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THE INFLUENCE OF THE DRIP IRRIGATION ON THE PHYSICAL AND CHEMICAL APPLE CHARACTERISTICS

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Abstract

The premise of scientific and technical experiments was to evaluate the behaviour during the winter storage of the 2 cultivars of apples (Generos and Florina) introduced into experimental and comparison with other cultivars. The drip irrigation was started from March 20, administering daily for 4 hours. Recommended watering periods, depending on the weather of the year are:5-15 of March; 1-15 of May (after the fruit tying); 15-25 of July; 10-15 of September; 1-15 of November, the supply. The needed water norms are between 300 and 700 m^3/ha.

Key words: *chemical, irrigation, organoleptic, physical, storage.*

INTRODUCTION

Influence of drip irrigation on production quality is the effect on the nutritional and food value of fruits (Atkinson D., 1977; Gherghi et. al., 1972). Nutritional and food value of the fruits represents the purpose for growing fruit trees, fruit bushes and strawberries as supplements of vitamins, sugars, minerals, acids and energy (calories) needed for proper body growth and development (Botu, 2003). In addition, the fruits also contain magnesium, manganese, copper, zinc and iron, as well as the important minerals in the diet (Gherghi A., 1983)

Apples in controlled storage conditions can prolong the storage period of 3-9 months without losing its qualities. Storage and consumption during the same organoleptic characteristics depend on the terms offered and the particular cultivar. It is known that during storage, the apples suffer structural-textural changes that are produced slower or faster depending on the characteristics of cultivars and storage conditions (Gherghi A et. all., 2001). When apples with great firmness at harvest are stored in controlled atmosphere storage, they can use the same value until the next harvest of early cultivars (Gherghi A., 1989).

MATERIALS AND METHODS

To establish the ability to maintain quality fresh apples were taken 5 homologated cultivars, of which Generos and Florina disease-resistant and Jonathan, Golden Delicious and Idared, with widespread in the current assortment in our country. Fruits were kept after harvesting a period of about 50-60 days, depending on cultivar, in the storage spaces of the resort, from where they were then taken for experiments and refrigerated in storage conditions (t=0...+4°C, RH = 90-95%) over a period of 110 days in cold storage of Belciugatele Didactic Station, located inside the Moara Domneasca Farm.

After removal from storage were made determinations regarding the following:

- the quantitative and qualitative losses recorded by the fruit during storage;
- modifying fruit firmness (penetrometer determined) during storage;
- evolution of the main chemical components of the apples during storage;
- organoleptic assessment (appearance, firmness, taste) of fruit after storage.

The premise of the scientific and technical experiments was to assess behavior during winter storage of the 2 cultivars of apples introduced in the experimentation and comparison with other cultivars. Existence of

optimal flow experience across storage-keeping with reference to standardized packaging units, space conditioning, refrigeration thermostatic cell, organoleptic testing laboratory, equipment and devices for measurements and analyzes provided made it possible to achieve this goal.

The experiments were conducted in 5 different comparative variants based on the mentioned cultivars, with 3 repetitions per variant. During storage it has been made the daily examination of the thermal-hydric factors in the refrigeration room, for ensuring that optimal conditions to maintain quality (temperature 0 ... 4^0C and RH 90 .. 95%). Also we proceeded to assess the ability to maintain fruit quality by findings the appearance changes occurred regarding dehydration, the appearance and evolution of different storage disease. Taking into account the high degree of maturity of the fruit during storage and quality changes occurring during storage it was estimated that during cold storage the limit is 110 days. After removing apples from the storage space the determinations were performed on the table and impairment losses (spoilage) and fruit firmness, biochemical analysis of the main components and organoleptic testing at this stage. Determination of mass loss and spoilage during storage products was done by weighing samples of fruit resulted, respectively the fruit impaired (spoiled) during storage, compared with the initial amount deposited, the results being expressed as a percentage.

