

REZULTATE PRELIMINARE PRIVIND INFLUENTA PORTALTOIULUI ASUPRA VIGORII SI PRECOCITATII LA UNELE SOIURI DE PRUN

PRELIMINARY RESULTS REGARDING THE INFLUENCE OF THE ROOTSTOCKS TO THE VIGOUR AND PRECOCITY OF SOME PLUM CULTIVARS

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Abstract

The most popular rootstock in Romania, like in the most European countries, is Myrobalan seedling, which is very vigorous and insufficient compatible with some cultivars. At present, very important roles in the intensification of plum orchards have vegetative propagated rootstocks. This is the reason that at RIFG Pitesti, Romania, started the breeding program and 6 vegetative plum rootstocks were registered. The aim of the present study is to evaluate the influence of 4 vegetative rootstocks ('Mirodad 1', 'Mirodad 2', 'Adaptabil', 'Redutabil') to the vigor and precocity of 3 plum cultivars ('Andreea', 'Pitestean', 'Cacanska Lepotica') in the second year after planting. The study was carried out at Genetics and Breeding Department - Research Institute for Fruit Growing Pitesti, Romania. The experimental plot was established in 2015 spring, in a randomized block design, 3 replications with 4 trees per replication. The following traits were recorded: trunk diameter (mm); number and length of shoots (cm) per tree, number of fruit buds, flowers and fruits per tree. As results of the investigations we found that: 'Redutabil' rootstock induced a low vigor to the varieties grafted on, 'Adaptabil' rootstock induced a very high vigor; 'Andreea' cv. had the largest trunk diameter, but a small number of shoots, this being a spur cultivar, with a small number of shoots. 'Cacanska Lepotica' and 'Pitestean' cvs. had a small trunk diameter, but a good capacity of shooting; all cultivar / rootstock combinations came into bearing since the second year after planting; the most fruits have been obtained when the cultivars were grafted on 'Adaptabil' rootstock and the less with 'Redutabil' rootstock; of all the varieties studied was noted 'Cacanska Lepotica' cv. with a high number of fruits per tree. 'Andreea' cv. had the lowest number of fruits per tree.

Cuvinte cheie: soiuri prun, portaltoii vegetativi, diametru trunchi, capacitate de lastarire, numar demuguri rod, numar fructe

Key words: plum cultivars, vegetative rootstocks, trunk diameter, capacity of shooting, number of fruit buds, number of fruits

1. Introduction

In Romania, European plum (*Prunus domestica* L.), the predominant species, was planted in a classical system, with 333 trees/hectare (Butac et al., 2014; Butac et al., 2015; Coman et al., 2010). Modern orchards, for growing trees in a high density, need dwarfing or semi-dwarfing rootstocks (Hartman et al., 2007; Sosna, 2002). The most popular rootstock in Romania, like in the most European countries is Myrobalan seedling, which is very vigorous and insufficient compatible with some cultivars (Blazec and Pistekova, 2009, 2012; Kaufmane et al., 2007; Sosna, 2002). At present, a very important role in the intensification of plum orchards has vegetative propagated rootstocks. This is the reason that at RIFG Pitesti started the breeding program for vegetative rootstocks. The main objectives in this program are: low to medium vigor, good ability to vegetative propagation techniques, resistance and/or tolerance to important pest and diseases, adaptability to pedo-climatic conditions of our country, good compatibility with plum cultivars and good influence to precocity, yield and fruit quality (Mazilu et al., 2013). As results of this program 6 vegetative plum rootstocks were registered. The aim of the present study is to evaluation the influence of 4 vegetative rootstocks ('Mirodad 1', 'Mirodad 2', 'Adaptabil', 'Redutabil') on vigor and precocity of 3 plum cultivars ('Andreea', 'Pitestean', 'Cacanska Lepotica') in the second year after planting.

