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GROWTH DYNAMICS OF SHOOTS RELATED TO CULTIVAR AND SHAPE OF THE NECTARINE TREE CROWN

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Abstract

The nectarine tree is pretentious as far as light is concerned, which is why the differentiation of the fruiting buds on annual branches is directly linked to the ensuring of sufficient light. A study was organised to establish both the optimal density of trees per hectare as well as the adequate shape of the trees crown in order to ensure a good lighting of the crown; also, the maintenance works and the harvesting have become mechanised. The research was carried out between 2008 and 2011 at R.S.F.G. Constanța and was focused on four nectarine tree cultivars ('Cora', 'Delta', 'Romamer 2' and 'Crimsongold') and four shapes of the crown and planting distances considered together: Tatura, planting distance 6/2 m= = 833 trees/ha; Vertical strap, planting distance 4/1.5 m= 1,666 trees/ha; Veronese vase, planting distance 4/3 m= 833 trees/ha; Improved vase, planting distance 4/3.5 = 714 trees/ha. The carried out determinations were focused on: a) The vegetative phenophases development – the vegetative buds burst, the beginning of shoot growth, the ending of shoot growth and b) The growth dynamics of shoots per cultivar and shape of the crown. The study revealed that, at all nectarine tree cultivars studied between 2008 and 2011 the vegetative buds burst occurred between March 5th and April 1st. The ending of shoot growth occurred at different moments according to the cultivar, the climatic year and the shape of the crown. The dynamics of shoot growth registered the lowest values at the 'Delta' cultivar (6.87 cm) and the shoots grew more in length in 2010 as compared to the other years of study.

Key words: *buds burst, cultivars, growths.*

INTRODUCTION

The nectarine tree is a very valuable species from an alimentary point of view. It can successfully adjust to different environmental conditions, it starts fruiting very quickly and it is very stable as far as the fructification is concerned. The nectarine tree is an important source of income for the countries which cultivate it (the USA, Italy, France, Spain, and Greece), its culture being among the first if one takes into account its profitability (Cociu, 1981). In France, the nectarines have been known ever since the Middle Ages under the name "brugnons", being the object of a small local trade (Debeunne and Thiault, 1969 apud Cociu, 1971). In modern fruit-growing, the shape of the crown of the tree holds a significant role in ensuring the bioconversion of the solar energy as well as in the production level and fruit quality. In Eastern Europe the most utilised shapes of the crown are the palmette with oblique branches, the bush spindle, the crown with a central axe, and the slim spindle, spread after 1980 especially in Poland, Hungary and the Czech Republic (Fideghelli C. Et al., 1987, apud Sumedrea D., et al., 2003). During the last decade, research has become more extensive in the USA and Canada regarding the shapes of the crown specific to intensive orchards: slim spindle, vertical axe, short spindle (the axe is cut during the first two years), tall spindle (the axe is not cut), shapes which are realised by means of highly simplified cuts and which ensure an efficient use of light (Baritt B. H. et al., 1997; Hampson C. R. Et al., 1997; Robinson T.L., 1997, apud Sumedrea D., et al., 2003). In Australia researchers considered creating shapes of the crown with horizontal or oblique branches (Tatura trellis, Lincoln) which would allow for the mechanisation of cuts in intensive orchards (Mckenzie D. W. et al., 1978, Sumedrea D., et al., 2003). The number of varieties planted in recent years has practically doubled (Fideghelli et al., 1998), the peaches representing 58%, the nectarines,

38% and the clingstones only 16% of all these varieties. Within this context, the choice of the combination cultivar - parent stock, of the appropriate shapes of the crown, of the planting distances, of the technology for maintaining and fertilising the soil and the trees, of the applied phytosanitary treatments should represent a major preoccupation for every fruit-grower (Lespinasse et al., 1998). Also, within the context of the new market demands (Fideghelli, 2002), where the horticultural production is becoming reoriented from quantity to quality, R.S.F.G. Constanța has attempted during the past several years to adopt a modern orientation in creating new cultivars. Among those which were preoccupied with the technology of peach tree and nectarine tree cultures were the following: Ivaşcu (2002; 2005); Spita (2002); Cociu (1971; 1981). The purpose of this paper is to determine the development of the main vegetative phases, as well as the growth dynamics of shoots per cultivar and shape of the crown in the conditions of the fruit-growing area Valu lui Traian.

