

RESEARCHES CONCERNING THE GROWTH CHARACTERISTICS AT SOME SPECIES OF THE GENUS *PRUNUS*

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Abstract. Genus *Prunus* is represented in crop by many species. Genetic variability of the species and varieties arising therefrom, requires assessment of growth differences, for knowing the biology of these plants. Genotypic and phenotypic differences serve to identify and assess agrobiological characteristics, in relation to environmental factors, to promote into the crop the most valuable and for their use in the breeding process. This paper argues identifying, quantifying and comparing different varieties of the species *Prunus domestica*, *Prunus armeniaca* and *Prunus persica*, in terms of growth, in the conditions of Northern Oltenia.

Keywords: species, variety, vigor, variability

INTRODUCTION

The genus *Prunus* comprises, after some 93 species (Botu, 2003; Botu, 2004), and by others, a total of 200 species (Bortiri, 2001; Wunsch, 2006; Potter, 2007), but only a few of them have contributed to the current varieties have been cropped.

The study of the growth characteristics at some species of the genus *Prunus* (*P.domestica*, *P.armeniaca*, *P.persica*) is a necessity in the breeding programs from agricultural research and also presents its economic role in the areas of high ecological valence and ornamental, in the public spaces, as current compositional elements.

The growth vigor shows a high degree of variability both between species (specific growth particularities), and within species, but is correlated with the rootstock used, technology and environmental conditions existing in the area.

Regarding the growth characteristics of the three species studied, global orientation is to use varieties with small size (dwarf) or medium, with short and durable fruit formations, to ensure high yields, constant and of quality.

Currently, in the fruit growing sector, there is a tendency to reduce the height of the trunk, this because is desired on the one hand, protecting against heatstroke and cool and dry wind during the winter, and on the other hand, in the order to execute more easily the works applied to the trees, especially cutting, sanitary treatments and harvesting (Chira, 2008). Growing fruit trees in public spaces has encouraging advantages in terms of environment, educational system and the community life, stimulating the population solidarity, in order to achieve a framework of proper management, on long-term (Ciobanasu, 2007).

MATERIAL AND METHOD

The researches were carried out at the University of Craiova-Research and Development Station for Fruit Growing Valcea, in Northern Oltenia, in a temperate

continental climate with Mediterranean influences and minimum nuances of hilly mountain climate.

The biological material consisted of varieties belonging to the species *Prunus domestica* (11 varieties), *Prunus armeniaca* (11 varieties) and *Prunus persica* (15 varieties), and shows ages between 11-18.

The plum and apricot varieties are grafted on rootstock Mirobolan yellow and the peach varieties are grafted on peach Franc.

For all species, the trees were conducted in the form of improved vessel. Planting distances were 5x4 m (plum), 6x4 m (apricot) and 5x2 (peach).

The soil was maintained with *Lolium perene* grassy between rows and black field with herbicide, on the row.

On the studied plants were made observations and biometric measurements, referring to the way of plants growth, depending on the species and variety, as follows:

- Determination of plants habitus:

- Determination of trunk section area (TSA), in cm²

$$TSA = \frac{D^2}{4 \times \pi}$$

- Crown diameter by measuring the crown projection on two perpendicular directions (m)

- The plants height (m)

- Crown volume (m³)

$$V_C = \frac{(D + d)^2}{2} \times H_C \times 0,416$$

- Classification of plants vigor:

To create a classification of the plant vigor and take into account all the growth elements presented, we used the method Botu (1978), in which for each element was set a rating:

- TSA – 1 pct. = 50 cm²

- Crown diameter – 1 pct. = 2 m

- The plants height – 1 pct. = 2 m

- Crown volume – 1 pct. = 10 m³

The four indicators were brought to a common denominator, according to which the vigor was delimited as follows:

- Small vigor, 0-10 points;

- Medium vigor, 10-20 points;

- Big vigor, larger than 20 points.

Registration of the observations and measurements performed was done in experiments with place in blocks randomized monofactorial, in 4 repetitions. In each experimental plot, measurements were made at four plants.

RESULTS AND DISCUSSIONS

Biometric measurements made at the plum varieties showed that growth elements are highly variable, but they are situated within certain limits (Table 1).

