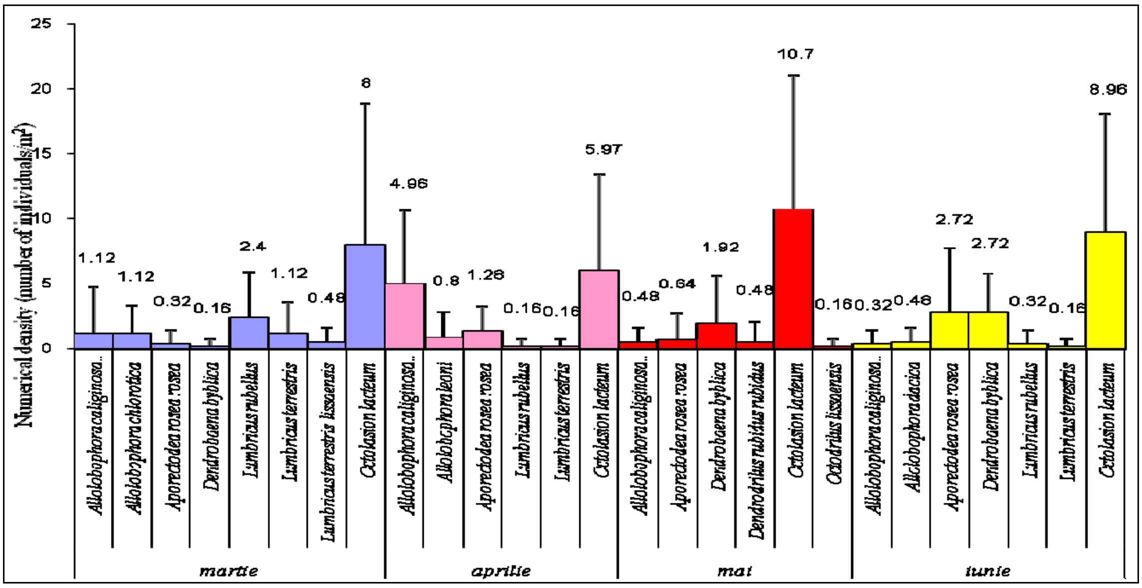

Fig. 8. Numerical density of lumbricidae in Cetate - grassland station (March-June 2008)

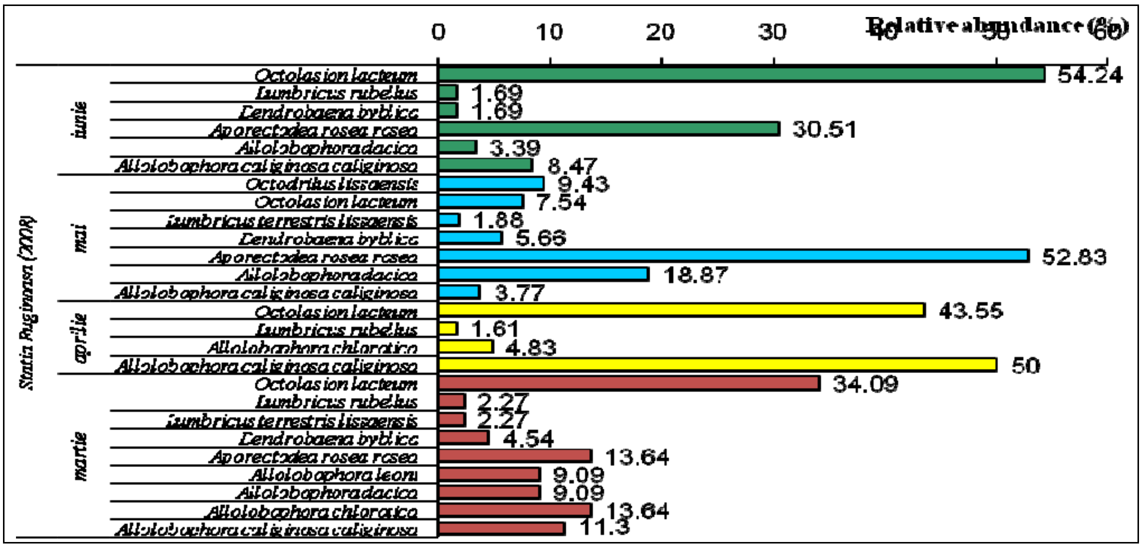

Fig. 9. Relative abundance (A%) of lumbricidae species in Ruginoasa station (March-June 2008)

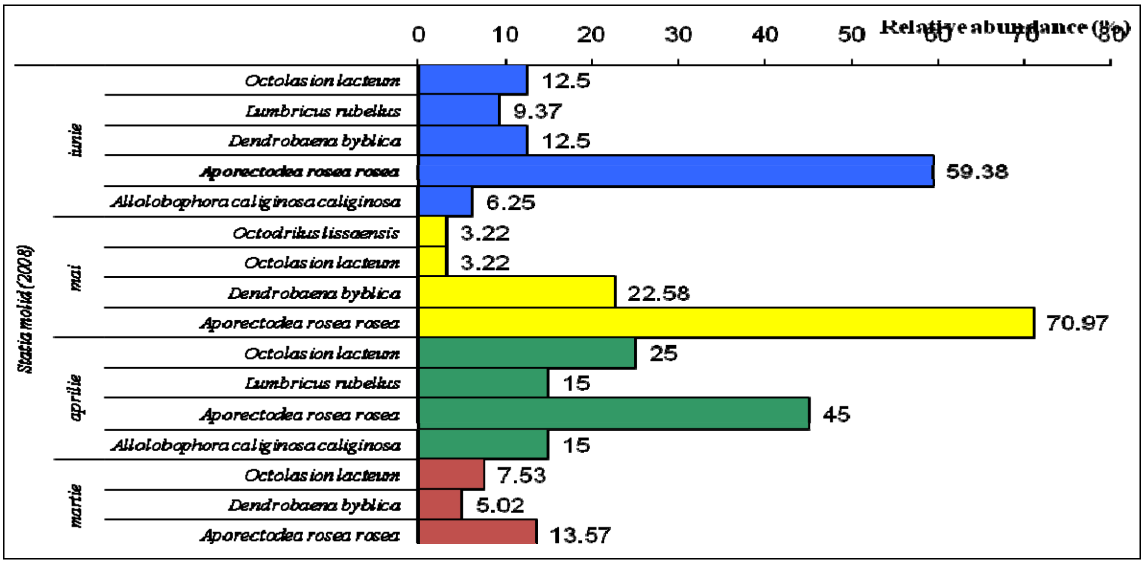

Fig. 10. Relative abundance (A%) of lumbricidae species in Cetate spruce station (March-June 2008)

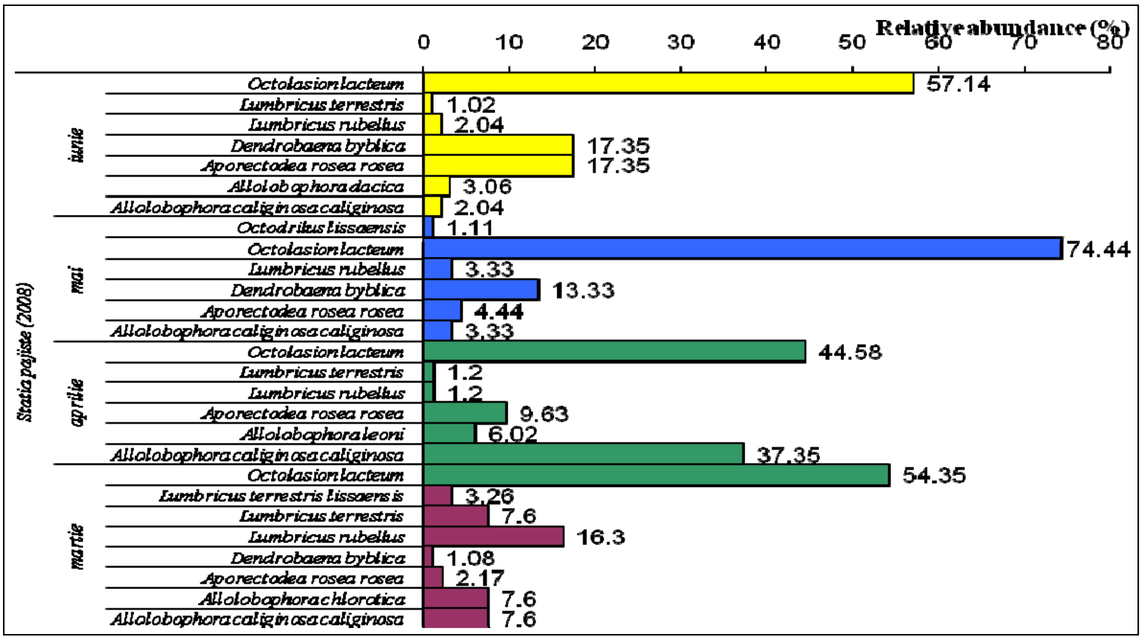

Fig. 11. Relative abundance (A%) of lumbricidae species in Cetate grassland station (March-June 2008)

Horticultural products - an alternative carbon source for production of bacterial cellulose by *Acetobacter xylinum* strain

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Keywords: fruits, glycerol, cellulose membrane.

ABSTRACT

Bacterial cellulose (BC) is preferred over the plant cellulose as it can be obtained in higher purity and exhibits a higher degree of polymerization and crystallinity index. It also has higher tensile strength and water holding capacity than plant cellulose, making it more suitable raw material for producing high fidelity acoustic speakers, high quality paper, and dessert foods, pharmaceutical and medical applications. The present work investigated bacterial cellulose biosynthesis by *Acetobacter xylinum* DSMZ 2004, using horticultural products – fruits and glycerol as carbon source. Significant cost reductions are possible with improvements in fermentation efficiency and economics of scale, the lower limit of the cost of microbial cellulose being determined by the price of the raw material substrates. Thus, one of the many promising applications for the use of glycerol is its bioconversion to high value compounds through microbial fermentation. Horticultural products and glycerol are not only cheap and abundant. Production rate was also improved by adding ethanol 1,4% (v/v). The production rate of bacterial cellulose on flasks in static culture was between 2-9 g/L. It has been demonstrated that the bacterial cellulose production was enhanced by the addition of glycerol to fruit substrate. The bacterial cellulose pellicle obtained after fermentation were purified and the membrane surface morphology was revealed using SEM imaging. FTIR spectroscopy was used primarily to identify the chemical structure of the BC membranes. Thermal properties of produced and rinsed bacterial cellulose were studied by the TGA and DSC methods.

INTRODUCTION

Bacterial cellulose (BC) is a biopolysaccharide secreted by *Acetobacter xylinum* (*Gluconacetobacter xylinus*).

It is a material with unique properties, including high water holding capacity, high purity and crystallinity, ultrafine fiber network, and high tensile strength (Klemm et al., 2001). Although chemically identical to plant cellulose, it has a unique fibrillar nanostructure, which determines its extraordinary physical and mechanical properties, characteristics which are quite promising for modern medicine and biomedical research. (Czaja et al., 2007) For example, membranes of bacterial cellulose were used as an artificial skin for temporary covering of wounds and bacterial cellulose tubes were produced as substitution material for blood vessels.

Bacterial cellulose has long been used in a variety of applications such as diaphragms in speakers and headphones (Iguchi et al., 2000), paper making (Hioki et al., 1995), separation membranes (Takai 1994), and electroconductive carbon film (Yoshino et al., 1991). Owing to its biocompatibility, BC has also recently attracted a great deal of attention for biomedical applications. For instance, BC has been successfully used as artificial skin for burn or wound healing material (Fontana et al. 1990; Ciechanska et al. 1998; Czaja et al. 2006; Alvarez et al. 2004; Legeza et al. 2004), artificial blood vessels for microsurgery (Klemm et al. 1999, 2001).

The gram-negative bacterium *A. xylinum* has long been regarded as an archetype for the study of cellulose biogenesis largely by the pioneering effort of Hestrin (Hestrin, S. 1962) and Colvin (Colvin, J.R. 1980). Static cultures of *A. xylinum* are characterized by a thick cellulosic surface pellicle, in which the embedded cells of this obligative aerobe have direct contact with the liquid/air interface (Schramm, M., and S. Hestrin. 1954).

Cellulose for industrial purposes is usually obtained from plant sources, but the production by bacteria has great potential. *Acetobacter xylinum*, one of the best bacteria for large-scale cellulose production, accepts a wide variety of inexpensive carbon substrates.

Widely available commodity sources of carbon which may be utilized by *Acetobacter* include dextrose (glucose), sucrose, fructose, invert sugar, ethanol and glycerol (Tarr H.L.A. and Hibbert H., 1931; Barsha J. and Hibbert H., 1934).

This diversity of utilizable substrates provides considerable flexibility in the location of the manufacturing facility since at least one of these substrates is produced in virtually every region of the world. The availability of inexpensive horticultural products which have inadequate quality and glycerol as a by-product of biodiesel, is a major economic factor in the commercialization this products.

Romania is an important European producer of apples, producing 500-550 thousand tons last year. Apples have the third position among the most popular fruit in our country. (http://faostat.fao.org)

This large amount of apples and glycerol, which are among of the most economical carbon sources, could widely used as a substrate in microbial fermentation for the production of bacterial cellulose.

The aim of this study is to investigate inexpensive BC production by *A. xylinum* DSMZ 2004 in glass flask using extract from inadequate quality apples and glycerol as a carbon source.

MATERIALS AND METHODS

Acetobacter xylinum DSMZ 2004 culture purchased from DSMZ (German Collection of Microorganisms and Cell Cultures), is known for its ability to produce cellulose under specific conditions.

The microorganism was maintained on an Hestrin-Schramm (HS) (7) agar medium composed of glucose – 2% (w/v), yeast extract – 0.5 % (w/v), bacto-peptone – 0.5 % (w/v), citric acid – 0.115 %(w/v), Na_2HPO4 – 0.27%(w/v), MgSO4·7H2O – 0.05 %(w/v), under laboratory conditions (+4°C). This culture also constitutes the preinoculum phase of an evolution cycle for the obtaining of microbial cellulose.

Dextrose powder, Yeast extract, Peptone, di-Sodium hydrogen phosphate anhydrous, citric acid monohydrate have been acquired from Scharlau Chemie.

Pre-inoculum for all experiments was prepared by transferring a single *A. xylinum* DSMZ 2004 colony grown on agar culture medium into a 50-mL Erlenmeyer flask filled with liquid culture medium. After 24 h of cultivation at 28-30°C, bacterial cellulose pellicle produced on the surface of the culture medium.

The liquid inoculum phase is based on the same HS medium recipe and is obtained under static conditions at 28-30°C, for 24 h.

Fermentation experiments were carried out in 500 mL conical flasks, each containing 50 mL of a fresh liquid culture medium. Each flask was inoculated using 2.5 mL of the inoculum solution, inoculation ratio being 5%, then were covered by a porous paper and kept at 30°C for 14 days. Prior to use, all flasks were sterilized at 121°C for 15 min in an autoclave.

Culture media composition was: extract from inadequate quality apple with different glucose concentrations 4.3 %, 7.24 % and 11.3 %; glycerol - 2.0%; 3.0%; 4.0% and ethanol – 1.4 v% added after sterilisation of the culture medium. (Table 1).

Magnesium sulphate, yeast extract and trace elements were added in the same concentration in all variants.

Bacterial cellulose has been obtained as pellicle in our laboratory from a *A. xylinum* DSMZ 2004 incubated for 14 days at 30°C in a static culture containing extract from inadequate quality apples with 4.3 %, 7.24 % and 11.3 % glucose and glycerol, adjusting pH with acetic acid to 3.3 in a glass flask. BC pellicles grown on the liquid surface were collected and washed with water and then immersed in 1 N NaOH for 2 days at 30°C to dissolve the cells in the pellicle. The pellicles were then immersed under distilled water with 0.02% NaN2 to reduce microbial contamination and then kept under 4°C, neutralized with 1% acetic acid and washed with distilled water, successively. It was then dried on a glass plate to measure the weight. Production of BC was quantified gravimetrically based on the dry weight of the insoluble BC obtained at the end.

To assay the glucose concentration of the culture broth, the orto-toluidine method was used.

FTIR spectroscopy was used primarily to identify the chemical structure of the BC membranes. FTIR spectra were registered on a SHIMADZU 8900 equipment using 40 scans and 4 cm^{-1} resolution. The samples were analyzed from KBr pellets.

Thermal properties of produced and rinsed bacterial cellulose were studied by the TGA and DSC methods. Thermogravimetric analyses (TGAs) were recorded on a Q 500 TA Instrument. The samples of 2.876 mg were heated from 30 to 400 °C at a scanning rate of 10°C/min under a constant nitrogen flow rate (40 ml/min).

Differential scanning calorimetry (DSC) thermograms were recorded on a NETZSCH DSC 204 F1 equipment.

The surface morphology of the purified bacterial cellulose pellicles was revealed using SEM imaging obtained with a HITACHI S2600N. All samples were covered with a silver layer prior to imaging.

RESULTS AND DISCUSSION

The main objective of this study was to develop a simple and relatively inexpensive fermentation process for the production of bacterial cellulose using static batch fermentation with unconventional horticultural products and glycerol as substrate combined.

It was tested the biosynthesis of BC on mixed substrate - CGM (glycerol- apple extract), as proposed model at laboratory level using Taguchi optimization method, where varying concentrations of carbon source: glucose and glycerol, is shown in Tables 1, 2.

During the breeding of *Acetobacter xylinum* DSMZ 2004 bacteria in stationary conditions, bacterial cellulose is synthesised in the form of film on the surface of the nutrient medium solution. The yield of the biosynthesis process depends on many factors i.e. temperature, time, and the relation of the surface area to the volume of substrate. The last parameter determines oxygen access because both its deficiency and excess adversely affect the bacterial cellulose synthesis process due to microorganisms.

The experiments were carried out using different concentrations of medium culture components (Table 1).

On the basis of preliminary research, the following conditions of breeding were assumed: a time of 14 days and temperature of 30 °C. The results obtained are presented in Table 2 and Figure 1.

After 14 days fermentation, a cellulose film was found growing on the surface of the medium. This result showed that the apple extract and glycerol can be used as a carbon source for the production of bacterial cellulose by *Acetobacter xylinum* DSMZ 2004.

The microbial cellulose obtained after fermentation is not pure; it contains some impurities like cells and/or the medium components. The membranes was purified to obtain transparent pellicle (Figure 2).

This study showed that glucose from apple and glycerol can be converted efficiently to bacterial cellulose by the supplementation of yeast extract and ethanol under static fermentation conditions at 30°C.

Apple extract and glycerol seem to be a better substrate than technical glucose. In view of energy consumption, the productivity of BC on this medium is high, which makes the production costs lower than expected.

Cellulose production by *Acetobacter xylinum* DSMZ 2004 was higher in mixed substrate medium apple-glycerol (6.52 g/L) after 14 days of fermentation, thereby demonstrating bioavailability of the apples substrate compared to control sample on Hestrin-Schramm (HS) medium containing technical glucose (1.628 g/L), maintaining the same conditions and compared with HS medium (conventionally used for *Acetobacter* strains), with a production of (0.6425 g/L) for strain *Gluconacetobacter subsp. xylinus* (ATCC 10245) after 72 h. (Houssni El-Saied et al., 2008)

This study showed that apples can be effectively converted to bacterial cellulose because microorganisms have a better bioavailability to biological substrate than to the synthetic one, which adds higher value to the bio-process.

The bacterial cellulose pellicle obtained after fermentation were purified and the membrane surface morphology was revealed using SEM imaging. FTIR spectroscopy was used primarily to identify the chemical structure of the BC membranes. Thermal properties of produced and rinsed bacterial cellulose were studied by the TGA and DSC methods.

The FTIR spectrum shows strong absorption in the range of 1490 cm^{-1}, which shows the presence of a carbonyl group in the bacterial cellulose. In the case of pure BC, a broad band at 3627.85 cm^{-1} is attributed to O–H stretching vibration. Band at 2925 cm^{-1} represents the aliphatic C–H stretching vibration. The diversity of functional groups in the range of 1 000–1 600 cm−1 is attributed to the lack of C–O and C=O. (Figure 3)

Thermo-gravimetric analysis (TGA) is a continuous process, involving the measurement of sample weight in accordance with increasing temperature in the form of programmed heating. The TGA curves obtained by plotting percentage weight loss against temperature indicated that BC was stable up to a temperature of 250°C. The percentage weight loss for BC at 271.28°C was 70 %. Since TGA provides better understanding of thermal decomposition behavior, the thermal stability and thermal decomposition of BC were investigated using TGA and the test results are given in Figure 4.

The non-isothermal DSC analysis was performed by heating a precise amount of sample (3.1 mg) from 20 to 300°C using a 10 K/min heating rate.
The bacterial cellulose showed a broad endothermic peak at 79.4 °C that can be attributed to the thermal decomposition of the cellulose. (Figure 5)

The microstructure of the bacterial cellulose membranes is revealed using SEM imaging. The SEM image shows the microfibrillar structure of bacterial cellulose, and aggregates of semicrystalline extended-cellulose chains in an ultrafine network structure. Figure 6 gives an overview of the dried bacterial cellulose.

Experimental data presented in Table 2 and represented in Figure 1 show that variant 6 is the best option for the production of bacterial cellulose with the production efficiency of 14.88%. It can be concluded that a concentration of glucose in the range of 7.24 - 11.3% is adequate for efficient production of biocellulose correlated with a glycerol concentration between 3-4%.

CONCLUSIONS

Results reported in this study demonstrate that horticultural products - inadequate quality apples could be used as potential carbon source for the biocellulose pellicle production.

Investigating optimum compositions of apple glucose and glycerol can introduce new routes to produce BC more economically, compared with the conventional technical glucose examined. For instance, cheaper sugar mixtures can be obtained from horticultural products such as apple and can widely be utilized in fermentations.

The cost of raw materials, especially carbon sources, governs the costs of microbial fermentation processes. Thus, use of a cheap carbon source is important for the industrial production of microbial products.

These results suggest that glycerol also could be a potential low-cost substrate for BC production by *Acetobacter xylinum* DSMZ 2004, leading to the reduction in the production cost.

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***http://faostat.fao.org

TABLES AND FIGURES

Table 1

CGM media variants obtained by Taguchi method

Media Nutrient % \ Variants	1	2	3	4	5	6	7	8	9
GLUCOSE	4.3	4.3	4.3	7.24	7.24	7.24	11.3	11.3	11.3
GLYCEROL	2	3	4	2	3	4	2	3	4
$(NH_4)_2SO_4$	0.1	0.2	0.3	0.2	0.3	0.1	0.3	0.1	0.2
CITRIC ACID	0	0.25	0.5	0.5	0	0.25	0.25	0.5	0

Table 2

BC production by *Acetobacter xylinum* 2004 grown on CGM medium in static culture for 14 days
The yield of the biosynthesis process (Y, w%) was calculated in the following way:Y=C/G·100 in %

where:
C – weight of dry film in g
G – weight of carbon source in substrate in g

CGM Medium Variants	Final pH	BC productivity (g/50mL)	BC productivity (g/100mL)	Production Efficiency (%)
1	2.92	0.1884	0.3768	15.33
2	3.30	0.2783	0.5566	19.55
3	3.29	0.1717	0.3434	10.6
4	3.55	0.1319	0.2638	7.32
5	2.78	0.2746	0.5492	13.75
6	3.11	0.3262	0.6524	14.88
7	3.4	0.1573	0.3146	6.06
8	2.94	0.2948	0.5896	10.57
9	2.81	0.2264	0.4528	7.58

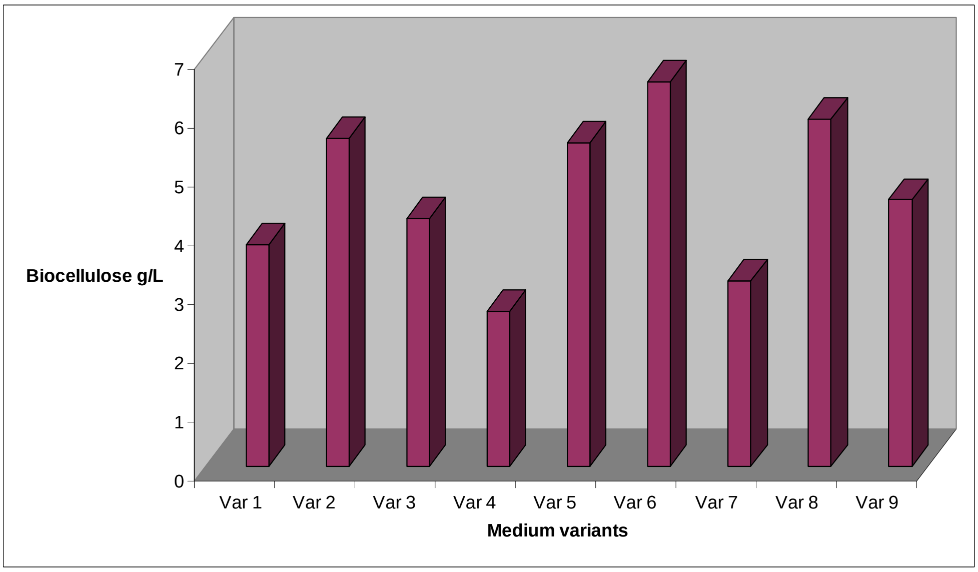
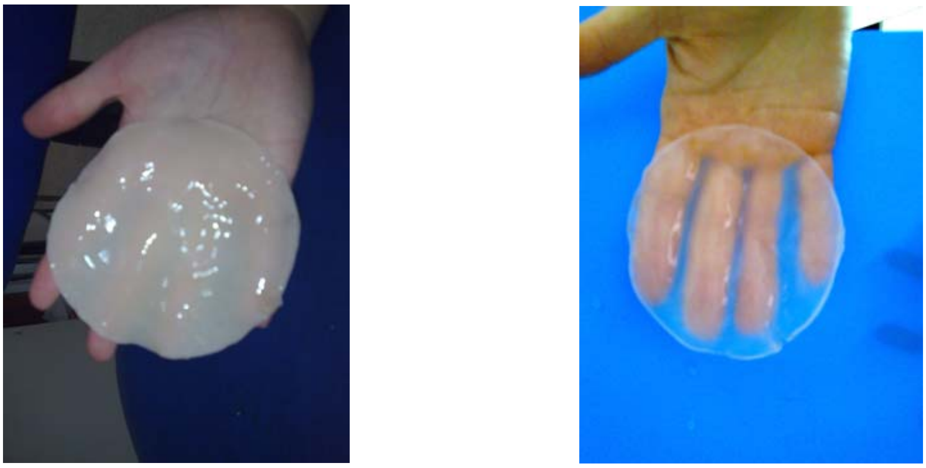


Fig.1. Dynamics of BC production by *Acetobacter xylinum* 2004 versus medium variants



A B

Fig. 2. BC pellicle formed in static culture A - before purification, B – after purification

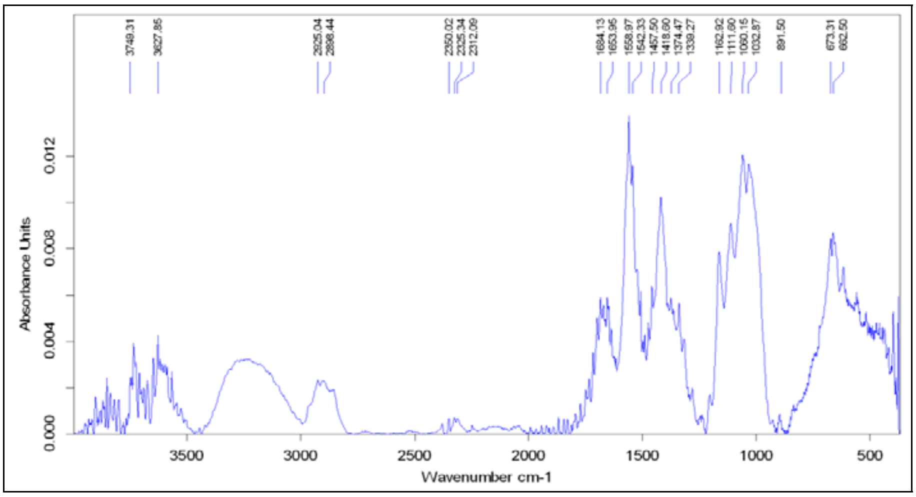


Fig. 3. The spectrum of bacterial cellulose obtained by the FTIR-ATR method.

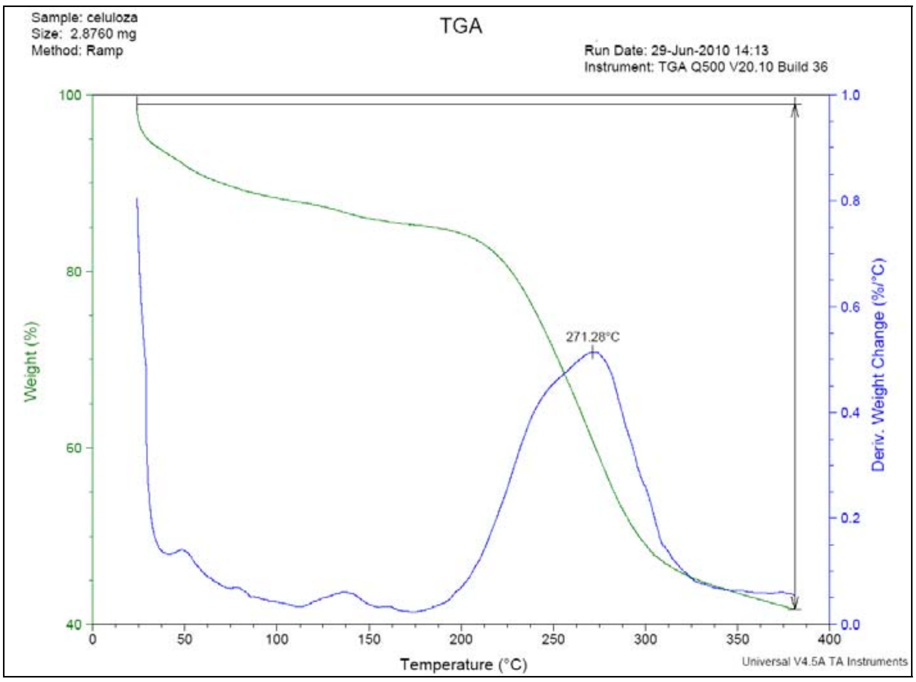


Fig. 4. TGA spectra of BC

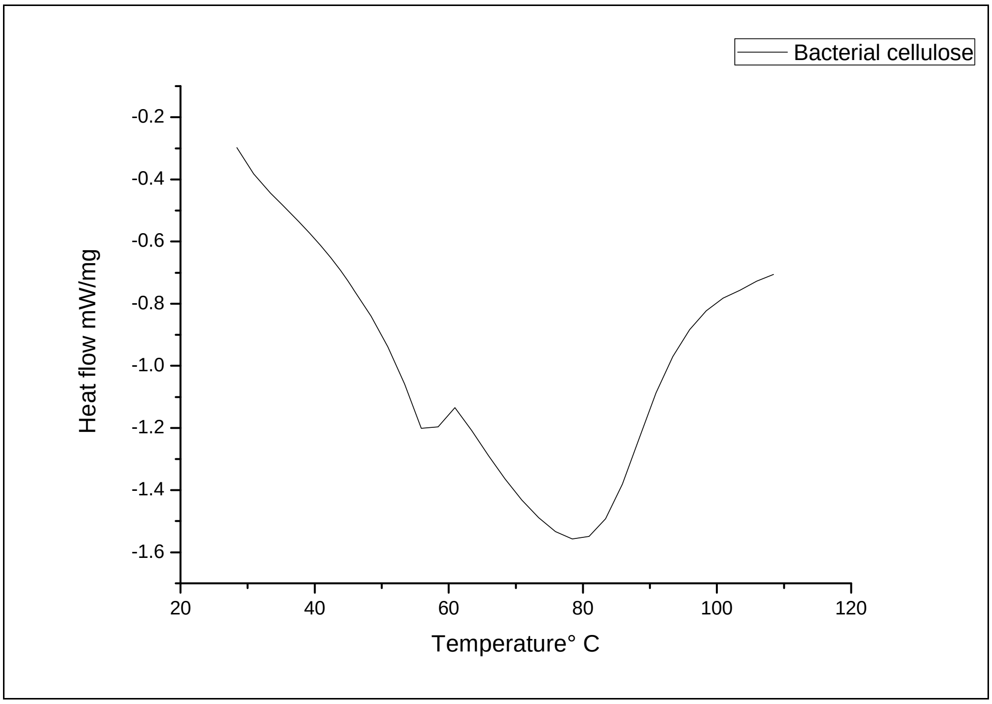


Fig. 5. DSC curve for BC

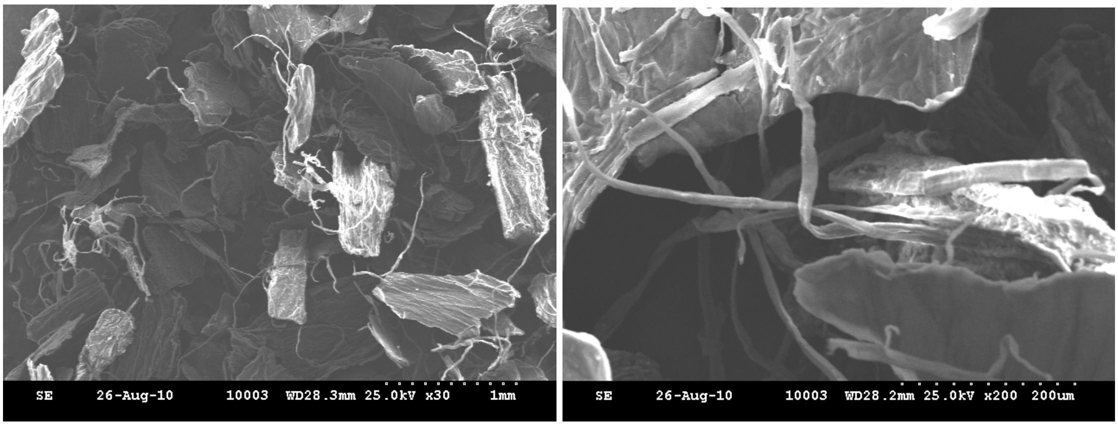


Fig. 6. SEM images of surface morphology of BC film in dry form,
magnification 30x-1mm (left) magnification 200x – 200 µm (right).

Achieving a pastry product, fortified with iron, destined to prevention and diet therapy of ferriprive anemia of children

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Key words: fortified, iron salts, cake, apricots

ABSTRACT

In present paper are presented results of the performed researches in order to achieve a pastry product fortified with iron:*"Cake with dehydrated apricots, fortified with iron"*. As fortification agents there were used ferrous sulfate, ferrous lactate and ferrous gluconate, and fortification levels were 40 mg Fe/kg flour and 60 mg Fe/kg flour. It was used white flour (type 480), because this has a low content of phytates. Taking into account role of phytase in hydrolysis of phytates and increasing of iron bioavailability into human body, in composition of pastry product it was added standardised fungal phytase. Product *"Cake with dehydrated apricots, fortified with iron"* was analyzed from sensorial, physic-chemical and microbiological point of view. The used fortification agents do not determine modifications of sensorial characteristics (appearance, colour, taste and smell), of product in comparison with control sample (cake without adding of dehydrated apricots and unfortified with iron). Iron content of the pastry product fortified with iron is in the range 2.49 – 3.12 mg/100g, and the control sample (cake without adding of dehydrated apricots and unfortified with iron), has an iron content of 1.32 mg/100g.

INTRODUCTION

According to the studies carried out by the World Health Organization the deficiency of iron affects almost 2 billion people. The most severe consequence of iron deficiency anemia is the asiderotic anemia (diminution of hemoglobin and hematocrit) that determines a state of accentuated physical fatigue stressed, children growth and development disorders, fall of vitality, reduction of immunity of the body, diminution of intellectual and memory performance, a tendency of suffocation, etc.

In Romania, according to studies achieved by U.N.I.C.E.F., Health and Family Ministry, Institute of Mother and Child Care “Alfred Rusescu”, about 50% of children aged to 2 years and about 30% of those aged to 5 years have ferriprive anemia (determined by iron deficiency). Also, according to the same studies about 25% of pregnant women and about 32% of those who suckle, have iron deficiencies and ferriprive anemia.

Enrichment of food products with micro-nutrients it is an essential element of strategies against nutritional deficiencies, of iron deficiency, especially, of population within developing countries. Adding of one micro-nutrient has to be done based on scientific researches, so that its concentration in product to be optimal for correction of nutritional deficiency, but, in the same time to keep the sensorial properties of product (appearance, taste, smell, colour) (Berger, 2003).

At the international level, they were achieved important researches for development of iron fortification technologies of food products (Mehansho, 2006).