MATERIALS AND METHODS

A bi-factorial experiment was organised at R.S.F.G. Constanța in the spring of 2002: Factor A = the cultivar, a1 = Cora, a2= Delta, a3= Romamer2, a4= Crimsongold and Factor B = the shape of the crown and the planting distance considered together, b1 = Tatura, planting distance 6/2 m= = 833 trees/ha; b2 = Vertical strap, planting distance 4/1.5 m= 1,666 trees/ha; b3 = Veronese vase, planting distance 4/3 m= 833 trees/ha; b4 = Improved vase, planting distance 4/3.5 = 714 trees/ha. The research was carried out between 2008 and 2011.

The planted material was produced in the nursery garden of R.S.F.G. Constanta, all the cultivars being grafted on the same parent stock, T16. As far as the technology applied to the nectarine tree culture is concerned, there were no differences; for all the cultivars, shapes of the crown and planting distances the technology was applied in an identical manner. Regarding the soil on which the experiment is situated, it is a calcareous chernozem (CZka), with a claylike texture and low alkaline pH (8.2) in its entire profile. Also, the climatic conditions in this area are very favourable to culture of nectarine trees. As far as precipitations are concerned, although the area is considered to be droughty, the nectarine trees are constantly irrigated, which solves the issue of the necessary quantity of water.

During the studied period (2008-2011), the average monthly temperature had a value of 12.4 °C, being higher than the normal value for the region by 1.7 °C; the value recorded during the vegetative period was of 19.1 °C, again higher than the normal value for the region by 1.7 °C. The average annual quantity of precipitations had a value of 590.7mm, from which 304.6 mm were recorded during the vegetative period, which proves that the area lacks in precipitations.

The average multi-annual quantity of precipitations per 25 years is of 421.0mm, from which 240.7mm were recorded during the vegetative period.

In order to determine the development of the main vegetative phases in the conditions of the fruit-growing area Valu lui Traian, phenological observations of the trees were carried out, both in the resting period as well as in the vegetative one, as follows:

a) Vegetative phenophases – The beginning of the buds burst, when the bud literally cracks and one can observe the tips of the leaves; the beginning of shoot growth, after the appearance of the first 5 leaves, takes place most years in the month of May; the ending of shoot growth, which was determined by means of the growth dynamics of shoots upon the appearance of the terminal bud and

b) The growth dynamics of shoots per cultivar and shape of the crown. The measurements were carried out on 10 shoots per tree for each cultivar, shape of the crown and planting distance, respectively. The shoots were labelled (in three different points of the tree) at the beginning of the measuring and every 7 days they mere measured and their length was recorded for the calculation of the dynamics. Based on the obtained data we were able to determine both the average length of the annual shoots as well as the average growth dynamics.

RESULTS ANS DISCUSSIONS

At the nectarine tree in the studied years 2008-2011 the cracking of the vegetative buds occurred between March 5th and 30th for the 'Cora' and 'Delta' cultivars, when the sum of active temperatures (over 6.5°C) reached a value ranging between 121°C and 156°C and between March 7th and April 1st for the 'Romamer 2' and 'Crimsongold' cultivars (Table 1), when the sum of active temperatures (over 6.5°C) reached a value ranging between 121°C and 162°C, 2008 being the earliest year for all the studied cultivars.

The triggering of the beginning of shoot growth phenophase is important because it is a critical moment for the ensuring of the plant's nutrition (the applying of nitrogen) and the protection against insects which attack the leaves (treatment warning).