2. Material and methods

The experimental plot was established during spring 2015 at Genetic and Breeding Department of RIFG Pitesti - Maracineni. Three plum cultivars grafted on four vegetative rootstocks were planted in a spacing 4 m between the rows and 3 m between trees (833 trees / hectare), according to the following

experimental scheme: Factor A – cultivar, with 3 graduations (a1-‘Andreea’; a2-‘Pitestean’; a3-‘Cacanska Lepotica’); Factor B – rootstock, with 4 graduations (b1-‘Mirodad1’; b2-‘Mirodad2’; b3-‘Adaptabil’; b4-‘Redutabil’). The experiment was carried out in a randomized block design, in 3 replications with 4 trees per replication. The trees were irrigated and their crowns were flat open center.

The experiment was done in following climatic conditions: 9.7°C - average annual temperature and 663.3 mm - average annual rainfall.

The following traits were recorded: trunk diameter, number and average length of shoots / tree, number of fruit buds / tree, number of flowers / tree, number of fruits / tree.

Trunk diameter (mm) was measured at 30 cm above the soil with digital calipers.

Annual shoots were counted and measured in centimeters using the centimeter ruler.

Precocity of fruiting was assessed by counting the fruit buds per trees, counting flowers and fruits, and then calculating the percent of fruits set.

The differences among the varieties were analyzed using analysis of variance.

3. Results and discussions

Rootstock effect on fruit tree adaptability, vigor and precocity is well known (Botu et al., 2002, 2004; Hrotko et al., 2002; Lanauskas, 2006; Webster, 2001).

3.1. Tree growth vigor

Statistical analysis of data regarding the *average trunk diameter* showed that between cultivars grafted on different rootstocks were significant differences. The largest vigor, expressed in trunk diameter, registered ‘Andreea / Adaptabil’ combination (35.39 mm), and the lowest value of this parameter was recorded ‘Pitestean / Redutabil’ combination (14.15 mm) (Tables 1.a and 1.b).

Analyzing the variation induced by the cultivar to the rootstock, it was found that the lowest trunk diameter was recorded when used ‘Redutabil’ rootstock (19.28 mm), and the highest value was recorded at the varieties which have been grafted on ‘Adaptabil’ rootstock (32.85 mm). After processing the data with analysis of variance it was found highly significant differences between ‘Adaptabil’ and ‘Mirodad 1’, between ‘Adaptabil’ and ‘Redutabil’, between ‘Mirodad 2’ and ‘Redutabil’, between ‘Mirodad 1’ and ‘Redutabil’ rootstocks (Table 1.b).

Analyzing the variation induced by the rootstock to the cultivar is noted that the lowest vigor, expressed by the average trunk diameter, registered ‘Pitestean’ cv. (25.16 mm) and ‘Cacanska Lepotica’ cv. (26.51 mm), and the highest trunk diameter registered ‘Andreea’ cv. (31.04 mm), between these cultivars being significant differences of trunk diameter (Table 1.a).

In conclusion, ‘Redutabil’ rootstock induced a low vigor to the varieties grafted on; ‘Adaptabil’ rootstock induced to the varieties a very high vigor. Dutu et al. (2001) reported the similar data about the vigor induced by the ‘Adaptabil’ rootstock to the peach cultivar ‘Red Haven’.

Regarding the *average number of shoots*, we found also significant differences between cultivar / rootstock combinations, the highest number of shoots, recorded ‘Pitestean / Adaptabil’ combination (19.66 shoots), and the lowest number of shoots registered ‘Cacanska Lepotica / Redutabil’ combination (5.00 shoots) (Tables 1.a and 1.b).

Analyzing the variation induced by the cultivar to the rootstock, it was found that the lowest average number of shoots was registered when used ‘Redutabil’ rootstock (6.66 shoots), and the highest average value of this parameter was recorded when used ‘Mirodad 2’ rootstock (13.33 shoots). The highly significant differences between ‘Adaptabil’ and ‘Redutabil’, ‘Mirodad 1’ and ‘Redutabil’, ‘Mirodad 2’ and ‘Redutabil’ rootstocks were found (Table 1.a).