MATERIAL AND METHODS

Experiments performed in order to achieve a pastry product fortified with iron (*"Cake with dehydrated apricots, fortified with iron"*) were done within the pilot plant of the National Institute of Research&Development for Food Bioresources – IBA Bucharest.

Within the performed experiments there were used the following raw materials and materials: white flour (type 480), sugar, eggs, sunflower oil, dehydrated apricots, salt, vanilla sugar, ferrous sulfate, ferrous gluconate, ferrous lactate, standardized fungal phytase, polypropylene bags.

In order to achieve pastry product fortified with iron there were made the following:
- analysis of flour quality used within experiments (sensorial, physic-chemical characteristics, farinogram)
- achieving in much more experimental variants of product *"Cake with dehydrated apricots, fortified with iron"*
- microbiological, sensorial and biochemical analysis of product *"Cake with dehydrated apricots, fortified with iron"* (6 experimental variants)
- definitivation of recipes and selection of optimal variant, from sensorial and nutritional point of view

In order to analyse quality of raw materials and pastry product fortified with iron there were used specific standardised methods.

Within the achieved experimental variants, the variable factors has been:
- iron fortification agent
- iron fortification level

In parallel with pastry product fortified with iron, it was achieved control sample (cake without adding of dehydrated apricots and unfortified with iron).

Technological flow for obtaining of pastry product fortified with iron, as for control sample, as well as for experimental variants it was the following: preparation of raw materials and materials, battering - frothing, dough preparation, baking, cooling, packaging, marking, storage.

RESULTS AND DISCUSSION

Fortification of food products is legislating through *REGULATION (EC) no. 1925/2006 of EUROPEAN PARLIAMENT AND COUNCIL*, on 20 December 2006. In this document are specified: requirements concerning adding of vitamins and minerals, restrictions concerning adding of vitamins and minerals and vitamins and minerals sources which can be added in food products.

In the case of wheat flour fortification, in order to achieve bakery products with high nutritional value, it has to take into consideration two aspects. The first one refers to the establishment of an iron level low enough, thus through consumption of some important bread quantities it is not the risk for adversely effects into human body (gastro-intestinal undesired effects, especially). In the same time, the iron level in wheat flour has to be high enough, so that it will be meet the nutritional benefit followed: prevention and diet-therapy of iron deficiencies, of vulnerable population groups. In this sense, it is used the tolerable superior limit of iron intake, that is the biggest daily iron intake which determines not a risk or adversely effects on the health of population majority.

In European Union, consultations concerning the superior limit of iron intake, there are not finished. In 1992, the Scientific Committee concerning Food (S.C.F.) has shown that the secondary effects at adults can appear, already, at levels of only 30 mg elementary iron; nevertheless, there were tolerated unique doses of 100 mg.

Food and Nutrition Board in U.S.A. has established in 2002 a tolerable superior limit of 40 mg iron in the case of patients with ages until 13 years and 45 mg iron, in the case of those with ages higher than 14 years, respectively. The tolerable superior limit of 45 mg iron it is applied also in the case of pregnant women and of those who suckle. As critical final point of iron intake, it was choose moment of gastro-intestinal disorders appearance.

Flour quantity daily consumed by a person it is very much variable according to food habits. For that a caloric intake of 2000 kcal/day to be achieved exclusively from flour, a person has to consume 540 g flour/day. Taking into consideration this aspect and the tolerable superior limit of iron intake (45 mg/day), nutritionists established *the safe maximum limit of iron in flour at 83 mg Fe/kg.*

Within the National Institute of Research&Development for Food Bioresources – IBA Bucharest, it was achieved a pastry product fortified with iron: *"Cake with dehydrated apricots, fortified with iron"*.

Taking into consideration of *safe maximum limit of iron in flour (83 mg Fe/kg*), within the performed experiments, there were used the following fortification levels with iron: 40 mg Fe/kg flour şi 60 mg Fe/kg flour. Also in case of this pastry product, in order to fortify it with iron, close to iron salts, there were used natural iron sources: yolk of egg and dehydrated apricots.

Considering phytase role in hydrolysis of phytates and increasing of iron bioavailability in human body, in the composition of pastry product, it was added standardized fungal phytase (0.1 g/kg flour).

Alongside control sample (cake without adding of dehydrated apricots and unfortified with iron), pastry product fortified with iron was achieved in 6 experimental variants (3 iron fortification agents, 2 iron fortification levels). All these were analysed from sensorial, biochemical and microbiological point of view.

White flour (type 480) used within experiments it was analysed from sensorial and physic-chemical point of view, results being presented in table 1.

Dehydrated apricots used within experiments excel through glucides, minerals and ß–carotene content (table 2).

After sensorial analysis of cakes with dehydrated apricots, fortified with iron, it remarks that for all experimental variants, the used fortification agents (ferrous sulfate, ferrous lactate, ferrous gluconate) do not determine modification of sensorial characteristics (appearance, colour, taste and smell), in comparison with control sample (cake without adding of dehydrated apricots and unfortified with iron).

Also after sensorial analysis, using *"Comparison method with unitary scores scale",* those six experimental variants of product *"Cake with dehydrated apricots, fortified with iron",* obtained qualifying **"very good**", having a total average score in the range 19.32 – 19.88.

According to physic-chemical analysis, product *"Cake with dehydrated apricots, fortified with iron",* achieved in 6 experimental variants, has a high energy value, excelling through content of glucides (71.03 – 72.04% d.m.), lipids (19.22 – 19.73% d.m.) and proteins (7.65 – 8.22% d.m.).

Iron content of this product varied in the range 2.49 – 3.12 mg/100g, and the control sample (cake without adding of dehydrated apricots and unfortified with iron), has an iron content of 1.32 mg/100g (figure 1).

After evaluation of microbiological and nutritional characteristics of pastry product fortified with iron, there were selected, as optimal variants, for each fortification agent, the following:

- V2 (fortification agent ferrous sulfate)
- V 4 (fortification agent ferrous gluconate)
- V6 (fortification agent ferrous lactate)

In table 3 are presented physic-chemical characteristics of those three optimal experimental variants for achieving of pastry product fortified with iron.

Microbiological analysis shown that those 6 experimental variants of cakes with dehydrated apricots, fortified with iron and control sample, are in conformity with the provisions of legislation in force.

CONCLUSION

1. It was achieved, at laboratory scale, a pastry product fortified with iron: *"Cake with dehydrated apricots, fortified with iron"*. As fortification agents there were used ferrous sulfate, ferrous gluconate and ferrous lactate, and the fortification levels 40 mg Fe/kg flour and 60 mg Fe/kg flour, respectively.
2. Sensorial analysis of cakes with dehydrated apricots, fortified with iron, shown that in all experimental variants, the used fortification agents (ferrous sulfate, ferrous lactate, ferrous gluconate) do not determine modification of sensorial characteristics (appearance, colour, taste and smell), in comparison with control sample (cake without adding of dehydrated apricots and unfortified with iron).
3. Iron content of product *"Cake with dehydrated apricots, fortified with iron"* varied in the range 2.49 – 3.12 mg/100g, and control sample (cake without adding of dehydrated apricots and unfortified with iron), has an iron content of 1.32 mg/100g.
4. Pastry product fortified with iron is valuable form nutritional point of view and it is destined to prevention and diet-therapy of children with ferriprive anemia, especially.

ACKNOWLEDGMENTS

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TABLES AND FIGURES

Table 1

Sensorial and physic-chemical characteristics of flour used within experiments

No.	Quality indicators	Results
1.	Appearance	Fine powder, white colour
2.	Smell	Pleasant, flour specific, without mould smell, hot or other strange smell
3.	Taste	Normal, nor bitter, nor sour, without mineral impurities (earth, sand, etc.)
4.	Moisture (%)	13.74
5.	Acidity (degrees)	2.10
6.	Wet gluten (%)	30.71
7.	Deformation index (mm)	3.0
8.	Falling Number (sec.)	352
9.	Ash (%)	0.47
10.	Fe (mg/kg)	1.21
11.	Proteins (% d.m.)	12.36

Table 2

Sensorial and physic-chemical characteristics of dehydrated apricots used within experiments

No.	Quality indicators	Results
1.	Appearance	Half of apricots, uniform size, sound, clean, without mould or fermentation marks
2.	Consistence	Pulp - elastic
3.	Color	Orange - bright
4.	Taste and smell	Sweet – sourish, pronounced aroma, specific for dehydrated apricots
5.	Moisture (%)	22.1
6.	Soluble glucides (%)	55.12
7.	Lipids (%)	0.38
8.	Proteins (%)	3.85
9.	Total ash (%)	3.01
10.	Vitamin C (mg/100g)	14.5
11.	ß-carotene (mg/100g)	9.15

Table 3

Physic-chemical analysis of product *"Cake with dehydrated apricots, fortified with iron"*, **in comparison with control sample**

Physic-chemical characteristics	Control	V2 (fortification agent – ferrous sulfate)	V4 (fortification agent – ferrous gluconate)	V6 (fortification agent – ferrous lactate)
Weight, kg	0.270	0.272	0.275	0.276
Moisture, %	18.90	20.30	20.90	20.55
Ash, % d.m.	0.63	1.09	1.16	1.08
Proteins, % d.m.	7.32	7.65	8.22	8.08
Lipids, % d.m.	19.61	19.22	19.52	19.48
Glucides, % d.m.	72.44	72.04	71.10	71.36
Iron, mg/100g	1.32	3.07	3.03	3.12
Energy value, kcal/100g	401.86	391.96	389.92	391.80

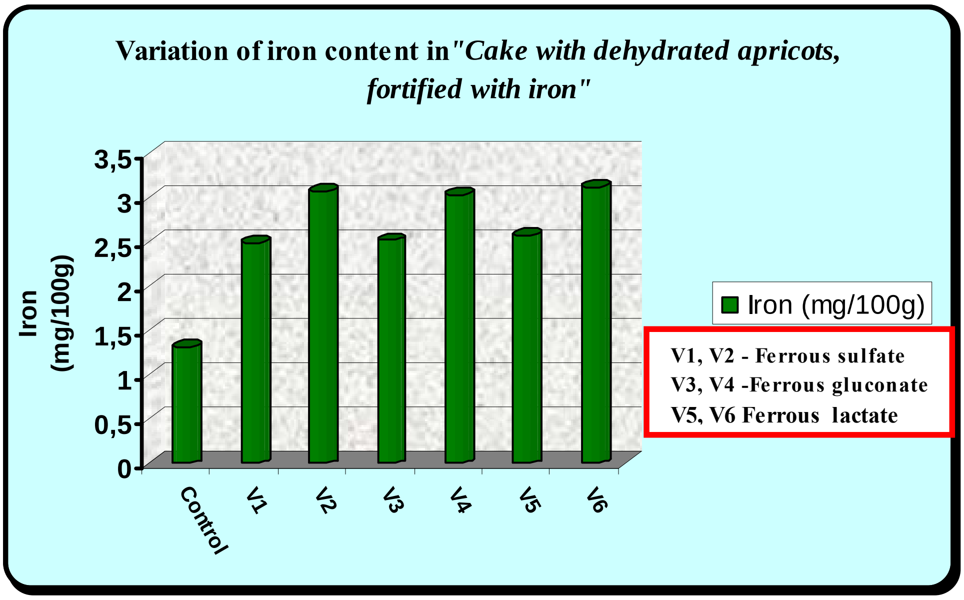

Fig. 1. Variation of iron content in *"Cake with dehydrated apricots, fortified with iron"* product

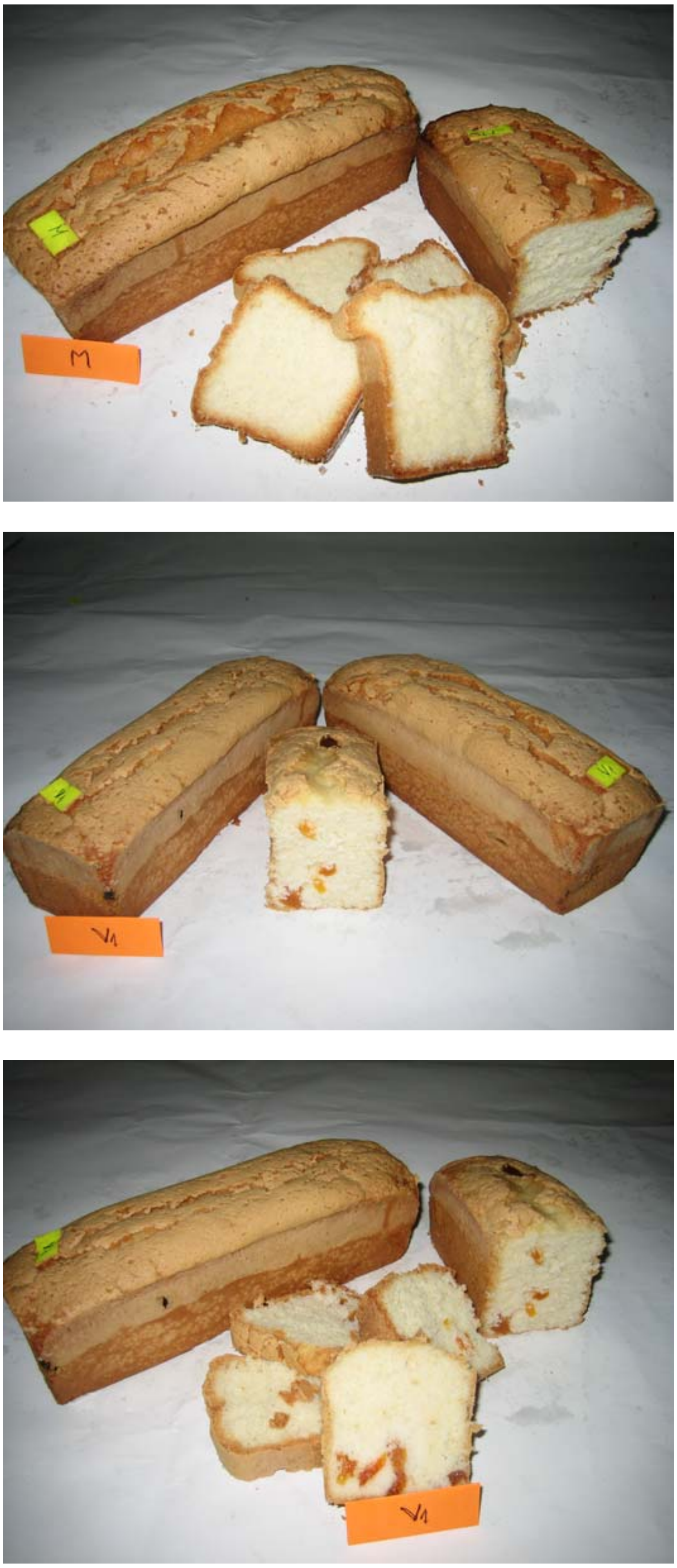

Fig. 2. "*Cake with dehydrated apricots, fortified with iron*", close to control sample

Sensorial analysis of food products fortified with iron

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Keywords: fortified, iron salts, score, evaluator

ABSTRACT

In this paper are presented results of the performed researches for sensorial analysis of food products fortified with iron, achieved within the National Institute of Research&Development for Food Bioresources – IBA Bucharest: bakery products (white bread, rolls with sun flower and sesame seeds, poppy sticks), fruit-based concentrated product (plums jam fortified with iron), pastry product (cake with dehydrated apricots). As fortification agents, there were used ferrous sulfate, ferrous lactate and ferrous gluconate, and fortification levels varied in the range 20 mg Fe/kg flour – 80 Fe/kg flour, in case of bakery and pastry products, and 4 mg/100g end product and 6.5 mg/100g end product, respectively, in case of fruit-based concentrated product.

In order to evaluate sensorial quality of food products fortified with iron, it was used *"Comparison method with unitary score scales"*.

The used fortification agents do not determine modification of sensorial characteristics (appearance, colour, taste and smell) of food products fortified with iron in comparison with control samples (food products unfortified with iron).

INTRODUCTION

Enrichment of food products with micro-nutrients it is an essential element of strategies against nutritional deficiencies, of iron deficiency, especially, of population within developing countries. Adding of one micro-nutrient has to be done based on scientific researches, so that its concentration in product to be optimal for correction of nutritional deficiency, *but, in the same time to keep the sensorial properties of product (appearance, taste, smell, colour)* (Berger, 2003).

The diet therapy of iron deficiency has a priority role in the latent deficiencies of this mineral and in prophylaxis as well (Yip, 1994).

Iron salts (ferrous sulfate, ferrous lactate, ferrous gluconate) soluble in water determine a high bioavailability of iron into human body, when there are used as fortification agents of food products (Hurrell, 1997).

A system for sensorial evaluation, organized and applied in a responsible way, it is essential for the success of a company on a long term. Sensorial evaluation can contribute to company profit, in a direct or indirect mode, because it provides specialized information at a low price and in a short time.

Sensorial analysis of food products fortified with iron it is an essential element for testing of their acceptance grade by consumers. A monitoring system of sensorial quality has to be correct, valuable and quick as time, uniform and consistent and simple.

MATERIAL AND METHODS

Sensorial analysis of food products fortified with iron it was achieved by specialists from the National Institute of Research&Development for Food Bioresources – IBA Bucharest. There were analyzed from sensorial point of view the following food products fortified with iron: White bread fortified with iron, Gluten free bread fortified with iron, Roll with sun flower and sesame seeds, fortified with iron, Poppy stick fortified with iron, Cake with dehydrated apricots, fortified with iron, Plums jam fortified with iron.

In parallel with food products fortified with iron there were analysed from sensorial point of view the control samples (products unfortified with iron).

As a remark, both food products fortified with iron and control samples were achieved by specialists of the National Institute of Research&Development for Food Bioresources – IBA Bucharest.

Food products fortified with iron were achieved in much more experimental variants, variable factors being:

- ✓ iron fortification agent
- ✓ iron fortification level
- ✓ ascorbic acid fortification level (only in case of plums jam fortified with iron)

In order to fortify with iron there were used iron salts soluble in water (ferrous sulfate, ferrous gluconate, ferrous lactate), which have a high bioavailability into human body.

Evaluation of sensorial quality of food products fortified with iron was done by experts panel, with 10 members, using *"Comparison method with unitary score scales"*. It was established a sensorial testing sheet, which will contain sensorial atributes important for each food product fortified with iron.

RESULTS AND DISCUSSION

In Romania, according to studies performed by U.N.I.C.E.F., Ministry of Health, Institute of Mother and Child Care "Alfred Rusescu", about 50% of children aged to 2 years and about 30% of those aged to 5 years have ferriprive anemia and achievement of some food products fortified with iron represents a necessity.

According to *Codex Alimentarius,* fortifying of food products is defined as being *"adding of one or more essential nutrients to food products, either it is included or not into food, normally, in order of prevention or correction of demonstrated deficiency of one or much more nutrients in population or specific groups of population"*.

Application of fortification strategy with iron involves establishment of food products which are consumed systematically and in sufficient quantities by population groups taking into consideration for prevention and diet-therapy of iron deficiencies (infants, children, adolescents, pregnant women, etc.). Also it is necessary to be established which iron compounds convenient are depending on their bioavailability and sensorial stability.

Taking into consideration these aspects, within the National Institute of Research&Development for Food Bioresources – IBA Bucharest there were achieved the following food products fortified with iron:

- White bread fortified with iron
- Gluten free bread fortified with iron
- Roll with sun flower and sesame seeds, fortified with iron
- Poppy stick fortified with iron
- Cake with dehydrated apricots, fortified with iron
- Plums jam fortified with iron

There were used iron salts soluble in water (ferrous sulfate, ferrous gluconate, ferrous lactate), which have high bioavailability into human body, observing the legislation in force (*REGULATION (EC) no. 1925/2006 of EUROPEAN PARLIAMENT AND COUNCIL*, on 20 December 2006, *Directive 2006/125/EC of European Community Commission* on 5 December 2006, concerning cereal-based preparations and food products for children, destined suckers and infants).

But, moreover high bioavailability into human body, iron salts used for fortifying of food products, have to fulfil the following requirements:

- to be stable
- to do not determine modification of sensorial characteristics (appearance, taste, smell) of fortified food products, in comparison with control samples

In order to assess sensorial quality, food products fortified with iron were tested by expert's panel, with 10 members, using *"Comparison method with unitary score scales"*. It was established a sensorial testing sheet, which contains sensorial attributes important for each food product fortified with iron (exterior appearance, appearance in section, consistence, taste, smell).

Each food product fortified with iron was evaluated from sensorial point of view by a panel with 10 members, trained concerning characteristics of the analyzed product. There were discussed and analyzed sensorial characteristics. Each evaluator received a sheet to complete it. Food products were examined in a light room, clean, without strange smells, at a temperature of 20-25°C.

Each sensorial characteristic was evaluated in the described conditions, through comparison with score scales of 0...5 points and obtaining of the average score given by experts' panel. Calculation of the weighted average scores, their sum for total average score obtaining and establishment of sensorial quality of product based on total average score, through comparison with a scale from 0 to 20 points.
Given scores are:

- 5 for qualifying: very good (product has positive specific characteristic, very well defined; it has not defects)
- 4 for qualifying: good (product has positive specific characteristic, quite outlined, but with very small defects)
- 3 for qualifying: satisfactory (product has positive specific characteristics, very poorly outlined, with small defects because of them it is at the minimum allowed level, through product standard)
- 2 for qualifying: unsatisfactory (product has lacks or defects of characteristic, because of them it does not fulfil the minimum condition of product standard, product can be used in directional consumption)
- 1 for qualifying: inadequate (product has lacks or different obvious defects of characteristic, thus it cannot be used into consumption, even after an adequate treatment).

Within this method used for sensorial analysis of food products fortified with iron, there were used the following calculation terms:

- *individual score (P_i):* result of evaluation through scores of one characteristic by each expert
- *average score (P_m):* arithmetical average of evaluation results through scores of one characteristic by experts panel
- *importance factor (f_i):* factor which indicates what is contribution of each sensorial characteristic to product quality, sum of importance factors being 1
- *conversion factor (f_t):* factor with it help it passes from scale of 5 points to scale with 20 points, in order to establish sensorial quality of product, conversion factor being always 4
- *weighted factor (f_p):* factor which is result of multiplication of importance factor with conversion factor ($f_p = f_i \times f_t$)
- *weighted average score (P_{mp})*: is result of multiplication of average score of one characteristic, given by experts panel, with importance factor and conversion factor or directly with weighted factor

Based on the total average score given by expert's panel it is made evaluation of sensorial quality of product through comparison with 20 points scale (table 1).

After sensorial analysis, using "*Comparison method with unitary score scales*", those six food products fortified with iron, achieved in six experimental variants, obtained the following qualifying:

- White bread fortified with iron – qualifying *"very good",* having a score in the range 19.44 – 19.82 (figure 1)
- Gluten free bread fortified with iron – qualifying *"very good",* having a score in the range 19.25 – 19.65 (figure 2)
- Roll with sun flower and sesame seeds, fortified with iron – qualifying *"very good",* having a score in the range 19.67 – 19.84 (figure 3)
- Poppy stick fortified with iron – qualifying *"very good",* having a score in the range 19.70 – 19.92 (figure 4)
- Cake with dehydrated apricots, fortified with iron – qualifying *"very good",* having a score in the range 19.32 – 19.88 (figure 5)
- Plums jam fortified with iron – qualifying *"very good",* having a score in the range 19.36 – 19.84 (figure 6)

According to the obtained results after sensorial analysis, it can be concluded that the used fortification agents do not determine modification of sensorial characteristics (appearance, colour, taste and smell), of food products fortified with iron, in comparison with control samples (food products unfortified with iron).

CONCLUSION

1. Within the National Institute of Research&Development for Food Bioresources – IBA Bucharest there were analysed from sensorial point of view, using *"Comparison method with unitary score scales"*, food products fortified with iron (White bread fortified with iron; Gluten free bread fortified with iron; Roll with sun flower and sesame seeds, fortified with iron; Poppy stick fortified with iron; Cake with dehydrated apricots, fortified with iron; Plums jam fortified with iron).
2. In order to fortify with iron food products, there were used iron salts soluble in water (ferrous sulfate, ferrous gluconate, ferrous lactate), which have a high bioavailability into human body.
3. After sensorial analysis, food products fortified with iron received qualifying *"very good",* having a score in the range 19.25 – 19.92.
4. Fortification agents used for fortification with iron of food products do not determine modification of sensorial characteristics (appearance, colour, taste and smell), of food products fortified with iron in comparison with control samples (food products unfortified with iron).

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TABLE AND FIGURES

Table 1

Total average score	Total qualifying
18.1.....20	Very good
15.1...18	Good
11.1......15	Satisfactory
7.1....11	Unsatisfactory
0...7	Inadequate

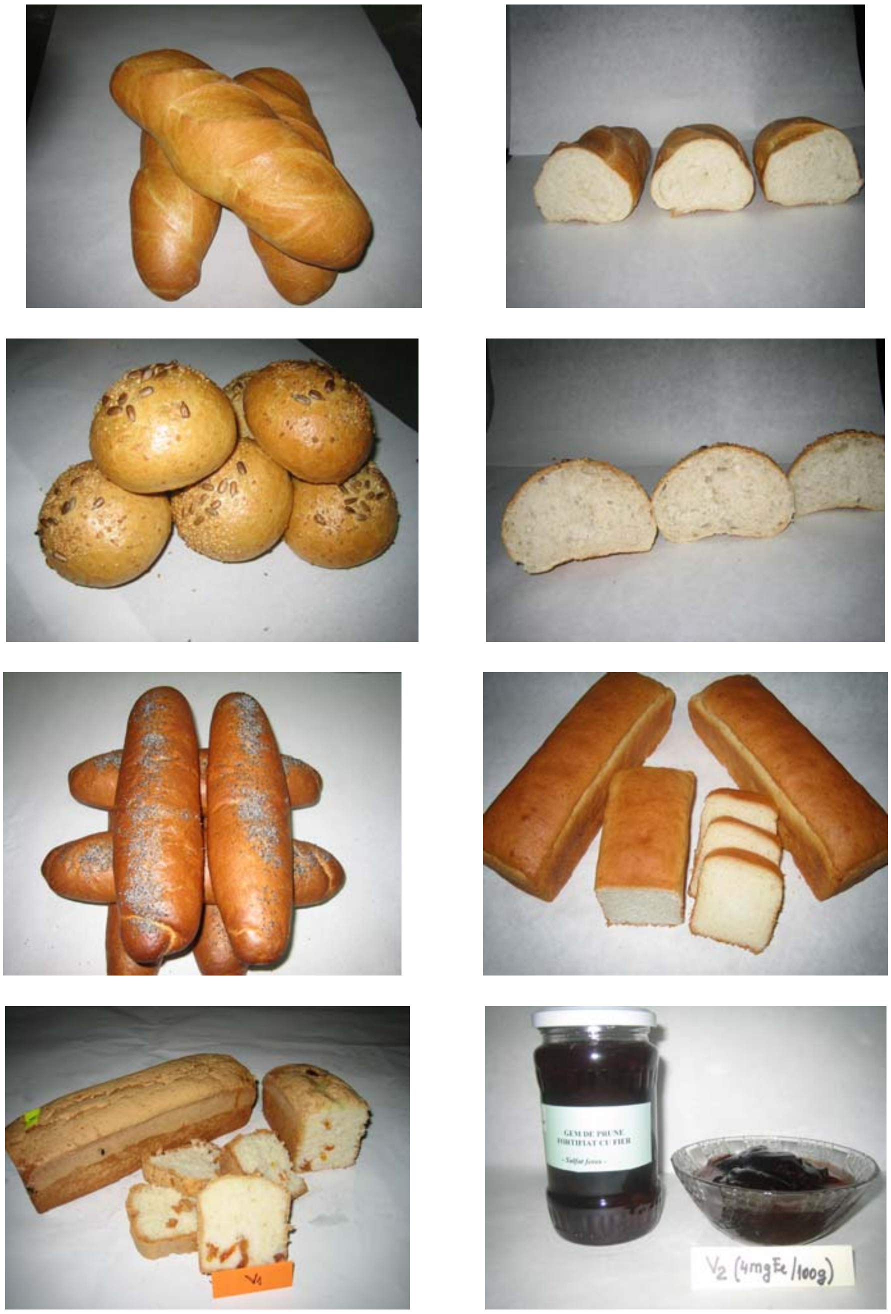

Fig. 1. Food products fortified with iron, achieved within IBA Bucharest

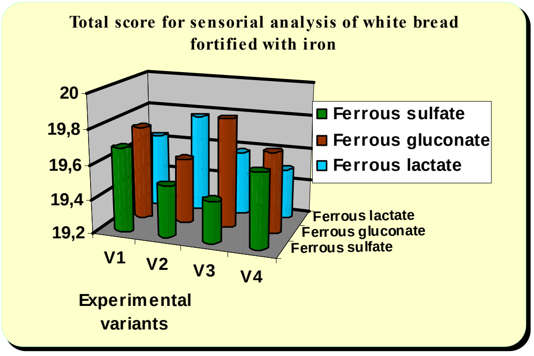

Fig. 2. Total score for sensorial analysis of White bread fortified with iron

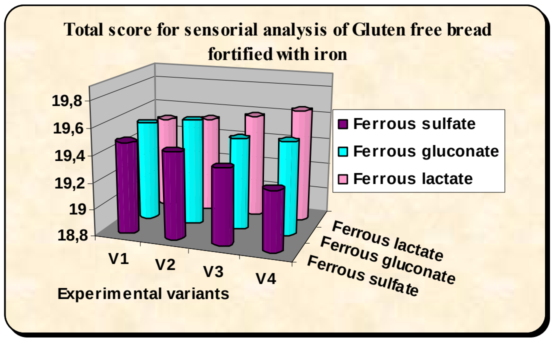

Fig. 3. Total score for sensorial analysis of Gluten free bread fortified with iron

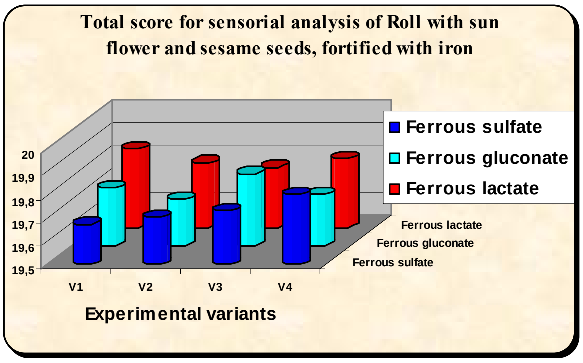

Fig. 4. Total score for sensorial analysis of Roll with sun flower and sesame seeds, fortified with iron

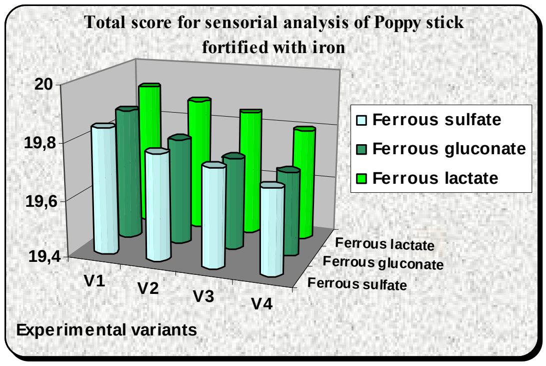

Fig. 5. Total score for sensorial analysis of Poppy stick fortified with iron

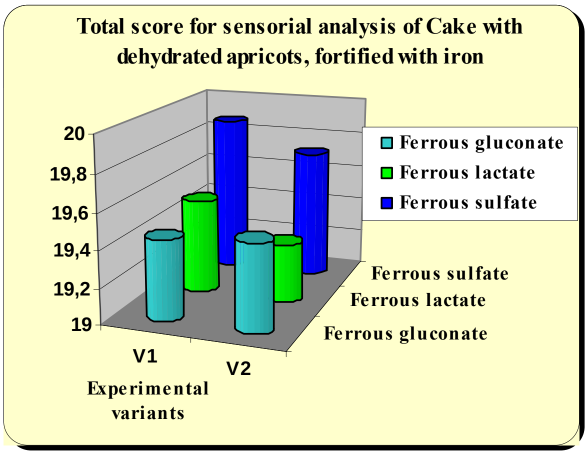

Fig. 6. Total score for sensorial analysis of Cake with dehydrated apricots, fortified with iron

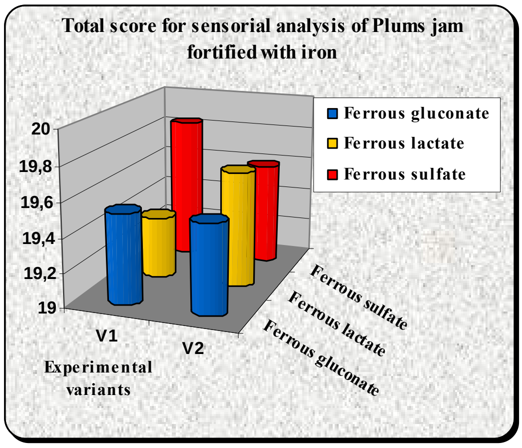

Fig. 7. Total score for sensorial analysis of Plums jam fortified with iron

The results obtained at maize green matter crop under different treatments from Lacu Sărat, Brăila

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Keywords: trial plot, treatment variants, yields

ABSTRACT

The maize is one of the plants with multiple uses including that of being used as fodder, not only as grains or processed feed, but as fresh green matter too. The maize green matter crop is sown after a previous crop harvested in late spring or early summer and it is used as fooder. Both maize green matter and silo crop are well agreed by all animal species, having a high coefficient of digestibility. Being a weeder plant, it leaves the land free for weeds and constitutes a good previous crop for many plants, it is a good user of mineral and organic fertilizers, and it reacts very strong to irrigation. In the natural background conditions of the trial plot, and taking into account the improvement scheme, the maize green matter crop responded well to most treatment variants, its yields obtained on different variants being significantly. The main purpose of the research was to pursue the influence of agrophytotechnical measures on soil and yields for the main field crops in the trial plot Lacu Sărat, Braila County, and, in this paper, the behaviour of the maize green matter crop has been observed.

INTRODUCTION

Central America and South America are the centre of maize origin. Maize was brought to Europe by Cristofor Columb in the late XVth century (1493) and it was firstly cultivated in Spain and after that in Italy.

In our country the maize is grown from the late XVIIth century in Muntenia, and then in Moldavia and Transylvania (Munteanu et al., 2003).

Biological and special food characteristics led to maize cultivation in various parts of the world, being the three crops of the world (over 130 million hectares), after wheat and rice. In our country, maize cultivated area is about 3 million hectares.

Beside the maize grown for grains, another crop with special importance is the maize cultivated for food, silage or green matter. Maize green matter is used as green feed and have the advantage that can be grown in stages for a long period (April-July) and with a low production cost.

The present paper aims to present the experimental researches on maize green matter crop in the Lacu Sărat trial plot, located in Braila Plain or Northern Bărăgan (Posea, 1989; Geografia României, 2005).

MATERIAL AND METHODS

Lacu Sarat trial plot is located in a depression area which accumulates ground waters from neighbouring higher areas, this phenomenon also being the cause of soil degradation processes by salinization and recurrent water logging. Surface deposits are made of loess and the texture varies from loamy-sandy to loamy-clayey. On the bottom of the valley, where the trial plot is sited, groundwater table reaches levels of less than 2 m and, in some parts, less than 1 m depth. Trial plot was located on slightly-moderately salinized chernozem (SRTS, 2003). The trial plot is cited in the dry steppe (Bogdan, 1999), characterized by hot and dry summers, with an average multiannual temperature of 10.9^{0}C, precipitations of 452 mm annually, potential evapotranspiration of 705 mm and a climatic water deficit of 345 mm (Braila Weather Facility).

The natural conditions of the trial plot (an area of 8 ha), were the basis to design the layout for several treatments, each of them composed from several ameliorative works, as follows: horizontal drainage, deep loosening, ameliorative irrigation, organic fertilization, chemical fertilization, soil tillage with soil material inverting, soil tillage without soil material inverting, mulching and amendment (table 1).

After applying ameliorative technologies in 1998, the following crops have been cultivated on the trial plot: maize, sunflower, sorghum and Sudan herb. The four crops were sown across al the 8 plots of treatments. The green matter maize crop was cultivated in agricultural years 1999/2000 and 2003/2004.

It has to be said that all technological components (plant species, fertilization, sowing, and weed control) were of ameliorative nature (Coteţ, 2008).