The beginning of shoot growth occurred between April 5th and May 14th in the studied years 2008-2011 for the 'Cora' and 'Delta' cultivars, when the sum of active temperatures had a value ranging between 309°C and 640°C, between April 7th and May 16th for the 'Romamer 2' cultivar (sum of active temperatures ranging between 328°C and 698°C) and between April 5th and May 16th for the 'Crimsongold' cultivar (sum of active temperatures ranging between 309°C and 669°C)

Table 1. The main vegetative stages in the period 2008-2011

No.	Cultivar	Year	Beginning of the swelling		Beginning of shoots growth		Ending of shoots growth	
			Date	∑ active temp. °C	Date	∑ active temp. °C	Date	∑ active temp. °C (>6,5 °C)
1	CORA	2008	5.03	121	5.04	309	8.08	2966
2		2009	10.03	156	5.05	557	23.08	3125
3		2010	15.03	106	5.05	640	23.08	3107
4		2011	30.03	138	14.05	581	11.08	3135
	Average		5.03-30.03	131	5.04-14.05	522	8.08-23.08	3083
5	DELTA	2008	5.03	121	5.04	309	8.08	2966
6		2009	10.03	156	5.05	557	23.08	3125
7		2010	15.03	109	5.05	640	23.08	3107
8		2011	30.03	138	14.05	581	11.08	3135
	Average		5.03-30.03	131	5.04-14.05	522	8-23.08	3083
9	ROMAMER 2	2008	8.03	130	7.04	328	8.08	2966
10		2009	12.03	162	9.05	616	27.08	3209
11		2010	17.03	109	9.05	698	27.08	3203
12		2011	01.04	156	16.05	617	15.08	3230
	Average		8.03-01.04	142	7.04-16.05	565	8-27.08	3152
13	CRIMSONGOLD	2008	7.03	121	5.04	309	8.08	2966
14		2009	8.03	139	7.05	586	25.08	3167
15		2010	15.03	109	7.05	669	25.08	3154
16		2011	01.04	156	16.05	617	18.08	3303
	Average		7.03-01.04	131	5.04-16.05	545	8-25.08	3147

The ending of shoot growth occurred at different dates: on August 8th for all the studied cultivars in 2008, between August 23rd and 27th in the years 2009 and 2010 and in 2011 on August 11th for the 'Cora' and 'Delta' cultivars, August 15th for the 'Romamer 2' cultivar and August 18th for the 'Crimsongold' cultivar. The highest value of the sum of active temperatures was of 2966°C, while the lowest was of 3209°C.

The dynamics of shoot growth was calculated in order to establish the periods with the highest shoot growth, period when, from a vegetative point of view, the largest quantities of nutrients and water are consumed per surface unit.

At the nectarine tree in 2008 the growth of the shoots was triggered at the beginning of the month of May; 12 biometric weekly measurements were performed on the shoots between May 7th and July 30th. For each

cultivar and shape of the crown 10 shoots per tree were measured every week.

In 2008 (Table 2) the shoot growths were modest for all the analysed cultivars. The average growth rhythm of the shoots at the 'Cora' cultivar recorded values ranging between 4.58 cm (Tatura shape of the crown, which recorded the lowest growth dynamics overall) and 5.8 cm (Improved vase, which recorded the highest growth dynamics overall). At the 'Delta' cultivar the average growth rhythm of shoots recorded values ranging between 5.25 cm (Veronese vase) and 5.66 cm (Improved vase). At the 'Crimsongold' cultivar, the values ranged from 4.41 cm (Tatura) to 5.52 cm (Improved vase). As average per cultivar of the average growth rhythm, the lowest values were recorded by the 'Crimsongold' cultivar (4.74 cm), while the highest were recorded by the 'Romamer 2' cultivar (5.68 cm). The dynamics of shoot growth, as well as the number, thickness and length of the shoots is directly correlated with the age of the trees, the quantity of fruit per tree, the applied agrotechnique (cuts, works on the soil, fertilizers, irrigation) and the vegetative behaviour of each cultivar.

