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INFLUENCE OF SOME ROOTSTOCKS ON THE GROWTH, YIELD AND FRUITS QUALITY AT THE 'JOJO' PLUM CULTIVAR

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Abstract

Mirobolan seedling (Prunus cerasifera) is the most popular rootstock for plums. Recently researches were begun about the vegetative and generative rootstocks suitability to conditions of Romania. In 2017-2019 periods the influence of six rootstocks on growth, yield and fruits quality at 'Jojo' cultivar was carried out at Genetics and Breeding Department, in Research Institute for Fruit Growing Pitesti, Romania. The trees were planted in the spring of 2015 at 4 x 3 m and comprised 3 trees/3 replications. As results of the investigations we found that: 'Mirobolan dawrf' and 'Mirodad 2' rootstocks induced a very low vigor; the smallest increase of trunk diameter was on the rootstocks 'Adaptabil' and 'Mirodad 2'; the 'Jojo' cv. yielded significantly better on 'Mirodad 1' and 'Mirodad 2' rootstocks; the largest fruits were obtained when the variety was grafted on 'Mirobolan dwarf', and the best taste was obtained in the case of the 'Mirodad 2' rootstock. The 'Jojo' cv. grafted on the 'Mirodad 2' rootstock was noted for its low vigor, high yielding capacity and fruits with high soluble solids content. It can also be observed that in the case of the 'Mirodad 2' rootstock the fruits weight was slightly lower due to the very high production.

Key words*: plum cultivar, rootstocks, growth, yield, fruits quality.*

INTRODUCTION

In Romania, plums are the main types of fruit crops, occupying an area of 65,910 hectares and producing 842,132 tons of fruit (Data FAO, 2020).

Like in the most European countries, in Romania plums were grown until the end of the last century in classical orchards (maximum 400 trees/ha) from which economically yields began in the 6th year after planting or later (Blazek and Pistekova, 2009; Butac et al., 2014, 2015; Kaufmane et al., 2007).

The most popular rootstock in these plum orchards was 'Myrobolan' seedling which is very vigorous, incompatible with some cultivars, causes late bearing and intensive suckering.

In the last 20 years have been established new plum orchards in an intensive system (1,250 trees/ha) with trees training form spindle bush, under fertirigation (Blazek and Pistekova, 2009, 2012; Botu et al., 2002; Butac et al., 2015, 2016; Hartman et al., 2007; Sosna, 2002; Zamfirescu et al., 2019).

Modern fruit growing, besides valuable cultivars, also require rootstocks suitable for a high density plum orchard (Sosna, 2002).

The objective of this paper is to study the influence of some rootstocks (obtained at RIFG Pitesti from the rootstocks breeding program) on the 'Jojo' cultivar. The 'Jojo' cv. was chosen for this study, because due to its resistance to Plum Pox Virus, it was extended in orchards from different European countries.

MATERIALS AND METHODS

The experimental field was established in 2015 at RIFG Pitesti - Maracineni, Genetic and Breeding Department. 'Jojo' cultivar grafted on six rootstocks were planted in a spacing of 4 m between the rows and 3 m between trees, according to the following experimental scheme: Factor A - cultivar, with one graduation (a1-'Jojo'); Factor B - rootstock, with six graduations (b1 -'Adaptabil'; b2 - 'BN4Kr'; b3 - 'Mirodad 1'; b4 - 'Mirodad 2'; b5 - 'Mirobolan dwarf'; b6 - 'Mirobolan'). The experiment was carried out in a randomized

block design, in 3 replications with 3 trees per plot.

In 2017-2019 periods, the following measurements were carried out: tree vigor expressed as trunk diameter at 30 cm above the soil in mm; fruit yield in kg/tree; mean fruit weight in g, soluble solids content with a digital refractometer in % Brix and titratable acidity in % or g/100 g fresh matter with the device Minititrator Hanna Instrument 84532.

The results of the experiment were analyzed statistically using Duncan's multiple range test at a 0.05% significance level.

RESULTS AND DISCUSSIONS

Rootstock effect on tree vigor, yield efficiency and fruit quality is well known (Webster, 2001; Botu et al., 2002, 2004; Hrotko et al., 2002).