Trunk section area varies between 153.9 cm² (Andreea) and 555.5 cm² (Rivers timpuriu). Compared with control variety Tuleu gras (426.2 cm²), TSA at varieties Rivers

timpuriu, Valcean, Agen 707 and Tuleu timpuriu is larger, with a very significant positive difference. The other varieties (Centenar, Stanley, Minerva, Andreea and Anna Spath) shows an TSA much smaller than the control variety (very significant negative). A single variety, Vanat romanesc cl.4 (426.2 cm²) stands at the level of Tuleu gras.

Table 1

The behavior of plum varieties in the process of growth (plants in age of 18 years)

Crt. No.	Variety	Trunk section area TSA (cm ²)	Difference towards control ±	Significance	Tree height (m)	Crown diameter (m)	Crown volume (m ³)	Difference towards control ±	Significance
1	Centenar	342.9	- 83.3	ooo	4.1	5.45	81.68	-46.8	ooo
2	Stanley	397.4	- 28.8	ooo	3.9	5.35	74.1	-54.3	ooo
3	Minerva	386.9	- 39.3	ooo	3.5	4.50	46.1	-82.3	ooo
4	Tuleu timpuriu	478.9	+ 52.7	***	4.5	5.55	94.3	-34.1	ooo
5	Andreea	153.9	- 272.3	ooo	4.0	4.65	57.7	-70.7	ooo
6	<i>Tuleu gras(ct)</i>	426.2	-	-	5.3	5.9	128.4	-	-
7	Agen 707	551.3	+ 125.1	***	4.4	5.3	83.8	-44.6	ooo
8	Anna Spath	277.5	- 148.7	ooo	3.5	4.15	39.2	-89.2	ooo
9	Rivers timpuriu	555.4	+ 129.2	***	4.5	5.9	106.6	-21.8	ooo
10	Vâlcean	534.7	+ 108.5	***	4.1	4.6	58.1	-70.3	ooo
11	Vânător românesc cl.4	426.2	-	-	5.2	5.5	109.2	-19.2	ooo
AVERAGE		411.9	-		4.3	5.2	79.9	-	

DL 5.0 % = 2.29

DL 1.0 % = 3.09

DL 0.1 % = 4.01

DL 5.0 % = 7.16

DL 1.0 % = 9.65

DL 0.1 % = 12.81

Reporting TSA at the number of plants years, indicates that in average, this element (TSA) increased with 8.5 cm² / year (Rivers timpuriu). Differences on TSA show a large range of variability, most varieties having a big trunk, with an average of 411.9 cm².

The crown diameter ranged between 4.15 m (Anna Spath) and 5.9 m (Rivers timpuriu and Tuleu gras). This indicator is important for determining the vigor of varieties, but is strongly influenced by environmental and technological factors. Differences between the diameters of the largest and lowest crowns are of 1.75 m, at an average of 5.2 m overall crown.

The plants height is an element ranging between 3.5 m (Anna Spath and Minerva) and 5.3 m (Tuleu gras). In general, the plants height is average (4.3 m) and this phenomenon is due to how plants were conducted (improved vessel). Greater height is recorded at varieties that have a tendency to grow erect and form natural axis (Tuleu gras and Vanat romanesc cl.4).

The crown volume is a basic element in assessing the vigor, recording a increase between 39.2 m³ (Anna Spath) and 128.4 m³ (Tuleu gras). All varieties shows a crown lower than the variety Tuleu gras, this resulting also from the fact that by comparison, the significance of those values is very significant negative.

The rate obtained determine the delimitation of the plum varieties as follows:

- small vigor – no variety
- medium vigor - Centenar, Stanley, Minerva, Andreea, Anna Spath
- big vigor - Tuleu timpuriu, Tuleu gras, Agen 707, Rivers timpuriu, Valcean, Vanat romanesc cl.4

The vigor of the plum varieties, at average is 20.1 points, resulting in the overall classification at medium vigor (Table 2).