In 2009 the beginning of shoot growth was triggered in the first half of the month of May; 14 biometric measurements were performed weekly on the shoots between May 12th and August 11th, when the growth of the shoots reached its end (Table 3). 10 shoots per tree were measured weekly for each cultivar and shape of the crown. At the 'Cora' cultivar the average growth rhythm of the shoots recorded values ranging between 5.28 cm (Vertical strap, which recorded the lowest growth dynamics overall) and 5.92 cm (Veronese vase, which recorded the highest growth dynamics overall). At the 'Delta' cultivar the values ranged from 6.21 cm (Vertical strap) and 7.00 cm (Veronese vase), while at the Romamer2 cultivar the values ranged between 6.14 cm (Veronese vase) and 6.91 cm (Vertical strap). At the 'Crimsongold' cultivar the values ranged from 5.92 cm (Vertical strap) and 6.14 cm (Tatura). As average per cultivar of the average growth rhythm in 2009, the lowest values were recorded by the 'Cora' cultivar (5.62 cm), while the highest values were recorded by the 'Delta' cultivar (6.62 cm).

In 2010 the beginning of shoot growth was triggered in the first half of the month of May; 14 biometric measurements were performed weekly on the shoots between May 11th and August 10th, when the growth of the shoots reached its end (Table 4). 10 shoots per tree were measured weekly for each cultivar and shape of the crown and the average per cultivar can be seen in the table. At the 'Cora' cultivar the average growth rhythm of the shoots recorded values ranging between 6.28 cm (Improved vase) and 7.00 cm (both Tatura and Vertical strap). At the 'Delta' cultivar the values ranged from 6.21 cm (Vertical strap) and 7.57 cm (Improved vase), while at the Romamer2 cultivar the values ranged between 6.42 cm (Veronese vase) and 6.78 cm (Improved vase), the differences being very small among the shapes of the crown for this cultivar. At the Crimsongold '' cultivar the values ranged from 6.21 cm (Vertical strap) and 6.57 cm (Veronese vase). As average per cultivar of the average growth rhythm in 2010, the lowest values were recorded by the 'Crimsongold' cultivar (6.37 cm), while the highest values were recorded by the 'Delta' cultivar (6.87 cm). In 2010 the average growth rhythm of the shoots (cm) was higher compared to the other studied years due to the fact that 2010 was richer in precipitations (rain) and the trees benefitted from more water in some critical moments, there being no need for irrigations.

In 2011 the beginning of shoot growth was triggered in the first half of the month of May; 16 biometric measurements were performed weekly on the shoots between May 5th and August 10th, when the growth of the shoots ended (Table 5). 10 shoots per tree were measured weekly for each cultivar and shape of the crown and the average per cultivar can be seen in the table. At the 'Cora' cultivar the average growth rhythm of the shoots recorded values ranging between 5.00 cm (Tatura) and 6.5 cm (Improved vase). At the 'Delta' cultivar the values ranged from 4.87 cm (Tatura) and 5.68 cm (Improved vase), while at the 'Romamer 2' cultivar the values ranged between 4.75 cm (Veronese vase) and 6.18 cm (Improved vase), the differences being

very small among the shapes of the crown for this cultivar. At the 'Crimsongold' cultivar the values ranged from 5.31 cm (Vertical strap) and 6.18 cm (Improved vase). The ending of shoot growth also depends on the evolution of climatic conditions, especially the maximum temperatures during summer and on the agrotechnical conditions (irrigation, pruning) and the nutritive substances in the soil. Analysing this phenophase (the ending of shoot growth) at 4 nectarine tree cultivars, planted at different distances and having different shapes of the crown, but grafted on the same parent stock (T16), we were able to determine that there are differences between cultivars but also differences between one year and the next at the same cultivar. Moreover, there are differences between the shapes of the crown concerning the date when the shoots stop growing.

Shoot length in the studied years (2008-2011)

Following the statistical analysis of the length of the shoots carried out in 2008 the obtained results were significantly positive at the 'Romamer 2' cultivar, Improved vase shape of the crown and distinctly significantly positive at the 'Cora' cultivar, Improved vase. The 'Crimsongold' cultivar, Tatura and Veronese vase shapes of the crown displayed significantly negative results (Table 6).