Analyzing the variation induced by the rootstock to the cultivar, were highly significant differences between cultivars, the lowest average number of shoots was registered with ‘Andreea’ cv. (8.75 shoots) followed by ‘Cacanska Lepotica’ cv (11.16 shoots), and the highest number of shoots registered ‘Pitestean’ (13.66 shoots) cv. It is noted that between the number of shoots and the average diameter of the trunk there was no significant correlation. For example, ‘Andreea’ cv. had the largest trunk diameter, but a small number of shoots, this being a spur cultivar, with a small number of annual shoots. ‘Cacanska Lepotica’ and ‘Pitestean’ cvs. had a small trunk diameter, but a good capacity of shooting (Table 1.b).

Regarding the *average length of shoots*, analyzing variation induced by the cultivar to the rootstock, we found highly significant differences between rootstocks, the lowest length of shoots was recorded when we used ‘Redutabil’ rootstock (26.62 cm), and the highest average value of this parameter was recorded when using ‘Adaptabil’ rootstock (79.89 cm) (Table 1.b).

Analyzing the variation induced by the rootstock to the cultivar we found highly significant differences between cultivars, the lowest average length of shoots was registered ‘Andreea’ cv. (50.42 cm) and the highest value of the average length of shoots was registered ‘Pitestean’ cv. (71.96) (Table 1.a).

The longest annual growth were recorded 'Pitesteian / Adaptabil' (95.94 cm), 'Pitesteian / Mirodad 1' (91.12 cm), 'Pitesteian / Mirodad 2' (70.62 cm) and 'Andreea / Adaptabil' (75.88 cm) combinations (Tables 1.a and 1.b).

It can be seen that, 'Andreea' and 'Cacanska Lepotica' cvs., although they had a small number of shoots, they had a sufficient length. 'Pitesteian' cv. had a high capacity of shooting, may be this trait inherited from its mother 'Tuleu gras' cv.

3.2. Precocity of fruiting

The average number of fruit buds / tree at 3 plum varieties grafted on 4 rootstocks had values between 30.66 fruit buds at 'Pitesteian / Adaptabil' combination and 1.00 fruit buds at 'Andreea / Mirodad 2' combination (Tables 2.a and 2.b).

Analyzing the variation induced by the cultivar to the rootstock, it was found highly significant differences between rootstocks, the lowest average number of fruit buds / tree was recorded when used 'Redutabil' rootstock (4.88 fruit buds), and the highest average value of this parameter was recorded when used 'Adaptabil' rootstock (15.66 fruit buds) (Table 2.b).

Analyzing the variation induced by the rootstock to the cultivar were significant differences between cultivars, the lowest average number of fruit buds / tree, had 'Andreea' cv. (2.25 fruit buds) and the highest average number of fruit buds / tree registered 'Pitesteian' cv. (23.00 fruit buds) (Table 2.a).

Statistical analysis of data regarding *the average number of flowers / tree*, showed that between cultivars and rootstocks were significant differences. The lowest number of flowers was recorded when used 'Redutabil' rootstock (8.37 flowers), and the highest average value of this parameter was recorded when used 'Adaptabil' rootstock (17.54 flowers) (Table 2.b).

Regarding the cultivars, is noted that the lowest average number of flowers / tree, was registered 'Andreea' cv. (2.00 flowers) and most flower were registered 'Pitesteian' cv. (26 95 flowers) (Table 2.a).

The average number of fruit / tree of 3 varieties grafted on 4 rootstocks had an average value of 0.95 fruits / tree, between cultivars and rootstocks being significant differences. The highest average number of fruits / tree recorded the following combinations: 'Cacanska Lepotica / Mirodad 1' (1.33 fruits / tree) and 'Cacanska Lepotica / Adaptabil' (5.22 fruits / tree) (Tables 2.a and 2.b).

Analyzing the number of fruits / tree we observed that almost all cultivars, in all cultivar / rootstock combinations, came into bearing since the second year after planting.

From table 2.b we observe that the most fruits have been obtained when cultivars were grafted on 'Adaptabil' rootstock (1.78 fruits / tree) and the less fruit when using 'Redutabil' rootstock (0.57 fruits / tree).

Of all varieties was noted 'Cacanska Lepotica' cv. with 2.11 fruits / tree. 'Andreea' cv. had the lowest number of fruits (0.18 fruits / tree) (Table 2.a).