Regarding ***tree vigor***, there are not significantly differences between combinations studied. However, the lowest tree vigor, expressed by the average trunk diameter was recorded when 'Jojo' cv. was grafted on 'Mirobolan dwarf' rootstock (58.39 mm - the average on three years) and the largest vigor was recorded on 'Mirobolan' rootstock (65.98 mm) (Table 1). Among the new registered rootstocks, 'Mirodad 2' also induced low vigor of the 'Jojo' cv. From previous studies it is known that the 'Adaptabil' rootstock induces high growth of the varieties grafted on it (Butac et al., 2016). It can be seen, from table 1, that the young plum trees on 'Adaptabil' grew more vigorously, but in the bearing age growth slightly decreased, and finally the increased growth was lower than in the other rootstocks (Table 1).

Table 1. Influence of the rootstocks on the vigor of the 'Jojo' cultivar

No.	Rootstock	Trunk diameter (mm)				Increased growth
		2017	2018	2019	Average	
1	Adaptabil	32.74 a	67.99 a	89.83 a	**63.52 a**	**57.09**
2	BN4Kr	31.65 a	64.98 a	94.43 a	**63.69 a**	**62.78**
3	Mirodad 1	33.01 a	66.96 a	96.40 a	**65.46 a**	**63.39**
4	Mirodad 2	32.93 a	65.81 a	92.33 a	**63.69 a**	**59.40**
5	Mirobolan dwarf	26.78 b	60.84 a	87.54 a	**58.39 a**	**60.76**
6	Mirobolan	32.33 a	66.99 a	98.62 a	**65.98 a**	**66.29**
	Average	**31.57**	**65.60**	**93.19**	**63.46**	

Duncan multiple ranges test. Mean values followed by the same letter within a column are not significantly different (P>0.05).

Regarding the ***fruits yield***, it can see that there are significant differences between combinations studied (Table 2).

Fruits production was recorded only in 2018 and 2019. In 2017, due to late spring frosts recorded in the young fruit stage, production was totally compromised. The average yield per tree of 'Jojo' was the highest on 'Mirodad 2' and 'Mirodad 1' rootstocks (23.21 kg/tree and 18.78 kg/tree, respectively). The average yield per tree on 'BN4kr' and 'Adaptabil' was lower than on other rootstocks (6.92 kg/tree, respectively, 10.00 kg/tree).

Table 2. Influence of the rootstocks on the yield of the 'Jojo' cultivar

No.	Rootstock	Yield (kg/tree)		
		2018	2019	Average
1	Adaptabil	8.27 cd	11.72 d	**10.00 de**
2	BN4Kr	5.47 d	8.36 e	**6.92 e**
3	Mirodad 1	20.93 a	16.62 b	**18.78 b**
4	Mirodad 2	25.08 a	21.34 a	**23.21 a**
5	Mirobolan dwarf	14.26 b	14.22 c	**14.24 c**
6	Mirobolan	11.52 bc	11.39 d	**11.46 cd**
	Average	**14.26**	**13,95**	**14,11**

Duncan multiple ranges test. Mean values followed by the same letter within a column are not significantly different (P>0.05).

It can also be seen that in 2018 fruits yield was higher than in 2019 (Table 2). The differences of yield among years can be explained not only by weather conditions, but also by a tendency

to biennially (Rubauskis et al., 2003), caused by too abundant cropping for 'Jojo' cv. (Kaufmane et al., 2007). 'Jojo' cv. had the regular yields on 'Mirodad 2', 'Mirobolan dwarf' and 'Mirobolan' rootstocks. However, the plums had lower biennially (Skrivele et al., 2000).

Fruit weight. Usually plum rootstocks have not significant effect on fruit weight (Hrotko et al., 2002; Sosna, 2002; Lanauskas, 2006). Statistical analysis of data on fruit weight, show that, between cultivar-rootstocks combinations were not significant differences. The largest fruits were obtained on 'Mirobolan dwarf' (55.07 g) and 'BN4Kr' (53.07 g) rootstocks (Table 3). Regarding 'Jojo'/'BN4Kr' combination the size of the fruits can be explained by the fact that the fruits yield was small in both years of study.

Table 3. Influence of the rootstocks on the fruits weight of the 'Jojo' cultivar

No.	Rootstock	Fruit weight (g)		
		2018	2019	Average
1	Adaptabil	50.30 b	51.27 b	**50.79 b**
2	BN4Kr	54.37 a	51.77 b	**53.07 ab**
3	Mirodad 1	51.80 ab	50.23 b	**51.02 b**
4	Mirodad 2	51.03 ab	50.13 b	**50.58 b**
5	Mirobolan dwarf	54.17 a	55.97 a	**55.07 a**
6	Mirobolan	49.17 b	57.00 a	**53.09 ab**
	Average	**51.81**	**52.73**	**52.27**

Duncan multiple ranges test. Mean values followed by the same letter within a column are not significantly different (P>0.05).