Similarly, in 2009 the results were significantly positive at the 'Delta' cultivar (Improved vase) and distinctly significantly positive at the same cultivar (Veronese vase); the results were very significantly negative at the 'Cora' cultivar, Tatura and Vertical strap shapes of the crown.

In 2010, the significance was positive at the Delta cultivar, Veronese vase shape and distinctly significantly positive at the 'Cora' cultivar, Tatura shape and the 'Delta' cultivar, Veronese vase shape of the crown. The results were distinctly significantly negative at the 'Delta' cultivar, Vertical strap shape and the 'Crimsongold' cultivar, again Vertical strap shape.

In 2011 the significance was positive at the 'Cora' cultivar, Improved vase shape of the crown and the 'Crimsongold' cultivar, again Improved vase shape and very significantly negative at the 'Romamer 2' cultivar, Veronese vase shape.

As average per shape of the crown for the 4 studied years, the Improved vase shape of the crown was distinctly significantly positive.

CONCLUSIONS

At the nectarine tree during 2008 and 2011 the cracking of the vegetative buds occurred between March 5th and 30th at the 'Cora' and 'Delta' cultivars and between March 7th and April 1st at the 'Romamer 2' and 'Crimsongold' cultivars, 2008 being the earliest year for all the studied cultivars. The beginning of shoot growth takes place in most of the studied in April or May (2008-2011), there being differences from one year to another. Also worth noting is the fact that at Valu lui Traian the potential negative temperatures which may occur until mid-May do not affect the vegetative phenophases of the nectarine tree. The vegetative buds are highly resistant to negative temperature during this phenophase. The growth dynamics of shoots recorded the highest values at the delta cultivar (6.87 cm). The shoots grew more in length in 2010 as compared to the other studied years because 2010 was rich in precipitations.

The ending of shoot growth occurred at different moments according to the cultivar, the climatic year and the shape of the crown.

The length of the shoots in the studied years 2008-2011 was greater at the 'Cora' cultivar, Improved vase, the 'Delta' cultivar, Improved vase and the 'Romamer 2' cultivar, Tatura and Improved vase.

As average per shape of the crown, during the four studied years the Improved vase was better from this point of view.

Table 2. The growth dynamics of shoots at the nectarine tree in 2008

Cultivar	Shape of the crown	Length of the shoots at different moments (cm)												Average growth rhythm (cm)
		May				June				July				
		07.05	14.05	21.05	28.05	04.06	11.06	18.06	25.06	02.07	09.07	16.07	30.07	
Cora	Tatura	9	13	19	23	29	36	44	49	55	58	62	64	4.58
	Vertical strap	12	17	20	25	31	35	48	55	62	65	69	73	5.08
	Veronese vase	6	11	15	18	27	33	42	49	54	57	62	65	4.91
	Improved vase	8	18	26	29	34	39	47	57	66	72	76	78	5.8
Average/cultivar														5.09
Delta	Tatura	7	18	24	28	35	41	49	56	59	63	67	71	5.33
	Vertical strap	5	13	21	27	33	38	45	52	56	69	71	73	5.66
	Veronese vase	9	16	19	23	29	36	44	49	56	64	69	72	5.25
	Improved vase	8	14	18	25	31	33	47	58	63	70	73	75	5.58
Average/cultivar														5.45
Romamer 2	Tatura	9	12	17	22	29	36	48	53	61	68	72	75	5.5
	Vertical strap	6	11	18	24	31	38	49	56	60	66	70	74	5.66
	Veronese vase	9	16	22	27	36	41	47	55	62	67	72	74	5.41
	Improved vase	11	16	19	23	29	36	44	59	67	75	81	85	6.16
Average/cultivar														5.68
Crimson-gold	Tatura	6	11	14	19	23	30	35	41	47	51	57	59	4.41
	Vertical strap	8	13	17	22	30	35	48	52	56	60	62	65	4.75
	Veronese vase	6	10	13	15	22	30	36	41	48	54	58	61	4.58
	Improved vase	8	14	21	29	34	39	45	51	59	64	68	71	5.25
Average/cultivar														4.74

