

INFLUENCE OF SO4 AND *Rupestris du Lot* (MONTICOLA)
ROOTSTOCKS ON THE PRODUCTION OF TANGRA
DESSERT VINE PLANTING MATERIAL

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Received on February 8, 2024

Presented by H. Najdenski, Corresponding Member of BAS, on April 23, 2024

Abstract

The role of the vine rootstock and its correct selection is the main step in creating vine plantations to achieve a balance between vine growth, yield and grape quality. The studies in this direction are aimed at determining the most suitable rootstock for the different vine varieties, with the objective of their optimal development.

In 2018–2021, the agrobiological parameters of vines of Tangra variety, grafted onto two rootstocks – SO4 (*Berlandieri* × *Riparia selection Oppenheim 4*) and Monticola (*Rupestris du Lot*), with different disposal of the root system and affecting the growth vigour and development of the vines, were studied in the Experimental nursery for grapevine rootings of IASS “Obratzov Chiflik”, Ruse, Bulgaria.

The experiment was carried out in two variants, each in four replications with 50 grafted cuttings with drip irrigation and micro-jet irrigation in the first month after planting for rooting.

The study aimed to recommend the most suitable rootstock for grafting Tangra dessert seedless variety to avoid adverse modification changes caused by it.

Monticola rootstock was found to influence positively on the percentage of premium rooted vines, forming a better root system and inducing better growth and maturing of the increment in the production of vine planting material, compared to vines, grafted onto SO4 rootstock.

Key words: grafted cuttings, vine rooting nursery, rooting, herbicides, weeds

Introduction. The need for the use of vine rootstock arose at the end of the 19th century, when phylloxera (*Dactylosphaera vitifoliae*) attacked the roots of *Vitis vinifera* and caused the gradual destruction of European vineyards. Finding a solution to the phylloxera problem led to a search for vine plants of *Vitis* sp., resistant or tolerant to the pathogen. In the studies of PAVLOUŠEK and MICHLOVSKÝ [1], it was found that *Vitis riparia*, *Vitis berlandieri* and *Vitis rupestris* were suitable for grafting with *Vitis vinifera*.

According to MILOSAVLJEVIĆ [2], all rootstocks used in viticulture have satisfactory compatibility with representatives of *Vitis vinifera* L., as the different vine varieties do not show the same degree of compatibility with one and the same rootstock.

GULLO et al. [3] and SABIR and SAHIN [4] found that root anatomy, morphology, development, and distribution differ among rootstock types.

The soil and climate conditions in the different wine-growing regions require the correct selection of the variety-rootstock combination, as a prerequisite for the production of quality grapes. The adaptation, i.e. the adaptability and resistance of rootstocks to environmental conditions (soil-climatic) is an extremely important feature determining its economic suitability in the production of certified rooted vines [5,6].

BIHARI [7] tested three different types of rootstocks (*Ruggeri 140*, *5C* and *Fercal*) on loess soil, aiming to prove that the grafted vine had better vegetative growth with suitable rootstock, thus rootstock quality was measured as cumulative shoot length.

The objective of the study was the primary manifestation of the degree of affinity between grafting components, the nature and degree of modification variability induced by SO4 and Monticola rootstocks to be determined. The ultimate practical goal was to recommend the most suitable rootstock for grafting Tangra seedless vine variety, in order to avoid the adverse modification changes caused by it.

Material and methods. Cuttings of Tangra seedless dessert vine variety were grafted onto two rootstocks – SO4 (*Berlandieri* × *Riparia* selection *Oppenheim 4*) and Monticola (*Rupestris du Lot*), with different disposal and development of the root system, and influencing the growth vigour and development of the vines.

Berlandieri × *Riparia*, sel. *Oppenheim 4* (SO4) rootstock forms numerous, highly branched, thinner yellowish-red roots and is characterized by high resistance to phylloxera and good resistance to nematodes. The rootstock withstands up to 45% total or 17% active carbonates in the soil, and deeper soils with a good water regime are best suited for it.

Rupestris du Lot (Monticola) rootstock is suitable for deep, medium-rich and light soils, as it develops a deep root system and withstands drought. The soil should not contain more than 25% carbonates or 14% active calcium carbonate. It

is resistant to fungal diseases and soil nematodes (non-insect pests). Vines grafted onto Monticola rootstock are long-lived, vigorous in growth and show tendency to putting forth aments.