Due to the fact that this paper presents only maize green matter behaviour, the technological cultivation characteristics are as follows:

- seedbed preparation was carried out by plowing with U 650 + paraplaw and disc harrowing with U 650 and HD 3,4 (the second time with uncoupled harrows);
- a cultivar with middle-late ripening – Opal – was used, requiring a sum of thermic units between 1400 and 1500^{0}C to reach ripening;
- sowing was done at the temperature of 8^{0}C in sol at the sowing depth of 10 cm, with a density of 75000 germinable seeds/ha, and the inter-row distance of 70 cm;
- fertilization was done by applying 600 kg/ha ammonium sulphate, providing 120 kg N/ha for the V_2 - V_{8a} treatments and 300 kg/ha ammonium sulphate, providing 60 kg N/ha for the V_1 treatment, on which manure (60 t/ha manure) was applied during the seedbed preparation;
- weed control was done by applying 2,5 l Guardian/ha during the field preparation, with surface incorporation, and 1 l Oltisan extra/ha in the growing season, in the 3-4 leaves stage of dicotyledonous weeds, together with a mechanical weeding;
- in order to control diseases and pests, maize seeds were treated with Furadan 28 l/ha;
- harvesting was done manually, at a 25 – 28% grain moisture and then the yields were weighed for each treatment.

RESULTS AND DISCUSSION

The yields for the studied maize green matter crop trial plot in 1999/2000 and 2003/2004 (figure 1), ranged between 9000 and 30000 kg/ha.

In the first trial year, the yield varied from 30000 kg/ha for V_1, where the manure was applied and 20000 kg/ha for V_{8a}. In the second year, it from 28400 kg/ha for V_1 and 18900 kg/ha for V_{8a}. In the third trial year, the yield varied from 20500 kg/ha for V_1 and 9000 kg/ha for V_{8a}, and in the last year of trial, in the first variant were obtained 20600 kg/ha and 9300 kg/ha for V_{8a}.

The best yields were obtained in the agricultural year 1999 – 2000, when in autumn - winter period, enough water has been provided: 208 mm (Meteorological Station Braila), exceeding the annual average of 184 mm, and the lowest production in the crop year 2002 - 2003, which was characterized as an medium year in terms of rainfall, 473 mm, but in terms of heat it was characterized as a cold year overall, annual average air temperature being 10.0^{0}C, multiannual average temperature being 10.9^{0}C, being the lowest in recent years. During the colder period of this year, 4 thermal stresses have been endured by fall crops which have been totally killed (barley, rape and, a part of wheat). The first three streses caused by very low temperatures occurred in December, February, April, and the fourth stress occurred in May.

The yields are presented both in absolute and in relative values (% of the benchmark treatment), which in the trial context can be considered V_{8a}. It can be seen that the best yields were obtained for the treatments with a distance of 20 m (figure 2) (Coteţ, 2008).

For the first variant V_1, with the most improvement methods, maize green matter has annual relative yields between 150 to 228%, close in the four study years.

For the V_2 variant, similar to V_1, but without organic fertilization, relative maize green matter yields are closed and between 143 and 223%, varying with approx. 5 to 7% from V_1, differences could be caused by the organic fertilizers application .

In the third variant V_3, where the tillage is done with soil material inverting, it should be noticed that the largest relative increases for this variant occur for relative yields from 118 to 211%, lower with 12 to 25% comparing with V_2.

In the fourth variant V_4, no organic fertilizers being applied and no deep loosening the relative yields increases are 121 to 200%, from the V_2 with approx. 22 to 23%, differences that may be caused by the deep loosening and the organic fertilizers application.

In the fifth variant V_5 in the absence of irrigation improvement methods, the relative increases are 129 to 184%, lower with ca. 14-39% of V_2.

The sixth variant V_6 relative yields increases vary between 116 and 172% and are lower with approx. 12 to 13% compared to the V_5, where the mulcing has not been done.

The seventh variant V_7, with moderate drainage, has relative yields increases varying between 117 and 137%, higher with ca. 1 to 35% of the increases obtained in the absence of drainage.

The eighth variant, V_8, in the absence of drainage, leads to relative yield increases between 102 and 114%, lower by 41 - 109% compared to V_2 when drainage was placed at 20 m.

Taking into consideration the response of maize green matter to these treatments, it could be said that the highest relative yields were obtained for V_1, V_2, V_5, V_4, V_6, with values between about 153 and 200%, and under the other treatments the relative yield was between 106 and 127% (figure 3).

CONCLUSIONS

1. Maize green matter responded favourably to most variants of treatment, best yields being obtained for variants V_1, V_2, V_3, V_4, V_5, V_6 with the distance between drains being 20 m.

2. The highest yield (with an average of 24875 kg/ha) has been obtained for V_1, characterized by following improvements: *drainage with 20 m between drains + deep loosening + ameliorative irrigation + organic fertilization + chemical fertilization + Paraplawing + amendment*, and the small yield (with an average of 15364 kg/ha) was obtained in variant V_8: *no drainage + Deep loosening + Ameliorative irrigation + Chemical fertilization + Paraplaw + Amendment*.

3. The most important conclusion of the research is that soils of the slightly-moderately salinized chernozem type can lead to yields close to those obtained on nonsalinized soils, if specific treatments as: drainage, ameliorative irrigation and organic fertilization are applied.

AKNOWLEDGEMENT

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TABLE AND FIGURES

Table 1

Improvements applied to Lacu Sărat trial plot, Brăila

Treatment variants	Treatments										
	Drainage					Fertilization		Soil tillage			
	high intense (20 m)	moderately intense (40 m)	no drainage	Deep loosening	Ameliorative irrigation	organic	chemical	with soil material inverting	without soil material inverting (paraplaw)	Mulching	Amendment
V_1	✓			✓	✓	✓	✓		✓		✓
V_2	✓			✓	✓		✓		✓		✓
V_3	✓			✓	✓		✓	✓			✓
V_4	✓				✓		✓		✓		✓
V_5	✓			✓			✓		✓		✓
V_6	✓			✓			✓		✓	✓	✓
V_7		✓		✓	✓		✓		✓		✓
V_8			✓	✓	✓		✓		✓		✓
V_{8a} (B)			✓				✓	✓			

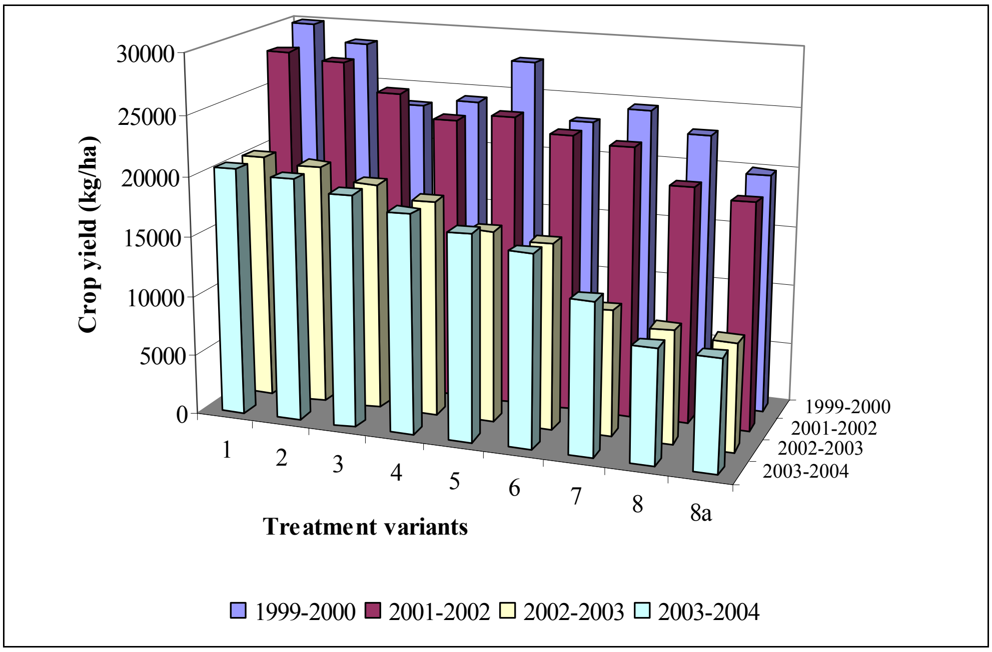

Fig. 1. Yields for maize green matter on variant of treatments and agricultural years

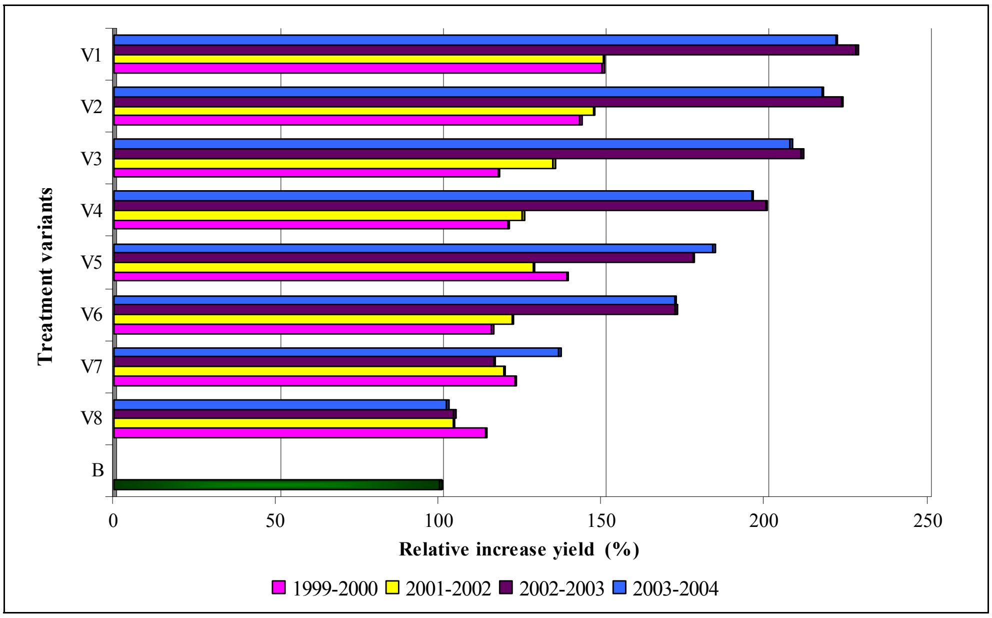

Fig. 2. Average yields obtained at different variants for maize green matter

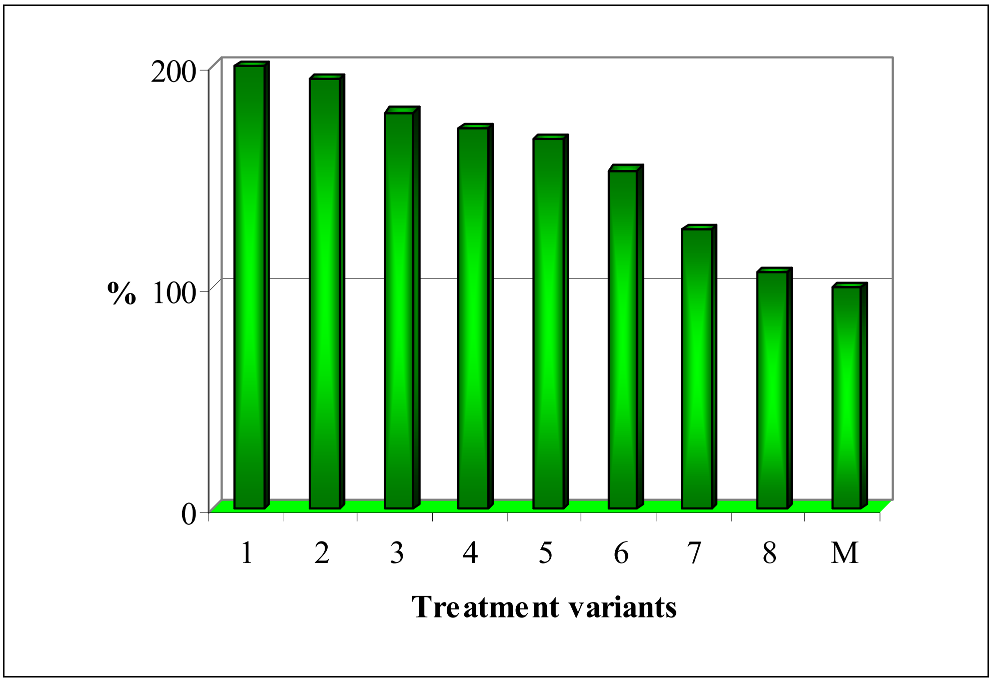

Fig. 3. Variation of averaged relative maize green matter yield (M = 100)
under different treatments

Systemic plant defense against pathogens: an overview

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Keywords: systemic acquired resistance, systemic induced resistance, elicitors, PR-proteins

ABSTRACT

Plants are exposed to a variety of biotic stress factors and in turn have developed sophisticated mechanisms for the perception of the attack and its transduction into an effective adaptive mechanisms using constitutive or inducible biochemical, and molecular mechanisms. This article reviews the most significant findings from the theoretical and practical view point, in systemic resistance against pathogens research, with a focus on recent advances.

INTRODUCTION

Plants are exposed to a variety of abiotic or biotic stress factors affecting them, whether they live in gardens, landscapes, forests, or are grown as indoor plants. Such problems may affect the aesthetics or lead to loss of quantity and quality of production and even death. However, biotic stress agents should be regarded as dynamic factors that can respond to climate changes, and insects and pathogens can cause striking changes of vegetation status, so they must be incorporated into models of vegetation changes (Malmström and Raffa, 2000). If we refer to biotic stress, this is a result of complex potential pathogens: fungi, bacteria, nematodes and insects which used photosinthetically plants assimilate products and viruses also use "the replication machine", a host based consumption.

In turn, plants have developed sophisticated mechanisms for the perception of the attack and its transduction into an effective adaptive mechanisms using constitutive or inducible biochemical, and molecular mechanisms (Ribeiro Do Vale et al., 2001; Huey et al., 2002; Gachomo et al., 2003; Bauer et al., 2004; Chen et al., 2004; Chi-Chen Chang, 2005; Duzan et al., 2005; Katou et al., 2005; Hofius et.al, 2007; Zhang et.al., 2008; Pinzón et al., 2009; Ahuja et al., 2010; Bruinsam, 2010; Walters, 2010 etc.).

Plants respond to pathogen attack by the command of a cascade network of events that begins with the attack perception and ends with the expression of a battery of target genes and although the defense in animals and plants vary considerably, connecting the signal transduction receptor activity for induction of defense response shows some similarities (Hirt, 2002). Plants trigger defense signalling through receptor-mediated recognition of conserved microbial structures named PAMPs (pathogen-associated molecular patterns) or elicitors (Nürnberger and Lipka, 2005; Ferrari et al., 2007).

The outcomes of plants continuous co-evolutionary struggle for dominance with their pathogens are of particular importance to human activities, as they can have dramatic effect on agricultural systems. From the perspective of bit organisms, recent convergence of molecular studies regarding plant immunity and pathogen infection strategies is revealing an integrated picture of the plant-pathogen interactions from the perspective of both organisms (Dodds and Rathjen, 2010).

STATE OF THE ART

Plant resistance to the pathogens attack may include the localized acquired resistance (**LAR**), systemic acquired resistance (**SAR**) or the induced systemic resistance (**ISR**) (van Loon et al., 1998).

In the case of ***LAR*** only the tissues exposed to the primary infection become more resistant. In the case of the other two resistance types, a signal propagates the enhanced defensive capacity throughout the plant.

SAR is commonly triggered by local infection and is correlated with the activation of pathogenesis-related (PR) genes that generally requires the involvement of the signal molecule salicylic acid (SA). Necrotrof infection by a pathogen (which causes host cell death) causes a signal formation that is transmitted in the plant. As a response, in healthy uninfected tissue defense genes are activated and express, so plant will manifest resistance to subsequent infection with a broad spectrum of pathogens, which normally are compatible with the host plant.

In opposite, ***ISR*** is generally triggered by non-pathogenic rhizobacteria followed by the expression of the genes involved in the jasmonate/ ethylene signalling pathways, which don't involved the accumulation of PR proteins. As recently Tarkka et al. (2008) pointed out, root inoculation with belowground bacteria, filamentous gram-positive streptomycetes can induce plant defense s responses in the roots, but also in the leaves and include priming (sensitizing) like characters.

After Percival (2001), SAR is the phenomenon by which a plant shows its own defense mechanism, induced by treatment with a chemical or biological agent. In the presented synthesis the author referred to some issue as: SAR mechanisms, biological agents that induce SAR, aspects of the history of SAR, SAR persistence, the use of chemical compounds INA (2,6-dicloroizonicotinic acid - CGA 41396 and its methyl ester - CGA 41 397) and other chemicals, including salicylic acid. Molinari and Baser (2010) demonstrated that application of SAR elicitors (salicylic acid, methyl salicylic acid, acibenzolar-S-dichloroisonicotinic acid) and other associated methods before inoculation differentially induced resistance to the root-knot nematode *Meloidogyne incognita* on tomato.

It was determined that *salicylic acid* plays a key role in establishing systemic acquired resistance (SAR). So, the signalling pathway begins with the synthesis, being described at least three types of SA regulators (Lu et al., 2009) and accumulation of this signal molecule, in both infected and non-infected tissues of the plant in response to the pathogen. The resistant tissue contains large amounts of salicylic acid. Also, after a hypersensitivity response to a pathogen attack, plants express a remarkable accumulation of salicylic acid (SA), being induced defense gene expression, particularly those encoding acidic pathogenesis-related proteins (PR) (Verberne et al, 2000).

Hypersensitive response (***HR)*** is performed at the pathogen entry, representing an expression of the recognition of a product of an avirulent gene of the pathogen, reflected in the rapid death of some cells that limits the progression of infection. Systemic acquired resistance is a local hypersensitive response (HR), to an avirulent pathogen that causes the infected parts of plants to resist to various pathogens normally virulent (Kuc, 1982). It has been also defined as a general plant defense response triggered by a pathogen attack, which occurs in distal, non-infected parts of the plant (Durrant and Dong, 2004). Therefore, HR is a high specificity, realizing only when a gene product of an avirulent pathogen interacts with the plant resistance gene product (Heil and Bostock, 2002).

Percival (2001) points out that although historically speaking, the focus was on discovering new resistance genes by molecular techniques and improvement, rather than use the existing potential resistance in plants, demonstrations of the effectiveness of SAR in laboratory and field presents very interesting opportunities in terms of disease control in urban trees. SAR based on multiple natural defense mechanisms makes it less likely that a pathogen easily develop resistance to this control measure. Plants treatment with different agents (e.g. virulent or avirulent pathogens, non-pathogens, cell wall fragments, plants extracts, synthetic chemical) can lead to the induction of resistance to subsequent pathogen attack, both locally and systemically (Walter et al., 2005). In the same context, Glazebrook et al. (1997) presented a systemic approach on defense issues, in *Arabidopsis*-pathogen model.

Defense responses can be divided into three general ways:
- Path to gene-gene resistance, which operates during response to non-virulent pathogens;
- Path of the acquired resistance (SAR) which allows a strong resistance against various pathogens;
- Path or pathways which operate to limit pathogen virulence.

Recently, transcript profiling has provided unparalleled perception into the mechanism underlying gene-for-gene resistance and basal defense , host vs. nonhost resistance, biotroph vs. necrotroph and pathogenicity of vascular vs. nonvascular pathogens, among many others. Genomic technologies have facilitated a system-wide approach to unifying themes and unique features in the interaction of hosts and pathogens (Wise et al., 2007).

To understand the cellular biology and biochemistry underlying plant-pathogen interactions there is no substitute for studying proteins which are directly responsible for cellular activity. Therefore, despite the enormous amount of data generated by transcription analysis, the picture is still incomplete and proteomic approach offers a new perspective that so far has been lacking (Quirino et al., 2010).

Mechanisms for achieving the two resistance reaction types are different.

For example, in the case of *SAR*, salicylic acid or methyl salicylates are produced as primary and secondary response, after which by the phloem pathway a signal compound is transported at a distal area. Salicylic acid accumulates at the distance is then converted to methyl salicylic acid, a volatile compound that is a signal to neighbouring plants. In addition, the coordinated activation of a specific set of genes named PR proteins with antimicrobial effect is formed in the distal parts of the plant (Hammerschmidt, 1999).

ISR developed as a result of colonization of plant root by plant growth promoting rhizobacteria (PGPR) is mediated by a SA- independent pathway and activation of PR genes requires jasmonic acid (JA) and ethylene (Pieterse and Van Loon, 2007). Rhizobacteria are considered as efficient microbial competitors in the root zone. Representatives of many different bacterial genera have been introduced into soil, onto seeds, roots, tubers or other planting material to improve crop growth. These bacterial genera include *Acinetobacter*, *Agrobacterium*, *Arthrobacter*, *Azospirillium*, *Bacillus*, *Bradyrhizobium*, *Frankia*. Elicitation of induced systemic resistance by plant associated bacteria was initially demonstrated using *Pseudomonas* spp. and other Gram-negative bacteria. Several species of *Bacillus amyloliquefaciens*, *B. subtilis*, *B. cereus*, *B. pumilus*, *B. mycoides*, and *B. sphaericus* elicit significantly reduction of the incidence or severity of various diseases on a diversity of host, as Choudhary and Johri reviewed (2008).

Selected strains of growth promoting bacteria (PGPR) suppress diseases by antagonism between the bacteria and soil-borne pathogens as well by inducing a systemic resistance in plant against both root and foliar pathogens. *Rhizobacteria* mediated ISR resembles that of pathogens induced SAR in that both types of induced resistance render uninfected plant parts more resistant towards a broad spectrum of plant pathogens. Several rhizobacteria trigger the salicylic (SA) dependent SAR pathway by producing SA at the root surface, whereas other trigger different signalling pathways independent of SA (Choudhary et al., 2007).

Both SAR and ISR are common a phenomenon called ***priming*** (Beckers and Conrath, 2007). This means that plant defense s mechanisms are not directly activated by the inducing agent but are potentate for enhance expression upon subsequent pathogen attack. Direct induction of resistance incurs costs in *Arabidopsis* and wheat, while the benefits of priming have been shown to outweigh costs in *Arabidopsis*, particularly in the presence of disease. Walters et al. (2008) were examined the costs and benefits of priming in barley under low and high disease pressures, using saccharin to prime barley for augmented defense expression following infection by the hemibiotrophic fungus *Rhynchosporium secalis.* The obtained data

data suggest that priming-induced resistance using saccharin does not incur significant allocation costs in barley and indeed, provides significant benefits under high disease pressure.

An and al. (2010) demonstrated that pre-inoculation of tomato with the bacterial isolates of *Burkholderia gladioli*, *Miamiensis avidus*, *Acinetobacter quenomosp* and *Bacillus cereus* promoted the growth of tomato seedling, also induced defense responses against late blight disease caused by *Phytophthora infestans*. Ward et al. (1991) showed that in inoculated and infected leaves there were induced at least nine families of genes, known as SAR genes, and the by-products of these genes have either direct antimicrobial activity or are closely related to classes of antimicrobial proteins.

Furthermore, Ahn et al. (2005) emphasized that vitamin B1 (thiamin) induces SAR in plants, as shown the experiments carried out in rice, *Arabidopsis thaliana* and vegetables, which are resistant to fungal, bacterial and viral infections. For example, thiamine treatment of *Arabidopsis* plants, ecotype Columbia-0 resulted in activation of PR-1, but not PDF1.2. It was also found that thiamine prevented bacterial infection in the *Arabidopsis* mutants insensitive to jasmonic acid or ethylene, but not mutants that were disrupted SAR pathway transduction. There was clearly demonstrated that thiamine induces SAR in plants, by salicylic acid and Ca^2 signalisation pathways.) Moreover, the expression pattern of *PR1* and *Phe ammonia-lyase1* (*PAL1*) and the induction of cellular defense responses like AOS accumulation and callose deposition were analyzed in *Arabidopsis* and its several defense-defective mutants. Results obtained by Ahn et al. (2007) demonstrate that thiamine-induced priming is in dwelling in plants without physiological alterations and is dependent on hydrogen peroxide accumulation, SA, and *NPR1* (nonexpressor of *PR* genes 1). Also, Goyer (2010) presented new aspects of multiple functions of B1 (thiamine diphosphate) in plants.

In conifers, there is evidence that salicylic acid (SA) and jasmonic acid (JA) can induce defense responses both locally and distally / systemic, but it is unclear whether these signal molecules are indeed expressed in the plant at functional levels. So, it has been preferred to use more general terminology of induced systemic resistance. Bonello and Blodgett (2003) studied the viability of *Pinus nigra* - *Sphaeropsis sapinea* pathosistem, as a model to investigate the responses of localized and systemic host defense in order to explain the plant resistance to pathogens that cause cancer. There were studied: the localized responses of secondary metabolites, which are correlated with disease resistance; determination whether the fungus infection induced systemically changes of the secondary metabolism; identification of pathogen-derived elicitors, which could be used in future molecular dissection of chemistry and biology of this interaction. When inoculation have been done on the basal stem area, at the plants aged 5 years, the decrease or accumulation of some soluble phenol substances and related cell wall, and increased deposition of lignin some substances have been induced, too. Also, it was found that inoculation resulted in a significant accumulation of compounds in the phloem, about 25 cm above the inoculation site, which showed induction of systemic metabolic pathways. Among induced metabolites there was included taxifolin (basal stem area only). Another flavonoid was reported only when trees were inoculated with live mycelium, suggesting a possible role of this compound as fitoalexine. On the other hand, lignin content and concentration of some metabolites considered important in resistance (as for instance stilbenes) were not correlated, or were positively correlated with the lesion size. Only three metabolites were negatively correlated with the lesion size, which suggested their possible role in resistance. As regard as stilbenes, Schnee et al. (2008) noticed their role in grapevine resistance to powdery mildew.

SAR induction was found also in the case of the exogenous application of some chemicals such as salicylic acid (SA), 2.6 - dicloroizonicotinic acid (INA) and benzol (1,2,3)-7-acid tiadiazol carbotionic-S-methyl ester (BHT) (Görlach et al., 1996). Biological control agents (BCAs) for plant disease are currently being examined as alternatives to synthetic pesticides due to the perceived, their increased level of safety and minimal impacts environmental (Brimner and Boland, 2003). The combination of biocontrol agents (as for example *Trichoderma harzianum*) and resistance inducer (as salicylic acid) could provide promising alternatives integrated in the suppression of *Fusarium* wilt disease of tomato plants, as Houssien et. al. (2010) demonstrated. Elad et al.(2010) shown that biochar (a solid coproduct of biomass pyrolysis) aplication as a soil amendment induces systemic resistance to the foliar pathogen *Botrytis cinerea* and *Leveillula taurica* at pepper and tomato and to the broad mite pest (*Polyphagotarsonemus latus* Banks) on pepper.

Also, *non-pathogenic bacteria can induce systemic resistance* in plants, phenotypically similar those induced by pathogens (SAR). Bacteria activation of the induced systemic resistance (ISR) has been demonstrated against fungi, bacteria and viruses in *Arabidopsis,* bean, cucumber, radish, tobacco, tomato. Bacterial determinants include: lipopolisaharides (LPS), siderofors and salicylic acid. If some bacteria induce resistance on the SA pathway, others require jasmonic acid and ethylene. Zeidler et al. (2010) noticed that in the case of *Arabidopsis thaliana* plants pre-treated with LPS there was registered an increased resistance to the virulent bacterial plant pathogen *Pseudomonas syringae* pv. *tomato* DC 3000. The mobilisation of and transport of LPS in *Arabidopsis* leaves, fluorescently labelled LPS from *Salmonella minnesoata* indicated that occurs through the xylem from local, treated leaves to systemic, untreated leaves.

Ryu et al. (2004) have examined whether ***volatile organic compounds*** (VOCs) associated with rizobacteria can initiate ISR. Thus, at *Arabidospsis* seedlings exposed to mixtures of volatile from *Bacillus subtilis* GB03 and *Bacillus amyloliquefaciens* IN937a, the disease severity due to the pathogenic bacteria *Erwinia carotovora* subsp. *carotovora* was significantly reduced, compared with unexposed plants to volatile substances, before the process of inoculation with pathogen. It was sufficient only four days exposure to volatile substances, to ISR activation. As regard as the chemical composition of volatile substances it was determined the emission of a series of low molecular weight hydrocarbons, including growth promoter VOC (2R, 3R)-(-)- butanediol. Exogenous application of racemic mixture (RR) and 2,3-butanediol isomers were found to trigger ISR. Transgenic lines of *B. subtilis* that emitted small amounts of 2,3-butanediol and acetoin conferred reduced *Arabidopsis* protection to pathogen infection, compared to lines exposed to VOCs from wild type bacterial lines. It was emphasised that by using transgenic lines and mutants of *Arabidopsis*, the signalisation path activated via volatiles from GB03 is dependent on ethylene, but independent of jasmonic acid and salicylic acid pathways.

Devadas and Raina (2002) have been shown using transgenic lines and mutants from *Arabidopsis* that mutant (*hrl1*) was characterized by increased defensive response, making it more resistant to virulent pathogens and PR-1 expression remains unaltered after infection with avirulent and virulent pathogens. HR repression at *hrl1* has been observed when an elicitor is expressed endogenously by using an inducible promoter, and missing of the HR phenotype in *hrl1* is overpass if the constitutive defense responses are compromised by a mutation of *NON EXPRESSOR OF PR-1* (*NPR1*) or by salicylic acid decreasing due to *nahG* gene expression.

Research has shown that inoculation of *Arabidopsis* leaves with avirulent *Pseudomonas syringae* induces secondary oxidative burst in discrete cells, in distant tissues and in fact, both ***primary and secondary oxidative burst*** are necessary for systemic immunity (Alvarez et al., 1998). Therefore, the cells around the necrosis become resistant to subsequent infection, which after Fritig et al. (1998) is a localized acquired resistance. Subsequently, these local responses often induce non-specific plant resistance, which allows a systemic acquired resistance, to ensure a durable protection against a broad spectrum of pathogens

(Sticher et al., 1997). In addition to the mechanisms involved in SAR (lignification and other structural barriers; PR proteins and their; salicylic acid signals) there are also mentioned results on the *biological role of sistemin, ethylene, jasmonats and electrical signal*s.

The existence of a transmissible signal derived in cells that have a hypersensitive reaction to pathogen invasion in the incompatible interaction of soybean variety Harosoy 1272, with race 1 of *Phytophthora sojae* fungus has been shown to cause rapid changes in the physiology of stomata, after leaf inoculation (McDonald and Cahill, 1999). Thus, in the case of the incompatible interaction stomata closure took place, unlike the compatible interaction, when stomata were closed very slowly or remained open. Furthermore, leaves treatment with an abiotic elicitor, silver nitrate and injury did not induce systemic closure of stomata.

Also, research performed by Fabro et al. (2004) in the same pathosistem (*A.thaliana* and *P. syringae*), both to the resistance activation according to gene for gene theory (avirulent pathogen: incompatible interaction) or disease development (virulent pathogen: compatible interaction) have evaluated whether ***proline metabolism*** is altered under biotic stress conditions. Proline has been shown to accumulate specifically in *Arabidopsis* leaf tissue that developed incompatible interaction, involving *avrRpt2* or recognition of *avrRpm1: RPM* and enabling HR response. This response involved transcriptional activation *AtP5CS2* but not *AtP5CS1* and can be induced by ROS. Moreover, proline accumulation reported by PRS2 pathway depends on salicylic acid, too.

Research has confirmed that the response reactions are multiple and in addition to reactive oxygen species producing, nitrogen oxide, is also involved a process of ***fosfolipases induction***, which acts on membranal lipids. The results is the emission of jasmonic acid, methyl jasmonate and other molecules, so confirming the potential role of jasmonic acid, ethylene and salicylic acid pathways in the signal pathway to activate plants defense genes (Ananieva and Ananiev, 1999). Experiments performed by Zeier et al. (2004) showed that, for example nitric oxide (NO) plays a central role in disease resistance, but in several other plants physiological processes, too. Also, in the leaves of bean plants (*Phaseolus vulgaris* L.) during the HR response to pathogenic bacterium *Pseudomonas syringae* pv. *phaseoli* it was determined the release of *volatile derivatives of lipids*, including cis-3-hexenol and trans-2-hexenal, originating from 13- linolenic acid hidroxiperoxide and some lipids derivatives possess some antimicrobial activity. Therefore, they are involved in plant resistance diseases (Croft and Juttner, 1993). Methyl salycilate, jasmonates, azelaic acid and diterpenoid have been implicated as mobile signals associated with SAR activation, by contrast with auxins that probably contribute to negative regulation (Ahah, 2009).

Lipoxigenase activity, production of volatile compounds derived from lipids and lipid peroxidation was determined also in leaves of pepper (*Capsicum annuum* L., cv. Calwonder Early-10R) during the HR response induced by race 2 of the bacterium *Xanthomonas campestris* pv. *vesicatoria* (Buonaurio and Servile, 1999). During incompatible interactions there were detected some volatile compounds derived from the lipoxigenases way [(E, E) - 2,4-hexadienal, 1-hexanol, 3-hexen-1-ol, 2,4-hexadienal and 2,4 - heptadienal] and carotenoid degradation. With advancing stages of HR response it has been registered a significant increase in the level of oxidative index (A_{235}/A_{205}) of lipid extracts from leaf and its determination on glicolipidic and phospholipid fractions showed that oxidative index increased significantly only in glicolipidic fraction. The hypothesis was that during the incompatible interaction is induced in a chloroplast a lipoxigenase, which is responsible with the lipid peroxidation processes intensification.

As regard ***mitochondria involvement in HR regulation***, Lam et al. (1999) presented detailed data based on studies of *alternative oxidase* (AOX) (the missing enzyme in animal cells and that catalyzes electron transport from ubichinone directly to molecular oxygen, avoiding the complexes III and IV the internal mitochondrial membrane). Possible explanation is that increased activity of this enzyme is a generator signal to induce cell death by HR, possible through ROS generation derivatives of the electron intermediate transport chain. Concerning the *mitochondrial alternative oxidase* (AOX), researches on transgenic tobacco (*Nicotiana tabacum*) with altered levels of AOX, to examine the potential role of protein in the electron transport chain in the resistance to tobacco mosaic virus, have highlighted that the AOX missing did not compromise the ability of salicylic acid treatment to increase resistance in susceptible plants. Also, plants that possessed the gene-N, the AOX missing did not compromise the hypersensitive response ability to restrict virus, or plant capacity to develop systemic acquired resistance. After Ordog et al., (2002) AOX expression did not increased susceptible plant resistance, but resulted in smaller areas hypersensitivity lesions, suggesting a link between mitochondrial function and programmed death event. From these studies it was concluded that AOX is not a critical component of salicyl salicylic hidroxamic acid pathway, which was previously mentioned as important in viral resistance. Kiba et al. (2009) studying the interaction between *Pseudomonas cichorii* and lettuce noticed depletion of cellular ATP and expression of AOX, suggesting mitochondrial dysfunction.

HR response and systemic acquired resistance is associated with the production of some substances with a low molecular weight, some proteins related to pathogenesis (**PR - protein**) and Dong (2001) explained the genetic aspects of acquired resistance.

PR proteins are defined as proteins *encoded by the host plant*, induced specifically in pathological or other similar situations, not only accumulate locally in the infected leaf, but they are induced and systemic, associated with the development of systemic acquired resistance (SAR) against infection with other fungi, bacteria or viruses. After Van Loon and Van Strien (1999) synthesis data results that they have been characterized in tobacco, both biochemical and by molecular biology techniques five main classes of PR proteins (PR 1-5), then were recognized 11 families (PR-1-11) for tobacco and tomato. During the last decade there were identified novel peptide families as plant-pathogenesis-related (PR) proteins. As for instance are *pathogenesis-related peptides*: proteinase inhibitors (PR-6 family), plant defensins (PR-12 family), thionins (PR-13 family) and lipid transfer proteins (PR-14-family) (Sels et al., 2008). After Van Loon et al. (2006) PR proteins are classified into 17 distinct families (PR-1 to PR -17) with a putative novel PR-18 family.

PDF1-2 is a member of a group of defensine plant, together with thionins, lipid-transfer proteins (*LPTs*), hevein-type, knottin-type and *Impatiens* antimicrobial peptides are families of peptides with antimicrobial activity in many plants. At least some of these peptides should be considered as PRs. Following discussions held at the 5th International Workshop on PRs issues in the plant, which took place in 1988 in Aussois, France, wanted to be included other three PRs families namely defensins (PR -12), thionins (PR-13) and LTPs (PR 14).

Many such proteins have destroying action on the parasite structures, as PR-1 and PR-5 interacts with plasmalema, while β-1 ,3-glucanases (PR-2) and chitinases (PR- 3, PR- 4, PR -8 and PR-11) attacks the β-1 ,3-glucans and chitin, which are components of cell wall in most fungi. PR-1 family is unknown although some function in tomato and tobacco were found on oomicets antifungal activity. However, PR-1 is a dominant group of PRs induced by pathogens or SA and is commonly used as a marker for SAR, since their discovery in 1970. Bertini et al. (2009) presented the first report correlating anifungal and ribonuclease activities of PR-4 protein in the case of wheat. A PR-5 protein was supposed to create transmembrane pores and therefore was called permatine. Some members of this family were shown to possess antifungal activity, particularly against oomicets. Chitinases can hydrolyze bacterial peptidoglucans activating as lysozyme. Microbial proteinases involved in pathogenesis are completely inhibited by an inhibitor of proteinases of tobacco. PR-6 group are inhibitors of proteinases involved in defense against insects, microorganisms and nematodes. PR-7 has been characterized in tomatoes and acts as an endoproteinase. PR-9 is a family of peroxidases that function at the cell walls level by catalyzing lignin deposition in response to microbial attack.