Table 3. The growth dynamics of shoots at the nectarine tree in 2009

Cultivar	Shape of the crown	Length of the shoots at different moments (cm)														
		May			June					July				August		Average growth rhythm (cm)
		12.05	19.05	26.05	02.06	09.06	16.06	23.06	30.06	07.07	14.07	21.07	28.07	04.08	11.08	
Cora	Tatura	7	13	17	24	31	39	47	55	67	75	80	84	85	86	5.64
	Vertical strap	9	14	19	22	30	37	44	53	61	69	75	78	80	83	5.28
	Veronese vase	11	16	18	23	29	33	41	53	65	71	82	89	91	94	5.92
	Improved vase	13	14	21	26	33	42	51	64	72	79	86	89	91	92	5.64
Average/cultivar																5.62
Delta	Tatura	9	14	19	26	29	36	47	50	63	75	87	95	100	102	6.64
	Vertical strap	12	15	22	27	33	39	48	55	71	80	87	93	98	99	6.21
	Veronese vase	7	13	17	21	27	36	49	62	77	84	97	101	103	105	7.0
	Improved vase	11	18	23	29	38	47	56	69	78	88	94	99	101	104	6.64
Average/cultivar																6.62
Romamer 2	Tatura	11	16	19	21	29	37	44	56	68	75	89	95	98	100	6.35
	Vertical strap	14	19	24	27	37	49	55	64	69	77	84	91	95	97	6.91
	Veronese vase	12	17	22	26	32	41	53	64	73	79	84	89	94	98	6.14
	Improved vase	9	15	18	25	37	45	56	64	76	83	89	94	98	101	6.57
Average/cultivar																6.49
Crimson-gold	Tatura	13	14	21	26	33	42	51	64	71	79	87	92	98	99	6.14
	Vertical strap	9	14	19	22	30	37	45	53	62	74	79	83	89	92	5.92
	Veronese vase	10	16	18	23	29	33	41	53	59	67	74	80	86	94	6.00
	Improved vase	6	10	14	21	29	37	44	52	61	72	79	85	88	91	6.07
Average/cultivar																6.03

Table 4. The growth dynamics of shoots at the nectarine tree in 2010

Cultivar	Shape of the crown	Length of the shoots at different moments (cm)														
		May			June					July				August		Average growth rhythm (cm)
		11.05	18.05	25.05	01.06	08.06	15.06	22.06	29.06	06.07	13.07	20.07	27.07	03.08	10.08	
Cora	Tatura	10	19	26	36	41	56	70	79	87	93	97	99	104	108	7.0
	Vertical strap	7	15	20	31	46	54	65	71	78	85	91	96	101	105	7.0
	Veronese vase	6	11	16	24	37	42	52	67	76	84	89	93	96	98	6.57
	Improved vase	13	15	21	30	44	51	68	76	85	89	92	96	98	101	6.28
Average/cultivar																6.71
Delta	Tatura	8	16	23	31	40	51	63	72	79	86	90	94	97	100	6.57
	Vertical strap	9	15	22	31	42	57	64	75	78	86	92	95	96	96	6.21
	Veronese vase	8	14	22	32	49	55	69	88	77	94	98	103	106	108	7.14
	Improved vase	6	13	25	32	46	57	69	78	85	90	99	104	107	112	7.57
Average/cultivar																6.87
Romamer 2	Tatura	12	17	25	31	36	43	58	67	73	85	91	100	103	104	6.57
	Vertical strap	10	18	29	34	58	64	77	85	91	97	100	102	103	103	6.64
	Veronese vase	9	16	26	35	47	56	64	71	78	85	89	93	96	99	6.42
	Improved vase	8	18	27	35	46	52	69	78	85	90	96	100	102	103	6.78
Average/cultivar																6.60
Crimson-gold	Tatura	9	15	22	31	42	57	64	75	78	86	92	95	97	98	6.35
	Vertical strap	10	19	26	36	41	56	69	77	84	89	95	96	97	97	6.21
	Veronese vase	8	14	22	32	49	55	69	78	87	92	98	99	100	100	6.57
	Improved vase	9	13	25	32	46	57	69	78	85	90	94	97	98	98	6.35
Average/cultivar																6.37