Regarding the *percent of fruits set*, it can be seen that there are significant differences between cultivars and rootstocks; the highest values recorded 'Cacanska Lepotica' cv. (22.95%) (Table 2.a).

The highest percent of fruits set was obtained in the case of grafting the cultivars on 'Adaptabil' rootstock (16.80%) and the lowest percentage of fruits set was obtained when grafted on 'Mirodad 2' rootstock (8.59) (Table 2.b).

Making a correlation between the number of flowers and number of fruits per tree, it can be see, for example, that the 'Pitesteian' cv. had high intensity of flowering, but the percent of fruits set was small. At 'Andreea' and 'Cacanska Lepotica' cvs. the intensity of flowering was low, but the percent of fruits set was good.

4. Conclusions

After this study, carried out in 2016 (the second year after planting), we observed that:

- 'Redutabil' rootstock induced a low vigor to the varieties grafted on; 'Adaptabil' rootstock induced to the varieties a very high vigor;
- 'Andreea' cv. had the largest trunk diameter, but a small number of shoots, this being a spur cultivar, with a small number of annual shoots. 'Cacanska Lepotica' and 'Pitesteian' cvs. had a small trunk diameter, but a good capacity of shooting;
- Analyzing the number of fruits / tree we observed that almost all cultivars, in all cultivar/rootstock combinations, came into bearing since the second year after planting;
- We can observe that the most fruits have been obtained when the cultivars were grafted on 'Adaptabil' rootstock and the less fruits when using 'Redutabil' rootstock;
- Of all the cultivars was noted 'Cacanska Lepotica' with a high number of fruits per tree. 'Andreea' cv. had the lowest number of fruits.

5. Acknowledgements

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References

1. Blažek, J., Pištěková, I., 2009. Preliminary evaluation results of new plum cultivars in a dense planting. Hort. Sci. (Prague), 36, 2009 (2): 45–54.
2. Blažek, J., Pištěková, I., 2012. Initial results from the evaluation of plum cultivars grown in a very dense planting. Acta Horticulturae 968 - Proceedings of the IInd Eufirin Plum and Prune Working Group Meeting, Craiova, Romania: 99-108.
3. Botu, I., Achim, G., Botu, M., Godeanu, I., Baci, A., 2002. The evaluation and classification of growth vigour of the plum cultivars grafted on various rootstocks. Acta Horticulturae 577: 299-306.
4. Botu, I., Achim, G., Botu, M., 2004. Evaluation of the stress capacity of different soil types on the scion-rootstock biosystem for plum. Acta Horticulturae 658: 413-419.
5. Butac, M., Chitu, E., Sumedrea, D., Militaru, M., 2014. Evaluation of some plum cultivars in a high density system. Fruit Growing Research, vol. XXX, Pitesti, Romania.
6. Butac, M., Chitu, E., Militaru, M., Sumedrea, D., Plopa, C., 2015. Orchards performance of some Romanian plum cultivars grafted on two rootstocks. Agriculture and Agricultural Science Procedia 6 (2015), Elsevier: 118-123.
7. Coman, M., Butac, M., Sumedrea, D., Dutu, I., Iancu, M., Mazilu, Cr., Plopa, C., 2012. Plum culture in Romania – Current status and perspectives. Acta Horticulturae 968 - Proceedings of the IInd Eufirin Plum and Prune Working Group Meeting, Craiova, Romania: 35-40.
8. Dutu, I., Parnia, P., Viscol, I., Mazilu, Cr., Ancu, S., 2001. Influenta adoi portaltoi vegetativi asupra marimii fructelor si productivitatii soiului de piersic Red Haven. Lucrari Stiintifice ale ICPP Pitesti-Maracineni, vol. XX: 75-77.
9. Kaufmane, E., Rubauskis, E., Skrivele, M., 2007. Influence of different rootstocks on the growth and yield of plum cultivars. Acta Horticulturae 734. Proc. VIIIth IS on Plum and Prune, Norway: 387–391.
10. Hartman, W., Kosina, J., Paszko, D., Beuschlein, H.D., Ogasanovic, D., 2007. Rootstocks in plum growing – Results of an international rootstock trial. Acta Horticulturae 734 - Proceedings of the VIIIth International Symposium on Plum and Prune Genetics, Breeding and Pomology, Norway: 141-148.
11. Hrotko, K., Magyar, L., Simon, G., Klenyan, T., 2002. Effect of rootstocks on growth, yield efficiency of plum cultivars. Acta Horticulturae 577: 105-110.
12. Lanauskas, J., 2006. Effect of rootstock on growth and yield of plum tree cvs. 'Stanley' and 'Kauno Vengrine'. Scientific works of the Lithuanian Institute of Horticulture and Lithuanian University of Agriculture, vol. 25(3): 243-249.
13. Mazilu, Cr., Dutu, I., Mladin, Gh., Ancu, S., Coman, M., Rovina, A., Plopa, C., 2013. Achievements and prospects regarding vegetative rootstocks breeding at the Research Institute for Fruit Growing Pitesti, Romania. Acta Horticulturae 981 – Proceedings of the Second Balkan Symposium on Fruit Growing, Pitesti, Romania: 407-412.
14. Sosna, I., 2002. Growth and cropping of four plum cultivars on different rootstocks in South Western Poland. Journal of Fruit and Ornamental Plant Research, Vol. X: 95-103.
15. Webster, A., 2002. Rootstocks for temperate fruit crops: current uses, future potential and alternative strategies. Acta Horticulturae 557: 25-34.