Fruit firmness was made manual with a penetrometer piston type Effe-gi 1 mm, on a total of 25 fruits per variant, each fruit was penetrated at 4 points in the equatorial zone after removing the epidermis in those points.

Tests for the main chemical components (dry substance, total sugar, titratable acidity and ascorbic acid) were performed by standard laboratory methods as follows:

- dry substance was determined by refractometry method using ABB table refractometer with results expressed in%:
- total sugar by Berthrand method with results expressed in %;
- acidity by titrimetric method with results expressed in % of malic acid;
- vitamin C (ascorbic acid) by spectrophotometer method, using UV-VIS Specol spectrophotometer and expression in mg/100g.

To assess organoleptic tasting were performed using the tasting sheets that contain a number of three assessment criteria (appearance, texture, taste). Notation (appreciation) was performed using 100 points scale. Each of the three assessment criteria has different weight in general notation, depending on their importance. Thus 'the aspect' represents 15%, 'texture' 35% and taste 50%. Depending on the score achieved 5 quality classes, according to Table 1.

Table 1. Classification of fruit after scoring

Rating (quality category)	Score
very good	80-100
good	60- 79
acceptable	40-59
mediocre	20-39
inappropriate	0-19

RESULTS AND DISCUSSIONS

Influence of drip irrigation on quantitative and qualitative losses

The results of the quantitative and qualitative losses recorded by the fruit during storage at the experimental variants are presented in Table 2.

Table 2. Losses while preserving apples

Var	Cultivar	Losses (%)			Remarks on damaged fruits
		Total	Weight	Damage	
V1	Jonathan	19.28	7.41	11.87	3.54 % gray rottenness 8.33% internal collapse
V2	Golden Delicious	24.20	8.62	15.58	gray rottenness
V3	Idared	17.55	5.17	12.38	gray rottenness
V4	Florina	14.66	5.88	9.08	4.26 % gray rottenness 4.82% heart rot
V5	Generos	5.94	5.94	-	-
	AVERAGE	16.33	6.60	9.78	

The data presented shows that total losses during storage are between 5.94-24.20% (depending on cultivar), with an average of 16.33%. Weight loss varies between 5.17-8.62% with an average of 6.6% and by spoiling from 0-15.58% with an average 9.8%.

The lowest total losses (5.94%) are recorded on Generos cultivar (Figure 1).

Figure 1. The aspect of apples from Generos cultivar after storage

This variant shows reduced mass loss and recorded spoiling due to disease attack. The total losses are recorded by Golden Delicious cultivar (24.20%) that both weight loss and spoiling is the highest (Figure 2)

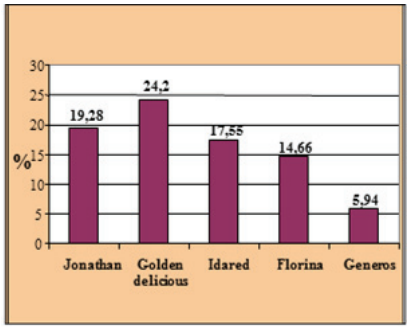

Figure 2. The total losses recorded at studied varieties

Influence of drip irrigation on fruit firmness

Results regarding the fruits firmness (penetrometer determined) during storage are presented in Table 3

Table 3. Firmness of apples during storage and after storage

Variant	Penetration value (kgf/cm²)			
	Cultivar	On insertion	After keeping	Reduction %
V1	Jonathan	3.93	3.73	5.09
V2	Golden	4.82	3.53	26.76
V3	Idared	4.08	3.93	3.68
V4	Florina	3.71	3.23	12.94
V5	Generos	4.10	3.86	5.85
Average	-	4.13	3.66	10.86

During cold storage the cultivars studied showed a different degree of pulp consistency, varying between 3.71 kgf/cm² (V4) and 4.82 kgf/cm² (V2).

Average value of the 5 variants was 4.13 kgf/cm², surpassed by the Golden Delicious cultivar (4.82 kgf/cm²).