PR-10 family proteins have similar ribonucleases sequences and are the only family which consists of cytoplasmic proteins. After Pühringer et al. (1998), PR-10 protein belonging to this class with many similarities are encoded by multiple genes (genes *Ypr10*) acting at different stages of development and response to microbial attack, fungal elicitors, mechanical injury and stress. Fernandes et al. (2008) described the structure of a complex between a classic PR-10 protein (yellow lupine LIPR-10.2 B) and the plant hormone, trans-zeatin, suggesting that this protein and probably other PR-10 protein acts as a reservoir of cytokinin molecules in the aqueous environment of the cell. Pulla et al. (2010) isolated and cloned *PgPR10-2* from 14-year –olg of ginseng (*Panax ginseng*). Its expression was especially abundant in roots and its transcripts showed differentially upregulated patterns against several given pathogens and abiotic stimuli. Observed enhanced ribonuclease activity and antifungal activity from tobacco transgenic lines suggest that the possible involvement of PgPR10-2 in defense-related mechanism via ribonuclease activity against biotic and abiotic stresses.

Poupard et al. (2003) have characterized a PR-10 gene subclass from apple, subclass called *Apa*, genes which were induced in leaves by abiotic stimuli, such as ethephon, injury, and by inoculation with an avirulent and a virulent race of the fungus *Venturia inaequalis*. It was noticed an early activation of *Apa* transcription when compatibility exist than incompatibility, but at higher levels in the latter case. In the case of both interactions it was detected polypeptide band PR-10 (18 kDa), while another band (17 kDa) was revealed only after a virulent race infection and gene expression products of *Apa* after infection with avirulent race was simultaneously with manifestation of resistance symptoms. Expression of two *Apa* subclass genes was observed (*Ypr10* Md.b* and *Ypr10* Md.d*), both transcriptional activated by ethephon or *V. inaequalis* race avirulent infection. After treatment with an analogue of salicylic acid it was induced only *Ypr10 * Md.d.*, suggesting that at least one pathway involving ethylene is activated in the case of incompatibility.

On the other hand (Zhang et.al., 2010) pointed out that PR genes have a distinctive pattern of expression in *Malus hupehensis*, in contrast with the *Arabidopsis*, tobacco and rice. It was surprised that *MhPR1*, *MhPR5* and *MhPR8* expression enhanced in response to SA, MeJa and ACC in leaves, stems and roots. Thus, these results indicated that more than one single signal pathway regulated one member of the PR genes together and a signal pathway could regulate some members of the PR genes at the same time. Signal pathway of resistance to pathogen of woody fruit trees is different from herbage plants.

A disease resistance protein (R) detects the presence of causative agent (bacteria, fungi, or viruses) by recognizing specific pathogen effectors molecules, molecules that are produced during the infection process (Martin et. al, 2003). Eugelme et al. (2004) indicated that plant resistance to diseases caused by microorganisms, by means of resistance genes is mediated through separate pathways regulating gene. Comparing the expression profiles of approximately 8,000 genes in *Arabidopsis* by activation of three *RPP* genes, directed against the pathogen *Peronospora parasitica* it was found that all three pathways may be converging, allowing activation of common sets of target genes. Recent genetic studies have pointed out that factors TAG (a conserved family of bZIPs) plays a key role in defense response by binding the promoter region of genes defense s, inclusive expression. Salicylic acid (SA) induces the expression of the gene encoding NIMIN-1 (an SA-induced gene from *Arabidopsis*), which interacts with NPR1/NIM1 (an intermediate cytosolic protein, which in its monomeric form migrates to the nucleus), a key regulator of systemic acquired resistance and Fonseca et al., (2010), clarified some intimately aspects using transgenic *Arabidopsis* plants.

During grapes fruit ripening there was emphasised that in grape pulp and epicarp there are accumulated PR proteins as thaumatine type (GO) and a chitinase (CHV5) at levels exceeding at least 10 times the existing level in species leaves or green fruits. It was determined that in vitro; these substances totally inhibit germination of *Botrytis cinerea* conidia, the effect being potentates by high glucose content of mature fruit. Surprising is that these results are in contradiction to what was observed under field conditions and in this context it was investigated the possibility that the grape PR proteins to be degraded to levels compatible with the development of the fungus. Moreover, there were detected virulence factors of the fungus, as soon as the first visible symptoms appeared, and among these factors, protease poligalacturonase and lacaze, as well as acid proteases appear to be secreted first, preceding any detectable degradation of PR proteins. Recently, stilbene phytoalexins were identified as defense response in pathogen–grapevine interactions, but little information is available on the role of stilbenes on *Erysiphe necator*, causal agent of grapevine powdery mildew (Schnee et al., 2008).

PR hydrolytic proteins as chitinaze type and β-1 ,3-glucanase have been much studied in transgenic plants and Broglie et al. (1991) showed that expression of chitinaze of rape and tobacco seed might reduce susceptibility to fungus *Rhizoctonia solani*.

Research performed by Fossdal et al. (2005) to spruce (*Picea abies* L. Karst.) 33 years old, in relation to wounding and colonization by *Heterobasidion annosum* led to the conclusion that host chitinases isoforms increased more during the first 7 days after injury and inoculation, following an expanding more along the lesion in the resistant clone, than in the sensible one. Tissue cultures of both clones induced increase chitinase isoforms during 6-24 hours after inoculation, which showed increased chitinase expression in response to pathogen, as a component of general defense response, both in mature clones and for tissue cultures.

In addition to PR proteins as transgenic resistance factors there were evaluated also other peptides and proteins with antimicrobial activity (Kazan et al., 2002) or peptides of animal origin, such as gene expression of sarcotoxin in transgenic tobacco (Mitsuhara et al., 2000). Moreover, even synthetic peptides have been shown to confer improved resistance to plant pathogenic bacteria or fungi (Osusky et al., 2000).

Cameron et al. (1999) studied the relationship between the accumulation of salicylic acid, PR-1 gene expression and degree of systemic acquired resistance (SAR) in *Arabidopsis* plants, comparing the response of wild ecotype Columbia (Col-0) and two mutants defective in HR response (*rps2-201* and *rps2-101C*) during the SAR response induced *Psudomonas syringae* pv. *tomato* (Pst) non-virulent. PR-1 expression was reduced in mutants *rps,* compared with wild type and SA accumulated to similar levels for Col-0 and alleles mutants *rps2*. SA accumulation ability was not predictive of ability of SAR elicit and SA accumulation alone is not sufficient for the SAR response.

However, expression of PR-1 family member in pear plants treated with *benzothiadiazole* (BTH) (known as SAR inducer) and salicylic acid, then inoculated with *E. amylovora* was found to be constitutive and unaffected by treatment. It therefore suggests that molecules, other than PR-1 may be important in the induction of systemic resistance induced by BTH, at pear, against the bacteria *E. amylovora* (Sparta et al., 2004). Benzothiadiazole was also tested in relation to the induction of SAR in apple rootstock M26 (very sensitive), in relation to *Erwinia amylovora* in greenhouse under controlled conditions (Bays et al., 2002). As a marker of resistance to physiological studies it was estimated peroxidase activity (PO) and as a component of the antioxidative protection system, glutathione-S-transferase (GST). Pre-inoculation application of BHT, every two days on M26 rootstock leaves reduced disease severity, also decreased the growth of bacteria in plant tissue. Reducing disease severity was correlated with decreased effects on the growth of bacteria up to 51% during infection. Also, at 28 and 168 hours after BHT application it has been a marked increase of PO and GST activity. It can be considered that this may be an indicator of induced resistance (IR) in plants protected with BHT. Sklodowska et al. (2010) noticed that BTH (an active compound of the commercial preparation Bion) studied as an elicitor of resistance to fire blight (*Erwinia amylovora*) mediated antioxidant system responses in apple leaf tissue, also.

Gel-electrophoresis comparative studies of leaves of resistant and susceptible *Pinus strobus*, to *Cronartium ribicola*, as regard as the characterization of the HR response emphasised the presence of 19 specific polypeptides at the resistant seedlings and 7 of these specific to infected resistant seedlings. It was registered an increase of about three times of 13 polypeptides in the resistant family P327, compared with leaf tissue of susceptible seedlings or where the inoculation was mimed. Detailed analysis showed that six proteins were found to be homologues of proteins with known role in disease resistance, five were found to be homologues of superfamily members leucine rich (LRR) and one a homologous of 90 protein (heat shock protein) that is a cofactor of the LRR family, with functional counterparts in *Pinus strobus* and molecular basis for resistance to rust (Smith et al., 2006).

Different signal pathways of SAR and ISR seem complementary, so high levels of protection are achieved by combining induction by a necrotrof pathogen on leaves and a non-pathogenic rhizobacteria on roots, without PR gene expression associated with SAR to be stimulated. SAR is dependent on accumulation of salicylic acid but not by jasmonic acid or ethylene. ISR requires jasmonic acid and ethylene perception, but is not associated with a significant increase of these compounds levels. Interesting data were also presented by Vleeshonwers et al. (2000), after their studies on the interaction between *Phytophthora infestans* (Mont.) Bary and a set of some wild *Solanum* species and varieties of potato (*S. tuberosum* L.) with different degrees of resistance. For wild species, for varieties known as possessor of resistance genes and that non-host, the main defense response was the hypersensitive response. In species with total resistance and non-host, HR response was rapidly being achieved in 22 hours, meaning the 1-3 cell death. In partially resistant clones, HR was induced within 16-46 hours and consisted in the death of five or more cells, demonstrating the quantitative nature of resistance to *P. infestans*.

Other defense-related responses were ***calose deposition and extracellular globules*** that contained phenolic compounds, which have been stored around cells that have expressed HR. Furthermore, studies on cucumber hypocotyls (*Cucumis sativus* L.) subject to infection with *Colletotrichum lagenarium*, either by raising seedlings in the presence of dicloroizonicotinic acid (DCIA) or cut segments pre-incubation with DCIA, salicylic acid (SA) or acid-5-clorosalicilic (5CSA) demonstrated induction of resistance (Siegrist et al., 1994). Resistance was mainly explained by inhibition of the fungus penetrate the epidermal cells, and fungus resistant hypocotyls induced an increase in deposit phenols (visualized by auto fluorescence), located mainly around the cell walls of epidermal papillae, as aspersoria. There have been quantified as polymers like lignines, or 4-OH-benzaldehyde, 4-OH-benzoic acid or 4 - cumaric acid. Pretreatment also induced a slight activation of chitinase.

Phenolic phytoalexins secreted by wounded or otherwise perturbed plants, repel or kill many microorganisms, and some pathogens can counteract or nullify these defense s or even subvert them to their own advantage. Bhattacharya et al. (2010) emphasized the roles of phenolics in the interactions of plants with *Agrobacterium* and *Rhizobium*.

Treatment of susceptible barley (*Hordeum vulgare*) to the fungus *Erysiphe graminis* f.sp. *hordei* with 2.6 dicloroizonicotinic acid (DCINA) induced disease resistance (Kogel et al., 1994). Cytological analysis revealed the reaction of interaction of hypersensitive cell collapse in attacked epidermal cells, transcription levels correlated with increased accumulation of protein coding genes and chitinase PR-1, but not β-1 ,3-glucanase.

Studies on the influence of pathogens on the content of salicylic acid of the lignified shoots of raspberry (*Rubus ideus* L.) showed that infection with the fungus *D. applanata* determined a doubling of the concentration of SA in distal areas of the inoculation point (around and between lesions), at the resistant variety - Latham. There were not produced the same changes at susceptible plants (M. Promise), which demonstrates SA participation in the defense response of woody plants to biotic stress (Bandurska et al., 2003).

In the interaction between *Arabidopsis thaliana* and *Pseudomonas* spp, rhizobacteria induced systemic acquired resistance independent of salicylic acid, but required the response to other host plant hormones, as for instance jasmonic acid and ethylene. *P. fluorescens* showed a great capacity to transform the ethylene precursor (1 - aminociclopropan 1 - carboxylic acid) to ethylene (Hase et al., 2003). Also, gene expression *OsPI-PLC1* (fosfoinozitid-specific phospholipase) may be involved in the signal pathways that induce resistance in rice (*Oryza sativa* L.) for disease caused by *Magnaporthe grisea*. The expression of this gene was induced by various chemical and biological inducers, including BHT, SA, probenazole (PBZ), jasmonic acid (JA) and methyl esters (Song and Goodman, 2002).

The hipersensitive response has been shown to be induced in non-host plants by *harpin*, a bacterial elicitor (a protein nature). In this context, to plant diseases control with this elicitor it was cloned gene ($hrpz_{pss}$) which encodes harpin of *Psudomonas syringae* pv. *syringae* (race LOB2-1, the causative agent of disease in bat) (Takakura et al., 2004). Research performed by Peng et al. (2003) showed that spraying with harpin, which induces hypersensitive cell death (HCD) developed SAR resistance without macroscopic necrosis, mentioning that sometimes HCD accompanies the development of resistance conferred by resistance genes (R) in *Arabidopsis*. Induction of resistance by harpin seems to develop simultaneously with cell death and resistance requires *NDR1* and *EDS1*, signal components for the functioning of R genes. Liang et al. (2009) demonstrated the importance of the applied methods of recombinant HarpinZ *Pseudomonas syringae* pv.*tomato* (rHrpZ) on tobacco to improve its bioavailability. Chen et al. (2008) emphasized a novel probe of harpin receptor in nonhost plants.

Also, in the case of infiltration with *Psudomonas syringae* pv. *tabaci*, or *Agrobacterium tumefaciens* of beet leaf (*Beta vulgaris*) (Sepulveda-Jimenez et al., 2004) it was induced betacyanine synthesis (knowing that roots accumulates mainly betanine), in leaf area affected by *P . syringae*, which demonstrates the hypersensitive response. Infiltration with *A. tumefaciens* did not induced the HR response, but it was elicited production of reactive oxygen species (ROS) before being induced betacyanine synthesis, that otherwise accumulated in the uniformly at the infiltration area. It is assumed that ROS are signals that induce betacyanine synthesis, and this in turn can lead to limit the damage caused by infiltration of the bacteria.

Borden and Higgins (2002) confirmed the crucial role of ROS in limiting plant colonization by fungi, as signal molecules for defense response. Regarding the formation of *reactive oxygen species*, there are other opinions, such as those expressed by Christopher-Kozjan and Heath (2003) after cytological and pharmacological studies on the hypersensitivity reaction. From the cytological point of view, authors revealed that the epidermal cells undergo hypersensitive response due to penetration of fungi (which produce rust or mildew) that have been done by two types of events: - in non-host cells, cell death process ends in at least one hour and trans-vacuolar filings remain initially visible after the cytoplasm currents stop; in resistant host cells, trans-vacuolar filings disappear with the cytoplasm current ending and cell death ends after an hour or longer.

The effects of riboflavin on defense responses and secondary metabolism in tobacco (*Nicotiana tabacum* cv. NC89) cell suspensions and the effects of protecting tobacco seedlings against *Phytophthora parasitica* var. *nicotianae* and *Ralstonia solanacearum* were investigated by Liu et.al (2010). Defense responses elicited by riboflavin in tobacco cells included an oxidative burst, alkalinization of the extracellular medium, expression of 4 defense-related genes with different kinetics and intensities, and accumulation of 2 total phenolic compounds, scopoletin and lignin. When applied to tobacco plants challenged by *P. parasitica* and *R. solanacearum*, riboflavin treatment resulted in 47.9% and 48.0% protection, respectively.

Pharmacological studies have suggested that the host and non host cell death required an influx of extracellular calcium, protein kinase activity and protein synthesis, but has not generated extra cellular reactive oxygen species. For instance, calcium influx is required for the initiation of the hypersensitive of *Triticum aestivum* to *Puccinia recondida* f.sp. *tritici* as Liu and al. (2010) demonstrated, comparing the changes of calcium localization in resistant and susceptible upon leaf rust infection. The obtained results shown that the main difference between resistant and susceptible wheat is the response time (after the recognition of the leaf rust). Host cells that respond faster to an invading pathogen is in close correlation with the leaf rust-induced cell death, but a delay in response to an attacking pathogen would lead to its infection.

Musette et al. (2004), followings of biochemical and ultrastructural studies of the apple infected by apple fitoplasma proliferation (APP), referring to the location of hydrogen peroxide, the role of peroxidase, malondialdehyde and reduced glutathione, on three varieties of apple, stated the following: at the restored trees, disease symptoms and pathogen disappeared from the plantation, but fitoplasma remained in the roots; cytochemical H_2O_2 was detected by its reaction to produce electron dense deposits, being found in phloem cells plasmalemma of leaves of the restored trees, but not in the healthy or affected by APP; in all varieties, peroxidase activity in tissues affected by the APA was greater than or equal to that of the reconstructed tissue, which in turn equaled or exceeded that of healthy trees. In contrast, the glutathione content of leaves decreased in reverse order. In the restored trees leaves it was observed a greater amount of malondialdehyde (MDA) than in the healthy or affected by APP, at three varieties, in relation to the date of determination, while on the other three varieties, the content was not significantly different at the healthy, damaged or rebuilt leaves. No significant differences were observed in the MDA content in leaves of healthy, restored and infected with APP, if the same variety, taken in May. The greatest differences were recorded in September, when on all varieties there were determined higher levels of MDA in restored leaves, compared with APP-asymptomatic or healthy leaves, the differences being significant for two of the three varieties. The results suggest that some oxidative systems from the rebuilt leaves are not very active, which allows overproduction of H_2O_2 and probably lipid peroxidation.

In conclusion, **recent advances in plant immunity research have provided exciting new insights into the underlying defense signalling and induced resistance.**

Hormones play a central role in the regulation of this network. There is a cross communication of their signalling pathways in an antagonistic or synergic manner, providing the plant with a powerful capacity to finally regulate its immune response. On the other hand, pathogen can manipulate the plant's defense signalling network for its own benefit by affecting phytohormone homeostasis to antagonize the host immunity response (Pieterse et al., 2009).

Induced resistance has the potential to revolutionize disease control in crops.

Agriculture is changing as are public expectations of, and attitudes towards agriculture. There is an increasing concern for the environment and as a result a desire to reduce pesticide use. By understanding the pathways activated and resistance mechanisms triggered by different agents, it should be possible to use cocktails of elicitors to provide effective and reliable protection (Walters, 2010). As Allwood et al. (2010) recently proposed, studying the metabolic profile of the separated host and pathogen ("dual metabolomics') can be a study system. This conclusion is based on results obtained using one of the most well characterised plant pathogenic interaction involving *Arabidopsis thaliana* and the bacteria *Pseudomonas syringae* pathovar *tomato*. Fourier transform infrared (FT-IR) spectroscopy was employed to assess the intracellular metabolomes (metabolic fingerprints) of both host and pathogen and their extruded metabolites (metabolic footprints) under conditions relevant to disease and resistance. Moreover, Yin et al. (2010) presented a synthesis as regard as oligochitosan, prepared from chitosan (one of the most abundant carbohydrates biopolymers in the world), a potent plant immunity regulator and its mode of action on plant is similar with general vaccines act on human and animal. Oligochitosan is a plant disease vaccine.

However, information on the application of priming in the fields is limited and thus its potential in food production is largely unknown. In this context, Capanoglu (2010) presented a synthesis concerning the potential of priming in food production based on the literature data and the effect of stress on the content of antioxidative compounds in fruits and vegetables. He claimed that conversion of a supposedly "negative" stimulus (the stress factor) to plants, fruits or vegetables can be converted to a positive attribute, which is enhanced content of health beneficial compound by priming. Clear proof for the potential of priming in food quality enhancement and exploitation of priming in commercial plant production will be a signalling significantly step forward in food science and industry.

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Pest insects in early cabbage in Băneasa – Giurgiu

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Keywords: cabbage, pests, damages, integrated control

ABSTRACT

Cabbage is one of the oldest plant cultures that has a significant share in our nutrition and in the range grown in our country. The staggered cabbage crops develop and grow on early summer or autumn and usually only in a protected area. In the early crop, the green area Baneasa is full of pest invasion: *Phyllotreta atra*, *Delia brassicae*, *Mamestra brassicae*, *Pieris brassicae brassicae* and *Brevicoryne brassicae*, the losses are huge and they are called *Delia brassicae* and larva of lepidopteres.

INTRODUCTION

Cabbage is one of the oldest plant crops that has a significant nutrition role and it is important in the range grown in our country. The staggered cabbage crops develop in early summer or autumn and in a protected area.

Cabbage is one of the oldest crop plants which holds a great weight in our diet and in our country's variety of plants tilled. The echaloned cabbage consume is provided by the early crops, of summer or of autumn, as well as the crops grown in protected areas (Ciofu Ruxandra end al., 2004). It is an important vegetable from the diet point of view because it contains a high amount of carbonate hydrates, mineral salts (Na, K, Mg, Fe, P, S, Ca), vitamins (A, B2, B6, PP, C) and nitrous substances.

Obtaining large yields and also high quality is possible only through healthy crops, well mentained. The main pests from the early cabbage crop are: mole cricket (*Gryllotalpa gryllotalpa*), the garden slug – (*Deroceras agreste*), the grey louse of cabbage (*Brevicoryne brassicae*), the black hopper of cabbage (*Phyllotreta atra),* the red bedbug of cabbage (*Eurydema ornata*), cabbage fly (*Delia brassicae),* the white buterfly of cabbage (*Pieris brassicae*), cabbage moth (*Mamestra brassicae*)(Paşol P. end al., 2007).

MATERIAL AND METHODS

The research method's purpose was to identify the main pests which can be frequently seen in the early cabbage crop, in Băneasa – Giurgiu area and their integrated control, through a series of methods, in order to avoid or reduce the attack's intensity.

The pests' attack can't be diminished only by using a superior agrotechnique, because certain treatments are also needed to be applied. These treatments must include plant protection products, because, in our days, they have proved to be the most efficient if we want to obtain large productions, worthwhile our effort and costs.

The integrated control scheme (table 1) was made for the following pests: cabbage hoppers (*Phylottreta atra* F.), cabbage fly (*Delia brassicae* Bche)*,* cabbage moth (*Mamestra brassicae* L.), the white butterfly of cabbage (*Pieris brassicae* L.) and the grey louse of cabbage (*Brevicoryne brassicae* L.).

In this struggle against pests, in the case of the cabbage fly and cabbage moth the warning method was used. It consists of collecting biological material pupa) in autumn and disposing them on the field in warning cages .The cages with the collected material were left to spend the winter in natural conditions on the field, buried under the ground at a 8-12cm depth, remaining uncovered only 3-5cm above the soil.

In spring, starting with April, observations were made in order to establish the correct time when the cabbage fly's adults appeared (*Delia brassicae* Bche.) and their flight.

For the cabbage moth (*Mamestra brassicae* L.) pest control, the same method was used. The integrated control was made daily, from the beginning of may until the first butterflies appeared.

RESULTS AND DISCUSSION

From the observations made, the cabbage fly's attack can be seen, which produced damages of 60% at the ***untreated*** variants, in 2008 -2009 study years. The attack proved to be significant and quite high, because in comparison with the attack produced by the other pests, where quality is depreciated and the final products' quantity is reduced, here, the plants attacked by this pest's larva whither completely, and nothing can be saved.

The best results were obtained when the pest control in the early cabbage crop was made preventive, meaning on **v*ariant 1.***

On variant 1 for controlling the cabbage fly adults (*Delia brassicae* Bche.) the first treatments were made at 2-3 days after the first adults' appearance with Sinoratox Plus 0,2%. The next treatment was applied at the adults' mass appearance, (at one week after the first one) using Novadim Progress 1,5l/ha.

To control pests such as lepidopteras (cabbage moth and the white butterfly of cabbage) on the first treatment, we used Decis 2,5 CE 0,04%, at 2-3 days from the adults' appearance and on the second treatment at the mass appearance of the adults, Talstar 10 EC 0,04%.

To control pests such as hoppers and cabbage louse, chimical treatments were applyed when the pests' density exceeded PED (the economical damage border).

The black hopper (*Phyllotreta atra* F.) was destroyed with Polytrin 200 EC 0,1l/ha.

To control the grey louse adults (*Brevicoryne brassicae* L.) we used Fastac 10 EC 0,02%.

On variant 2 the chimical treatments were made this way:

For the cabbage fly (*Delia brassicae* Bche.) at the mass appearance of the adults we administrated Novadim Progress 1,5l/ha;

For the lepidoptera larvas (cabbage moth and the cabbage's white butterfly) at 2-3 days after the appearance of the first larvas,we used Decis 2,5 CE 0,04%;

For the black hopper (*Phyllotreta atra* F.) we used Karate 2,5 EC 0,3 l/ha;

For the grey louse (*Brevicoyne brassicae* L.) we used Mospilan 20 SG 0,0125%.

On Variant 3 there weren't applyed any chimical treatments, these remaining untreated plants.

CONCLUSIONS

In the early cabbage crop from Băneasa Giurgiu area, the same pests are noticed annually: the black hopper of cabbage (*Phyllotreta atra* F.); cabbage fly (*Delia brassicae* Bche.); cabbage moth_(*Mamestra brassicae* L.); the white butterfly of cabbage (*Pieris brassicae* L.) and the grey louse (*Brevicoryne brassicae* L.), but the biggest damages are made by the cabbage fly and lepidoptera larvas.

The damages made by this pest vary from year to year, this way:

1. In the rainy years, when the early cabbage tilling is done later, in the optimal period, this aspect makes the pests' attack favourable, which, due to the weather and the warmth, will start their activity sooner.
2. On early cabbage, to avoid and reduce the pests' attack, it is recommended to till a strong seedling, in nutrient cubes.
3. When the tilling was done early and with a strong seedling, the cabbage fly's attack will be reduced with up to 90%, because the plants have their stalk lignified during the attack, so the larvas can't intrude inside the root.

4. The best results were obtained when preventive pest control systems were made, against cabbage fly *Delia brassicae* Bche.) and lepidopteras.

5. The products with the highest efficiency in pest control from the cabbage crop were:

- For destroying the lepidopteras: Talstar 10 EC 0,04 % and Decis 2,5 CE 0,04%;
- For the cabbage fly, the best results were obtained with Sinoratox Plus 0,2% (which was off the market on 31.I.2009) and Novadim Progress 1,5l/ha.

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TABLE

Table 1

The variants used in the integrated control of the main pests in the cabbage crop-Giurgiu

Var.	Used product	Concentration (%) dose	Pest species	Application moment
V1	Sinoratox Plus	0,2%	*Delia brassicae*	2-3 days, from the adults appearance
	Novadim Progress	1,5l/ha	*Delia brassicae*	At the adults' mass appearance
	Decis 2,5 EC	0,04%	*Mamestra brassicae Pieris brassicae brassicae*	2-3 days, from the adults appearance
	Talstar 10 EC	0,04%.	*Mamestra brassicae*	At the adults' mass appearance
	Polytrin 200 EC	0,1l/ha.	*Phyllotreta atra*	At the adults' appearance
	Fastac 10 EC	0,02%.	*Brevicoryne brassicae*	At the appearance of the first colonies
V2	Novadim Progress	1,5l/ha	*Delia brassicae*	At the adults' mass appearance
	Decis 2,5 EC		*Mamestra brassicae Pieris brassicae brassicae*	2-3 days, from the appearance of the first larvas
	Karate 2,5 EC	0,3 l /ha	*Phyllotreta atra*	At the adults' appearance
	Mospilan 20 SG	0,0125%.	*Brevicoryne brassicae*	At the appearance of the first colonies
V3	Untreated			

Biotechnique methods attract & kill to control moth pests in Romanian orchards and vineyards

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Keywords: pheromones, *Attract & Kill*, codling moth, summer fruit tortrix moth, grapevine moth

ABSTRACT

This paper presents the results from studies carried out during 2006-2009 in different Romanian apple orchards and vineyards to control codling moth (*Cydia pomonella*), summer fruit tortrix moth (*Adoxophyes reticulana*) and grapevine moth (*Lobesia botrana*) by *Attract & Kill* biotechnique. Romanian products which consist of specific pheromones of the pests and a piretroid, developed by Research Institute for Chemistry "Raluca Ripan" Cluj-Napoca, were used. The formulations were applied by hand, twice in the season – first time just after noticing first moths in pheromone traps and the second one about 6 weeks later. Males contacting a drop die within a few hours, reducing the reproduction and the level of populations.

The results showed good efficacy of the products formulated for *Attract & Kill* method with the percents ranging: 73.9-90.8% for codling moth, 84.6-91.8% for summer fruit tortrix moth, 73.0-89.4% for grapevine moth.

This strategy can be recommended in small orchards or vineyards where it can be applied by hand.

INTRODUCTION

The codling moth (CM) (*Cydia pomonella* L.), the summer fruit tortrix moth (SFTM) (*Adoxophyes reticulana* Hb.) and the grapevine moth (GvM) (*Lobesia botrana* D&S) (Lepidoptera: Tortricidae) are major pests of the apple orchards and of the vineyards respectively, in Romania. Currently, these pests are controlled by conventional spray applications. The development of the resistance to insecticides and the necessity of the environment protection were a reason to develop new control strategies to control these pests.

The *Attract & Kill* method was a new approach using sex pheromones and insecticides against pests, studied many years ago (Charmillot et al., 1996, 1997, 1998, 2000; Dickler et al., 1998; Lösel et al., 1998; Trematerra et al., 1999) or more recently (Alma et al., 2001; Angeli et al., 2000, 2003; Barić and Ciglar, 2003; Ebbinghaus et al., 2001; Lösel et al., 2000, 2002; Puciennik et al., 2002, 2004, 2006; Stará and Kocourek, 2004, Charmillot and al. 2005). *Attract & kill* technique, involving the combination of the pheromone with an insecticide, is very useful for integrated management because it attracts only the targeted pests without harming beneficial organisms.

The aim of the work described in this paper was to investigate the efficacy of Romanian products, synthesised by Research Institute for Chemistry "Raluca Ripan" Cluj-Napoca. The results of four years studies are presented.

The studies carried out in two national partnership projects during 2006-2009, have been show good results in Romania and some papers present partial data (Drosu and al., 2008, 2010; Cazacu and al., 2009).

MATERIALS AND METHODS

The products MESAJ CP, MESAJ AR and PRELUDIU LB, obtained by Research Institute for Chemistry "Raluca Ripan" Cluj-Napoca and consisted into a mixture between the specific codling moth, summer fruit tortrix moth, respectively grapevine moth pheromone and a pyrethroid, included into a paste, were used. This mixture was applied manually with a special applicator ranging the drops uniformly per hectare per application (400g) dispensed on the apple tree branches at approximately 1.5 m high or on the branches of the vines.

The first application was done when the first moths were detected in the pheromone traps (second week of May) and the second application was done about six weeks later (end of June to begin of July).

The experiments to evaluate the efficacy of MESAJ CP in controlling the CM (*Cydia pomonella*) were carried out into apple orchard situated in the centre of the country (Research Development Institute for Fruit Growing, RDIFG Pitești-Mărăcineni) and another near Bucharest (Research Development Institute for Plant Protection, RDIPP).

The field trials with MESAJ AR, containing SFTM (*Adoxophyes reticulana*) pheromone, used in *Attract and Kill* method carried out in 2008-2009 in 3 locations: apple orchard from RDIPP Bucharest, RDIFG Pitești-Mărăcineni and RDSFG Voinești-Dâmbovița, where were noted high level of attack (30-40%) of the SFTM, in the previous years.

For the GvM (*Lobesia botrana*) the studies were done in 2006-2007, with PRELUDIU LB, at Research Development Institute for Viticulture, RDIV, Valea Călugărească, in 3 sites.

Each surface of the experiences was divided into 3 sections. In the first, the *Attract & Kill* treatment was applied on about 0.5 ha; the second variant was the commercial treatment (standard); several trees or vines without treatment against target pests constituted the third section (untreated) for each location. In the second variant (standard) the treatments with the registered insecticides at the warning moment were applied.

The efficacy estimation of the products used in *Attract & Kill* treatments was made by the following: (i) pheromone traps to monitor the flight activity in those 3 variants; the catches of the target pest males were checked weekly and sticky inserts were changed in case of need; (ii) the observation on the eggs lying after the pick of the first flight; (iii) paper belt traps to monitor the population density; it were distributed 10 traps in random pattern on both treated and untreated plots; (iv) evaluation of the fruit injury on treated as well as on untreated plots; this assessment was done after the flight of the first generation and at harvest time, sampling 1000 fruits taken at random from 50 trees for the codling moth and summer fruit tortrix moth or checking 400 blossoms for the 1st generation and 400 grapes for the 2nd and 3rd generations from 50 vines for the grapes.

The biological efficacy of the products was calculated by Abbot Formula $E= (1-x/y)*100$, where x is attack level at treated variant and y is attack level at untreated variant.

RESULTS AND DISCUSSIONS

The results on the efficacy estimation of the products used in *Attract & Kill* method are presented below.

(i) <u>Pheromone traps monitoring the flight of the species studied</u>

Table 1 presents the situation of the catches of CM in the pheromone traps, showing that the treatment with MESAJ CP reduced considerably the number of CM males caught in pheromone traps, meaning the population of the pest. At RDIPP Bucharest it was caught 0.3-1.6 males/trap in *Attract & Kill* variant, 15.6-42.3 males/trap at standard and 52.0-96.3 males/traps at untreated variant respectively. At RDIFG Pitesti-Mărăcineni it was caught 1.0-2.2 males/trap in *Attract & Kill,* comparatively with 31.5-36.7 males/trap at standard and 89.7-94.3 males/traps at untreated.

Table 2 shows the situation of the catches of SFTM in the pheromone traps; at RDIPP Bucharest no catches means lack of the pest, demonstrated by lack of attack on leaves and fruit; at RDIFG Pitesti-Mărăcineni was low level of attack corresponding at 4.3-13.0 males/trap in untreated plot, 1.6-2.6 males/trap in standard variant and 0-0.3 males/trap in *Attract & Kill* variant; at RDSFG Voinești-Dâmbovița the level of attack in the previous years was high and the catches reflect this situation: 0.3-3.6 males/trap in *Attract & Kill,* comparatively with 3.6-26.0 males/trap at standard and 15.3-61.0 males/traps at untreated; the treatment with MESAJ AR reduced the number of SFTM males caught in pheromone traps.

Table 3 presents the situation of the catches of grape vine moth in the pheromone traps. In those 3 locations was recorded 0.3-13.2 males/trap in *Attract & Kill* variant comparatively with 13.6-68.5 males/trap at standard and 94.3-193.8 males/traps at untreated. The treatment with PRELUDIU LB reduced considerably the number of GvM males caught in pheromone traps, meaning the population of the pest.

It can be observed that *Attract & kill* variant recorded a low number of the catches; that means there is a low copulation activity. The combination pheromone-insecticide has a contact action; males are attracted by pheromone and are killed by the insecticide within hours.

(ii) <u>The observation on the eggs lying after the pick of the first flight</u>

Table 4 presents the situation of the number of the *Cydia pomonella* eggs lying, at RDIPP Bucharest; table 5 presents the situation of the number of the *Adoxophyes reticulana* egg masses lying, at RDSFG Voinesti-Dambovita. The results show absence or low mating activity in the *Attract & Kill* variant (0-2 CM eggs and 0 SFTM egg masses lying), compared with those untreated (97-131 CM eggs lying and 6-13 SFTM egg masses lying); that mean good efficacy of the product, compared with untreated variant.

(iii) <u>Paper belt traps to monitor the population density</u>

The number of CM larvae in paper belt traps at RDIPP Bucharest (Table 6) shows that the population density of the pest in the untreated plots was higher than in the treated one, so the product was efficient. In the plots treated by MESAJ CP the population density was considerably reduced (8.5 and 5.8 larvae/tree in 2007 and 2008 respectively) in comparison with the untreated plots (24.6 and 35.8 larvae/tree).

(iv) <u>Evaluation of the fruit injury</u>

The table 7 and the figure 1 show the efficacy of the product MESAJ CP controlling CM in the apple orchards in 2006-2009. The efficacy of *Attract & kill* method was between 73.9% and 90.8%, comparable with those recorded at standard (72.1%-89.4%), the attack level (fig.1) being in those orchards 2.1-10.2% at treated variant and 12.9-85.1% at RDIPP Bucharest, even more (94.4%) at RDIFG Piteşti-Mărăcineni in untreated plots. The high values of the codling moth attack level at the untreated variants show the high density of the populations that had influenced the efficacy of the treatment.