Tables and Figures

Table1.a. Tree growth vigor of cultivars grafted on vegetative rootstocks - variation induced by the rootstock to the cultivar

Cultivar	Rootstock	Trunk diameter (mm)	No. of shoots	Average length of shoots (cm)
a1-Pitestean	Mirodad 1	26.61	9.66	91.12
	Mirodad 2	28.33	17.33	70.62
	Adaptabil	31.57	19.66	95.94
	Redutabil	14.15	8.00	30.18
	Average	25.16	13.66	71.96
a2-Andreea	Mirodad 1	30.57	10.33	45.62
	Mirodad 2	30.58	9.00	51.23
	Adaptabil	35.39	8.66	75.88
	Redutabil	27.64	7.00	28.96
	Average	31.04	8.75	50.42
a3-Cacanska Lepotica	Mirodad 1	27.43	16.66	68.46
	Mirodad 2	30.99	13.66	59.55
	Adaptabil	31.58	9.33	67.85
	Redutabil	16.04	5.00	20.71
	Average	26.51	11.16	54.14
LSD 5%		2.808	1.140	1.138
LSD 1%		4.646	1.887	1.883
LSD 0.1%		8.696	3.531	3.524

Table1.b. Tree growth vigor of cultivars grafted on vegetative rootstocks - variation induced by the cultivar to the rootstock

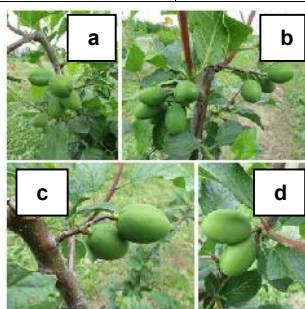
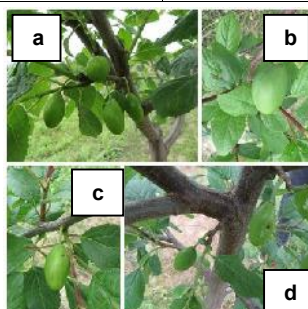
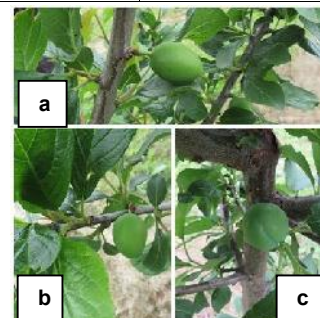
Rootstock	Cultivar	Trunk diameter (mm)	No. of shoots	Average length of shoots (cm)
b1-Mirodad 1	Pitestean	26.61	9.66	91.12
	Andreea	30.57	10.33	45.62
	Cacanska Lepotica	27.43	16.66	68.46
	Average	28.20	12.22	68.40
b2-Mirodad 2	Pitestean	28.33	17.33	70.62
	Andreea	30.58	9.00	51.23
	Cacanska Lepotica	30.99	13.66	59.55
	Average	29.97	13.33	60.47
b3-Adaptabil	Pitestean	31.57	19.66	95.94
	Andreea	35.39	8.66	75.88
	Cacanska Lepotica	31.58	9.33	67.85
	Average	32.85	12.55	79.89
b4-Redutabil	Pitestean	14.15	8.00	30.18
	Andreea	27.64	7.00	28.96
	Cacanska Lepotica	16.04	5.00	20.71
	Average	19.28	6.67	26.62
LSD 5%		2.081	0.664	0.859
LSD 1%		2.854	0.911	1.178
LSD 0.1%		3.885	1.240	1.603