During storage, the fruit firmness decreased in all variants in different ratios, ranging from 3.93 kgf/cm² on an average of 3.66 kgf/cm², value with 7.4% less than the original.

Fruits which remained firmed are related to: V3 (Idared), V1 (Jonathan) and V5 (Generos) on which firmness decreased from 3.68-5.85%. Firmness showed the largest decrease in variant V2 (Golden Delicious) were registered drastically firmness decreased from 37.15%, respectively to 26.76%.

Influence of drip irrigation on chemical and physical characteristics to apples

Results on the evolution of the main chemical components during storage are presented in table 4.

Table 4. Principal chemical components of apples during and after storage

Cultivar	Dry Soluble Substance (%)		Titratable acidity (%) (malic acid)		Total carbohydrates (%)		Ascorbic acid (mg/100g)	
	initial	final	initial	final	initial	final	initial	final
Jonathan	13.4	13.5	0.50	0.42	11.26	10.29	9.45	7.66
Golden	11.8	12.2	0.39	0.32	9.90	9.00	9.18	7.35
Idared	11.8	13.0	0.60	0.53	9.60	8.59	6.70	5.41
Florina	12.8	13.1	0.59	0.41	10.66	9.88	9.65	7.68
Generos	13.3	13.9	0.65	0.56	11.05	10.47	9.06	7.22
Average	12.62	13.14	0.55	0.45	10.50	9.65	8.81	7.06
Differences (%)		+5.20		-17.0		-8.70		-16.4

Initial dry substance content at the experimental variants was between 11.8 and 13.4%, with an average of 12.62%, Jonathan cultivar and Generos cultivar with the highest values and the lowest at the Golden Delicious and Idared cultivar. During cold storage the content of dry substance increased in all variants reaching on average of 13.14%. The average increase recorded was 5.20%. The initial acidity of the fruit (expressed in malic acid /100g) ranged from 0.39-0.65%, with an average of 0.55%. The lowest acidity was recorded by Golden Delicious cultivar and highest by Generos and Idared cultivars.

During cold storage fruit acidity decreased in all variants on average with 17.0%.

Total carbohydrate content initially ranged between 9.60% and 11.26% depending on the variant, with an average of 10.50%. The lowest values were seen in Idared cultivar and the highest at Jonathan cultivar. During cold storage, the carbohydrate content decreased by average of 8.7%. Initial content of ascorbic acid (vitamin C) ranged from 6.70-9.65 mg/100g depending on the variant, with an average of 8.81 mg/100g. Fruits with high content of ascorbic acid belong to the Florina and Jonathan cultivars. During cold storage, the ascorbic acid content decreased in all cases, with an average of 16.4%. The results of the measurements regarding the weight average, structural-texture firmness and the form index of apples are shown in table 5.

Table 5. Physical features of apples

No. crt.	Variant	Cultivar	Average weight (g)	Firmness (kgf/cm²)	Form index
1	V1	Jonathan	171.05	3.47	0.84
2	V2	Generos	207.37	4.85	0.84
3	V3	Idared	209.20	4.48	0.83
4	V4	Florina	179.58	6.24	0.92
5	V5	Golden delicious	149.16	4.47	0.94
Overall average			183.27	4.70	0.87

Influence of drip irrigation on organoleptic

Organoleptic test results from Apple (appearance, firmness, taste) after storage are presented in Table 6

In terms of appearance it was found that the Generos cultivar has obtained the highest score (15.0) of all experimental variants while Golden Delicious had the lowest score from experience. From the point of view of apple appearance all variants showed a high score from 12.00–15.00 points depending on the variant, with an overall average of 13.46 points.

Regarding firmness, the apples obtained from 27.00-34.00 points depending on the variant, with an overall average of 31.40 points. Top-rated variants were Idared and Florina, the lowest being Jonathan cultivar.