The results on efficacy of the product MESAJ AR controlling SFTM are presented in table 8 and figure 2. The first generation attack level was evaluated on leaves, the fruit injuries being sporadically in this period; for the second generation the fruit attack level at harvest was evaluated and the efficacy of *Attract & kill* method was between 84.6% and 91.8% comparable with standard treatments where was 76.3-88.8%. The attack level (fig.2) ranged between 0.3-3.3% at treated variant and 3.5-27,1% at untreated variant.

For the GvM control with PRELUDIU LB using *Attract & kill* method the results are presented in table 9 and figure 3. The efficacy in those 3 sites with different densities of the populations (attack level at untreated variant ranged between 3.4-13.4%) was 73.0-89.4% at treated variant and 61.2-93.0% at standard.

The results of the studies presented in this paper confirm those of the authors from different countries. The literature, based on the results obtained during many years on the large surfaces, shows that the *Attract & kill* technique and the products used have reduced the attack level of the target pests (Angeli and al. 2000, Alma and al. 2001, Charmillot and al.

2005, Ebbinghaus and al. 2001, Pluciennik and Olszak 2006). The conclusion is that it can recommend this method due to the specificity of the sex-pheromones employed that ensures that only the target specie is affected, avoiding deleterious effects on beneficial and other non-target organisms, thus being a safety method for humans and environment.

CONCLUSIONS

- *Attract & kill* technique, involving the combination of the pheromone with an insecticide, is very useful for integrated management because it attracts only the targeted pests without harming beneficial organisms;
- Romanian products to control important pests by *Attract & kill* technique were used in 4 year studies (2006-2009);
- MESAJ CP controlling codling moth (*Cydia pomonella*) presented efficacy ranged between 73.9-90.8% in apple orchards;
- MESAJ AR controlling summer fruit tortrix moth (*Adoxophyes reticulana*) in apple orchards, registred efficacy between 84.6-91.8%;
- PRELUDIU LB controlling grapevine moth (*Lobesia botrana*) in vineyards, has 73.0-89.4% efficacy;
- The presented results were comparable with those at commercial standard treatments, having in the same time safety benefits for humans and environment;
- The method *Attract & kill* can be recommended in small orchards and vineyards where the manual application is possible.

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TABLES AND FIGURES

Table 1

The situation of the catches of codling moth in the pheromone traps

Year	Mean capture numbers/variant					
	RDIPP Bucharest			RDIFG Pitesti-Maracineni		
	Attract & Kill	Standard	Untreated	*Attract & Kill*	Standard	Untreated
2006	1.0	42.3	96.3	1.0	37.6	89.7
2007	1.6	34.3	88.2	2.2	31.5	94.3
2008	0.3	22.7	52.0	-	-	-
2009	1.3	15.6	67.8	-	-	-

Table 2

The situation of the catches of summer fruit tortrix moth in the pheromone traps

Site	Mean capture numbers/variant					
	2008			2009		
	Attract & Kill	Standard	Untreated	*Attract & Kill*	Standard	Untreated
RDIPP Bucharest	0	0	0	0	0	0
RDIFG Pitești-Mărăcineni	0.3	2.6	13.0	0	1.6	4.3
RDSFG orchard 1	2.0	19.6	32.0	0.3	3.6	15.3
RDSFG orchard 2	3.6	26.0	61.0	3.6	10.3	28.0

Table 3

The situation of the catches of grape vine moth in the pheromone traps

Site	Mean capture numbers/variant					
	2006			2007		
	Attract & Kill	Standard	Untreated	*Attract & Kill*	Standard	Untreated
1	5.4	58.7	193.8	13.2	68.5	142.3
2	2.3	22.6	113.0	4.0	21.6	94.3
3	1.6	19.6	132.0	0.3	13.6	115.3

Table 4

The situation of the number of the *Cydia pomonella* eggs lying, RDIPP Bucharest

Year	*Attract & Kill*	Standard	Untreated
2006	2	7	123
2007	0	16	131
2008	1	9	97

Table 5

The situation of the number of the *Adoxophyes reticulana* egg masses lying, RDSFG Voinesti

Year	*Attract & Kill*	Standard	Untreated
2008	0	5	13
2009	0	2	6

Table 6

The number of codling moth larvae in paper belt traps, RDIPP Bucharest

Variant	CM larvae/tree	
	2007	2008
MESAJ CP	8.5	5.8
Standard	12.7	7.2
Untreated	24.6	35.8

Table 7

The efficacy of MESAJ CP to control the codling moth

Year		RDIPP Bucharest			RDIFG Pitesti-Maracineni		
		Attract & Kill	Standard	Untreated	*Attract & Kill*	Standard	Untreated
2006	Attack (%)	10.2	16.8	85.1	18.2	12.4	94.4
	Efficacy (%)	83.3	80.3	-	80.7	86.9	-
2007	Attack (%)	6.2	8.8	56.6	13.8	6.3	73.6
	Efficacy (%)	89.1	84.5	-	74.1	87.8	-
2008	Attack (%)	3.4	3.6	12.9	-	-	-
	Efficacy (%)	73.9	72.1	-	-	-	-
2009	Attack (%)	2.1	3.5	23.2	-	-	-
	Efficacy (%)	90.8	89.4	-	-	-	-

Table 8

The efficacy of MESAJ AR to control the summer fruit tortrix moth

Variant	Year	Attract&Kill		Standard		Untreated	
		% atac	Efficacy (%)	% atac	Efficacy (%)	% atac	Efficacy (%)
RDIFG Pitesti-Maracineni	2008	3.1	88.6	3.9	85.6	27.1	-
	2009	0.3	91.4	0.7	80.0	3.5	-
RDSFG Voinesti orchard 1	2008	0.8	91.8	1.1	88.8	9.8	-
	2009	2.1	90.9	2.8	87.0	23.2	-
RDSFG Voinesti orchard 2	2008	3.3	84.6	5.1	76.3	21.5	-
	2009	1.9	89.1	2.6	85.1	17.8	-

Table 9

The efficacy of PRELUDIU LB to control the grapevine moth

Site	2006						2007					
	Level of attack			Efficacy			Level of attack			Efficacy		
	A&K	Std.	Untr.	A&K	Std.	Untr.	A&K	Std.	Untr.	A&K	Std.	Untr.
1	1.6	1.9	8.7	81.4	87.6	-	1.4	2.7	4.3	89.4	61.2	-
2	3.6	0.9	13.4	73.0	93.0	-	-	-	-	-	-	-
3	-	-	-	-	-	-	0.4	0.2	3.4	74.2	87.8	-

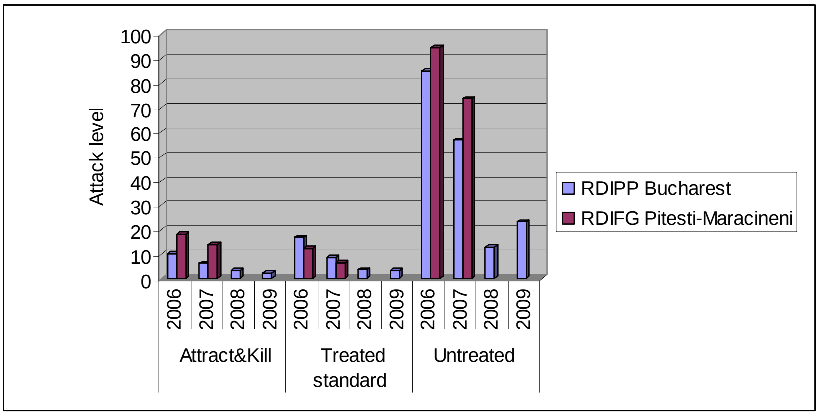

Fig. 1 Attack level of the codling moth

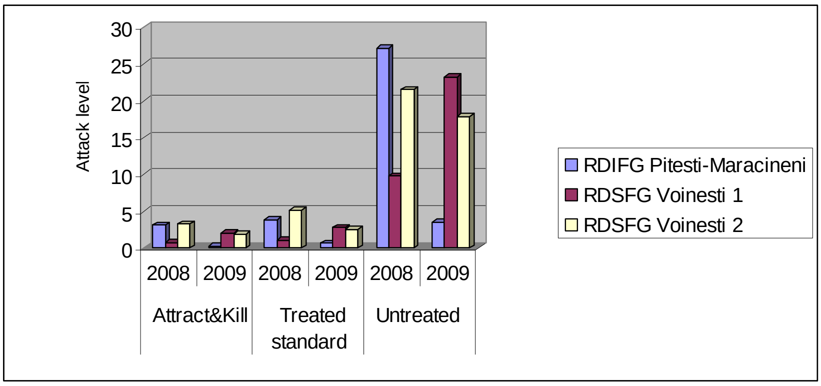

Fig. 2 Attack level of the summer fruit tortrix moth

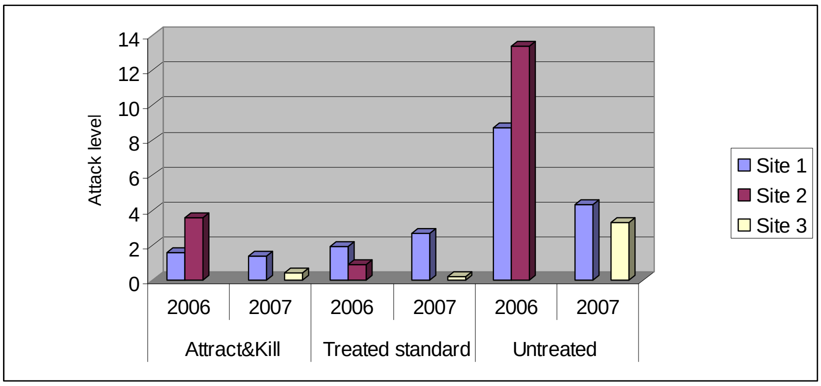

Fig. 3 Attack level of the grapevine moth

The establishment of *in vitro* propagation biotechnology for *Arnica montana* L. species

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Keywords: *Arnica montana* L., iniţiere, multiplicare, înrădăcinare, aclimatizare

ABSTRACT

The paper reveals the *in vitro* propagation biotechnology for *Arnica montana* L. species, as part of the project no. 32160/2008, regarding the chorological study of sozological categories for Argeş county flora, to restore endangered phytopopulations through conventional and biotechnological methods of propagation. The established biotechnology provides the usage of the next nutritive media, as follows: for initiation – base medium MS, with ½n, 0,005:2 mg/l auxins/citokinine, 20 mg/l NaFeEDTA, 20 g/l sucrose, 7g/l agar; for multiplication – base medium LF, with n concentration, 0,02:0,4 mg/l auxins/citokinine 0,02:0,4 mg/l, 32 mg/l NaFeEDTA, supplemented with 40 g/l dextrose and 7g/l agar; for rooting – the usage of ½n macro and micronutrients MS, n vitamins LS, 0,1mg/l AG_3, 0,2mg/l IBA, 38 mg/l NaFeEDTA 38 mg/l, 30 g/l dextrose, 7g/l agar and 0,3 g/l activated carbon.

INTRODUCTION

Arnica montana L. is a herbaceous perennial plant, with hibernating vegetative organs, medicinal, common through all the Carpathian mountain chain, in wet meadows and pastures, rarely through the glades and tickets, to subalpine region, rarely in alpine area.

MATERIALS AND METHODS

Stock plants were harvested from Cheile Brusturetului area, from which were taken vegetative apexes (Alexiu, 1998; Pop, 2006).

Biological material disinfection was performed by washing with water and 2 drops of chlorine based disinfectant, followed by sterilization in 96% ethanol (C_2H_5OH) for 2 minutes and 6% calcium hypochlorite ($CaCl_2O_2$) for 4 minutes. Throughout the sampling explants, the biological material was kept in distilled water sterilized by autoclaving.

Protocol requirements for *in vitro* propagation biotechnology were followed for all culture stages.

Culture media used for vitroplants initiation, multiplication and rooting are presented in table 1.

Taking into account that *in vitro* culture biotechnology for *Arnica montana* is completed, please note that instead of presenting all the experimental variants for all 3 phases, we displayed only the final ones.

During the experiments, in the growing chamber were provided controlled conditions for: temperature (24°C ± 2^0C), photoperiodism (14 ore) and light intensity (3000 lux).

For vitroplants acclimatization was used as nutritive substrate peat for professional use.

RESULTS AND DISCUSSION

The results have been recorded as follows: growing percentage for the initiation phase, multiplication rate (rosettes/explant) for the multiplication phase, rooting percentage for the rooting phase and acclimatization percentage for the acclimatization phase.

For initiation phase we note that explants were represented by meristematic tissue and 2-3 leaflets, taken from active growing plants; several nutritive solid media were tested varying the phytohormones and their concentration; the use of culture media: macronutrients

MS, micronutrients MS, vitamins MS, all with ½n, 0,005:2 mg/l auxins/citokinine, 20 mg/l NaFeEDTA, 20 g/l sucrose, 7g/l agar has resulted in 90% growing plants.

For multiplication phase, using the nutritive media: macroelements LF, microelements LF, Vitamins LF, with n concentration, 0,02:0,4 mg/l auxins/citokinine 0,02:0,4 mg/l, 32 mg/l NaFeEDTA, supplemented with 40 g/l dextrose and 7 g/l agar, the multiplication rate was 5 rosettes/explants.

The culture media: ½n macro and micronutrients MS, n vitamins LS, 0,1mg/l AG_3, 0,2mg/l IBA, 38 mg/l NaFeEDTA 38 mg/l, 30 g/l dextrose, 7g/l agar and 0,3 g/l activated carbon was used for rosettes with 97,4% rooting percentage.

The two culture substrates: perlit/peat 1:1 and only perlit assured the same vitroplants acclimatization percent - 787%.

CONCLUSIONS

We present the *in vitro* culture phases for *Arnica montana* L. (Fig 1.):

- 0 stage: active growing plants;
- I stage (20 days): transition of meristematic tissue and 2-3 leaflets on the nutritive medium;
- II stage (35 days): plantlets the transfer from initiation medium on the multiplication medium;
- III stage (30 days): multiplied plantlets individualization and their transfer on the rooting medium;
- IV stage (25 days): acclimatization of *in vitro* rooted plantlets (Fig 2.).

The established biotechnology will provide a large number of plants that will be fortified and used in the subsequent stages to repopulate the problem-areas.

ACKNOWLEDGEMENTS

We are grateful to our project partners: University of Pitesti, Arges Museum and Biophan.

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TABLE AND FIGURES

Table 1

Nutritive media composition for biotechnology phases

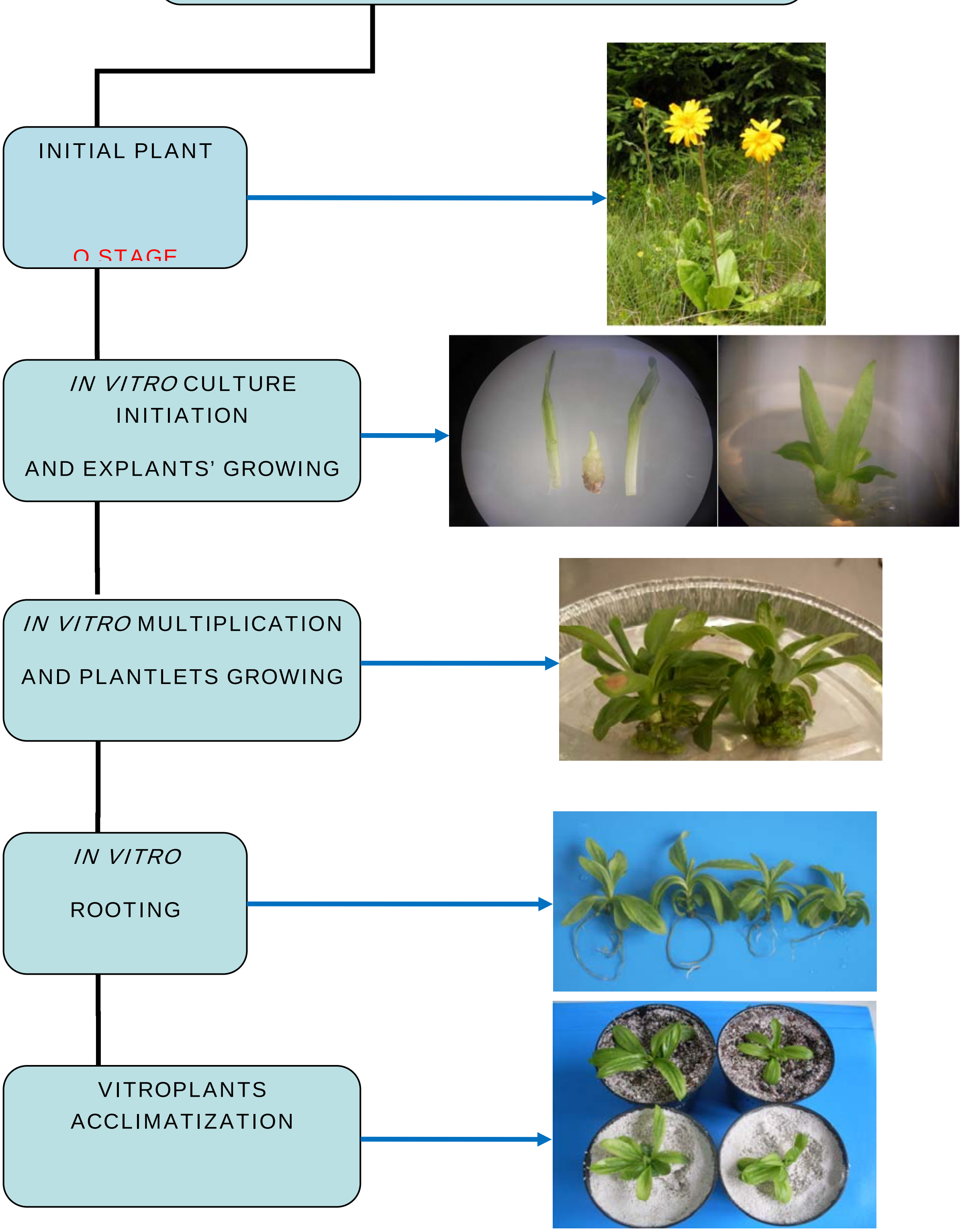
Composition	Initiation	Multiplication	Rooting
Macro MS	½ n	-	-
Micro MS	½ n	-	-
Vitamins MS	½ n	-	-
Sucrose (g/l)	20	-	-
Agar (g/l)	7	-	-
BAP (mg/l)	2	-	-
NAA (mg/l)	0,005	-	-
NaFeEDTA (mg/l)	20	-	-
Macro LF	-	n	-
Micro LF	-	n	-
Vitamins LF	-	n	-
Dextrose (g/l)	-	40	-
Agar (g/l)	-	7	-
BAP (mg/l)	-	0,4	-
IAA (mg/l)	-	0,2	-
NaFeEDTA (mg/l)	-	32	-
Macro MS	-	-	½ n
Micro MS	-	-	½ n
Vitamins LS	-	-	n
Dextrose (g/l)	-	-	30
Agar (g/l)	-	-	7
G_3A(mg/l)	-	-	0,1
IBA (mg/l)	-	-	0,2
NaFeEDTA (mg/l)	-	-	38
Activated carbon(g/l)			0,3

Legend: MS = Murashige-Skoog (1962), LF = Lee-Fossard (1977), LS = Linsmaier-Skoog (1965).

Fig 1.

***IN VITRO* CULTURE PHASES**

FOR *ARNICA MONTANA* L. PRESENTED



Plant	Biotechnology phases (Weeks)															
	1	2	3	4	5	6	7	8	9	10	11	12	13	14	15	16
Arnica montana L.	Initiation phase (20 days)															
				Multiplication phase (35 days)												
									Rooting phase (30 days)							
													Acclimatization phase (25 days)			

Fig 2. Implementation period of each biotechnology phase

Diaphania perspectalis (Walker, 1859) (Lepidoptera:Crambidae) a new pest of *Buxus* spp. in Romania

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Keywords: *Diaphania perspectalis*, introduced species, *Buxus* spp., distribution, damages

ABSTRACT

Diaphania perspectalis **(Walker, 1859) (Lepidoptera:Crambidae) is a moth native to Asia causing severe defoliation on box (*Buxus* spp.). After an initial finding in Germany in 2007, it has been found in other 5 western European countries. This paper represents the first report of the presence of the pest in Romania. Aspects regarding the history of introduction and geographical distribution in Europe are presented. Also, species description and biology are discussed together with preliminary data about morphology of the pest, symptoms of attack and possibilities for detection and control.**

INTRODUCTION

Diaphania perspectalis is also known by the synonym *Glyphodes perspectalis* (Walker, 1859). The area of origin of the species is East Asia, until 2007 only known from Japan, China, Korea Republic. Since the first finding in the southeast of Germany, around the Baden-Wurttemburg area, larvae have been found in more location across Germany, sometimes causing severe defoliation as they feed on box (Buxus spp.). By 2008, *D. perspectalis* had been reported from five countries: Switzerland (first found in 2007 near Basel, then in Aargau, Graubunden, Jura, Solothurn, Thurgau, Vaud, Zurich and Zug), Netherlands (found in 2008), France (first found in August 2008 in Alsace and in 2009 in Ile-de-France), United Kingdom (first found in September 2008 in southern England) and Austria (first report in 2009 in Vorarlberg, Steiermark, Vienna). *D. perspectalis* was added to the EPPO Alert List in 2007. The introduction of such a pest in Europe could represent a seriously threat to nurseries, parks and gardens.

The biology of *D. perspectalis* in Europe, dispersal and method of detection and control are not fully known yet, as it is a recent discovery here. In August 2010 we have discover the presence of the pest in 3 different locations in Bucharest and we consider that an opportunity to start our programme of study.

MATERIALS AND METHODS

The damage causing by *D. perspectalis* larvae were observed from August to September 2010 together with data regarding pest behaviour and preliminary data about biology in field conditions. In the same time we start the regular data collection and analysis of the existing information (publications, reports etc.). From each location we collected larvae, brought to the laboratory and placed them in plastic containers for mass-rearing. In laboratory conditions we studied the influence of three different temperatures (15, 20 and 25^{0}C) on pupal and adult size and percent survival to the adult stage.

RESULTS AND DISCUSSION

Damage, dispersal and detection: larvae feed on *Buxus* leaves and shoots (figure 1) and severe infestation can lead to complete defoliation of the plants (figure 2). Younger larvae eat the lover surfaces of the leaves only and leave the upper epidermis intact, in this period it is easy to ignore his presence, though fungal attack can cause similar patches of box leaves. Older larvae feed inside webbing and skeletonise the leaves. Webbing, excrement and black shed head capsules of earlier larval stages are very apparent; detecting this aspect is the easiest method of finding *D. perspectalis*. Moth dispersal capabilities are not known, that represent an item of interest regarding this species. It is though that trade in Chinese commodities is the probable source of the initial introduction, hence trade in box plant is an obvious means of dispersal.

Host plants: In Europe, *D. perspectalis* larvae have only been observed eating species of box: *Buxus microphylla, B. microphylla var. insularis, B. sempervirens and B. sinica* since in Japanese literature other reported hosts include *Ilex purpurea, Euonymus japonicus* and *E. alata*. In Romania we found the larvae feeding on *B. sempervirens.*

Description:

- Larvae: the younger larvae are coloured greenish yellow, with black heads. As the larvae get older the green body develops dark brown stripes. Mature larvae retain the green ground colour to their bodies and develop a striking pattern of thick black and thin white stripes along the length of the body, with large black dots outlined in white on the dorsal side, they are feeding surrounded by loose webbing (figure 3: a, b, and c). The late instars is up to 4 cm long, our measurements, made on a total of 300 larvae, showed an average length of 4.2 cm (table 1).
- Pupae: initially green with dark stripes on the dorsal surface (figure 4), while older pupae turn brown. They are concealed in a cocoon of white webbing spun among the leaves and twigs (figure 5 and 6). The pupae are between 1.5 and 2 cm long, our data revealed an average length of 1.8 cm. Rearing temperature had no significant effect on the length of pupae, percent of pupation or on the .
- Adults: the moths are medium sized, with a wingspan of around 4 cm (figure 7 and 8). The most common colour form has a thick dark brown border of uneven width around the edges of white-coloured wings. The forewings have a white extension to the central white portion of the wing, which extends into the brown border towards the front of the wing. The moths are faintly iridescent, with the brown areas having a golden sheen, and the white parts with tinges of purple (figure 9).

Biology:

Data is lacking on the biology of the pest, in China(Shanghai), 3 to 4 generations per year have been observed. The biology of *D. perspectalis* in Europe is not fully known yet, research on the species is only just starting and is mainly done by German specialists. In southwest Germany, there are two or three generation per year. At a temperature of 20^{o}C, development time from egg hatching to adult emergence is around 40 days. In the Netherlands in 2009 it cited to have developed three generations as well. *D. perspectalis* overwinters as a larva, spinning a cocoon between two box leaves in autumn, and completing its development the next spring.

Control measures:

There is little published data available on the control of *D. perspectalis*, most of them recommend pyrethroid insecticides, products containing deltamethrin, cypermethrin or diflubenzuron. Physical control, by picking off eggs or caterpillars could be considered for small surfaces or depending on the situation in the field. One biological control option is the entomopathogenic bacteria *Bacillus thuringiensis* var *Kurstaki.* The composition of the pheromone has been identified for Japanese populations, but the results of the field trials in Europe are unsatisfactory until now.

Because *D. perspectalis* do not have natural enemies to reduce his population in area of occurrence (we obtain higher percent of adult emergence in our research in 2010 as you can see in table 1), an important issue for further research are control methods, especially for use by private garden owners.

CONCLUSIONS

1. *Diaphania perspectalis* (Walker) (Lepidoptera:Crambidae) is an exotic pest recently introduced in the Europe that has been signalled for the firs time in Romania in 2010,
2. Severe attacks of box tree pyralid can lead to defoliation and completely skeletonise the *Buxus* plants which are grown for ornamental purpose, so the introduction of such a new pest could represent a threat to nurseries, parks and private garden;
3. Characteristic larval feeding damage can be a easiest method of finding *D. perspectalis*;
4. Preliminary data about species morphology, damages and presence in Romania where discussed;
5. Further research must establish a system for accumulation the data regarding the pest together with a programme for field monitoring survey.

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*** http://www.lepidoforum.de

TABLES AND FIGURES

Table 1

Preliminary data about *D. perspectalis* population reared in laboratory conditions

Variant of mass-rearing temperature	Late instar Larval Length -cm-	Pupation %	Pupal Length -cm-	Adult emergence %	Wingspan -cm-
15^0C	1.8	100	1.4	100	4.1
20^0C	1.7	100	1.3	99	4.0
25^0C	1.9	100	1.4	99	4.2

Fig. 1. A box plant affected by *D. perspectalis* larvae

Fig. 2. Severe infestation, showing a plant completely skeletonised

a) in laboratory

b) outside, feeding on the top of branch

c) deeply hidden inside the Buxus plant

Fig. 3 *D. perspectalis* larvae feeding on box, surrounded by loose webbing- various aspects

Fig. 4 *D. perspectalis* pupa removed from the cocon

Fig. 5 *D. perspectalis* pupation in laboratory conditions

Fig. 6 *D. perspectalis* pupation in field conditions

Fig. 7 Newly emerged adult of *D. perspectalis* obtained in laboratory rearing

Fig. 8 Adult of *D. perspectalis* prepared for measurement

Fig. 9 Adult of *D. perspectalis* iridescence of wings

Landscaping and industrial archeology

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Keywords: postindustrial landscape, sustainable, Grand Hornu

ABSTRACT

The existing landscape which has resulted from the previous industrial activities has had a great contribution in deteriorating not only the urban environments located in its proximity, but also the public's opinion toward these habitable locations. In Grand-Hornu the landscape seems that it has not been subjected to father time's punishing effects. The houses were restored or preserved in different stages, the ex-colliery fosse was shut down permanently and a tower was demolished; the rest of the industrial complex was prepared to undergo a preservation process in order to be able to slowly attract the interest of potential investors. Now the field is vacated by houses, built in a distinct neoclassic architectural style, chimneys from factories and collieries and vacant strips of land which depict former buildings where various industrial activities took place are now mixed with spontaneous patches wild vegetation. This mix of vegetation and abandoned human establishments creates quite an unattractive landscape, which in turn generates a series of concerns to why has this area has been neglected for such a long time. The only chance for this area to recover its functionality would lie in the hands of young experts and visionaries, capable of taking the area architecturally and also functionally into the next century.

INTRODUCTION

The industrial archeology, as an interdisciplinary method, of studying all the testimonies, material or immaterial of documents, of artifacts and of structures, of human settlements and urban or natural landscapes, which were created for or by the industrial processes (Borsi, 1978). This uses the most suitable methods of investigation in order to raise the understanding level of the industrial past and present.

The term of industrial archeology started to be used in the midd 1950s in Great Britain, where the stratifications of the industry had marked almost all of the national territory, starting with the middle of the XVIIIth century.

A society's preoccupation, better said affinity, toward molding their surrounding environment in order to better suit their cultural and economic needs reflects a certain degree of morality and perspective (Travis, 1982).

Refurbishing and investing in former industrial sites through different economical strategies like custom types of tourism, like industrial archeology, is one of the signs that a local community has reached that certain degree of awareness in its existence as a social entity (Leloup, 1998).

By choosing industrial archeology as a mediator between the landscape's cultural importance and economical perception one creates an emblem that shall remain visible through time, thus triggering two key factors in any business, namely sustainability and feasibility (Volker, 2003). Any location with a landscape which can relate to the one presented in the current paper has a very high chance in succeeding economically if it focuses on conserving its cultural elements.

As a downside to this solution many professional archeologists might condemn the principles of industrial archeology, seeing it as a unsuccessful hybrid between true conservation of a certain artifact and refurbishing something in order to use it as a tool for economical development.

In reality this niche type of tourism called industrial archeology, sets out to conserve a significant episode in man's technological evolution and insure that it shall remain a part of his existence for generations to come (Pearce, 1999). Perhaps, the most interesting and at the same time unique trademark for this type of tourism is that it creates vast outdoor museums which serve as inspiration and as a historical landmark in our passing through time.

"Le Grand-Hornu" is situated in Borinage, Wallonia, Belgium, at 15 km West South-West of Mons. It was the first area of the European mainland to be industrialized as the Industrial Revolution spread across the globe from Britain (Boulanger 2001).

Even Grand-Hornu wasn't the biggest mine its owner was an industrial visionary. Henri De Gorge was born in a agriculture family but he launches himself in the coal business. He acquired Hornu Colliery in 1810 and combined with the socially idealistic architect Bruno Renard from Tournai in planning a complete coal- mining township between 1816 and 1835. At the end of 1823 the resulting edifice was something between an industrial complex and a functional city. This kind of town is the first in Europe.

RESULTS AND DISCUSSION

It was a true town project, built in a pure neo-classic style. It includes: the industrial complex, workers' estate and the residence of the directors. The Neo-Classical central complex comprises of two grand courtyards that have now been mostly conserved.

The pediment triple-arched portal leads through the 100m long entrance façade with its hipped-roof corner pavilions into the entrance court, which housed stables, vehicle sheds, and hay and straw stores. A second gateway led through to a large arcaded elliptical central court which has high-vaulted engineering workshops for constructing steam engines (1831) facing a pediment office block with a dome. The cathedral-like seven three-aisled -bay workshops included a foundry and an assembly shop. The two semicircular ends of this great enclosure are terminated by continuous curved arcades that once fronted other small workshops, for garaging fire engine, and iron, oil, and pattern stores.

Surrounding these former workshops and offices are some 425 workers' houses, providing homes for 2500 people, which were exceptionally comfortable for the period and were set in a rectilinear layout of paved roads flanked by pavements. Each collier's house had a communal room, a kitchen, and a bedroom on the ground floor with three bedrooms upstairs. In the rear garden were a shed and toilet. A well and oven were provided communally for every ten houses. The settlement is ornamented by two squares: the Place Verte, which formerly had a bandstand where the town band gave concerts twice a year in the summer, and the Place Saint-Henri facing the original de Gorge family residence. A school, library, baths, a ballroom, and eventually a hospital, the latter now demolished, were also added to this colliery settlement, which had been created on enlightened social lines (Robert, 2002).

After the decision of CECA (Communauté Européenne du Charbonne et de l'Acier), in 1954, activities ceased and most of the functional surface elements of the shaft heads have been demolished. However, the workshops, stables, and offices together with the workers' settlement still form a complex of international importance.

Grand-Hornu was abandoned and soon it became a ruin and in 1969 it was condemned to demolition. But in 1971 the architect Henri Guchez bought the ruins and began the first rehabilitation. In 1984 it's created the association "Grand-Hornu Images" which began its work with the same conviction, that the site is very important and that it can be developed and in the same time preserved (Holyoake, 2002).

In 1994 the architect P. Hebbelinck was selected and until 1998 the M.A.C. (Contemporary Arts Museum for the French community) project was achieved. In the year 1999, it was inaugurated. MAC's a space open to both lovers of contemporary art and those who admire heritage. The big temporary exhibition which the museum stages several times a year, give you the opportunity to discover the great names in modern art through works on loan or from museum's collection.

In order to improve the landscape and to develop Borinage region in a post-industrial society, in a sustainable way, the Walloon government and with the help of the European Union, created a developing scheme, a marketing plan using Mons, the capital, as a motor for *diversification:* service development and most of all for the tourism industry, high technology industries, culture and environment (Erlet, 1994). Also the marketing plan includes the preservation of the site Grand-Hornu, creation of a developing pole, a socio-economic one, and the MAC's implementation in the same place for its survivability. It was also created with spaces which housed meetings and conferences; a part of the space was rented for offices and biros of high-tech companies.

The Grand-Hornu landscape is somehow different because of the architect visions especially the industrial site, the neo-classic taste and its importance in industrial archaeology (Ray, 2000). It is very well preserved "as it was find" the "cathedral" or there were "inside changes" which don't affect the architecture, even some buildings were added and the architectural taste had nothing to do with the rest, the main idea wasn't altered.

Choosing a motor of development for Borinage region wasn't a difficult task. The region being highly urbanized with a typical landscape of ex-colliery, which is in this post-industrial society considered 'not in fashion' adding the socio-economic problems, the need for development was urgent (Esping-Anderson, 1999).

Mons even it wasn't in the middle of coal mining is the central town has an important patrimony heritage, an active cultural life and all kind of possibilities for economic development (Watelet, 1980).

The diversity of Mons's cultural heritage and its surroundings makes the tourist to stop a little longer than they expected. Their integration in landscape and the tourist facilities can bring to surface another face of the place, isolated after the early industries were shot down, now it looking for it place in today post-industrial society (Kumar, 2005).

Implementation of high-tech industries such as: telecommunication, cybernetics, informatics, etc its relationship with Mons University. New technological sites are building, a new model of techno-pole. The Grands Prés site is a vast surface area of 85 hectares, of which a part is reserved for the INITIALIS Scientific Complex. It will centralise, on a single site, the worlds of business, research, trade and small industry.

In concrete terms, the project is based on four sectors: Imagic, a centre for leisure activities, training and the production of all aspects of virtual images; a multi-purpose hall, with a surface area of 17,000 m^2, offering companies the possibility of exhibiting their products and to advertise these. It will also offer individuals the opportunity of attending all kinds of performances; a comprehensive shopping centre; and activity complex to complement activities in the town centre (Ghershuny, 2000). This implies a global investment of Euro 4.6 millions, but will also create approximately one thousand direct jobs. Two other competence centres have been inaugurated: "Multitel", which orients its research around the area of telecommunications (and intends to promote technologies linked to advanced telecommunications and to assimilate these within the industrial fabric of their region, and to develop their use within small and medium-sized companies, etc), and "Materianova", working on the development of new materials (polymers and new ceramics, etc.), an area in which the Mons region has considerable tradition and skills.

As being nearby, new tourist attractions were introduced in the circuit only a few years ago. The hydraulic boatlifts from the Historic Central Canal, the new boatlift of Strepy-Thieu and the complex Grand-Hornu: the preserved industrial archaeological site collaborated with a museum and a society that handle cultural or business meetings (Lanfant, 1995). In site Grand- Hornu the economical and cultural base was diversified: some spaces were rented to high technology companies to use it as offices, the relicts were preserved and MAC's buildings are well integrated. Culture is at home in Grand- Hornu site even it is contemporary or almost 200 years old.

CONCLUSIONS

Industrial archaeology sites have an advantage over other industrial sites; also taking into consideration specific and inertia factors, localisation and sustainability factors. The major implication is the marketing: ‘How is to be done?’ in this specific connotation.

We concur that the first right steps taken were developing the Grand- Hornu site. This proved to be sustainable after the MAC implementation, and with other developing plans for high-tech industries and tourism. The complex after it was preserved like it was found and integration of the new building of MAC became an odd mixture of architectural style, but at the same time an attractive one. The public interest and taste was raised after exhibition and meetings, it was re-educated, and now, no industrial values are neglected.

