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COMPARATIVE STUDY IN THE NURSERY OF VEGETATIVE PLUM ROOTSTOCKS, 'MIRODAD 1' AND 'SAINT JULIEN A'

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Abstract

In Romania, for plum species, the last registered vegetative rootstock was 'Mirodad 1'. The purpose of the research was to study the behavior of the 'Mirodad 1' vegetative rootstock compared to the 'Saint Julien A' rootstock at propagating by softwood cuttings, at planting and grafting in nursery conditions from the Southern part of Romania. In the nursery, the interaction of the two rootstocks with the plum varieties 'Tuleu gras', 'Jojo' and 'Romanța' was evaluated. The indicators monitored were the rooting percentage of softwood cuttings, viable rootstocks remaining after planting and growth indicators of grafted trees (height, cross-section area of the trunk, number and length of shoots). The results of the propagation showed that the 'Mirodad 1' rootstock has a significantly higher rooting percentage than the 'Saint Julien A' rootstock. After grafting, the 'Mirodad 1' rootstock induces the same vigor as the 'Saint Julien A' rootstock to the 'Tuleu gras' and 'Romanța' cultivars. In the case of the 'Jojo' cv., the 'Mirodad 1' rootstock induces greater vigor than the 'Saint Julien A' rootstock.

Key words*: grafted trees, plum, propagation, vegetative rootstocks, vigor.*

INTRODUCTION

At international level, there is a permanent concern to obtain vegetative rootstocks which have easy propagation, induce low vigor to the grafted cultivars and have resistance to diseases and pests specific and also to abiotic factors. Among them, were noted the following rootstocks: 'Krymsk 1' ('VVA-1'), 'Krymsk 86', 'Krymsk 2' ('VSV-1') in Russia; 'Mirobolan 29 C', 'Citation', 'AP-1', 'Marianna' group in the USA; 'Myrobolan A', 'Micronette', 'Dospina 235', 'Docera 6' in Germany; 'Myrocal', 'INRA GF31', 'INRA Saint Julien 655/2', 'Myram', 'Ishtara', 'Prumina', 'Ferlenain' in France; 'Myrobolan B', 'Saint Julien A', 'Pixy', 'Brompton', in Italy; 'MRS2 /5', 'Penta', 'Tetra' in England; 'MI-BO-1', 'MY-KL-A' in Slovakia; 'Besztercei szilva' in Hungary; 'Wavit' in Austria (Hartmann et al., 1997; Botu et al., 2004; Czinege et al., 2012; Necas and Krska, 2013; Zamfirescu, 2022).

Although at international level there are numerous plum vegetative rootstocks, due to the pedo-climatic conditions from Romania there is a permanent concern for the creation of plum rootstocks with vegetative propagation. From Romanian rootstock breeding program resulted numerous and valuable generative ('Roșior văratic', 'Buburuz', 'Renclod verde', 'Voinești B', 'Scolduș', 'Porumbar de Iași', 'Mirobolan dwarf', 'Mirobolan C5', 'BN4Kr', 'Oteșani 8') and vegetative rootstocks ('Oteșani 11', 'Miroval', 'Rival', 'Corval', 'Oltval', 'Pinval', 'Corcoduș 163', 'Mirodad 1') (Mazilu et al., 2013, 2014). In the current period, the research trend is to obtain vegetative rootstocks, which are identical to the mother plant and induce to the grafted trees low vigor and uniformity.

The purpose of the research was to study the behavior of the 'Mirodad 1' vegetative rootstock compared to the 'Saint Julien A' rootstock at propagating by softwood cuttings, at planting and grafting in nursery conditions from the South part of Romania.

'Mirodad 1', approved as a vegetative rootstock, was obtained by controlled hybridization between 'Mirobolan dwarf' (*Prunus cerasifera*) and 'Adaptabil' (*Prunus besseyi*).

MATERIALS AND METHODS

Field trial and plant material

The observations were carried out at the Research Institute for Fruit Growing Pitești, in

the experimental fields of the nursery, located in the Southern part of Romania, at 44°51'30" North latitude and 24°52' East longitude.
In the nursery, the interaction of the two rootstocks (‘Mirodad 1’ and ‘Saint Julien A’) with the three plum cultivars (‘Tuleu gras’, ‘Jojo’ and ‘Romanța’) was evaluated.