Table 5. The growth dynamics of shoots at the nectarine tree in 2011

Cultivar	Shape of the crown	Length of the shoots at different moments (cm)																Average growth rhythm (cm)
		May			June					July				August				
		5.05	12.05	19.05	26.05	02.06	09.06	16.06	23.06	30.06	07.07	14.07	21.07	28.07	04.08	11.08	18.08	
Cora	Tatura	10	12	19	26	33	41	54	63	71	77	82	85	88	89	90	90	5.00
	Vertical strap	9	10	14	22	35	44	52	67	73	78	85	87	89	91	92	92	5.18
	Veronese vase	7	11	16	21	30	39	51	62	69	75	79	85	88	92	95	97	5.62
	Improved vase	6	9	16	25	34	46	59	69	82	91	98	103	105	108	109	110	6.5
Average/cultivar																		5.57
Delta	Tatura	6	11	22	34	45	53	61	65	72	78	80	81	82	83	83	84	4.87
	Vertical strap	8	14	19	27	38	49	57	69	75	79	81	83	84	85	86	87	4.93
	Veronese vase	7	12	20	31	37	48	58	66	73	77	79	81	83	85	87	88	5.06
	Improved vase	6	10	14	22	33	44	53	64	72	78	83	87	91	93	95	97	5.68
Average/cultivar																		5.13
Romamer 2	Tatura	10	16	21	29	37	49	58	69	78	87	91	94	97	100	103	105	6.12
	Vertical strap	9	13	19	27	36	45	56	72	81	87	92	94	96	97	98	99	5.62
	Veronese vase	7	12	17	25	33	42	51	64	71	77	78	79	80	81	82	83	4.75
	Improved vase	8	14	20	28	39	47	59	68	79	87	91	95	98	101	104	107	6.18
Average/cultivar																		5.66
Crimson-gold	Tatura	6	9	17	29	38	49	54	65	71	77	83	86	88	91	92	92	5.37
	Vertical strap	10	12	20	31	39	48	57	68	76	81	85	89	93	94	95	95	5.31
	Veronese vase	6	11	16	27	36	41	52	61	69	75	79	83	88	90	92	93	5.43
	Improved vase	9	14	21	33	39	48	59	67	76	83	89	94	99	104	106	108	6.18
Average/cultivar																		5.57

Table 6. The length of the shoots in the years of study (2008-2011)