The marketing plans for the Borinage region just began and its own creators estimate it shall be completed by the year 2015, but of course everybody knows that there is a lot of work to be done and this program has to be supported by the citizens, private investors and everyone who believes that there is room for more and better. At the beginning its progress was very slow and the resultants could be seen quickly, but fortunately they are heading toward the right direction.

The topic of industrial archeology has not been very popular in our country, being a method which can be used in conserving industrial sites and other elements of cultural heritage. Romania has a real potential in this field, having many sites or monuments from different periods of the industrialization process. A re-utilization of these monuments can be achieved through a flexible strategy of touristic diversification. Investing in these kinds of sites can lead to an economic revival. Industrialization is mentally related to the pre-december politics in our country, and the affective impact is a negative one.

Although there are many successful examples in this field, in Romania the value of land exceeds the intrinsic value of the industrial site in some citizens’ perception. The interdependence between civilization and technique is emphasized through the industrial archeology.

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Soil erosion control by using an appropriate land cover and management

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Keywords: water erosion, runoff plots, alluvia, steep slopes, winter crops.

ABSTRACT

Soil erosion is one of the most important forms of soil degradation along with soil compaction, low organic matter, and loss of soil structure, poor internal drainage, salinisation, and soil acidity problems. Soil erosion is a naturally occurring process on all lands. In the mean time, soil erosion is also a result of anthropogenic activities, in excess of accepted rates of natural soil formation, causing a deterioration or loss of one or more soil functions, mainly its fertility. As it is known, a good status of land cover has an important role in reducing of runoffs and soil loss in the torrential agricultural watersheds. The effectiveness of land cover in reducing soil erosion depends upon the plants' density, height and continuity of the canopy. The paper presents some of the main findings of a study carried out at the Aldeni/Buzău Research Station on Soil Erosion and the adjacent torrential watersheds, concerning soil loss, mainly under different crops and climatic conditions. There were taken into account both cultivated and spontaneous vegetation, main crops as well as orchards and vineyards. Based on the long time field measurements conducted on the runoff plots, in the period 1993-2010, the role of the vegetation and crop factor from the USLE erosion model were checked. Also, some correlations were established between soil losses on different slope steepness.

INTRODUCTION

Soil and land degradation, in the broad sense of the words, is generated by action of several factors, natural and anthropogenic. Thus, on more than about 12 million hectares out of the 15 million hectares of agricultural lands in Romania, soils are subject to the influence of one or several factors of degradation, such as: erosion, increasing of the salt contents due to raising of the ground water level, compaction, acidizing and chemical pollution (pesticides, heavy metals, fluorides, oil, etc.).

In Romania, about 43% from the total agricultural area is situated on the slopes more than 5%. Average slope of the Romanian agricultural lands is about 9.2%, which means that 35% from the total arable land is situated on the slopes greater than 5%. Due to its characteristic conditions of relief, lytology, pedoclimatics and vegetation, it can be said that the main Romanian agriculture problem in the hilly areas is soil erosion, as well as the drought in the plain regions or even in the hilly areas. Almost 5.3 million hectares of agricultural land are vulnerable to surface and depth erosion and to landslides. Water erosion is considerable on about 3.5 million hectares of this area, so that, in certain regions situated in Subcarpanthians Curvature area (Vrancea and Buzau Counties) soil loss reaches about 30-45 tons/ha/year, as against to the natural regenerative capacity of the soil, which is about 3 - 6 tons/ha/year, only.

Although the arable land is located on gentler slopes, this is a major source for soil loss because the high ratio of the row-crops (corn, dry beans, sunflower, and potatoes) has determined a high rate of the erosion processes. The non-adequate management of the pastures had an unfavourable influence, too. For example, an area more than 55% out of the about 4.8 million hectares of pastures and meadows is affected by erosion and landslides because of the severe slope, mainly, (about 75% of pastures and meadows are situated on slope greater than 5% and an area estimated at 35% from the total area covered by pastures and meadow is situated on slope greater than 20%.)

The affected areas by water erosion, which include the agricultural lands, forests and the unproductive areas on slopes, are as follows: slight erosion - 46.3%; moderate and high erosion - 41.5% and severe - excessive erosion - 12.2%.

Concerning the agricultural eroded lands only, it has been found that the slight-severe erosion class is about 43% of the whole area, according to the data presented in Table 1.

MATERIAL AND METHODS

Using a valuable climatic and soil erosion database, since 1970, based on field measurements carried out at the Soil Erosion and Conservation Research Station; illustrate the influence of slope and crops on soil loss, as reported in Table 2, as well as the best conservation measures. The Research Station is located the Subcarpanthians Curvature zone (Figure 1), Slănic River watershed, Aldeni – Buzău. This area is one of the most and well-known hilly region affected both by severe water erosion as well as associated processes in Romania. The researches were carried out both on the standard runoff plots of 40 sqm and 100 sqm respectively, having the slopes of 15% and 20% (Figure 2), as well as along the adjacent watersheds. From pedological point of view, there are mainly loamy textured chernozems and, the mean annually precipitation of about 450 mm, out of which about 350 mm are fallen during the vegetation period. After each rain producing runoff have been measured the soil loss under different crops in rotation, such as corn, winter wheat, sugar beet, soybean etc., as well as perennial grass crops.

Evaluation of the protection capacity of the vegetation over the soil have been established by doing the ratio between the soil loss under different species or associations of plants and the soil loss under the bare soil, or a crop that can offer a poor protection to the soil. Reports are done in relative values, considering the bare soil as a reference or etalon runoff plot, having the value equal 1.

Based on the direct field determinations of the soil loss on the runoff plots, during the vegetation period of the years 1993-2010, there have been established the correction coefficients C function of crop, specifics to the real conditions from the Subcarpanthians Curvature region.

RESULTS AND DISCUSSION

Data presented in Table 2 show the big importance of a very good land cover in reducing erosion, obviously the most recommended crops being those with a big density, compared with row crops, especially maize. Also, there is obviously a big difference between the soil loss rates under the same crop, occurred on the gentle slopes compared with the slopes that are very steep for arable purpose, even from simple to double.

The obtained correction coefficients C, function of crop, have very close values in comparison with those coefficients used in the USLE model, adapted for the Romanian conditions by M. Motoc, in 1978. For example, if considering C=1 for corn in monoculture, as etalon, there were obtained the following values: C = 0.11 for winter wheat, compared with C = 0.14 in design instructions, and C = 0.006 for perennial grasses, against C = 0.001 from the design instructions.

The effectiveness of any crop, management system or protective cover also depends on how much protection is available at various periods during the year, relative to the amount of erosive rainfall that falls during these periods. In this respect, crops which provide a food, protective cover for a major portion of the year (for example, alfalfa or winter cover crops) can reduce erosion much more than can crops which leave the soil bare for a longer period of time (e.g. row crops) and particularly during periods of high erosive rainfall. However, most of the erosion on annual row crop land can be reduced by leaving a residue cover greater than 30% after harvest and over the winter months, or by inter-seeding a forage crop.

CONCLUSIONS

Soil erosion potential is increased if the soil has no or very little vegetative cover of plants and/or crop residues. Plant and residue cover protects the soil from raindrop impact and splash, tends to slow down the movement of surface runoff and allows excess surface water to infiltrate. The erosion-reducing effectiveness of plant and/or residue covers depends on the type, extent and quantity of cover. Use of winter vegetation and residue combinations that completely cover the soil, and which intercept all falling raindrops at and close to the soil surface, are the most efficient measures in controlling soil (e.g. forests, permanent grasses).

Some other conservation measures can also reduce soil erosion by water. For example, tillage and cropping practices, as well the good land management practices, directly affect the overall soil erosion problem and solutions on a farm. When crop rotations or changing tillage practices are not enough to control erosion on a field, a combination of approaches or more extreme measures might be necessary. Contour plowing, strip cropping, or, most expensive terracing may be also considered. In the meantime, reforestation of the lands that are severe degraded by water erosion, have also hidrological and antierosion effects, this solution being the best way to reuse such a degrated lands.

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TABLES AND FIGURES

Table 1

Agricultural eroded lands by the erosion rate in Romania (after M. Motoc, 1984)

No. crt.	Class of the erosion intensity	Variation limits of the erosion intensity t/ha/year	Mean rate value t/ha/year	Percentage from the agricultural lands (%)
1	Non-appreciable erosion	less 1	0.5	57.4
2	Slight erosion	2 - 8	5.0	3.0
3	Moderate erosion	9 - 16	12.0	19.0
4	High erosion	17 - 30	23.0	18.0
5	Severe erosion	31 - 45	37.5	2.6

Table 2

Average soil loss, in tons/ha/year, from the runoff plots, between 1995-2005

Crop / Slope	Bare soil	Corn	Winter wheat	Perennial grass crop	Bean	Sugar beet	Buffer strip
S=15%	40.9	13.1	2.9	0.2	10.7	4.3	1.3
S=20%	97.9	32.9	3.8	0.3	16.6	9.2	6.3

Fig. 1. Sketch of the Slănic-Buzău watershed with the studied sub-watersheds

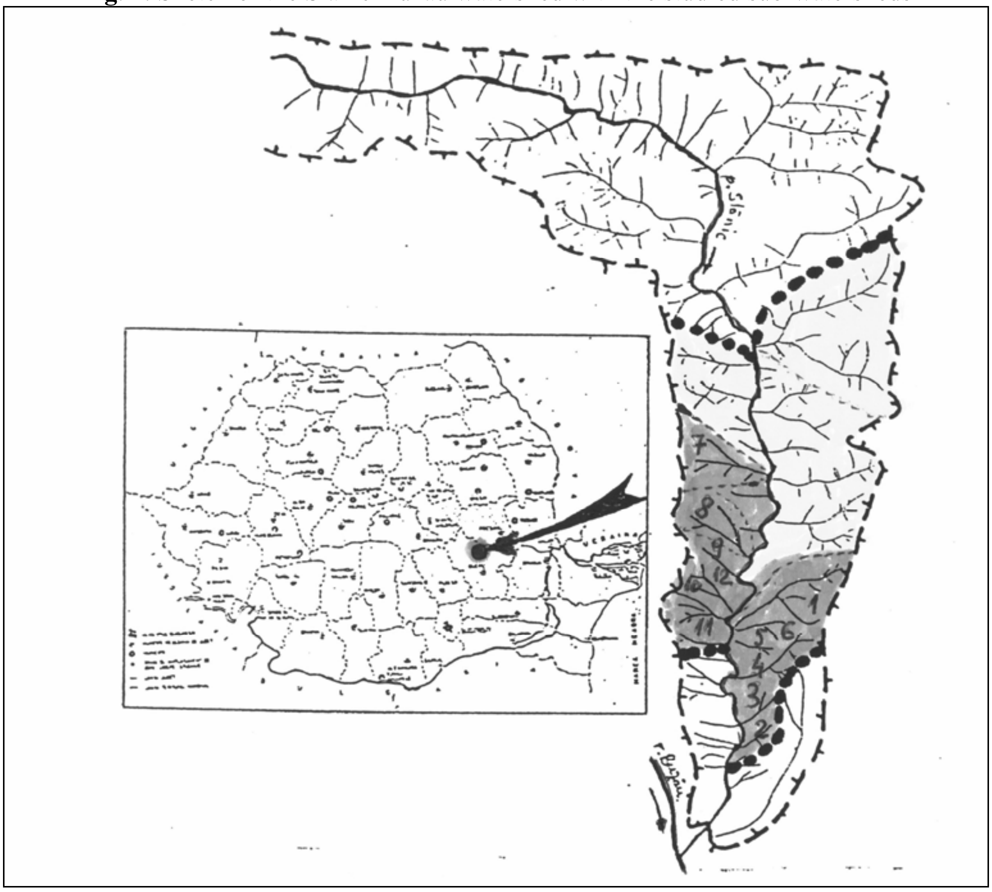
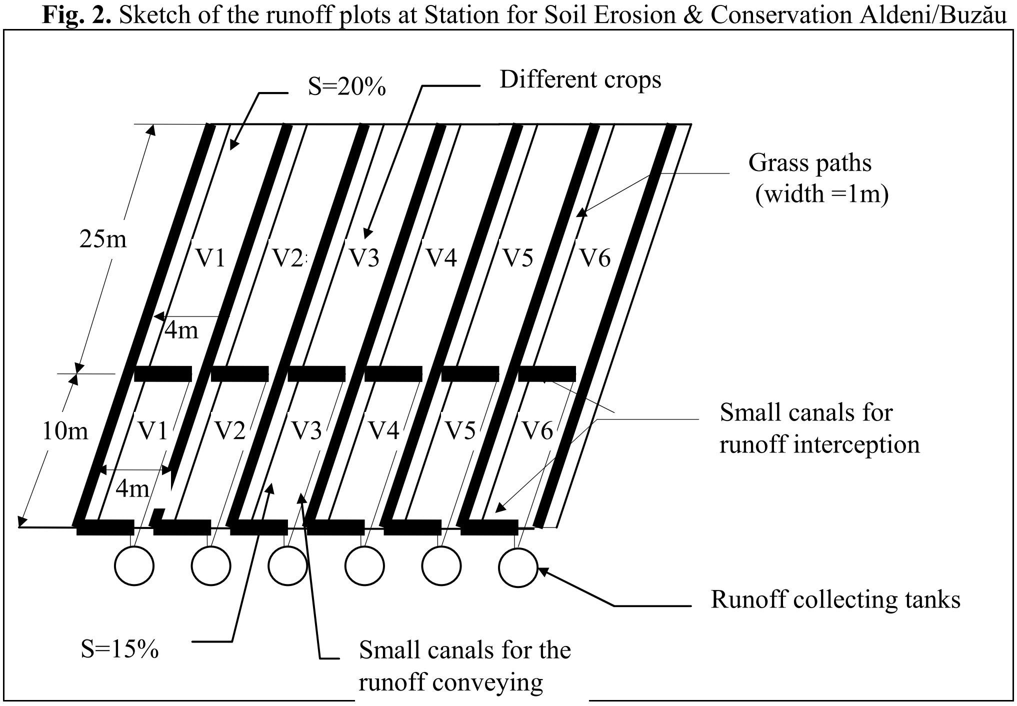


Fig. 2. Sketch of the runoff plots at Station for Soil Erosion & Conservation Aldeni/Buzău



Validation of procedures for extraction of fat from food and cleanup of extracts, in order to determine dioxins and furans content

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Keywords: extraction, quantification standard, cleanup, egg, oil

ABSTRACT

In this paper are presented results of the performed researches in order to validate procedures for extraction of fat from food and cleaning of extracts for determination of dioxins and furans content. Within experiments there were used two food matrices: oil and eggs. In order to validate procedure for extraction of fat from eggs and of it for cleanup of extracts from eggs and oil, there were used mixtures of standards of dioxins and furans labeled with ^{13}C (*standards for verification of extraction efficiency–S6 and quantification standards–S7).*

Fat extraction from eggs was achieved in much more steps with organic solvents (ethyl alcohol HPLC grade (99.7%, v/v), diethyl ether pico grade, n–hexane pico grade). Extracts cleanup was achieved on multiple columns, using different absorption materials (acid silica gel, aluminium oxide, florisil activated with ultrapure water). Concentration of cleaned extract was achieved under nitrogen flow, at 40ºC and pressure 5 psi, about 15 -18 minutes.

Separation, identification and quantification of different compound PCDDs/PCDFs were achieved with complex equipment: *System of two high resolution gas chromatograph in combination with high resolution mass spectrometer*.

Within the performed experiments, in case of standard S6 recovery was in the range 83.67% - 88.67%, and in case of standard S7 recovery was in the range: 56.83% - 99%.

INTRODUCTION

Dioxins *(polychlorinated dibenzo-p-dioxins – PCDD)* and furans *(polychlorinated dibenzofurans – PCDF)* represent a group of chemical substances extremely toxically for animal and human body.

Dioxins have 75 congeners, of which 7 are the most toxically, and furans have 135 congeners with variable toxicity. Among these, compound with the highest toxicity is: 2,3,7,8-tetrachlorinated dibenzo-*p*-dioxin (2,3,7,8-TCDD) (Bernard, 1999).

Accumulation of dioxins into human body is caused, through consumption of contaminated food products, especially (over 90% of cases). Inhalation of contaminated air and absorption at derma level there are minor sources for contamination of human body with dioxins and furans. *Dioxins and furans have numerous deleterious effects on human body:* induction of hepatic, genital and lung cancer, derma wounds and teratogene effects (heart malformations, hydrocephalus, spina bifida), induction of spontaneous abortions, of infertility and dysfunctions of endocrine glands, induction of immune-suppressions through direct action on lymphocytes T and B, or indirect, through influence on the involved hormones in immune response of human body (Otles, S. and Yildiz, H., 2003).

Dioxins in food products cannot be destroyed through preparation, there are not metabolized into organism and cannot be eliminated through excrements or urine, but, on the contrary there will accumulate, their concentration increasing from each to other food in fat storages.

Because of extremely toxicity of dioxins and furans, at European and International level it is according a special attention to monitoring of these contaminant concentrations, both in environment (water, air, soil) and in food products.

Analytical methods for determination of dioxins and furans in food products, using *high resolution gas chromatography in combination with high resolution mass spectrometry, present high sensitivity and selectivity.* The first method for determination of dioxins and furans through *high resolution gas chromatography in combination with high resolution mass spectrometry,* was elaborated by *U.S. Environmental Protection Agency Office of Water-Engineering and Analysis Division,* under coordination of prof. dr. William A. Telliard in 1994 (Telliard, 1994).

MATERIAL AND METHODS

In order to validate procedures for extraction of fat and cleanup of extracts, for determining of dioxins and furans content, there were used two food matrices: oil and eggs.

Within the performed experiments there were much more steps, as following: preparation of test sample, fat extraction, extract cleanup and concentration, separation, identification and quantification of different compound PCDDs/PCDFs.

Fat extraction from eggs was achieved in much more steps with organic solvents (ethyl alcohol HPLC grade (99.7 %, v/v), diethyl ether pico grade, n–hexane pico grade). Extracts cleanup was achieved on multiple columns, using different absorption materials (acid silica gel, aluminium oxide, florisil activated with ultrapure water). Concentration of cleaned extract was achieved under nitrogen flow, at 40ºC and pressure 5 psi, about 15 -18 minutes.

Validation of procedure for fat extraction from eggs and of it for cleanup of extracts from eggs and oil, means use of mixtures of standards of dioxins and furans labeled with ^{13}C (*standards for verification of extraction efficiency–S6 and quantification standards–S7)*.

Separation, identification and quantification of different compound PCDDs/PCDFs were achieved with a complex equipment: *System of two high resolution gas chromatograph in combination with high resolution mass spectrometer (Capillary column* - 5% phenyl – 95% dimethylpolysiloxan, 5MS, L = 30 m, d_i = 0.25 mm, thickness film = 0.1 µm; *Carrier gas* = He 6.0, *Flow of carrier gas* = 15 mL/min; *High resolution mass spectrometer – Ionization type* = EI+; *Ionization energy* = 30–50 eV; *Resolution* =10,000; *Source temperature* = 260ºC).

In order to achieve calibration curves of those 17 native congener of dioxins and furans from the analyzed egg samples, there were used standard solutions S1, S2, S3, S4, S5 (solutions certified BCR – 614, LGC Promochem, Wesel, Germany).

RESULTS AND DISCUSSION

There were much more steps to determine dioxins and furans, as following:

- ✓ Preparation of test sample
- ✓ Fat extraction
- ✓ Extract cleanup
- ✓ Extract concentration
- ✓ Separation, identification and quantification of different compound PCDDs/PCDFs

In case of egg samples, preparation of test sample means the following operations: washing under water stream, eggs colecting and homogenising (minimum 5 eggs), weighting of minimum 50 g sample. In case of oil samples, the only necessary operation for preparation of test sample is weighting of 5.5 - 6 g oil.

Fat extraction from eggs is achieved in much more steps with organic solvents (ethyl alcohol grade HPLC (99.7%, v/v), diethyl ether pico grade, n–hexane pico grade). Verification of extraction efficiency is made with internal standard S6, which is added in sample prior to starting of this operation.

Standard S6 contains the following compounds: $^{13}C_{12}$–12378 PentaCDF (100 pg/µL), $^{13}C_{12}$–123789 HexaCDF (100 pg/µl), $^{13}C_{12}$–1234789 HeptaCDF (200 pg/µl). Before use standard S6 is diluted with nonane of 25 times.

In the case of determination of dioxins and furans in egg samples, the average recovery factors of the internal standards used for control of extraction efficiency - S6 are in the following range: 83.67% - 88.67%.

Organic phase in which is solubilized fat from eggs, is concentrated under vacuum until complet remove of solvent. Removing of solvent traces is achieved under nitrogen flow.

Before cleanup operation, in sample extract (both in case of egg sample and of oil sample), is added internal standard S7 (*quantification standard*). This internal standard contains solution in n-nonane pico grade, of the following compounds: $^{13}C_{12}$–2378 TetraCDF (4 pg/µl), $^{13}C_{12}$–23478 PentaCDF (4 pg/µl), $^{13}C_{12}$–123478 HexaCDF (4 pg/µl), $^{13}C_{12}$–123678 HexaCDF (4 pg/µl), $^{13}C_{12}$–234678 HexaCDF (4 pg/µl), $^{13}C_{12}$–1234678 HeptaCDF (8 pg/µl), $^{13}C_{12}$–OctaCDF (8 pg/µl), $^{13}C_{12}$–2378 TetraCDD (4 pg/µl), $^{13}C_{12}$–12378 PentaCDD (4 pg/µl), $^{13}C_{12}$–123478 HexaCDD (4 pg/µl), $^{13}C_{12}$–123678 HexaCDD (4 pg/µl), $^{13}C_{12}$–1234678 HeptaCDD (8 pg/µl), $^{13}C_{12}$–OctaCDD (8 pg/µl).

Extracts cleanup was achieved on multiple columns, using different absorption materials (acid silica gel, aluminium oxide, florisil activated with ultrapure water).

Internal standard S8 (*recovery standard*) is added in a cylindrical bottle with conical bottom, in which will be colected cleaned extract through column with Florisil activated with water. Standard S8 contains the following compounds: $^{13}C_{12}$–1234 TetraCDD (16 pg/µL), $^{13}C_{12}$–123789 HexaCDD (16 pg/µL).

Concentration of cleaned extract was achieved under nitrogen flow, at 40ºC and pressure 5 psi, about 15-18 minutes.

In case of egg samples, for quantification standard S7 it was achieved a recovery in the range 56.83% - 99%, and in case of oil samples recovery of compounds labeled with $^{13}C_{12}$ it was in the range 60.50% - 91.00%.

Separation, identification and quantification of different compound PCDDs/PCDFs were achieved with a complex equipment: *System of two high resolution gas chromatograph in combination with high resolution mass spectrometer (Capillary column* - 5% phenyl – 95% dimethylpolysiloxan, 5MS, L = 30 m, d_i = 0.25 mm, thickness film = 0.1 µm; *Carrier gas* = He 6.0, *Flow of carrier gas* = 15 mL/min; *High resolution mass spectrometer – Ionization type* = EI+; *Ionization energy* = 30–50 eV; *Resolution* =10,000; *Source temperature* = 260ºC).

In order to achieve calibration curves of those 17 native congener of dioxins and furans from the analyzed egg samples, there were used standard solutions S1, S2, S3, S4, S5 (solutions certified BCR – 614, LGC Promochem, Wesel, Germany).

CONCLUSION

1. In this paper are presented results of the performed researches for validation of procedures for extraction of fat from food products and cleanup of extracts in order to determin content of dioxins and furans.
2. Within experiments there were used two food matrices: oil and eggs. In order to validate procedure of fat extraction from eggs and procedure of extracts cleanup from eggs and oil, there were used standard mixtures of dioxins and furans labeled with ^{13}C (*standards for verification of extraction efficiency–S6 and quantification standards–S7)*.
3. In case of determination of dioxins and furans in egg samples, the average recovery factors of the internal standards used for control of extraction efficiency-S6 are in the following range: 83.67% - 88.67%.
4. Extracts cleanup was achieved on multiple columns, using different absorption materials (acid silica gel, aluminium oxide, florisil activated with ultrapure water).
5. In case of egg samples, for quantification standard S7 it was achieved a recovery in the range 56.83% - 99%, and, in case of oil samples, recovery of compounds labeled with

$^{3}C_{12}$ was in the range 60.50% - 91.00%.

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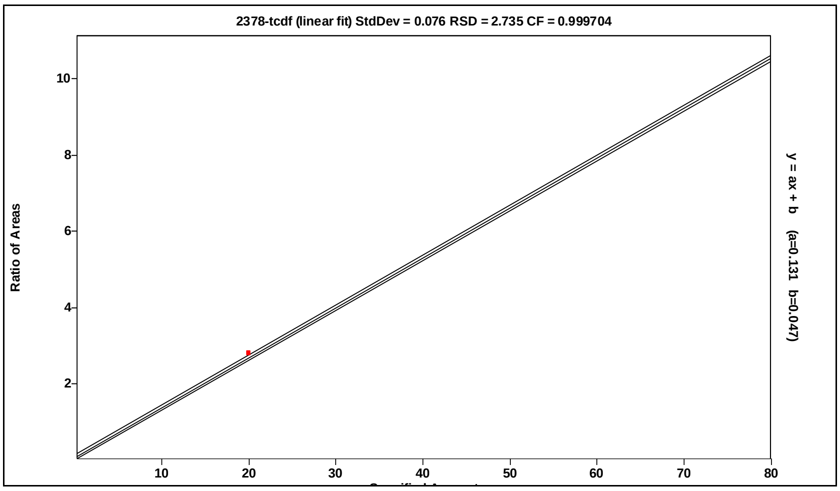
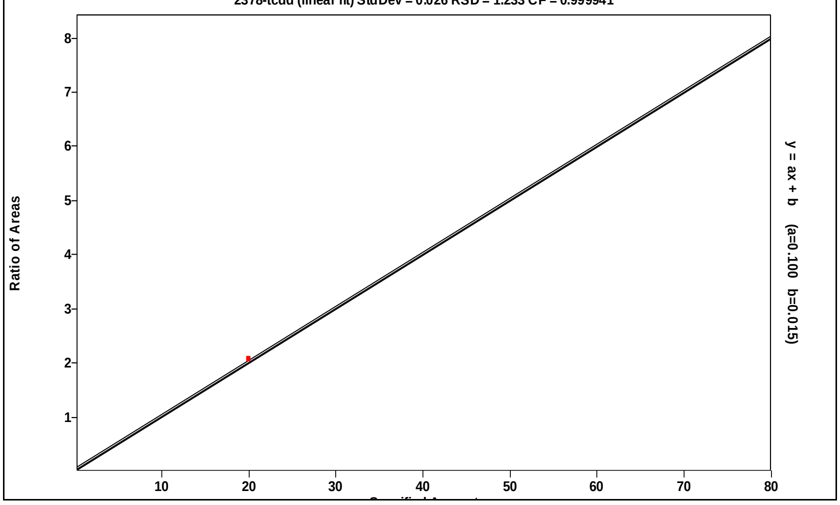
FIGURES



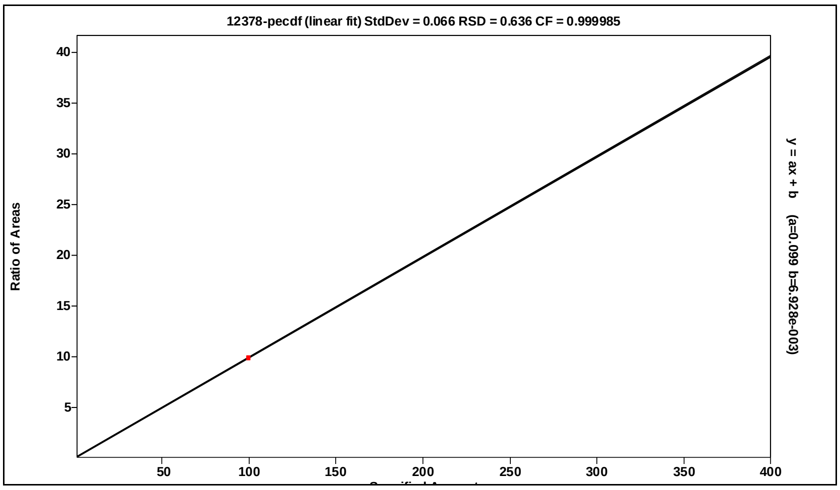
Specified Amounts

Fig. 1. Calibration curve for 2378-TetraCDF



Specified Amounts

Fig. 2. Calibration curve for 2378-TetraCDD



Specified Amounts

Fig. 3. Calibration curve for 12378-PentaCDF

Fig. 4. Extraction and concentration of fat from egg

Fig. 5. Cleanup of extracts

The influence of Reldan 40EC and Actara 25WG insecticides upon gall-bladder structure in *Rana* (*Pelophylax*) *ridibunda*

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Keywords: chloropyrifos-methyl, thiamethoxame, gall-bladder, epithelial metaplasia

ABSTRACT

The histopathology of Reldan 40EC and Actara 25WG insecticide, on the gall-bladder in frog *Rana* (*Pelophylax*) *ridibunda*, which is one of Romanian major frog species, were determined by light microscopy. The frogs were experimentally exposed to sub-lethal concentrations (0.01ml chloropyrifos-methyl/g body weight and 0.5mg thiamethoxame/g body weight) of these insecticides for 3 weeks at two thermic levels (4-6˚C and 22-24˚C). The toxic was administered by intraperitoneal shots, one shot every two days, in a scheme of 3 weeks. Tissues were normal in the control group. In both toxic substances investigated, one can notice the epithelial metaplasia in response to the harmful action of the toxic and the presence of leukocyte infiltrations at its base. The toxic effects of the two insecticides are more pronounced at the temperature of 22-24˚C, probably due to the more intensive metabolism of poikilotherms at this temperature. These pesticides cause morphological changes in the gall-bladder dealing especially with the covering epithelium.

INTRODUCTION

Over the last few years many amphibians' populations are declining dramatically and extinction has occurred in a few populations, caused by man-made changes in the environment (Carey and Bryant 1995). The increasing use of pesticides in modern agriculture has been mentioned as one of the reasons for the decline of the amphibian fauna (Phillips, 1990; Berrill et al. 1994). Pesticides such as chlopyrifos and thiamethoxame are used for pest control programs in the agricultural lands adjacent to the Arges River. Agricultural runoff, aquaculture effluents, and domestic effluents directly enter into the river through drains and tributaries. In addition, the industries located in the vicinity of tributaries discharge effluents into the river.

Disturbance of living processes at the molecular and subcellular levels of biological organization by xenobiotics can lead to cell injury, resulting in degenerative and neoplastic diseases in target organs (Pacheco and Santos, 2002).

Therefore, the objective of the present study was to investigate contaminant-related histopathology in gall-bladder frog *Rana (Pelophylax) ridibunda*, exposed experimentally to sublethal concentration at two insecticides (Reldan 40EC and Actara 25WG) at two thermic levels (4-6ºC and 22-24ºC).

MATERIAL AND METHODS

The animals, frog *Rana (Pelophylax) ridibunda*, were captured in the surrounding areas of the city Pitesti (Romania) and were kept in aquaterrarios filled with tap water. The water was changed daily to avoid the accumulation of toxic substances. After 10 days of adaptation in the lab, the frogs were separated in lots, which were used separately for the following experiments: two lots of control individuals, containing animals kept in laboratory at 4-6^{o}C, respectively at 22-24ºC with no treatment, in running water which was changed everyday, (1) one lot containing animals which were subjected with Reldan 40EC insecticides in a dose of 0.01ml chlopyryfos-methil/g of body weight and kept at 4-6ºC, (2) a second lot containing animals which were subjected with Reldan 40EC insecticides in same dose and kept at 22-24ºC, (3) a third lot contains animals treated with Actara 25WG insecticides in a dose of 0.5mg thiamethoxame/g body weight and kept at 4-6ºC and (4) a fourth lot contains animals treated with Actara 25WG insecticides in same dose and kept at 22-24ºC.

The administered dosage of insecticide was not lethal as none of the subjects died through the experiment. The toxic substances were administered by intraperitoneal injection, one injection at 2 days in a scheme for 3 weeks.

We began sacrificing the animals at the end of treatment by decapitation, under chloroform anesthesia, and gall-bladders were quickly removed. The pieces were fixed in 8% formalin for poikilotherms and further processed for paraffin wax-embedding using routine protocols. Consecutive 5 µm-thick sections were cut using a rotary microtome (Slee Maintz Cut 5062) and a series of sections were stained with H&E and Sirius red for collagen (Juncueira et al. 1979).

The toxic substances used were the insecticide commercialized under the generic name „Reldan 40EC" which has as an active substance the chloropyrifos-methyl and Actara 25WG insecticides with thiamethoxame as an active substance.

Reldan 40EC is an organophosphorous pesticide that is currently registered, or has tolerances pending, for crops and livestock, ornamental plants, turf, household pests, and mosquito control. The most obvious threat to the aquatic environment is its use as a mosquito larvicide's; fish and aquatic invertebrates can also be affected through runoff due to certain terrestrial uses (Cebrián, 1992).

Thiamethoxam is a neonicotinoid insecticides and its chemical name is: {3-[(2-chloro-5-thiazolyl)methyl]tetrahydro-5-methyl-*N*nitro-4*H*-1,3,5-oxadiazin-4-imine}. These chemical structures are slightly different than the other neonicotinoid insecticides, making it the most water soluble of this family (Fishel, 2005). The mode of action is essentially one of cytotoxicity, cell death, both as single cell necrosis and apoptosis, and increased cell replication rates (Green et al., 2005).

RESULTS AND DISCUSSION

The frogs possess a gall-bladder in which hepatic bile, the immediate secretion product of the liver, is stored between meals before being discharged into the duodenum during digestion. Although the volume of the gall-bladder may be only one thirtieth of the volume of bile secreted daily by the liver, the gall-bladder selectively concentrates the bile and can thereby hold up to one half of the daily output of hepatic bile (Schmidt and Ivy, 1937). The lining epithelium consists of a single layer of columnar cells resting upon the connective tissue layer. The fibro-muscular coat contains collagen and elastic fibers together with smooth fibers (fig.1a, b).

Animals receiving Reldan 40EC insecticide in concentration of 0.01ml chlorpyrifos/g body weight and kept at a temperature of 4-6°C have highlighted changes in the gallbladder, which tend to consist of epithelial stratification as a result of toxic action (fig.2a). Epithelial cell nuclei are more elongated. The fibro-muscular coat is thickened and has more collagen fibers intensely colored in Sirius red. In animals treated with the same concentration of insecticide but kept at a temperature of 22-24°C the epithelial metaplasia is more pronounced, due to the fact that the insecticide action is more pronounced at this heat level (fig.2b). This reaction is explained by the tendency of epithelium to protect deep structures. The epithelial cells are provided with cellular infiltrations reaching the capillaries located in the fibro-muscular coat.

Actara 25WG in concentration of 0.5mg thiamethoxame/g body weight also shows its toxic action on the gallbladder. Thus, in animals kept at a temperature of 4-6°C, one can notice the hypertrophy of epithelial cells with a tendency of stratification and epithelial disorganization. Cells have a slightly disorganized apical membrane and elongated picnotic nucleus (fig.3a). The striated plateau characteristic of these cells is not well individualized, which is likely to make them lose their resorption function. The basement membrane is integral. The same concentration of toxic causes a more pronounced pseudo-stratification of gallbladder epithelium to animals kept at 22-24°C (fig.3b). Epithelial cells are tall and oblong. There are certain lipid granules that push the nucleus to the periphery. The epithelial cells are provided with cellular infiltrations from blood capillaries in proximity to the epithelium.

CONCLUSIONS

Intraperitoneal administration of sublethal concentrations of insecticides (Reldan 40EC and Actara 25WG) is the cause of morphological changes in the gallbladder dealing especially with the covering epithelium. In both toxic substances investigated, one can notice the epithelial metaplasia in response to the harmful action of the toxic and the presence of leukocyte infiltrations at its base. It can also be concluded that the toxic effects of the two insecticides are more pronounced at the temperature of 22-24˚C, probably due to the more intensive metabolism of poikilotherms at this temperature.