Tangra variety was created in 2012 at the Experimental Vineyard of IASS “Obratzov Chiflik”, Ruse, Bulgaria, via inbreeding (self-pollination) of 3–32 (*Bolgar* × *Alphonse Lavallée*) hybrid form. Tangra is a typical dessert seedless variety. The cluster is large, uniform. The berry is large, red-black, with a harmonious taste and a crispy consistency. The seeds are rudiment and do not feel unpleasant when consumed. The grapes of the variety are transportable and suitable for market realization in late autumn and winter. The variety is not prone to millerandage and has increased resistance to cold.

The paraffinized and stratified cuttings were rooted in two-row beds, in the Experimental nursery for grapevine rootings of IASS “Obratzov Chiflik”, Ruse, in the period 2018–2021, with an exposed paraffined part and grown according to the technology of TODOROV [8], with drip irrigation and microjet watering in the first month after planting.

The experiment was carried out in two variants, according to the rootstock used, each in four replications, 50 grafted cuttings in each of them.

After starting the experiment, the vine rooting area was kept clear of weeds. Weed control was carried out with pendimethalin 455 g l⁻¹ (Stomp Aqua – 3 l ha⁻¹) soil cereal herbicide. The herbicide was fertilized into the row and inter-row space, once, at a consumption of working solution 0.4 l ha⁻¹ and pressure of the working nozzle $P_{\max}$ 300 kPa. Pendimethalin was used after planting the vine cuttings and earthing up, without incorporation. After the 60th day of planting, for the destruction of the johnsongrass, emerging from seeds and partially preserved rhizomes, and secondary weed infestation with cereal weeds, during the growing season it was treated with propaquizafop 100 g l⁻¹ (Agil 100EK – 2 l ha⁻¹).

Pendimethalin maintained a low degree of weed infestation and had a more effective control of unwanted vegetation in the nursery for vine rootings, compared to the period after hand weeding. Its duration of action exceeded sixty days and in combination with the action of propaquizafop against johnsongrass (*Sorghum halepense* L.) and secondary weed infestation with cereal weeds, it allowed the young vines to absorb nutrients from the environment, with reduced competition [9]. After the fertilization with the herbicides and the visual inspections, no visible manifestations of phytotoxicity and suppression of the growth of the grafted rooted vines were observed.

The grafted cuttings from all variants of the variety-rootstock combinations were fertilized equally with nitrogen, phosphorus and potassium fertilizers. During the study, the following parameters were followed: mature shoot length (cm), mature shoot mass (g), second internode diameter (mm), internode length (cm), average number of roots, including roots with a thickness below and over 2 mm and

average yield of first-class rooted vines (%), which were reported after certification of the planting material. Measurements were made on eight vines from each replication.

Statistical analyses were performed using SPSS 17.0 software program [10]. The differences in the values of the agrobiological parameters, characterizing the growth of the grafted rooted vines, in both variety-rootstock combinations, were determined using One-Way-ANOVA ($P \leq 0.05$). Data reported in the article were presented as means $\pm$ standard deviations of four replications and compared using the LSD test of Tukey. The strength of influence of the factors and its significance were calculated according to the method of Plohinsky, and determined as a part of the intergroup variation in the total variation [11].

Results and discussion. The agrobiological parameters characterizing the growth of the certified rooted vines in both variants were presented in Table 1. The length and mass of the mature increment in the variant grafted onto Monticola rootstock had proven better maturing of the shoots compared to the vines on SO4 rootstock. On average for the period, in terms of the length of the mature increment, the difference between the variants with Monticola and SO4 amounted to 18.92 cm (49%), and in terms of mass – to 9.3 g (69%), for which statistical differences were found at $P \leq 0.05$.

Statistical differences (at $P \leq 0.05$) were also found in the values of the parameters diameter of the second internode and length of the internodes of the shoots, depending on the rootstock. According to the results presented in Table 1, the diameter of the second internode and the length of the internodes in the variant with Monticola rootstock, had higher values (0.66 ± 0.04 and 3.50 ± 0.10), compared to the variant with SO4 rootstock (0.50 ± 0.03 and 2.59 ± 0.8). On average for the period, the reported differences in the values of the studied parameters were in favour of the variant with Monticola rootstock by 0.16 mm (25%) and 0.91 cm (0.26%), respectively. The results of the biometric measurements fully confirmed the observed tendency for more intensive growth of the above ground parts of the grafted vine cuttings on Monticola rootstock, compared to SO4 rootstock.