Table 2.a. Precocity of cultivars grafted on vegetative rootstocks - variation induced by the rootstock to the cultivar

Cultivar	Rootstock	No. of fruit buds	No. of flowers	No. of fruits set	% of fruits set
a1-Pitestean	Mirodad 1	25.00	26.00	0.77	2.96
	Mirodad 2	26.33	27.00	1.11	4.11
	Adaptabil	30.66	36.13	1.11	3.07
	Redutabil	10.00	18.66	0.00	0.00
	Average	23.00	26.95	0.75	2.54
a2-Andreea	Mirodad 1	2.00	2.43	0.22	9.05
	Mirodad 2	1.00	1.53	0.00	0.00
	Adaptabil	3.33	1.90	0.22	11.58
	Redutabil	2.66	2.13	0.33	15.49
	Average	2.25	2.00	0.18	8.72
a3-Cacanska Lepotica	Mirodad 1	9.33	9.20	1.33	14.45
	Mirodad 2	4.00	4.06	0.88	21.67
	Adaptabil	13.00	14.60	5.22	35.75
	Redutabil	2.00	4.33	1.00	23.09
	Average	7.08	8.05	2.11	22.95
LSD 5%		0.329	2.001	1.373	-
LSD 1%		0.544	3.311	2.272	-
LSD 0.1%		1.017	6.196	4.252	-

Table 2.b. Precocity of cultivars grafted on vegetative rootstocks - variation induced by the cultivar to the rootstock

Rootstock	Cultivar	No. of fruit buds / tree	No. of flowers / tree	No. of fruits set / tree	% of fruits set / tree
b1-Mirodad 1	Pitestean	25.00	26.00	0.77	2.96
	Andreea	2.00	2.43	0.22	9.05
	Cacanska Lepotica	9.33	9.20	1.33	14.45
	Average	12.11	12.54	0.77	8.82
b2-Mirodad 2	Pitestean	26.33	27.00	1.11	4.11
	Andreea	1.00	1.53	0.00	0.00
	Cacanska Lepotica	4.00	4.06	0.88	21.67
	Average	10.44	10.86	0.66	8.59
b3-Adaptabil	Pitestean	30.66	36.13	1.11	3.07
	Andreea	3.33	1.90	0.22	11.58
	Cacanska Lepotica	13.00	14.60	5.22	35.75
	Average	15.66	17.54	2.18	16.80
b4-Redutabil	Pitestean	10.00	18.66	0.00	0.00
	Andreea	2.66	2.13	0.33	15.49
	Cacanska Lepotica	2.00	4.33	1.00	23.09
	Average	4.89	8.37	0.44	12.86
LSD 5%		0.736	7.609	1.334	-
LSD 1%		1.009	10.435	1.829	-
LSD 0.1%		1.373	14.203	2.490	-

**Fig. 1. Cacanska Lepotica cv. grafted on: a-Mirodad 1; b-Adaptabil c-Mirodad 2; d-Redutabil****Fig. 2. Pitestean cv. grafted on: a-Adaptabil; b, c-Mirodad 1 d-Redutabil****Fig. 3. Andreea cv. grafted on: a-Adaptabil; b-Mirodad 1; c-Redutabil**