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FIGURES

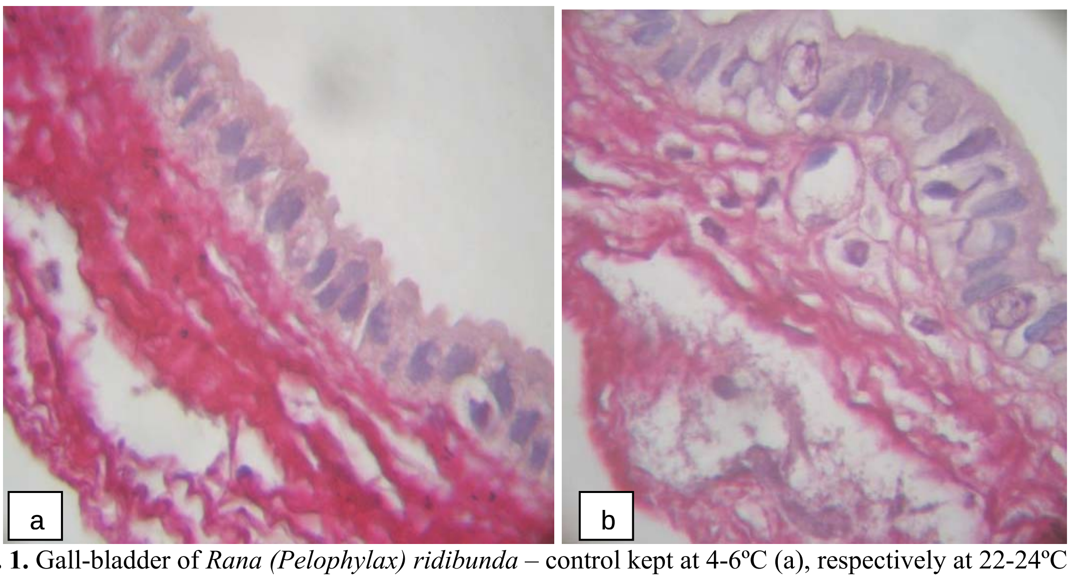

Fig. 1. Gall-bladder of *Rana (Pelophylax) ridibunda* – control kept at 4-6ºC (a), respectively at 22-24ºC (b). 400×. H-Sirius red.

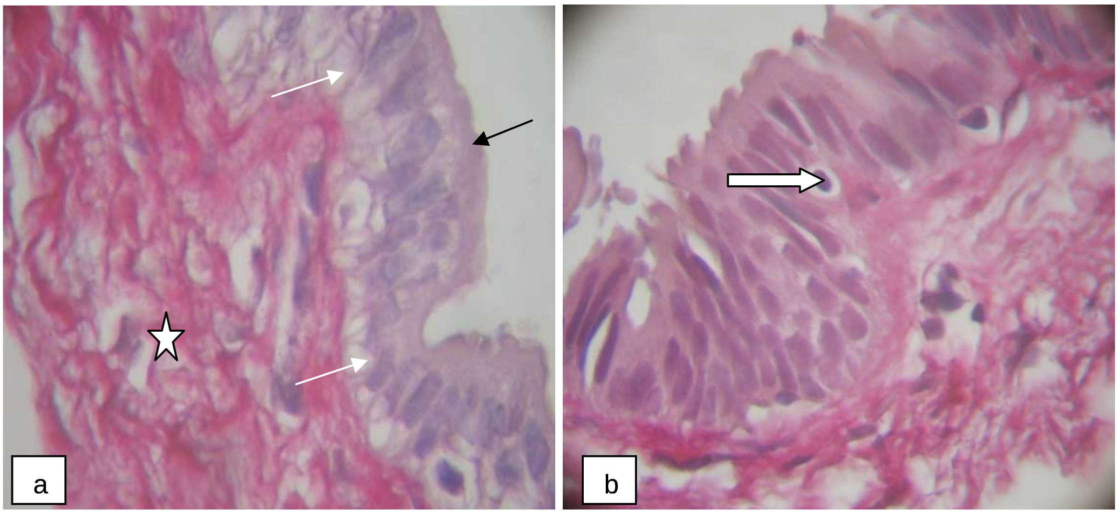

Fig. 2. a) Gall-bladder of *Rana (Pelophylax) ridibunda* treated with Reldan 40EC in a dose of 0.01ml/g body weight and kept at 4-6ºC: lining epithelium (black arrow); lipid granules (white arrows); fibro-muscular coat (star). b) Gall-bladder of *Rana (Pelophylax) ridibunda* treated with Reldan 40EC in a dose of 0.01ml/g body weight and kept at 22-24ºC. 400×. Perls, H-Sirius red.

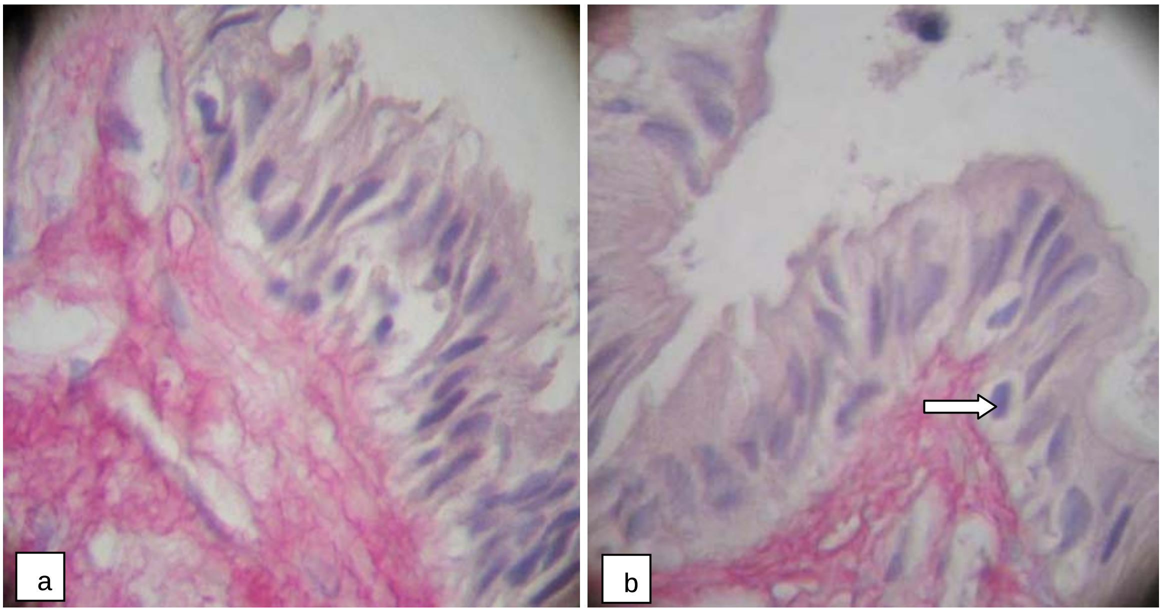

Fig. 3. a) Gall-bladder of *Rana (Pelophylax) ridibunda* (treatment with Actara 25WG in a dose of de 0.5mg/g body weight and kept at 4-6ºC). b) Gall-bladder of *Rana (Pelophylax) ridibunda* (treatment with Actara 25WG in a dose of 0.5mg/g body weight and kept at 22-24ºC): white arrow shows cellular infiltration. 400×. H-Sirius red.

Controlled cultivation of edible mushrooms on lignocellulosic wastes

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Keywords: edible mushrooms, semi-solid state cultivation, winery and vine wastes

ABSTRACT

The main aim of this work was focused on testing new practical procedures in order to optimize the efficiency of edible mushrooms cultivation by enhancing their fruit body formation during the semi-solid state cultivation on lignocellulosic wastes such as winery and vineyard wastes. According to this purpose, two mushroom species of Basidiomycetes, namely *Lentinus edodes* as well as *Pleurotus ostreatus* were used as pure mushroom cultures in experiments. The experiments of inoculum preparation were set up under the following conditions: constant temperature, 23°C; agitation speed, 90-120 rev min^{-1}; pH level, 5.0–6.0. All mycelia mushroom cultures were incubated for 120–168 h. In the next stage of experiments, the culture composts for mushroom growing were prepared from the lignocellulosic wastes as vineyard cuttings and marc of grapes in order to be used as substrata in mycelia development and fruit body formation. The tested culture variants were monitored continuously to keep constant the temperature during the incubation as well as air humidity, air pressure and a balanced ration of the molecular oxygen and carbon dioxide. In every mushroom culture cycle all the physical and chemical parameters that could influence the mycelia growing as well as fruit body formation of *L. edodes* and *P. ostreatus* were compared. In the final stage, the mushroom fruit bodies were harvested and weighted the results showing the percentage of 40-50% from the culture media weight.

INTRODUCTION

The agricultural works as well as the industrial activities related to vine crops and wine processing have generally been matched by a huge formation of wide range of waste products. Many of these lignocellulosic wastes cause serious environmental pollution effects, if they are allowed to accumulate in the vineyards or much worse to be burned on the soil (Chahal, 1994). The solid substrate fermentation of plant wastes from agro-food industry is one of the challenging and technically demanding of all biotechnologies known to humankind (Beguin and Aubert, 1994). The major group of fungi to degrade cellulose and lignocellulosic materials are the edible mushrooms of Basidiomycetes Class (Carlile and Watkinson, 1996).

The main aim of this work was to find out the best biotechnology of recycling the winery and vineyard wastes by using them as a growing source for edible mushrooms and, last but not least, to protect the vineyard ecosystems (Petre and Petre, 2009). Taking into consideration that most of the edible mushrooms species requires a specific micro-environment including complex nutrients, the influence of all physical and chemical factors upon fungal biomass production and mushroom fruit bodies formation of has been studied by testing new biotechnological procedures (Petre et al., 2007).

MATERIALS AND METHODS

According to the main purposes of this work, two fungal species of Basidiomycetes group, namely *Lentinus edodes* (Berkeley) Pegler (folk name: Shiitake) as well as *Pleurotus ostreatus* (Jacquin ex Fries) Kummer (folk name: Oyster Mushroom) were used as pure mushroom cultures isolated by authors from the natural environment and now being preserved in the local collection of the University of Pitesti. The stock cultures were maintained on malt-extract agar (MEA) slants (20% malt extract, 2% yeast extract, 20% agar-agar). Slants were incubated at 25°C for 120-168 h and stored at 4°C. The pure mushroom cultures were expanded by growing in 250-ml flasks containing 100 ml of liquid malt-extract medium at 23°C on rotary shaker incubators at 110 rev min^{-1} for 72-120 h. To prepare the inoculum for the spawn cultures of *L. edodes* and *P. ostreatus* the pure mushroom cultures were inoculated into 100 ml of liquid malt-yeast extract culture medium with 3-5% (v/v) and then maintained at 23-25°C in 250 ml rotary shake flasks.

The experiments of inoculum preparation were set up under the following conditions: constant temperature, 25°C; agitation speed, 90-120 rev min $^{-1}$; initial pH, 5.5–6.5. All the seed mushroom cultures were incubated for 120–168 h. After the inoculum preparation, the experiments were focused on getting the spawn of *L. edodes* and *P. ostreatus*. In this respect, the seed cultures of these mushroom species were inoculated in liquid culture media (20% malt extract, 10% wheat bran, 3% yeast extract, 1% peptone) at pH 6.5 previously distributed into rotary shake flasks of 1,000 ml. During the incubation time period, all the spawn cultures were maintained in special culture rooms, designed for optimal incubation at 25°C (Ropars et al., 1992). In the next stage of experiments, the culture composts were prepared from the lignocellulosic wastes resulted from vineyard cuttings and marc of grapes. In this respect, there were prepared three variants of culture compost made of marc grapes and vineyard cuttings in the following ratios: 1:1, 1:2, 1:4 (w/w).

The vine and winery wastes were mechanical pre-treated by using an electric grinding device to breakdown the lignin and cellulose structures in order to make them more susceptible to the enzyme actions (Lamar et al., 1992; Leahy and Colwell, 1990). After that, the specific sources of carbon, nitrogen and minerals were added in the mentioned amounts to each variant of culture composts. All the culture compost variants made of ground vineyard and winery wastes were transferred into 1,000 ml glass jars and disinfected by steam sterilization at 120°C for 60 min. When the jars filled with composts were chilled they were inoculated with the liquid spawn already prepared.

RESULTS AND DISCUSSION

Each culture compost variant for mushroom growing was inoculated using liquid spawn having the age of 72–220 h and the volume size ranging between 3–9% (v/w). During the period of time of 18–20 d after this inoculation, all the mushroom cultures had developed a significant mycelia biomass on the culture substrata made of vineyard cuttings and marc of grapes (Petre and Petre, 2008).

According to the registered results of the performed experiments the optimal laboratory-scale biotechnology for edible mushroom cultivation on composts made of marc of grapes and vineyard cuttings was established. The effects induced by some additional ingredients as carbon sources upon the mycelia growing during the incubation were investigated, as it is shown in Fig. 1.

Each carbon source was added to the basal composts at a concentration level of 5% (w/w) and the incubation time period lasted for 168-288 h (Petre et al., 2009; Smith, 1998).
Maltose, as one of all tested carbon sources, had shown the highest influence upon the mycelia growing and fresh fungal biomass production about of 28–35g%. The effects of nitrogen sources were registered as they are shown in Fig. 2.

Among these five nitrogen sources examined, wheat bran was the most efficient upon the mycelia growing and fungal biomass producing, at 35-40 g% fresh fungal biomass weight, being closely followed by the malt extract at 25–30 g%. At the same time, malt extract was one of the best nitrogen sources for a high mycelia growing at about 25–30g% fresh fungal biomass weight. Peptone, tryptone and yeast extract are also well known nitrogen sources for fungal biomass synthesis but their efficiency in these experiments was relatively lower than the mycelia growing and fungal biomass production induced by the wheat bran added as natural organic nitrogen sources (Petre and Petre, 2008). All the experiments were carried out for 288 h at 25°C with the initial pH 6.5 and all data are the means of triple determinations carried out on the variants of composts made of vineyard cuttings and marc of grapes in the ratio 1:4.

The influence of various mineral sources upon fungal biomass production was examined at a standard concentration level of 1% (w/w). Among the various mineral sources examined ($CaCO_3$, $CaSO_4$, $MgSO_4 \cdot 5\ H_2O$, K_2HPO_4 and KH_2PO_4), $CaCO_3$ yielded the best mycelia growing as well as fungal biomass production at 28-32 g% and for this reason it was registered as the most favourable mineral source (Fig. 3).

Almost similar observations were made by Stamets (1993), during the experiments concerning other techniques of mushroom cultivation as well as other researchers (Moser, 1994; Verstraete, 1992; Wainwright, 1992). Also, other tested mineral sources, such as $MgSO_4 \cdot 5\ H_2O$ have shown an optimal influence upon the fungal biomass growing. At the same time, the mineral sources K_2HPO_4 and KH_2PO_4 as essential phosphates could improve the pH level through their buffering action, but they were less favourable for mycelia growing in submerged as well as in surface cultures of mushrooms.

The experiments were carried out for 144 h at 25°C with the initial pH 6.5. Data are the means of triple determinations carried out on the variants of composts made of vineyard cuttings and marc of grapes in the ratio 1:4. The influence of initial pH upon mushroom fruit body formation and development was noticed and registered (Fig. 4). The optimal pH levels for the mushroom fruit body production were 6.5 – 7.0 for both mushroom species, registered at the temperature level of 17°C.

The whole period of mushroom growing from the inoculation to the fruit body formation lasted between 30–60 d, depending on each fungal species used in experiments and for this purpose there were used special culture rooms. During the whole processes of fruit body formation and development, the culture parameters were set up and maintained at the following levels, depending on each mushroom species: air temperature, 15–17°C; the air flow volume, 5–6m^3/h; air flow speed, 0.2–0.3 m/s; the relative moisture content, 80–85%, light intensity, 500–1,000 luces for 8–10 h/d.

The final fruit body production of these mushroom species used in experiments was registered between 1.5 – 2.8 kg relative to 10 kg of composts made of vineyard and winery wastes.

CONCLUSIONS

1. The registered data revealed that by applying this biotechnology, the winery and vineyard wastes could be recycled as useful raw materials for culture compost preparation in order to get edible mushrooms

2. Studying the comparative effects of physical and chemical factors that could influence the mycelia growing as well as fruit body formation and development of *L. edodes* and *P. ostreatus* there were registered the following representative results:

- maltose, as one of all tested carbon sources, had shown the highest influence upon the mycelia growing and fresh fungal biomass production about of 28–35 g%;
- among the five nitrogen sources examined, wheat bran was the most efficient upon mycelia growing and fungal biomass production of *L. edodes* and *P. ostreatus* at 35-40 g% fresh fungal biomass weight, being closely followed by the malt extract at 25–30 g%
- $CaCO_3$ yielded the best mycelia growing as well as fungal biomass production at 28-32 g% and was registered as the best mineral source;
- the optimal pH levels for the mushroom fruit body production were 6.5 – 7.0 for both mushroom species, registered at the temperature level of 17°C;

3. The final fruit body productions of these two mushroom species were registered between 1.5 – 2.8 kg relative to 10 kg of composts made of vineyard and winery wastes.

ACKNOWLEDGEMENT

This work was supported by the contract no. 51-002/2007, in the framework of National Research Programme, granted by The Ministry of Education and Research of Romania.

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FIGURES

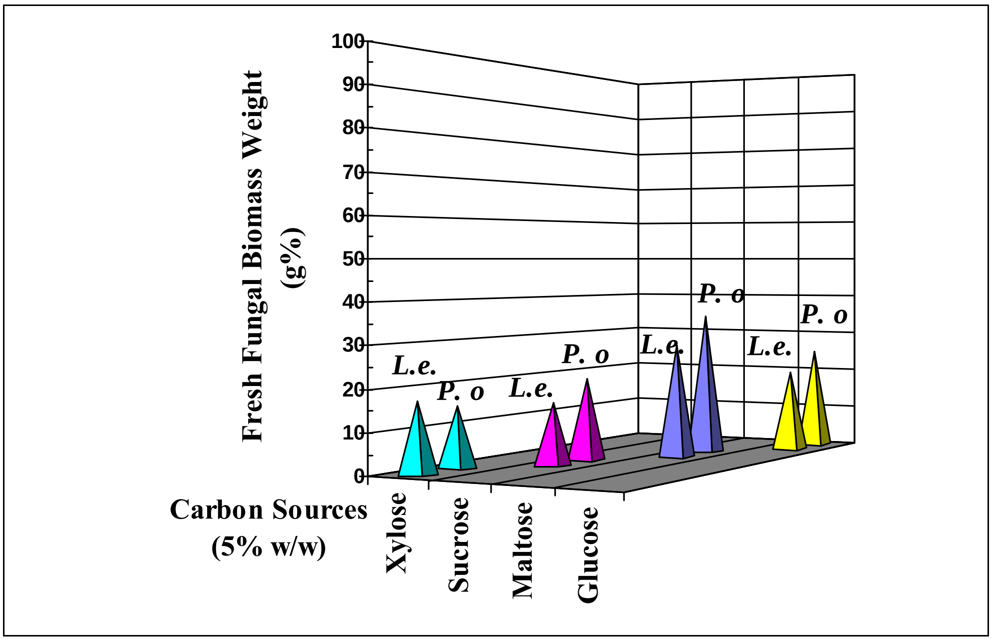

Fig. 1. Comparative effects of carbon sources upon mycelia growing of *L. edodes* (*L. e.*) and *P. ostreatus* (*P.o.*)

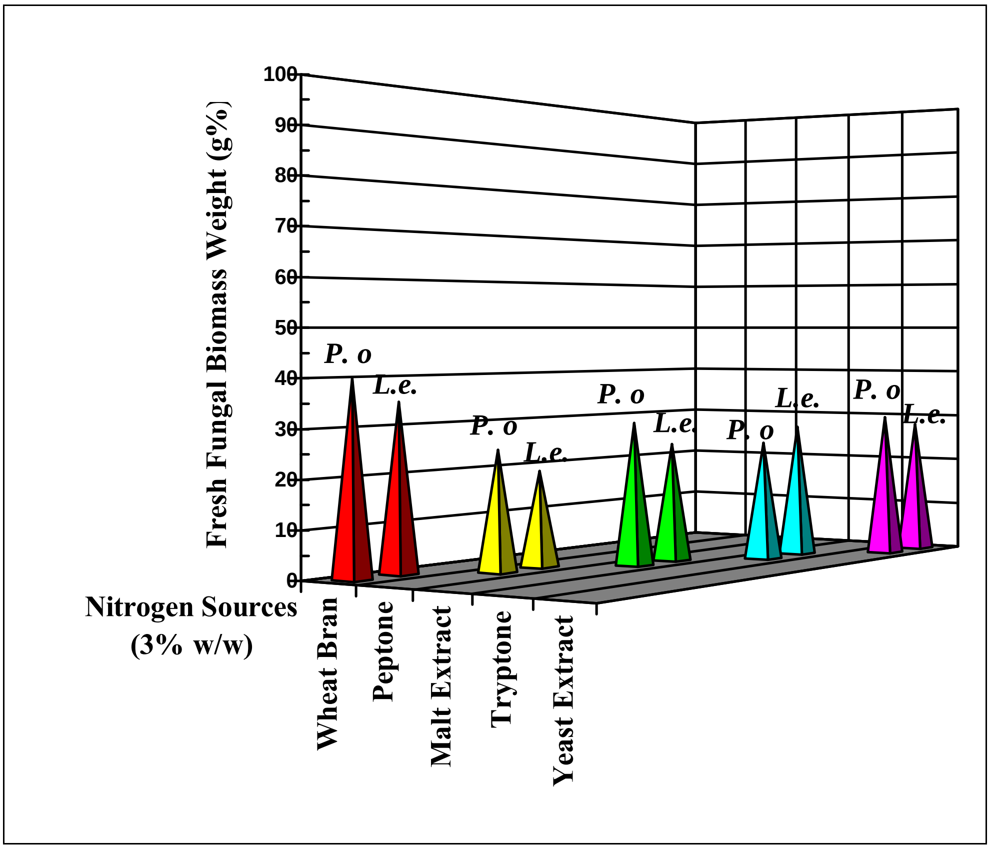

Fig. 2. Comparative effects of nitrogen sources upon mycelia growing of *L. edodes* (*L. e.*) and *P. ostreatus* (*P.o.*)

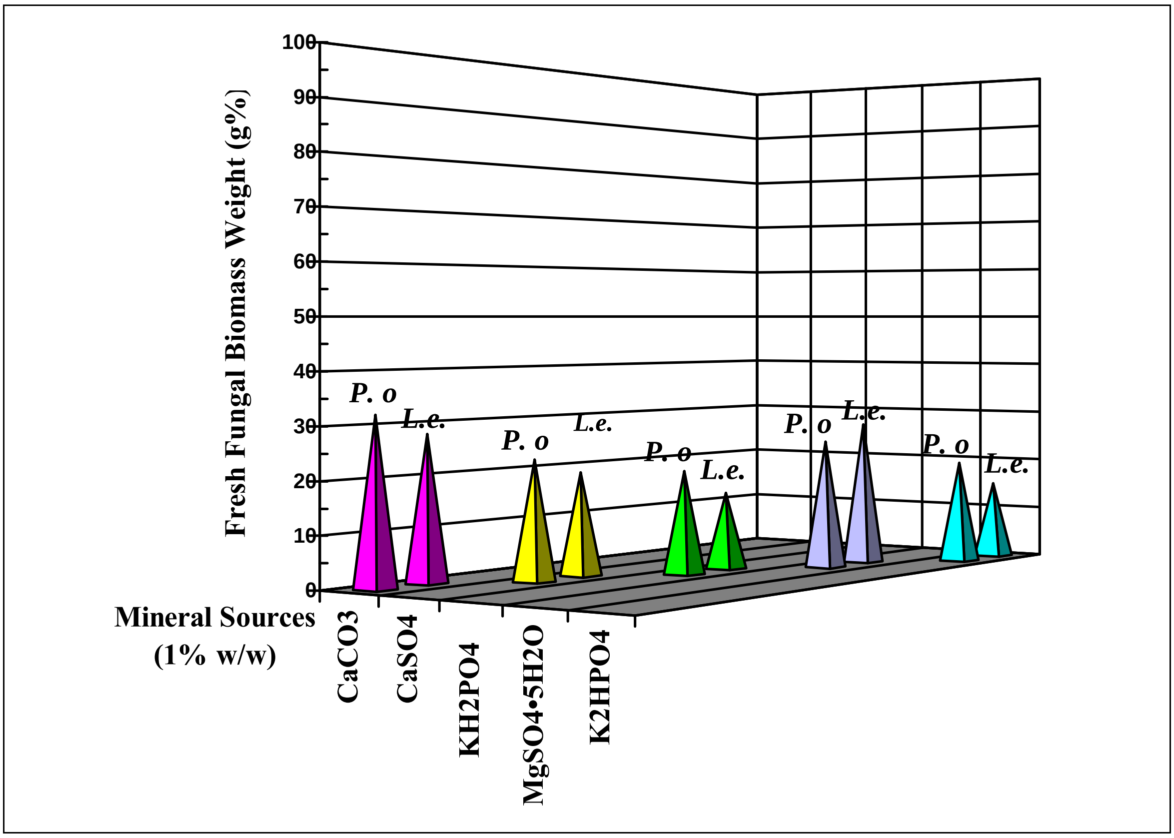

Fig. 3. Comparative effects of mineral sources upon mycelia growing of *L. edodes* (*L. e.*) and *P. ostreatus* (*P.o.*)

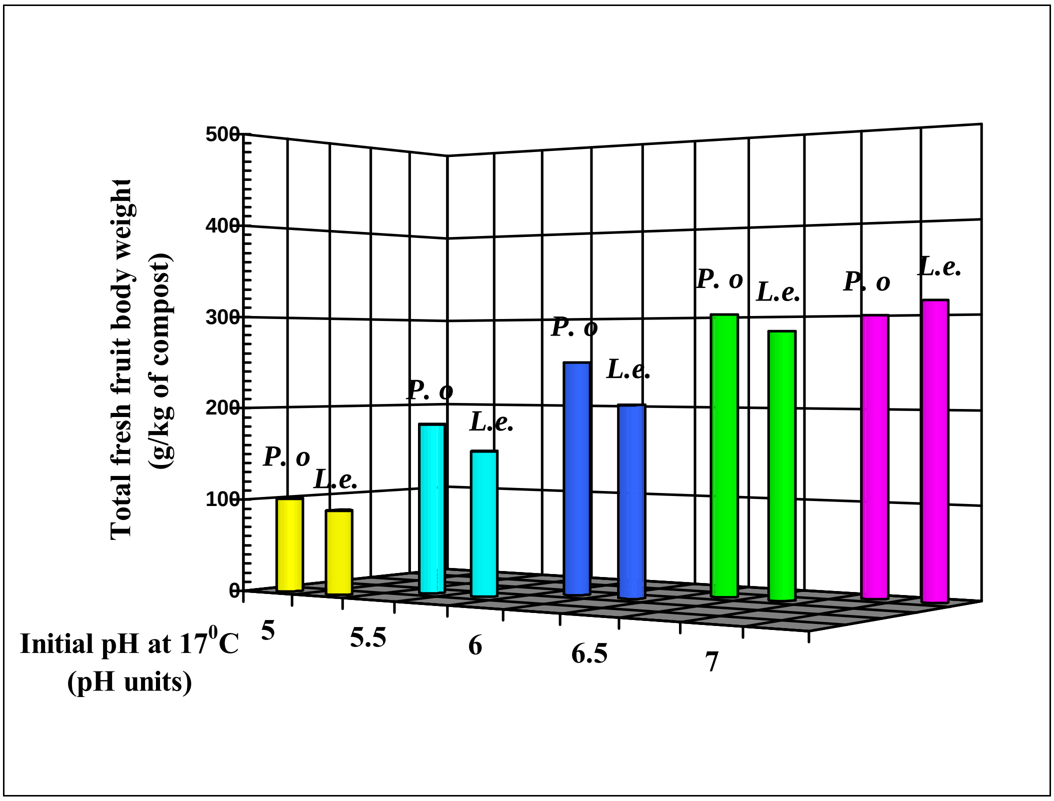

Fig. 4. The influence of initial pH upon fruit body formation of *L. edodes* (*L. e.*) and *P. ostreatus (P.o.)*

Characterization of soil chemical parameters at *Arnica montana L.*

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Keywords: *Arnica montana*, soil, parameters, proprieties

Abstract

According to the Red List of higher plants from the Romanian flora, this species is considered vulnerable and rare. *Arnica montana* is a long-lived perennial species, whose distribution is restricted to Europe. Formerly, *A. montana* was a common plant of nutrient-poor grasslands and dry heathlands. Research on soil analysis is part of the theme project called "Chorology study of the flora sozological categories Arges county to restore endangered by conventional methods of breeding and biotechnology". Analysis performed consisted in determining soil pH, hydrolytic acidity (HA), cation exchange bases sum (BC), total cation exchange capacity (CEC), cation saturation level (BS). Soil samples of the random selected plots have been analysed at a laboratory of Soil Science from University of Pitesti. The results of pH soil of *Arnica montana* species are part from strong soil acid reaction category. The average result of base cations was 12.42 meq/100 g. Results will be used to achieve a nutrient mixture on the propagation of rare medicinal species.

INTRODUCTION

Arnica montana L. has been used over the years in traditional medicine in Europe and North America. The plant inflorescence has valuable anti-inflammatory and cicatrizing properties. These properties are due to the presence of sesquiterpene lactones of the helenalin type. These lactones also have a cardiotonic and cardiotoxic action (Malarz et al., 1993). For these reasons, *Arnica montana* has been excessively collected and became rare.

According to the Red List of higher plants from the Romanian flora (Olteanu et al., 1994), this species is considered vulnerable and rare. *Arnica montana* is a long-lived perennial species, whose distribution is restricted to Europe (Hultén, Fries 1986). Formerly, *A. montana* was a common plant of nutrient-poor grasslands and dry heathlands (Kahmen and Poschlod 2000). Recently, habitat fragmentation, abandonment of pasturing and collection for herbal use has led to its rapid decline. Consequently, *A. montana* is considered one of the most threatened grassland species in the Netherlands and in Central Europe (Pegtel, 1994). In the Alps, *A. montana* is locally present in mountain areas with low-intensity land use practices, and its collection has been regulated since 1932 at the national level and since 1977 regionally due to its frequent use as a medicinal plant (Parolo et al., 2008). Following the European Union (EU) Habitats Directive 92/43/EEC (Annex V), *A. montana* has been designated as a plant species of community interest, whose exploitation may be managed and whose conservation should be encouraged. The C.E. Directive no. 92/43/EEC from the 21 of may 1992 regarding the conservation of natural habitats and wild flora and fauna, in the 5-th Anexe, concerning plant species of comunitarian interest, the drawing and exploitation of witch are the subject of management plans, specify at this category the species: *Lycopodium selago* L., *Lycopodium alpinum* L., *Lycopodium annotinum* L., *Lycopodium clavatum* L., *Lycopodium tristachyum* Pursh (Lycopodiaceae family), *Galanthus nivalis* L. (Amarillidaceae family), *Arnica montana* L. (Asteraceae family) and *Gentiana lutea* L. (Gentianaceae family) (Alexiu, 2008).

Edaphic factors, through their properties, are limiting factors that determine plant growth and development, and creation and development of plant communities are closely related.

Soil acidity influences the composition and microbial activity, thereby causing both the speed of decomposition and mineralization of organic matter and type of mold resulting from such processes (Hopkins et al., 1990, Greszta et al., 1992, Raubuch and Beese, 2005).

MATERIALS AND METHODS

Research on soil analysis are part of the theme project called "Chorology study of the flora sozological categories Arges county to restore endangered by conventional methods of breeding and biotechnology" funded by the National Center for Program Management – Bucuresti.

Analysis performed consisted in determining soil pH, hydrolytic acidity (HA), cation exchange bases sum (BC), total cation exchange capacity (CEC), cation saturation level (BS).

Soil samples of the random selected plots have been analysed at a laboratory of Soil Science from University of Pitesti. All analysis has been determined to get information about chemical parameters of *Arnica montana* soil.

The pH is defined as the negative logarithm of the hydrogen ion activity. Since pH is logarithmic, the H-ion concentration in solution increases ten times when its pH is lowered by one unit. The pH normally found in soils varies from 3 to 9.

Determination of pH was done by potentiometric method in suspensions of soil with a pH meter. PH analysis was performed through the five repetitions.

Cation-exchange capacity (CEC) is defined as the sum total of exchangeable cations that a soil can adsorb. The CEC is a reversible reaction in the soil solution and may arise from permanently charged or pH-dependent sites on organic and mineral colloid surfaces. The CEC is commonly expressed in units of meq 100 g^{-1} soil and can range from less than 1.0 to greater than 100 meq 100 g^{-1} soil. The CEC is dependent upon negative charges of soil components. The mechanisms for these charges are isomorphic substitution within layered silicate minerals; broken bonds at mineral edges and external surfaces; dissociation of acidic functional groups in organic compounds; and preferential adsorption of certain ions on particle surfaces (Rhoades, 1982).

Hydrolytic acidity (HA) is that fraction of total acid cation exchange which corresponds to the amount of acidity to be neutralized to achieve adequate response in ordinary course of soil microbiological activity and plant nutrition. Hydrolytic acidity was determined by Kappen method by titration of soil suspensions with NaOH 0.05n.

Cation exchange bases sum is the sum of exchangeable cation content (Ca^{2+}, Mg^{2+}, K^+, Na^+). Base cation exchange sum (BC) was determined by the Kappen.

Total cation exchange capacity (T) was determined by summing values hydrolytic acidity and sum of base cation exchange.

Base saturation level is a defining component of cation exchange properties. Degree of base saturation (BS (%)) was calculated by using the following mathematical relations in function of hydrolytic acidity:

$$BS\ (\%) = [BC / (HA + BC)] * 100$$

Data are presented as average of the five sampling dates.

RESULTS AND DISCUSSION

PH analysis was performed through the five repetitions. The results are shown in Figure 1. The results of the nutrient substrate *Arnica montana* species are part from strong soil acid reaction category. Average results obtained after analysis was 4.08 (fig. 1). Other researchers have reported 4.49 level for pH (Kleijn, 2008).

In order to determine hydrolytic acidity were performed five repetitions, the average results of hydrolytic acidity value was 2.95 me / 100 g. Hydrolytic acidity (HA) results were expressed in milliequivalents/100 g soil (Fig. 5).

Base cations are the sum of exchangeable cation content (Ca^{2+}, Mg^{2+}, K^+, Na^+). In determining the base cations were made five repetitions. Results were expressed in milliequivalents/100 g soil. The average result of base cations was 12.42 meq/100 g soil (fig. 3).

Growth sites of rare and common plant species typical of heathland and closely related acidic nutrient-poor grasslands differed significantly in the concentration of soil NH4 and the soil NH4/NO3 ratio but not in concentrations of any other biogeochemical factor known to influence plant fitness (Kleijn, 2008). The absence of rare species from sites with high concentrations of NH4 may be the result of them being outcompeted by more competitive species. A range of the investigated rare species has been found to be more sensitive to high NH4 concentrations or high NH4/NO3 ratios (Dueck and Elderson, 1992).

Because of the strong relationship between the pH and Al/Ca ratio it is difficult to establish which factor is more important in constraining the persistence of species. Furthermore, this suggests that the relationship between Al/Ca ratios and the occurrence of rare heathland species observed by Fennema (1992) could equally well be explained by differences in pH rather than differences in tolerance to high Al/Ca ratios. In part, this may be related to the poor dispersability and short *Arnica montana* seed longevity of the more endangered heathland species (Strykstra et al., 1998).

Cation exchange cation results (CEC) was between 14,63 and 15,97 meq/100 g (fig. 4).

According to the results shown in figure 5 of substrate nutrient of the *Arnica montana* species fall within the soil mezobazice terms of the degree of base saturation (80.8%).

CONCLUSIONS

Edaphic factors, through their properties, are limiting factors that determine plant growth and development, and creation and development of plant communities are closely related. Soil acidity influences the composition and microbial activity, thereby causing both the speed of decomposition and mineralization of organic matter and type of mold resulting from such processes.

The results of the soil substrate *Arnica montana* species are part from strong soil acid reaction category. Average results obtained after analysis was 4.08. Base cations are the sum of exchangeable cation content (Ca^{2+}, Mg^{2+}, K^{+}, Na^{+}). The average result of base cations was 12.42 meq/100 g soil. Cation exchange cation results (CEC) was between 14,63 and 15,97 meq/100 g.

Results will be used to achieve a nutrient mixture on the propagation of rare medicinal species.