Meanwhile Jonathan and Golden got the lowest score (12.0).

Regarding taste, the apples obtained from 42.86-48.57 points depending on the variant, with an average of 45.14 points.

Table 6. Organoleptic assessment of apples after storage

Cultivar	Rating cultivar taste - (points)				Grade	Place
	Aspect	Firm-ness	Taste	The average amounts		
Jonathan	12.86	27.00	44.29	84.15	Very good	5
Generos	15.00	32.00	48.57	95.57	Very good	1
Idared	13.71	34.00	44.29	92.00	Very good	3
Florina	13.71	34.00	45.71	93.42	Very good	2
Golden delicious	12.00	30.00	42.86	84.86	Very good	4
Overall average	13.46	31.4	45.14	90.00		

The highest score for taste assessing was obtained by Generos. At the opposite side it was Golden Delicious cultivar with the lowest score of assessment.

The total score in apples taste assessing was 84.15-95.57 points depending on variant and rated 'very good', with an overall average of 90.00 points. On the first place it stands Generos. Latest seats were occupied in order by Golden Delicious and Jonathan.

CONCLUSIONS

Conclusions on losses

Among the cultivars tested best behaved was Generos, which ranked first a total loss of 5.94% without losses through spoilage. Golden Delicious presented the worst results, with 24.20% total losses of which 15.58% through spoilage.

Conclusions on fruit firmness

Compared to the initial firmness of 3.71-4.82 kgf / cm ² depending on the cultivar, apples after storage showed firmness values of 3.23-3.93 kgf / cm ² depending on the cultivar.

The apples firmness dropped during cold storage levels in average with 7-10%, with a range between 3.68-26.76% depending on the cultivar. Between cultivars were observed in this order Idared, Jonathan and Generos with fruit firmness reduction between 3.68-5.85%. On the last place between cultivars was located Golden Delicious whose firmness decreased by 26.76%.

Conclusions on changes in chemical constituents

The main chemical components (soluble dry substance, titratable acidity, total sugars and ascorbic acid) during storage of apples undergo some changes regarding the increase or the decrease of their recorded content during the storage in refrigerated space. In that period of 110 days, the soluble solids substance content increased by 5.20% and the titratable acidity, total sugars and ascorbic acid were reduced by 17.0%, 8.70% and 16.40%

From the analysis resulted it is showed that among all variants, a balanced content of these components is found at the variants V1-Jonathan cultivar.

Conclusions on fruit size and shape index

Apples of the late maturing apple cultivars studied, differs in fruit size, structural-textural firmness and form index. The average weight of the fruit ranges from 149.16-209.20 g (depending on variant), with an overall average of 183.27 g. The fruits over 200g/pcs presented the Generos and Idared cultivars.

Firmness of apples varies between 3.47 and 6.24 kgf / cm ^{2} (depending on variant) with an overall average of 4.70 kgf / cm ^{2}. The highest value was determined from Florina cultivar, and the lowest, from the Jonathan cultivar. The form index of apples had an overall average of 0.87 with a range from 0.83-0.94, depending on the variant.

Conclusions on some organoleptic characteristics

In terms of apple's appearance, all variants showed a high score of 12-15 points, with an overall average of 13.46 points. Generos cultivar obtained the maximum possible score of 15 points, while Golden Delicious cultivar had the lowest score. In terms of firmness, the apples obtained from 27.00 to 34.00 points with an overall average of 31.40 points. Idared and Florina cultivars were best rated and Jonathan cultivar received the fewest points. Regarding the taste, the apples obtained from 42.86-48.57 points, with an average of 45.14 points. The highest score on taste assessing was obtained by the Generos cultivar. On the opposite side was the Golden delicious cultivar with the lowest score.

The total score at the apples assessing taste was 84.15-95.57 points and was rated 'very good', with an overall average of 90.00 points. The first place was located by the Generos cultivar. The last place was taken in order by the Golden Delicious and Jonathan cultivars.

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