Table 2

The quantification of the growth vigor of plum varieties according to their score amounted at the growth elements

No.	Variety	Score					
		TSA	Crown diameter	Tree height	Crown volume	Score amount	Vigor classification
1	Centenar	6.9	2.7	2.0	8.2	19.8	medium
2	Stanley	7.9	2.7	1.9	7.4	19.9	medium
3	Minerva	7.7	2.3	1.8	4.6	16.4	medium
4	Tuleu	9.6	2.8	2.3	9.4	24.1	big
5	Andreea	3.1	2.3	2.0	5.8	13.2	medium
6	Tuleu gras	8.5	3.0	2.6	12.8	26.9	big
7	Agen 707	11.0	2.6	2.2	8.4	24.2	big
8	Anna Spath	5.5	2.1	1.8	3.9	13.3	medium
9	Rivers	11.1	3.0	2.3	10.6	26.9	big
10	Vâlcean	10.7	2.3	2.0	5.8	20.8	big
11	Vânăț	8.5	2.8	2.6	10.9	24.9	big
AVERAGE		7.9	2.1	2.1	8.0	20.1	-

At the varieties of apricot there has been an increase with large variability if we refer to the four biometric elements studied (Table 3).

TSA varied between 292.4 cm² (Litoral) and 633.1 cm² (Sirena). Compared with TSA of control variety Cea mai buna de Ungaria (593.7 cm²), variety Sirena has a very significant positive value, Comandor does not differ from the control, and the other varieties recorded very significant negative values.

The diameter of the crown at the apricot varieties are between 4.9 m (Sulina) and 6.95 m (CR 2-63). The amplitude of the crown diameter is of 2 m and show a high variability of this element of growth.

Another element of the growth is the plant height. This was between 4.0 m (Litoral and Olimp) and 5.7 m (CR 2-63).

The crown volume is relatively large at apricot varieties, ranging between 65.4 m³ (Olimp) and 193.4 m³ (CR 2-63). Compared with the control variety, the crown volume at varieties Mamaia and CR 2-63 record very significant positive values. All other varieties have very significant negative values.

In order to achieve a uniform classification of vigor at the apricot cultivars studied, we applied the same methodology of analysis and drew up a rating that differentiates the plant vigor (Table 4). Depending on the amounted score on the four elements of the growth were obtained values between 17.6 points (Litoral) and 33.3 points (CR 2-63). Apricot varieties vigor classification is as follows:

- small vigor – no variety
- medium vigor – Sulina, Litoral, Olimp
- big vigor – CR 2-63, Mamaia, Comandor, Cea mai buna de Ungaria, Excelsior, Sirena, Favorit, Dacia

Average score achieved at the 11 apricot varieties is 24.9 points, fits varieties into the group of varieties with big vigor.

Table 3

The behavior of apricot varieties in the process of growth (plants in age of 18 years)

No.	Variety	Trunk section area TSA (cm ²)	Difference towards control ±	Significance	Tree height (m)	Crown diameter (m)	Crown volume (m ³)	Difference towards control ±	Significance
1	Excelsior	463.5	- 130.2	ooo	4.6	5.35	89.9	-25.9	ooo
2	Sirena	633.1	+ 39.4	***	4.4	5.9	103.8	-12	ooo
3	Favorit	467.4	- 126.3	ooo	5.2	5.45	107.3	-8.5	ooo
4	Litoral	292.4	- 301.3	ooo	4.0	5.2	72.2	-43.6	ooo
5	Sulina	369.6	- 224.1	ooo	4.6	4.9	75.4	-40.4	ooo
6	Comandor	593.7	-	-	4.9	5.5	102.1	-13.7	ooo
7	Dacia	467.4	- 126.3	ooo	4.5	5.7	99.5	-16.3	ooo
8	Olimp	440.9	- 152.8	ooo	4.0	4.95	65.4	-50.4	ooo
9	Mamaia	463.5	- 130.2	ooo	5.6	5.6	123.1	7.3	***
10	Cea mai bună de Ungaria(ct)	593.7	-	-	4.5	6.15	115.8	-	
11	CR 2-63	386.9	- 206.8	ooo	5.7	6.95	193.4	77.6	***
AVERAGE		470.2	-		4.7	5.6	104.3	-	

DL 5.0 % = 3.87
DL 1.0 % = 5.22
DL0.1%= 6.93

DL 5.0 % = 7.56
DL 1.0 % = 10.31
DL0.1%=13.68

Table 4

The quantification of the growth vigor of apricot varieties according to their score amounted at the growth elements