Fruit soluble solids, acid content and soluble solids/acid content ratio (SS/AC).

The *soluble solids content* (SSC) gives the information about value of the fruits. In the present study the SSC varied from 17.63% in 'Jojo'/'Mirobolan' combination to 15.05% in 'Jojo'/'Mirodad 1' combination. After statistical analysis of fruit soluble solids content data, no significant differences between cultivar-rootstock combinations were found. The highest soluble solids content was recorded on 'Mirobolan' and 'Mirodad 2' rootstocks (17.63 % Brix, respectively 16.57 % Brix) and the lowest on 'Mirodad 1' (15.05 % Brix) (Table 4). The same results were obtained in the same experience in previous years (Zamfirescu et al., 2019). In conclusion, soluble solids content were not affected by rootstock. The same results were reported by Sitarek and co-workers (2007) and also by Milosevic and Milosevic (2012).

Organic acids of fruits have a good effect on stomach and the intestine tract and they also determine the taste qualities of fruits (Bozhkova, 2014). As a whole, the 'Jojo' cv. has a low acids content varying from 0.39% on 'Mirobolan' rootstock to 0.65% on 'Mirodad 1' rootstock. The differences between cultivar-rootstock combinations regarding acids content were statically insignificant, which is in agreement with a previous study of plum rootstock (Sitarek et al., 2007). In our study it can be seen that the 'Jojo'/'Adaptabil' combination which has higher soluble solids content had a higher percentage of titratable acids. The 'Jojo'/'Mirobolan' combination which has higher soluble solids content had a lower percentage of titratable acids. On the other hand, it can also be seen that the 'Jojo' cv. on the 'Mirodad 1' rootstock has low soluble solids content, but a high percentage of acids (Table 4).

For plum, higher *soluble solids/acid content* ratio (SS/AC) is correlated with higher eating quality (Crisosto et al., 2007). Effects of interaction on the SS/AC ratio were not significant. There was a significantly higher SS/AC ratio on 'Mirobolan' rootstock and lower SS/AC ratio on 'Mirodad 1' rootstock (Table 4). A high SS/AC ratio means high soluble solids by low acidity (Milosevic and Milosevic, 2012).

Table 4. Influence of the rootstocks on the fruits soluble solids content and titratable acidity of the 'Jojo' cultivar

No.	Rootstock	Fruits soluble solids content (% Brix)			Titratable acidity (%)			Soluble solids: Titratable acidity
		2018	2019	Average	2018	2019	Average	
1	Adaptabil	16.53 a	15.20 c	**15.86 a**	0.38 b	0.87 a	**0.63 ab**	**25.17**
2	BN4Kr	15.47 ab	15.50 c	**15.48 a**	0.30 d	0.61 b	**0.45 ab**	**34.40**
3	Mirodad 1	13.70 bc	16.40 bc	**15.05 a**	0.44 a	0.86 a	**0.65 a**	**23.15**
4	Mirodad 2	14.73 ab	18.40 ab	**16.57 a**	0.35 c	0.61 b	**0.48 ab**	**34.52**
5	Mirobolan dwarf	12.80 c	18.13 ab	**15.47 a**	0.28 e	0.60 b	**0.44 ab**	**35.16**
6	Mirobolan	15.33 ab	19.93 a	**17.63 a**	0.40 b	0.38 c	**0.39 b**	**45.20**
	Average	**14.76**	**17.26**	**16.01**	**0.36**	**0.66**	**0.51**	**32.93**

Duncan multiple ranges test. Mean values followed by the same letter within a column are not significantly different (P>0.05).

CONCLUSIONS

As results of the investigations we found that:
- 'Mirobolan dwarf' and 'Mirodad 2' rootstocks induced a very low vigour; the smallest increase of trunk diameter was on the rootstocks 'Adaptabil' and 'Mirodad 2';
- the 'Jojo' cv. yielded significantly better on 'Mirodad 1' and 'Mirodad 2' rootstocks;
- the largest fruits were obtained when the variety was grafted on 'Mirobolan dwarf', and the best taste was obtained in the case of the 'Mirodad 2' rootstock.
- The 'Jojo' cv. grafted on the 'Mirodad 2' rootstock was noted for its low vigor, high yielding capacity and fruits with high soluble solids content. It can also be observed that in the case of the 'Mirodad 2' rootstock the fruits weight was slightly lower due to the very high production.

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