Measurements

Between 2019-2021, the following parameters were appreciated and measured: the rooting percentage of softwood cuttings; the cuttings remaining after planting in the first field of the nursery and the influence of the rootstocks on the growth of the three cultivars in second field of the nursery.
The softwood cutting was carried out at the beginning of July. The cuttings, 25 cm long, were planted on high beds, in the sand substrate, under artificial fog conditions. Two experimental variants have been used: V0 – control without biostimulatory; V1 – treated with Radistim V2 (ANA based rooting biostimulatory) applied in powder form. For each variant, 100 cuttings were planted at a distance of 8 x 5 cm. The rooting percentage was determined in November, at harvest time, when the root of the cutting is lignified. In the springs of 2020 and 2021, the cuttings were planted at a distance of 90 x 15 cm in the first field of nursery. The rootstocks remaining after planting were determined at the beginning of June. In August, 2020, the three plum cultivars (‘Tuleu gras’, ‘Jojo’ and ‘Romanța’) were grafted using the chip-budding method (60 rootstocks for each rootstock - cultivar combination). The indicators monitored before harvesting of the grafted trees were the vigor and the shooting capacity for each cultivar - rootstock combination. The vigor was expressed by the average trees height and the trunk cross-sectional area (TCSA) at 20 cm above the grafting point. The shooting capacity was appreciated by the number and length of shoots/tree (over 50 cm above the grafting point).

Statistical analysis

The data were included in an Excel database. The significance of the influence of the experimental factors on cutting, planting and grafting was highlighted using the ANOVA variance analysis test. Differences between means were highlighted at 0.05% level of probability.

RESULTS AND DISCUSSIONS

Softwood cuttings propagation

‘Saint Julien A’ is a vegetative rootstock widely used throughout the world due to its good compatibility with plum varieties, the low vigor induced to the cultivars and the fact that it does not issue layers in the orchard. It is propagated vegetative both by macropropagation with hardwood or softwood cuttings (Markovski et al., 2015) and by micropropagation (*in vitro*) (Nacheva et al., 2023).
‘Mirodad 1’ is a vegetative plum rootstock with low vigor, resistant to diseases and well adapted to the soils of Romania. It is compatible with most European plum cultivars, and does not emit suckers in the orchard (Duțu et al., 2016).
Figure 1 shows images of cuttings rooted on the two rootstocks studied.

a **b**

Figure 1. ‘Saint Julien A’ (a) and ‘Mirodad 1’ (b) – rooted cuttings

The ‘Saint Julien A’ rootstock propagation by softwood cuttings had a rooting percentage between 2.15% in the V0 variant and 55.56% in the V1 variant. The ‘Mirodad 1’ rootstock had a significantly higher rooting percentage than ‘Saint Julien A’, in the both variants, ranging between 72.38% (V0) and 98.99% (V1) (Figure 2).

Figure 2. The influence of the rootstock on the rooting percentage
(Notes: Means with different letters between rootstocks are statistically different, P≤0.05)

The best rooting percentage was recorded in 2020 in the V1 variant treated with Radistim V2 with a maximum of 98.99% at 'Mirodad 1' and 55.56% at 'Saint Julien A' (Figure 3). Our results are similar with results obtained by Lopez-Bucuio et al., 2003, regarding use of biostimulators.

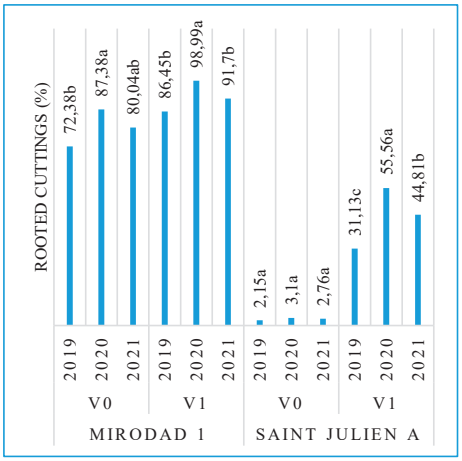

Figure 3. The variation of the rooting percentage of the softwood cuttings in the experimental period
(Notes: Means with different letters between years are statistically different, P≤0.05)