No.	Variety	Score					
		TSA	Crown diameter	Tree height	Crown volume	Score amount	Vigor classification
1	Excelsior	9.3	2.7	2.3	9.0	23.3	big
2	Sirena	12.7	2.9	2.2	10.4	28.2	big
3	Favorit	9.3	2.7	2.6	10.7	25.3	big
4	Litoral	5.8	2.6	2.0	7.2	17.6	medium
5	Sulina	7.4	2.4	2.3	7.5	19.6	medium
6	Comandor	11.9	2.8	2.4	10.2	27.3	big
7	Dacia	9.3	2.8	2.2	9.9	24.2	big
8	Olimp	8.8	2.5	2.0	6.5	19.8	medium
9	Mamaia	9.3	2.8	2.8	12.3	27.2	big
10	Cea mai bună de Ungaria	11.9	3.0	2.2	11.6	28.7	big
11	CR 2-63	7.7	3.5	2.8	19.3	33.3	big
AVERAGE		9.4	2.8	2.3	10.4	24.9	-

At the peach varieties, biometric measurements were made at plants in the age of 11, when peach trees achieve maximum dimensions of habitus, then start the decline of plants.

The 15 varieties studied shows wide variability of the growth elements (Table 5).

TSA at the peach varieties was between 98.5 cm² (Crimsongold) and 298.5 cm² (A 164 PN). The amplitude of this element is of 200 cm², which highlights the wide variability of this character.

The crown diameter was framed between 2.8 m (C4R1T14) and 4.5 m (A 164 PN), with amplitude of 1.7 m between varieties.

The plant height ranged between 2.4 m (C4R1T14) and 3.3 m (ARK 85 T and A 164 PN), with an amplitude of only 0.9 m. The variability of this character is reduced and is due to genotype, and also to the way of leading crown (improved vessel).

The crowns at peach varieties are lower than plum and apricot varieties. They oscillate between 12.1 m³ (C4R1T14) and 43.9 m³ (A 164 PN).

Analysis carried out on quantification vigor peach varieties and their classification according to the rate achieved, revealed that growth vigor is differentiated as follows (Table 6):

-small vigor - Redhaven, Harken, Miorita, Crimsongold, NJC 110, NJC 105, NJC 89, Fortuna, Chaterine, C2R6T178, C4R1T14

-medium vigor – Harvester, ARK 85 T, A 164 PN, Romamer 2.

We remark that the varieties ranked at medium vigor realize a rate near group of small vigor. From this quantification it results that, in average, the vigor of the studied varieties is ranked in the medium group (9.4 points).

Determining the average values of the growth elements and transform them into unitary points, revealed the following:

- TSA at groups of varieties is higher than the average with 15% (*Prunus domestica*) and 37% (*Prunus armeniaca*) and at *Prunus persica*, lower by 52%, being a big difference between these groups.

- The crown diameter is an element that differ less around the average so, only the varieties of *Prunus armeniaca* is 27% higher than average, instead *Prunus domestica* and *Prunus persica* groups have relative values lower by 5% and respectively 18% than average.

-The plants height is higher by 7% (*Prunus domestica*) and 17% (*Prunus armeniaca*) than the average and at *Prunus persica* 13% lower than the average.

- The crown volume shows large differences between groups of varieties. If the group of varieties of *Prunus armeniaca* exceeds with 46% the average and that *Prunus domestica* with 13% the average, at the *Prunus persica* group, the crown volume represents only 39% of the average.

After scoring amounted elements it follows that the greatest vigor occurs in apricot (38% above the average), followed by plum (10% above average) and the lowest vigor is at peach (52% of the general average).

Studied species possess a large number of varieties each and those, in different technological and ecological conditions, can alter the growth values at every element of growth and overall group.