Variant	Shape of the crown	2008			2009			2010			2011			Average		
		Shoot length (cm)	Diff. comp. to the average	Signif.	Shoot length (cm)	Diff. comp. to the average	Signif.	Shoot length (cm)	Diff. comp. to the average	Signif.	Shoot length (cm)	Diff. comp. to the average	Signif.	Shoot length (cm)	Diff. comp. to the average	Signif.
CULTIVAR																
a1. CORA																
a1b1	b1.Tatura	64	-6.9	oo	86	-10.0	ooo	108	+6.2	**	90	-5.4	-	87.0	-4.0	o
a1b2	b2.Vertical strap	73	+2.1	-	83	-13.0	ooo	105	+3.2	-	92	-3.4	-	88.2	-2.8	-
a1b3	b3.Veronese vase	65	-5.9	o	94	-2.0	-	98	-3.8	o	97	+1.6	-	88.5	-2.5	-
a1b4	b4.Improved vase	78	+7.1	**	92	-4.0	-	101	-0.8	-	110	+14.6	***	95.2	+4.2	**
	Average	**70.0**	**-0.9**	**-**	**88.7**	**-7.3**	**oo**	**103.0**	**+1.2**	**-**	**97.2**	**+1.8**	**-**	**89.7**	**-1.3**	**-**
a2. DELTA																
a1b1	b1.Tatura	71	+0.1	-	102	+6.0	*	100	-1.8	-	84	-11.4	oo	89.2	-1.8	-
a1b2	b2.Vertical strap	73	+2.1	-	99	+3.0	-	96	-5.8	oo	87	-8.4	o	88.7	-2.3	-
a1b3	b3.Veronese vase	72	+1.1	-	105	+9.0	***	108	+6.2	**	88	-7.4	o	93.2	+2.2	-
a1b4	b4.Improved vase	75	+4.1	-	104	+8.0	**	112	+10.2	***	97	+1.6	-	97.0	+6.0	**
	Average	**72.7**	**+1.8**	**-**	**102.5**	**+6.5**	**	**104.0**	**+2.2**	**-**	**89.0**	**-6.4**	**o**	**92.0**	**+1.0**	**-**
a3. ROMAMER 2																
a1b1	b1.Tatura	75	+4.1	-	100	+4.0	-	104	+2.2	-	105	+9.6	**	96.0	5.0	**
a1b2	b2.Vertical strap	74	+3.1	-	97	+1.0	-	103	+1.2	-	99	+3.6	-	93.2	+2.2	-
a1b3	b3.Veronese vase	74	+3.1	-	98	+2.0	-	99	-2.8	-	83	-12.4	ooo	88.5	-2.5	-
a1b4	b4.Improved vase	85	+14.1	***	101	+5.0	*	103	+1.2	-	107	+11.6	**	99.0	+8.0	**
	Average	**77.0**	**+6.1**	*	**99.0**	**+3.0**	**-**	**102.2**	**+0.4**	**-**	**98.5**	**+3.1**	**-**	**94.1**	**+3.1**	*
a4. CRIMSONGOLD																
a1b1	b1.Tatura	59	-11.9	ooo	99	+3.0	-	98	-3.8	o	92	-3.4	-	87.0	-4.0	o
a1b2	b2.Vertical strap	65	-5.9	o	92	-4.0	-	97	-4.8	oo	95	-0.4	-	87.2	-3.8	o
a1b3	b3.Veronese vase	61	-9.9	ooo	94	-2.0	-	100	-1.8	-	93	-2.4	-	87.0	-4.0	o
a1b4	b4.Improved vase	71	+0.1	-	91	-5.0	-	98	-3.8	o	108	+12.6	***	92.0	+1.0	-
	Average	**64.0**	**-6.9**	**o**	**94.0**	**-2.0**	**o**	**98.2**	**-3.6**	**o**	**97.0**	**+1.6**	**-**	**88.3**	**-2.7**	**-**
SHAPE OF THE CROWN																
b1	b1.Tatura	67.2	-3.7	-	96.7	+0.7	-	102.5	+0.7	-	92.7	-2.7	-	89.8	-1.2	-
b2	b2.Vertical strap	71.2	+0.3	-	92.7	-3.3	-	100.2	-1.6	-	93.2	-2.2	-	89.3	-1.7	-
b3	b3.Veronese vase	68.0	-2.9	-	97.7	+1.7	-	101.2	-0.6	-	90.2	-5.2	-	89.3	-1.7	-
b4	b4.Improved vase	77.2	+6.3	*	97.0	+1.0	-	103.5	+1.7	-	105.5	+10.1	**	95.8	+4.8	**
		X=70.9 DL 5% =5.0 DL1% =6.9 DL0.1% =9.6			X=96.0 DL 5% =4.4 DL1% =6.1 DL0.1% =8.5			X=101.8 DL 5% =3.4 DL1% =4.7 DL0.1% =6.5			X=95.4 DL 5% =6.3 DL1% =8.8 DL0.1% =12.2			X=91.0 DL 5% =3.0 DL1% =4.2 DL0.1% =5.8		

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