The success of the rooting process depends on numerous factors such as the health and nutrition of the mother plants, the vegetation stage of the shoot in which the softwood cuttings was made, the substrate and rooting biostimulator used, the amount of water and the watering interval in the greenhouse, etc.
Variation in either of these factors can result in changes in rooting percentage from year to year.
In the case of this experience, regardless of the substrate, the cuttings' moment and the biostimulator used were the same between the cutting years, significant differences appear both in the 'Mirodad 1' rootstock in both variants and in 'Saint Julien A' in the V1 variant. In the present case, the reason could be the amount of water and watering intervals during the rooting period.
The statistical data showed that in the V1 variant – treated with Radistim V2 the rooting percentage is significantly higher than in the V0 variant – without biostimulator (Figure 4).

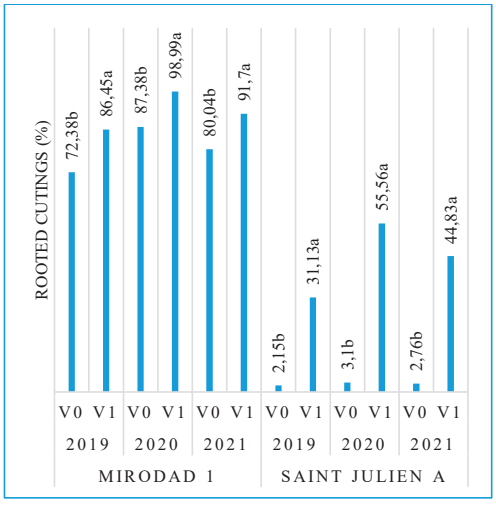

Figure 4. The influence of the biostimulator on the rooting capacity of rootstock cutting
(Notes:Means with different letters between variants are statistically different, P≤0.05)

Planting of rooted cuttings

In the springs of 2020 and 2021, the rootstocks were planted in the first field of the nursery at a distance of 90 cm between rows and 15 cm between plants per row, in order to graft in August. The evaluation of the rootstocks remaining after planting showed that in the case of 'Saint Julien A' rootstock there was a significantly higher percentage (97.77%) than in the case of 'Mirodad 1' rootstock (95.5%), average values over two years (Figure 5).

Figure 5. Rootstocks left after planting for grafting
(Notes: Means with different letters between rootstocks are statistically different, P≤0.05)

The vigor induced by the rootstock to the grafted cultivars

In August, three plum cultivars 'Tuleu gras', 'Romanța' and 'Jojo' were grafted, using the chip-budding method, on 'Mirodad 1' and 'Saint Julien A' rootstocks. 'Tuleu gras' and 'Romanța' are Romanian cvs. spread in commercial orchards from Romania. 'Jojo' cv., registered in Germany, was recently introduced in our country due to Plum Pox Virus resistance (Butac et al., 2018).

In order to evaluate the influence of the studied rootstocks on the three plum cultivars, tree vigor and shooting capacity, in the second field of the nursery, were carried out (Table 1).

The average height of the trees varied between 164.71 cm for the 'Romanța' cv. grafted on 'Saint Julien A' and 102.73 cm for the 'Jojo' cv. grafted on the same rootstock.

The average surface of the trunk section varied between 159.54 mm^2 la 'Romanța / Mirodad 1' combination and 59.51 mm^2 la 'Jojo / Saint Julien A' combination. It can be seen from Table 1 that regarding the trees vigor, expressed by the trees height and the surface of the trunk section, the cultivars grafted on the 'Saint Julien A' rootstock have a slightly smaller vigor than those grafted on 'Mirodad 1', the differences being insignificant. The results regarding the influence of the 'Saint Julien A' rootstock on the vigour of 'Jojo' cv. are similar with other reported by Blazek et. al., 2009. Regarding 'Romanța / Mirodad 1' combination similar results were reported by Butac et al. in 2023.