Table 5

The behavior of peach varieties in the process of growth (plants in age of 11 years)

No.	Variety/Biotype	Trunk section area TSA (cm ²)	Difference towards control ±	Significance	Tree height (m)	Crown diameter (m)	Crown volume (m ³)	Difference towards control ±	Significance
1	Harvester	200.1	+ 18.7	*	3.2	3.85	32.5	-7	ooo
2	Redhaven	109.3	- 72.1	ooo	3.0	3.6	24.4	-15.1	ooo
3	Harken	167.3	- 14.1	-	2.8	3.55	23.7	-15.8	ooo
4	NJC 105	160.5	- 20.9	o	3.1	3.7	26.9	-12.6	ooo
5	Chaterine	183.8	+ 2.4	-	3.1	3.5	24.0	-15.5	ooo
6	Fortuna	118.8	- 62.6	ooo	3.2	4.25	36.9	-2.6	-
7	C2R6T178	100.2	- 81.2	ooo	3.0	3.2	19.3	-20.2	ooo
8	NJC 110	134.7	- 46.7	ooo	3.2	4.0	31.4	-8.1	ooo
9	Crimsongold	98.5	- 82.5	ooo	3.0	3.35	21.1	-17.4	ooo
10	ARK 85 T	198.4	+ 17.0	*	3.3	3.65	28.2	-11.3	ooo
11	NJC 89	134.7	- 46.7	ooo	3.2	4.0	32.7	-6.8	ooo
12	A 164 PN	298.5	+ 117.1	***	3.3	4.55	43.9	4.4	*
13	Miorița	160.5	- 20.9	o	3.0	3.6	25.4	-14.1	ooo
14	C4R1T14	198.4	+ 17.0	*	2.4	2.85	12.1	-27.4	ooo
15	Romamer 2 (ct)	181.4	-	-	3.1	4.4	39.5	-	-
AVERAGE		163.0	-		3.06	3.7	28.1	-	

DL 5.0 % = 16.48

DL 1.0 % = 22.05

DL0.1%=28.8

Table 6

The quantification of the growth vigor of peach varieties according to their score amounted at the growth elements

No.	Variety	Score					
		TSA	Crown diameter	Tree height	Crown volume	Score amount	Vigor classification
1	Harvester	4.0	1.9	1.6	3.3	10.8	medium
2	Redhaven	2.2	1.8	1.5	2.4	7.9	small
3	Harken	3.3	1.8	1.4	2.4	8.9	small
4	NJC 105	3.2	1.8	1.5	2.7	9.2	small
5	Chaterine	3.7	1.7	1.5	2.4	9.3	small
6	Fortuna	2.4	2.1	1.6	3.7	9.8	small
7	C2R6T178	2.0	1.6	1.5	1.9	7.0	small
8	NJC 110	2.7	2.0	1.6	3.1	9.4	small
9	Crimsongold	2.0	1.7	1.5	2.1	7.3	small
10	ARK 85 T	4.0	1.8	1.6	2.8	10.2	medium
11	NJC 89	2.7	2.0	1.6	3.3	9.6	small
12	A 164 PN	6.0	2.2	1.6	4.4	14.2	medie
13	Miorița	3.2	1.8	1.5	2.5	9.0	small
14	C4R1T14	4.0	2.4	1.2	1.2	7.8	small
15	Romamer 2	3.6	2.2	1.5	3.9	11.2	medium
AVERAGE		3.3	1.8	1.5	2.8	9.4	-

Table 7

The comparison between groups of varieties belonging to different species on growth vigor

No.	Specification (species)	The average value of the score that defines growth vigor										Classification of average vigor at group of varieties from different species
		TSA		Crown diameter		Tree height		Crown volume		The average amount of the score		
		SCORE	%	SCORE	%	SCORE	%	SCORE	%	SCORE	%	
1	<i>P.domestica</i>	7.9	115	2.1	95	2.1	107	8.0	113	20.1	110	medium
2	<i>P.armeniaca</i>	9.4	137	2.8	127	2.3	117	10.4	146	24.9	138	medium
3	<i>P.persica</i>	3.3	48	1.8	82	1.5	77	2.8	39	9.4	52	small
AVERAGE		6.87	100	2.2	100	1.96	100	7.1	100	18.1	100	-

From the presented data regarding the way of manifestation in the growth process of some varieties groups that belongs to the genus *Prunus*, it results that the growth vigor is differentiated between varieties of within the same species and between species as such (Table 7).

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CONCLUSIONS

The plum, apricot and peach trees are plants with tradition and economic importance in our country, each species with numerous varieties in the crop.

These distinct groups of plants are genetically close, but by their behavior in the crop vary greatly.

Growth characteristics highlighted in the study revealed differences existing between species and also between varieties of the same species, characteristics with wide or similar variability.

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