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FIGURES

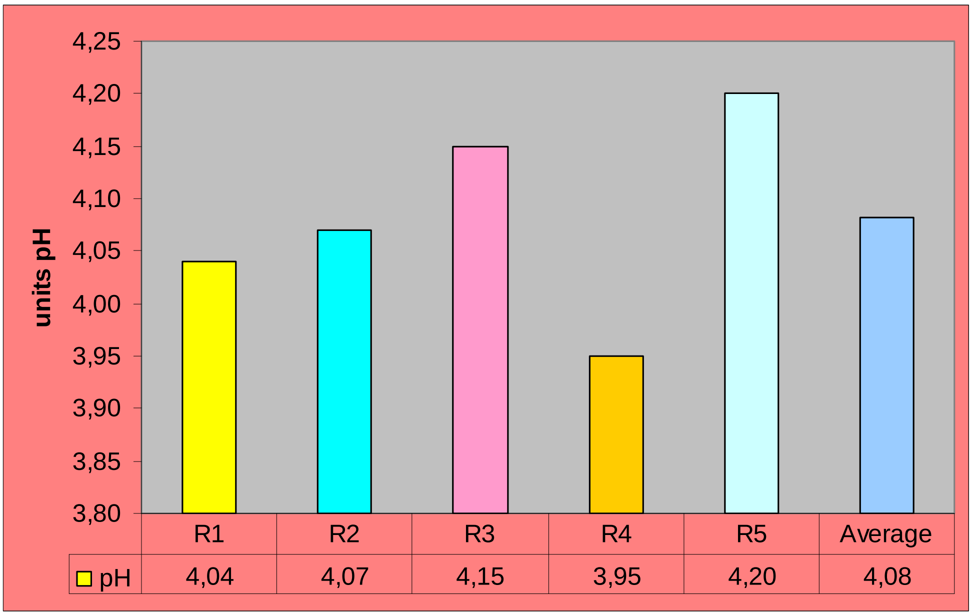

Fig. 1. pH results

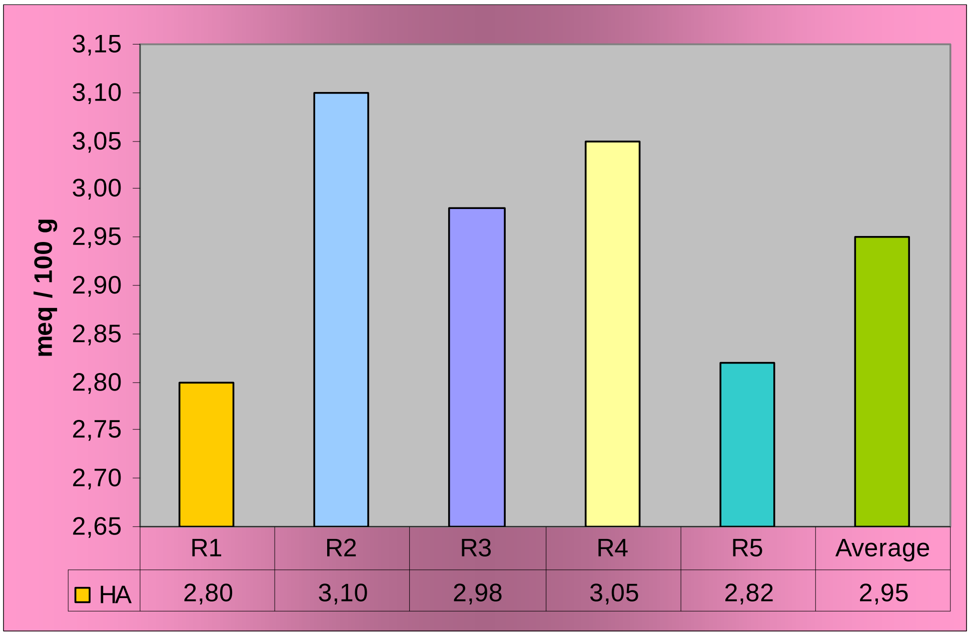

Fig. 2. Hydrolytic acidity results (HA - meq / 100 g)

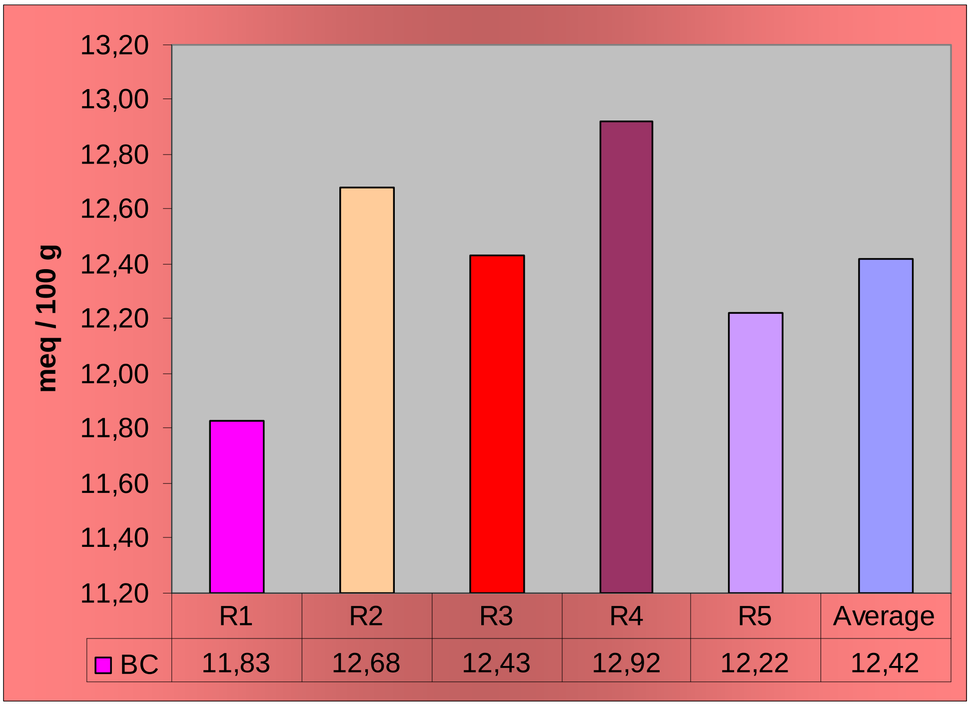

Fig. 3. Base cations (BC - meq / 100 g)

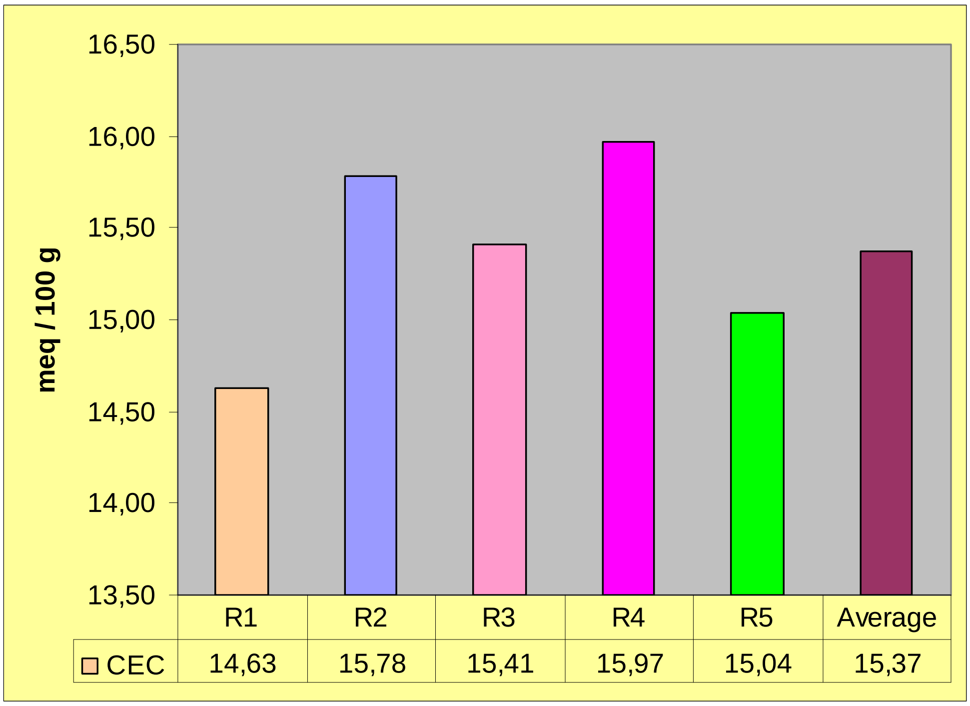

Fig. 4. Cation exchange cation results (CEC - meq / 100 g)

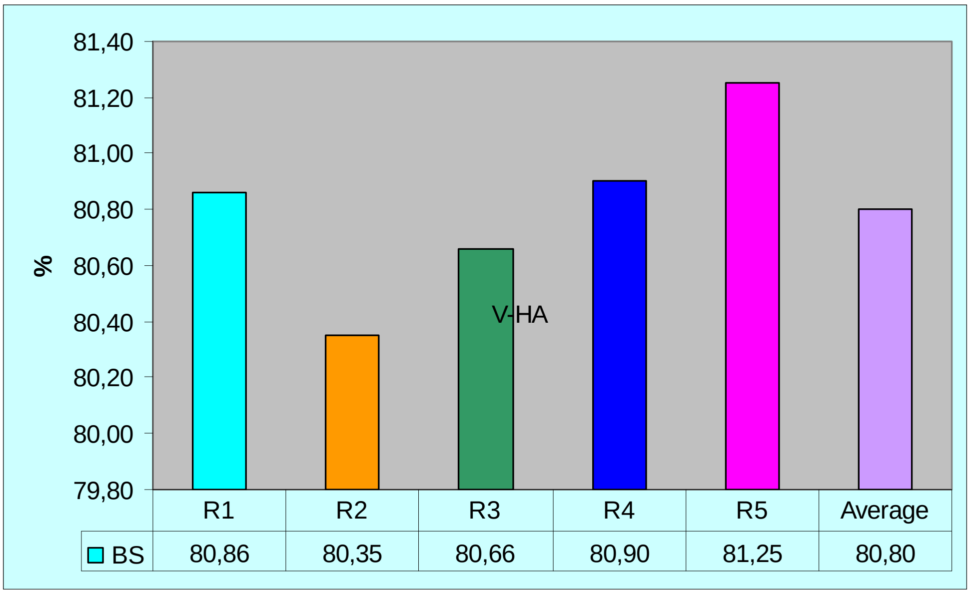

Fig. 5. Base saturation (BS - meq / 100 g)

Geographic and climatic conditions specific to Urziceni area correlated with the biological monitoring as method of studying the pollution level of an area

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Keywords: witness sample, lichen indicator, transplanted bioindicators, micobiont, determinator

ABSTRACT

The urbanization and the industrialization have an influence on the natural environment, the air, sublayer, affecting and making lean the diversity of lichens species. The morphologic particularities of lichens are directly influenced by the natural conditions specific to the human presence. Thus, away from the city, where there are better living natural conditions for lichens, one can find various species having lamellar and other types of thalluses.

INTRODUCTION

The characterization of the physical and geographical conditions and the analysis of the vegetation situation allow us to suppose a strong connection between the geologic, climatic, orographic factors, etc, regarding the structure and development of the vegetation and the anthropic factor. This last factor introduced into the green areas, apart from the autochthon species, a series of allochthonous species, benefic to the human health. Still, the present situation and the dynamics of the environmental factors quality are not examined very close. The study is adding new species among the inferior plants and is suggesting real bio-indicators in order to test the quality of the air, water, soil, etc.

MATERIALS AND METHODS

Urziceni area is situated in the Romanian Plain, in the central part of Baragan. Its neighbours are Ploiesti area in northern side, Buzau area in western side, Slobozia area in southern side and Voluntari-Ilfov in eastern side. Urziceni town, by its location, is situated to distances almost equal (50-60km) from Ploiesti, Buzau, Slobozia and Bucharest, being thus a connection point regarding communications (in the southern part of Carpathians) between N and S, or E and W sides of the country.

The relief of the investigated area is a hilly plain, being crossed by flowing waters, the most important being Ialomita river. There are also natural lakes and storage lakes. The climate of Urziceni area is clement. There are major changes of the climate which could be observed during the last years, meaning that summers are catching, canicular and dry periods alternating with rain storms and floods. Winters have keen frosts and blowing snows, when the snow is depositing unevenly. The springs and autumns became short, the transition to different temperatures being very sudden. During the winter time, it is the wind from the N, N-E the one which predominates and during summer time the one from W, S-W.

Regarding the soil, it's the levigated black carths which predominate. The investigated area is situated into the hydrographic basin of Ialomita river and its affluents, which are considered small rivers, having their beds not so deep, a little declivous, having small quantities of water, which, sometimes, during rainy periods cause floods, raise the ground water level and cause the emergence of swamps.

The examination of the vegetation is a complex procedure which represents not only a technique, but also a scientific research. This is why the lichens distribution is being recorded around the pollution sources, taking into account the regular spectrum of the existing species in various areas and each species specific frequency in the respective areas, the two characteristics being determined by the particular sensitiveness to pollution of each species.

The relief altitude or the height over the sea level is measured in meters with the altimeter. The altitude has been established according to the topographic maps having level curves and quota. When the fixed point is on a level curve, its altitude corresponds with the value represented by the curve. If the respective point is among the curves, its altitude will be found out through interpolation.

The relief character results from indicating the geographic and morphologic unit in which the investigated ecosystem exists and the relief form which he occupies.

The values of the meteorologic coefficients (the directions predominated by the movements of the air-masses, the values of temperatures, of the air humidity, of solid suspensions, SO_2, SO_4, CO, NO, NO_2, phenol, aldoform) have been established according to the data of the Hydrometeorologic Service of Slobozia and Urziceni Municipality.

The intensity of the road traffic has been determined according to the basic methodology, on the main streets, average time 10 min. (or 1 h), taking into account the rush hours of a day, a week and a year.

The minimum prominence surface of a plant formation, consisting in recording all the plants species, represents a sample surface called *witness*. The witnesses' number, meaning the sample surfaces from the plant formation, depends on the plant formation surface and on the plant formation itself. It can measure 1 sqm in case of lichens on the rocks and soil or even less (0,50 sqm), on the trees barks. The witnesses the most used are square or rectangular-shaped.

It is important to make right investigations; this is why certain norms and methods which have been already approved in similar researches must be complied with.

Lichens can be collected during all year long, precisely in rainy periods, when the thallus impregnates with water and gets the specific shape of the respective species. The samples are collected by using a strong knife, which allows the separation of the thallus from the woody underlayer or using a hammer and a chisel. It is necessary to collect both the thallus and the fructifying parts of the organism, using the eye glass - soredia, etc. The collected samples will be put in envelopes or paper-made packages having the size of 25 * 15 cm. The wet material will be dried out in airy rooms. Each sample will have its own label, indicating the collecting place, vegetation type, host underlayer, altitude above the ground, soil's particularities, brightness, date, and collector's name.

A label example used by us:

<table>
<tr><td colspan="4">Lichens in Urziceni area</td><td rowspan="8"></td></tr>
<tr><td><u>Ecosystem :</u></td><td>Sinesti forrest</td><td><u>Altitude</u></td><td>80 m</td></tr>
<tr><td><u>Exhibit:</u></td><td>E</td><td><u>Host</u></td><td>Acer platanoides</td></tr>
<tr><td rowspan="2"><u>Speciile:</u></td><td colspan="3">1. Physcia grisea - 15% of the sublayer's surface</td></tr>
<tr><td colspan="3">2. Xanthoria parietina -10%</td></tr>
<tr><td><u>Collection date:</u></td><td colspan="3">25.05.07</td></tr>
<tr><td><u>Collected by:</u></td><td colspan="3">Stupcanu Valeria</td></tr>
<tr><td><u>Determyned by:</u></td><td colspan="3">Campeanu Gheorghe, Stupcanu Valeria</td></tr>
</table>

The process of determining the sample into the lab starts visually first, by establishing the color, the ramification type. Then the color images, the drawings and the description of the species, their types have been examined, using the information from the speciality books. It has been sometimes necessary to cut the thallus, being then examined using the magnifier or the microscope. Chemical reagents have been also used, which, depending on the presence or the absence of certain lichens acids, color in different ways the thallusses.

The thallus color is more obvious in fresh samples.

The size of the collected samples depends also on easiness with which we can detach the material (for ex: as it is difficult to detach and transport the rock, we can choose the little samples having as much lichens as possible).

Lichens on the rocks can be separated intactly because they are pulled out slowly, by handling the knife cutting edge under the thallus, with slow moves. If the sublayer can not be recognized on the spot, a sample can be taken out of it, also, in order to identify it into the lab. The lichens having crusts are taken together with rock pieces.

Lichens on the trees barks or on dead or rotten wood are usually being detached together with the sublayer and they are being collected together. Lichens on the soil are being pulled out with little quantity of sublayer (about 6mm – 1 cm).

RESULTS AND DISCUSSION

Following the examination the lichens species presented in *Table 1* have been determined.

Lichens transplanting and examination methods

Most of the times, the epiphyte lichens are being used for transplantation. Their thalluses, together with the sublayer, having disk shapes, are being detached from the tree. These disks will be further distributed on the territory of the investigated ecosystem. If the MG evaluation into the ecosystem is foreseen, then it will not be recommended the use of metallic tools in order to collect and prepare the lichens thalluses for transfer and transplanting. The thalluses of the species easily collected will be chosen for transplanation. In Europe, for indicating the plants, it is the *Hypogymnia physoides, Evernia prunastri, Parmelia sulcata* species which are usually used. It is suggested to use a percentage in order to see how much the exponent layer has been affected comparing to its total surface during all examination period. The measurements are made by comparing the data gathered until and after the exhibit period (for ex: once per month).

Lichens gathered for exhibition are being collected together with their sublayer, from the old fallen trees, belonging to the same species (such trees are usually looked for during winter time). The disks which have been cut must be covered with well developped lichens samples on at least 2/3 of their surface. The lichens can be coolected from the growing trees only in exceptional cases. Lichens growing in different habitats can react differently to new conditions. This is why, for each measurements series, the exhibited lichens must be collected from the same vegetal group, as possible as this can be, having similar climate conditions (for ex, they must grow in an identical area as the tree grew).

Several lichens transplanting methods are known, but we used the method which supposes to fix the transplants using thin metallic wires on the trees bodies. The sample consist in lichens thalluses detached together with parts of the old trees external layer on which they developped, from the trunk of certain young spontaneous typical trees. The maximum altitude at which the samples will be placed on the trunk will be about 2 m to the soil level. During all research period and on the entire examined territory, the exhibits must be oriented in the same way to light (usually towards N). In order to fix external changes, meaning the deterioration of the sublayer, the lichens must be photographed before exhibiting them, according to the terms already set. Before taking each picture, the lichens must be splashed with distilled water, after which we have to wait (about 5 min.) until the water drops disappear from the lichens layer

Apart from the indices of external aspect, the dynamics of other indices can be worked up in the lab, like: accumulation of certain chemical elements, physiologic parameters, etc, which requires the layers examination.

Many trees species, present in the green area of the examines territory, have a great capacity of accumulating the sour gas (*Populus balsamifera*- until 180 g/t , *Ulmus laevis*-120 g/t, *Tilia cordata*-100 g/t, *Betula pendula*-90 g/t, *Acer negundo*-30 g/t, *Cornus sanguinea*-45 g/t, *Acer platanoides*-20 g/t, etc.). Some others have the capacity to ionize the air (*Robinia pseudoacacia, Quercus robur, Salix alba, Picea excelsa, Acer saccharinum, Sorbus nigra, Populus pyramidalis, Pinus silvestris*, etc.). There are also species with benefic influences on human healt (*Thuja orientalis, T. occidentalis, Morus nigra*, majoritatea speciilor din g. *Acer*, etc.). The correspondence between the lichens and trees used for transplantation can be seen in <u>*Table 2.*</u>

CONCLUSIONS

The characterization of the physical and geographical conditions and the analysis of the vegetation situation allow us to suppose an strong connection between the geologic, climatic, orographic factors, etc, regarding the structure and development of the vegetation and the anthropic factor. This last factor introduced into the green areas, apart from the autochthon species, a series of allochthonous species, benefic to the human health. Still, the present situation and the dynamics of the environmental factors quality are not examined very close. The study is adding new species among the inferior plants and is suggesting real bio-indicators in order to test the quality of the air, water, soil, etc.

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Table 1

Lichens in Urziceni area and morphological and ecological features

Gr. de Txtl	Lichens species	Morphological and ecologic				Systematic afiliation
		Thall	Sublayer type	Humidity type	Brightness type	
I	*Evernia prunastri (L.)Ach.*	Frut.	Cort.	Xf	Ff	Fam. Usneaceae
	Ramalina fraxinea (L.)Ach.	Frut.	Cort.	Xf	Ff	Fam. Ramalinaceae
	R .farinacea (L.)Ach.	Frut.	Cort.	Xf	Ff	Fam. Ramalinaceae
	Hypogymnia physodes (L.)Nyl.	Fol.	Cort., sax.	Mxf	Fsf	Fam. Hypogymnaceae
	Usnea hirta (L.)Krb.	Frut.	Cort.	Mxf	Ff	Fam. Usneaceae
	Physcia stellaris (Ach.)Nyl.	Fol.	Cort.	Xf	Ff	Fam. Physciaceae
II	*Parmelia sulcata Tayl.*	Fol.	Cort.	Xf	Ff	Fam. Parmeliaceae
	P. scortea Ach.	Fol.	Cort.	Xf	Ff	Fam. Parmeliaceae
	P. caperata (L.)Ach.	Fol.	Cort.	Xf	Ff	Fam. Parmeliaceae
	P. acetabulum (Neck.)Dub.	Fol.	Cort.	Mxf	Fsf	Fam. Parmeliaceae
	Parmeleopsis ambigua Nyg.	Fol.	Cort.	Mxf	Fsf	Fam. Parmeliaceae
	Graphis scripta (L.)Norm.	Crus.	Cort.	Mxf	Sf	Fam. Graphidiaceae
III	*Bacidia luteola (Mudd.)*	Crus.	Cort.	Mxf	Fsf	Fam. Lecidiaceae
	Lecanora allophana Ach.	Crus.	Cort.	Mxf	Sf	Fam. Lecanoriaceae
	L. carpinea	Crus.	Cort.	Xf	Ff	Fam. Lecanoriaceae
	Parmelia verruculifera	Fol.	Cort.	Xf	Ff	Fam. Parmeliacea
	Physcia aipolia Hampe.	Fol.	Cort.	Xf	Ff	Fam. Physciaceae
	Ph. orbicularis Hampe.	Fol.	Cort., sax.	Mxf	Fsf	Fam. Physciaceae
	Ph. hispida (Schreb.)	Fol.	Cort.	Xf	Ff	Fam. Physciaceae
	Ph. pulverulenta (Schreb.)Hampe.	Fol.	Cort.	Xf	Ff	Fam. Physciaceae
	Ph. cilliata (Hoffm.)DR	Fol.	Cort.	Xf	Ff	Fam. Physciaceae
	Arthopyrenia alba (Schrad.)Lesd.	Crust.	Cort.	Mf	Ff	Fam.Pleosporaceae
IV	*Lepraria aeruginosa Ach.*	Crust.	Cort., sax.	Xf	Ff	Fam. Phlyctidiaceae
	Lecidea glomerulosa Stend.	Crust.	Cort.	Mxf	Fsf	Fam. Lecidiaceae
	Physcia ascendens (Fr)Oliv.	Fol.	Cort.	Mxf	Fsf	Fam. Physciaceae
	Ph.caesia Hampe.	Fol.	Cort.	Xf	Ff	Fam. Physciaceae
	Ph.grisea (Lam.)A.Z.	Fol.	Cort.	Xf	Ff	Fam. Physciaceae
	Xanthoria parietina (L.)Th.Fr.	Fol.	Cort., sax.	Xf	Ff	Fam. Candelariaceae

Legend:
Frut-fruticulos; **Fol**-lamellar; **Crus**-with crust; **Cort**-corticol; **Sax**-saxicol; **Xf**- xerofit; **Mxf**-mezo- xerofit; **Ff**-fotofil; **Fsf**-foto-sciofil; **Sf**-sciofil

Table 2

Correspondence between lichens and trees species

Lichens species \ Trees species	*Acer platanoides*	*Fraxinus excelsior*	*Quercus robur*	*Aesculus hypocastanea*	*Betula pendula*	*Salix caprea*	*Salix argentea*	*Tilia cordata*	*Populus alba*	*Cerasius avium*	*Juglans regia*	*Padus avium*
Arthopyrenia sp.								*				
Bacidea luteola	*							*	*		*	
Evernia prunastri	*							*	*			
Graphis scripta		*		*								
Hypogymnia physodes									*			
Lecanora allophana			*									
Lecanora carpinea					*					*		
Lecidea glomerulosa	*			*		*		*			*	*
Parmeleopsis ambigua						*						
Parmelia acetabulum								*	*			
Parmelia caperata	*		*									
Parmelia scortea	*							*				
Parmelia sulcata	*		*			*		*	*			
Parmelia verruculifera	*											
Physcia aipolia	*					*			*			
Physcia ascendens	*		*	*	*	*			*		*	
Physcia caesia	*	*	*	*		*		*	*	*	*	*
Physcia cilliata						*					*	
Physcia grisea	*	*			*	*			*		*	
Physcia hispida	*	*	*	*		*	*	*	*		*	*
Physcia orbicularis	*		*	*				*				
Physcia pulverulenta	*	*	*			*	*	*	*			*
Physcia stellaris	*				*							
Ramalina farinacea									*			
Ramalina fraxinea									*			
Usnea hirta									*			
Xanthoria parietina	*	*	*	*	*	*	*	*	*	*	*	*
Total	16	6	9	7	5	10	4	13	14	2	9	6

Theoretical and experimental aspects of determining bruise tissue volume resulting from impact apples with a hard surface

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Keywords: injuries, impact force, Golden Delicious, Jonathan

ABSTRACT

Keeping commercial quality of fruit is a priority in the processes of harvesting, handling, sorting and packing. More than 30% of Golden Delicious apples are affected by these processes. These lesions cause reduced quality and lower commercial value of fruit. Impact between fruit or fruit between storage systems, packaging is a major cause of occurrence of injuries. Injuries caused by the impact loading depends on each fruit tissue structure. Dense tissue, with a low volume of air-filled interstitial space, is susceptible to deep bruises that are typically not visible at the skin surface and will often develop internal cone-shaped and radial fractures when impacted. The research followed by analytical determination of tissue bruise volume based on the values of impact force, so the height of fall on a hard surface.

INTRODUCTION

Mechanical harvesting and handling subject fruits to impact situations which often cause bruising. This type of damage is a result of the impact of the fruit on another fruit, the tree limb, or a hard or inadequately cushioned surface. The severity of the damage depends on the distance the fruit falls, the impact energy, the number of impacts, the type of impact surface, and the size and maturity of the fruit. The need to understand the factors influencing bruising caused by impact has led researchers to develop theoretical methods to analyze impact problems (Hamann, 1970; Horsfield et al., 1972; Rumsey and Fridley, 1977; Chen and Yazdani, 1991) and to develop instrumentation for measuring these parameters and relating them to bruising (Diener et al., 1979; Chen and Sun, 1981; Brusewitz et al.,1991). As a result, both theoretical and empirical methods for predicting damage in a fruit resulting from impacting on a hard surface or a surface of known firmness are readily available.

The objectives of this study were to:

• Investigate the degree of bruise in “Golden Delicious” and “Jonathan” apples caused by being dropped from different heights onto a hard surface.

• Analytical determination by the volume of tissue bruise.

MATERIALS AND METHODS

The fruits used in this study were “Golden Delicious” and “Jonathan” apples picked from SCDP Voinesti. They were picked on 15 September, and placed in a cold storage room at 2 ÷ 6 ^{0}C, being removed with 24 hours before the experiments. Fruits with bruises, cuts, or other visible damage or abnormalities where eliminated. After four months of storage the fruits were selected, they were numbered sequentially (from 1 to 24), and the weight and dimensions of each fruit were recorded.

The device used (Fig. 1) described by Vintila, M. (2002), is equipped with an attachment and detachment of the fruit, allowing the orientation of the fruit after center of mass.

The fruit is caught between two rods with rounded ends that go into the stem and calcium cavity, allowing direction rotation until after the center of mass.

After the fruits have been subjected to impact were stored at a temperature of 20^{o}C, in compartmentalized boxes and kept for five days, after which analysis was done to determine the impact area of injury.

Injury or visual examination was performed with a magnifying glass with magnification of 10X and 40X. To cut the bruise, the gauge is measuring, diameter and depth of bruise area.

Regarding the method of calculating the volume of tissue bruise, was done by approximating the geometric measurements. Given some considerations (Mohsenin 1986, Casandroiu et al., 1993) requiring that the volume of tissue bruise is obtained from two spherical segments with the same base, a circle of radius "*a*" (ray trace), one with a height $\delta = a^2/2R$, and the other height as the maximum depth "*b*", achieving bruise area calculation relationship:

$$V = \frac{\pi}{2}a^2 b + \frac{\pi}{6}b^3 - \frac{\pi}{2}b\delta(b-\delta) \text{ [mm}^3\text{] (1)}$$

where δ is the maximum strain during impact.

Under the simplified form the relationship (1) becomes:

$$V \approx \frac{\pi}{2}a^2 b + \frac{\pi}{2}b^2\left(\frac{b}{3} - \delta\right) \text{ [mm}^3\text{] (2)}$$

For relatively small amounts of tissue bruise volume, neglecting terms containing the δ causes errors under 2% resulting formula used for calculating final question:

$$V = \frac{\pi}{2}a^2 b \text{ [mm}^3\text{] (3)}$$

Computed values and observations on the fruit are presented in Tables 1 and 2.

RESULTS AND DISCUSSION

Noted in experiments conducted in the presence of a zone unaffected thighs, located in the first cell layer and another layer cell brown, usually at 1-2 mm depth of pulp, the shock wave limta. The presence of such areas has been found by other researchers (Horsfield et al.,1972, Casandroiu et al., 1994,). Injured cells have evolved over time during the five days of storing.. All these aspects are illustrated in figures 2 to 6.

Graphics study and analysis of fruits after five days resulted following:

- changes in tissue bruise volume growth is continuous from drop height of 150 mm, the highest values occurring in falls from a height of 400 mm to Jonathan variety;
- volume of damaged tissue from the same drop height is greater than the Jonathan variety, due to the structure and maturity of this variety;
- for drop height of 250 mm and 300 mm, there are no major differences in perspective concerning injured tissue;
- fruits that had a greater mass and volume were greater tissue bruise, which allows us to say that although the fruits had the same initial speed, mass and hence the fruit impact influenced the volume of damaged tissue.

CONCLUSIONS

On impact, plastic properties of the fruit, conferred by their viscoelastic behavior, do not have time to manifest, because of a shortly time in which the collision is produced, and the fruit behave as a rigid body. In this case, the shock energy which generate the flesh deformation, is not dissipated in the mass flesh and the flesh is crushed in contact point, the fruit is bruising, and for this reason is reduced the period of storage.

Following the analysis of fruit, were found damaged by the impact, often perfectly bounded, firmness reduced and presents a translucent appearance.

Level of shock intensity, variety and maturity of the fruit influence the volume of tissue bruise.

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TABLES AND FIGURES

Table 1

Tissue bruise on the variety Golden Deliceous

Version	Fruit mass [g]	Height drop [mm]	Fruit radius impact area [mm]	Diameter bruise area [mm]	Maximum depth of bruise area [mm]	Volume of tissue bruise [mm^3]
G1	115,60	100	30,75	-	-	-
G2	124,41	100	32,00	-	-	-
G3	125,36	100	32,10	-	-	-
G4	138,07	100	32,70	-	-	-
G5	115,93	150	30,25	9,6	1,0	36,190
G6	128,57	150	32,00	10,6	0,9	39,711
G7	129,88	150	30,30	4,8	3,7	33,477
G8	133,37	150	30,20	9,0	2,6	53,502
G9	113,38	200	30,50	11,4	1,0	51,035
G10	118,01	200	31,70	8,9	1,9	59,100
G11	125,65	200	32,30	8,7	1,8	82,702
G12	137,96	200	32,75	8,0	4,9	123,15
G13	108,13	250	30,50	9,8	1,8	67,887
G14	126,60	250	29,25	19,0	1,8	180,956
G15	127,03	250	31,75	12,8	3,0	193,019
G16	133,94	250	31,50	12,4	2,9	175,106
G17	112,44	300	31,70	11,5	3,9	202,544
G18	121,67	300	31,20	11,8	5,0	273,390
G19	131,92	300	31,80	12,9	4,8	313,675
G20	134,29	300	32,50	17,5	4,6	553,215
G21	106,32	400	28,95	16,7	4,0	438,079
G22	124,79	400	31,40	15,9	5,9	585,742
G23	132,55	400	30,80	17,7	3,7	676,658
G24	138,08	400	32,20	18,6	5,5	747,220

Table 2

Tissue bruise on the variety Jonathan

Version	Fruit mass [g]	Height drop [mm]	Fruit radius impact area [mm]	Diameter bruise area [mm]	Maximum depth of bruise area [mm]	Volume of tissue bruise [mm^3]
J1	157,54	100	34,90	-	-	-
J2	166,22	100	36,25	-	-	-
J3	172,98	100	37,20	-	-	-
J4	195,09	100	38,70	-	-	-
J5	151,23	150	33,65	17,5	4,6	553,21
J6	163,70	150	35,75	15,9	5,9	585,74
J7	172,00	150	36,90	17,2	5,9	685,43
J8	183,52	150	37,50	17,9	5,9	742,36
J9	134,40	200	31,70	17,5	6,3	757,66
J10	162,66	200	35,90	15,7	7,4	716,29
J11	169,97	200	36,40	18,6	6,4	869,49
J12	177,60	200	36,85	20,4	6,5	1062,.26
J13	150,58	250	32,35	22,1	4,9	939,81
J14	164,53	250	36,10	21,1	5,8	1014,03
J15	170,53	250	36,90	21,0	6,4	1108,35
J16	179,32	250	37,75	24,5	5,8	1367,16
J17	142,96	300	31,45	23,5	6,3	1366,26
J18	156,80	300	34,20	26,43	5,2	1548,26
J19	169,30	300	36,40	21,8	7,9	1474.,4
J20	178,50	300	36,95	22,9	7,7	1585,71
J21	142,30	400	32,70	21,5	11,4	2069,38
J22	155,71	400	34,10	24,3	7,7	1785,51
J23	165,61	400	36,35	23,8	11,4	2535,82
J24	175,39	400	36,55	28,9	8,7	2853,48

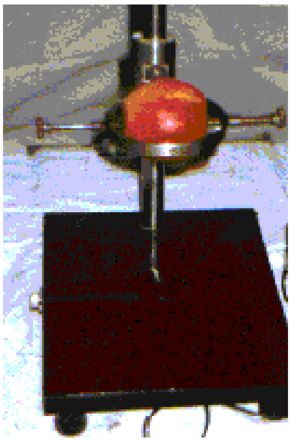


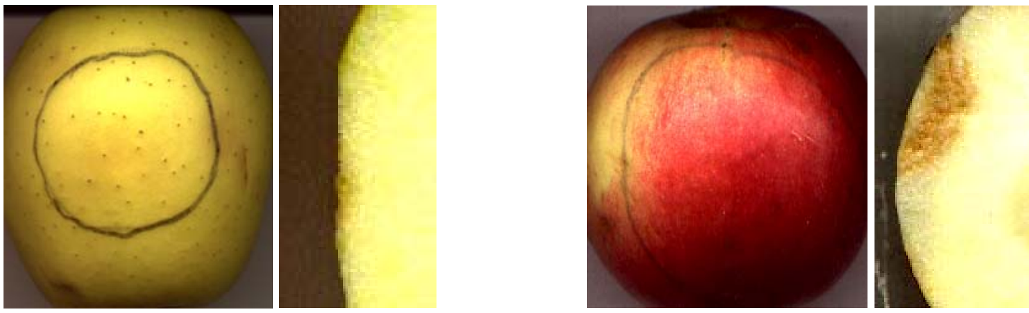
Fig. 1 – The Assembly of Basis Plate

Golden Deliceous Jonathan

Fig. 2. Aspects of damaged tissue - 150 mm drop height

Golden Deliceous Jonathan

Fig. 3. Aspects of damaged tissue - 200 mm drop height

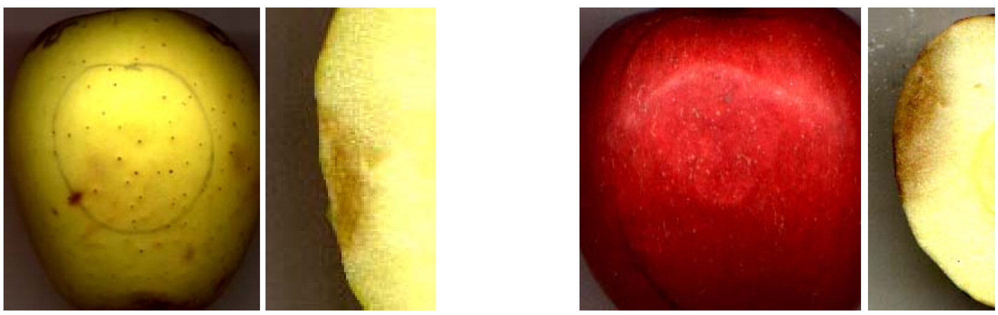


Golden Deliceous Jonathan

Fig. 4. Aspects of damaged tissue - 250 mm drop height

Golden Deliceous Jonathan

Fig. 5 Aspects of damaged tissue - 300 mm drop height



Golden Deliceous Jonathan

Fig. 6 Aspects of damaged tissue - 400 mm drop height

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