The shooting capacity was the highest at 'Tuleu gras' cv. grafted on 'Mirodad 1' (4.7 shoots/tree). At the other extreme being 'Jojo' cv. grafted on 'Saint Julien A', the shooting capacity being very low, almost non-existent (0.09 shoots/ tree).

The average length of the shoots on the tree varied between 31.56 cm for the 'Tuleu gras' cv. grafted on 'Saint Julien A' and 1.36 cm for the 'Jojo' cv. grafted on the same rootstock.

Following the statistical analyses, it was observed that there were no significant differences between the trees of 'Tuleu gras' and 'Romanța' cvs. grafted on 'Mirodad 1' and 'Saint Julien A' rootstocks in case of tree vigor and shooting capacity.

In the case of the 'Jojo' cv., it is observed that the trees grafted on 'Mirodad 1' have significantly higher vigor and shooting capacity than the trees grafted on 'Saint Julien A'.

Although there are differences between the Romanian cultivars and the 'Jojo' cv., still the average effect of the rootstock on the three cultivars showed that 'Mirodad 1' rootstock induces the same vigor and shooting capacity in the nursery as 'Saint Julien A' rootstock (Table 1).

Table 1. The influence of the rootstock on the growth indicators of the grafted tree

Growth indicators	Rootstock	Cultivar			Average rootstock effect
		Tuleu gras	Romanța	Jojo	
Tree height (cm)	Mirodad 1	136.81a	152.94a	130.62a	**140.12a**
	Saint Julien A	143.46a	164.71a	102.73b	**136.96a**
TCSA (mm^2)	Mirodad 1	124.17a	159.54a	158.02a	**147.24a**
	Saint Julien A	125.15a	159.15a	59.51b	**114.60a**
Number of shoots/ tree	Mirodad 1	4.78a	2.5a	2.68a	**3.32a**
	Saint Julien A	3.31a	2.88a	0.09b	**2.09a**
Length Of shoot /tree (cm)	Mirodad 1	18.13a	29.57a	20.68a	**22.79a**
	Saint Julien A	31.56a	26.49a	1.36b	**19.80a**

Notes: The values are compared vertically. Means with a different letter are statistically different (P≤0.05).

Figure 6 represent tree of 'Romanța' grafted on 'Mirodad 1' at harvest moment.

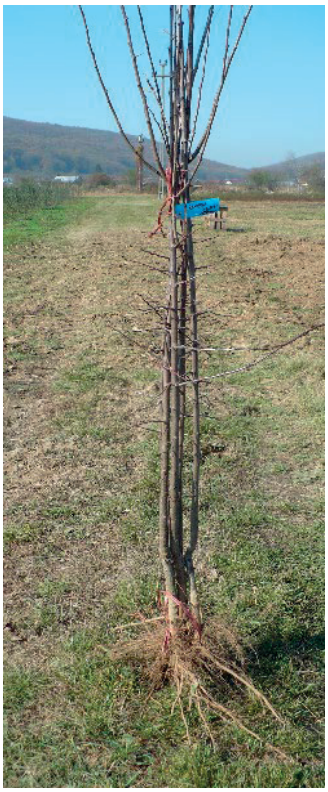

Figure 6. Romanța/Mirodad 1- grafted trees

CONCLUSIONS

The 'Mirodad 1' rootstock has a significantly higher rooting percentage than 'Saint Julien A', the highest value being in the variant with the rooting biostimulator based on naphthyl acetic acid (Radistim V2).

The percentage of rootstocks remaining for grafting after planting was greater than 95%, being significantly better for the 'Saint Julien A' rootstock than for the 'Mirodad 1' rootstock. The two rootstocks induce in the nursery vigor similar to the trees of the 'Tuleu gras' and 'Romanța' cvs. instead of the trees of 'Jojo' cv. grafted on 'Saint Julien A' have lower vigor and shooting capacity than trees of the same cultivars grafted on 'Mirodad 1' rootstock.

In conclusion, as a medium effect, rootstock 'Mirodad 1' induces, in the nursery, grafted cultivars similar vigor and shoot capacity to rootstock 'Saint Julien A', but with easier propagation by softwood cuttings.

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