T a b l e 1

Agrobiological parameters, characterizing the growth of grafted rooted vines,
Tangra variety, on average for the period 2018–2021

Variants	Length of the mature increment, cm	Mass of the mature increment, g	Diameter of the second internode, mm	Length of the internodes, cm
SO4	$19.09^a \pm 1.78$	$4.17^a \pm 0.95$	$0.50^a \pm 0.03$	$2.59^a \pm 0.8$
Monticola	$38.01^b \pm 2.60$	$13.47^b \pm 2.23$	$0.66^b \pm 0.04$	$3.50^b \pm 0.10$

Different letters within the column mean significant differences among the rootstocks ($P \leq 0.05$); values are means $\pm$ standard error (SE)

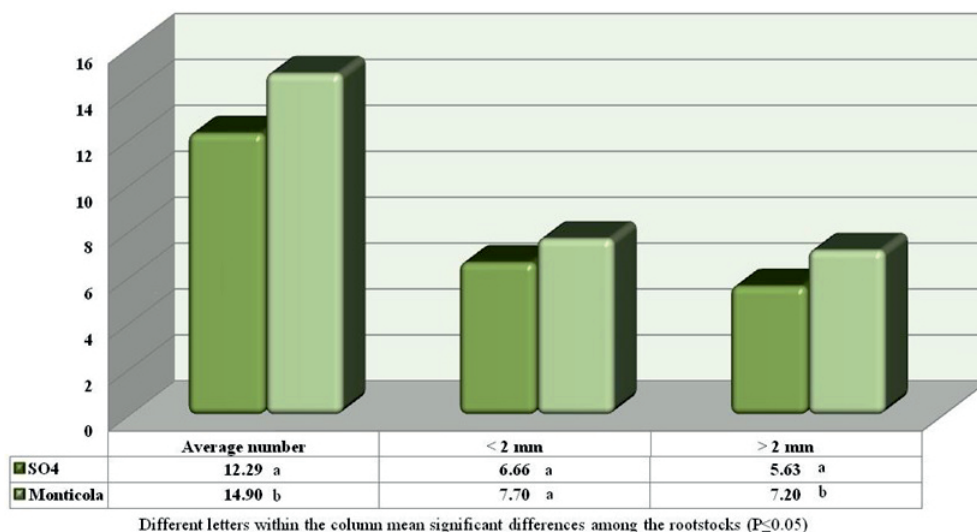


Fig. 1. Average number and thickness of roots (< 2 mm and > 2 mm) after removing the vines, for the period 2018–2021

UZUNOVA et al. [12] proved that the rootstocks used had specific effects on certain agrobiological and growth traits in different vine varieties.

A main quality parameter of grafted rooted vines was the development of their root system, which was determined by counting the number and thickness of roots (> 2 mm and < 2 mm), graphically presented in Fig. 1.

In the variant with Monticola rootstock, a higher average number of roots (14.90 pcs), number of roots with thickness < 2 mm (7.70 pcs) and > 2 mm (7.20 pcs) were found, which exceeded those reported in SO4 rootstock by 17.52%, 13.5% and 21.8%, respectively. The reported higher values of those parameters were statistically proven at a level of significance $P \leq 0.05$.

Similar results were reported by other authors who found that both cultivar and rootstock affected the number, type and size of the root system [13, 14]. RADULOV [15] found that vines with a greater number of roots, counted after being removed from the Experimental nursery for grapevine rootings and planted into a permanent place, were taking roots better and had more intensive growth.

The strength of the influence of the factors was determined via the two-factor variance analysis. It was found that the year (Y) and the rootstock (C) influenced only on the parameter mass of mature increment (12.88% and 77.71%), which had the highest level of significance $\alpha = 0.001$. Regarding the other three parameters, they were completely influenced by factor C (rootstock), had a very good probability of the differences and the highest level of significance $\alpha = 0.001$. The factor Y (year) and the interaction between the two factors ($Y \times C$) had an unproven strength of influence on all parameters characterizing the growth of grafted rooted vines.

T a b l e 2

Two-factor comparative analysis of the parameters, characterizing the growth and development of grafted rooted vines in Tangra variety

Source of variation	Strength of influence, %						
	Diameter of the second internode	Length of the internodes	Length of the mature increment	Mass of the mature increment	Average number	< 2 mm	> 2 mm
Year (Y)	0.92 n.s.	4.02 n.s.	2.60 n.s.	12.88***	15.14 n.s.	37.72 n.s.	5.95 n.s.
Rootstock (C)	88.06***	80.96***	94.12***	77.71***	64.35***	24.73 n.s.	69.16***
Y $\times$ C	1.08 n.s.	8.91 n.s.	0.89 n.s.	5.87 n.s.	8.83 n.s.	13.23 n.s.	15.81 n.s.
Error	9.94	6.11	2.39	3.51	11.68	24.32	9.08

Significant at: $\alpha = 0.001$ (***) and n.s. – non-significant

The influence of factor C (rootstock) was greater than factor Y (year), and with very good statistical significance at $\alpha = 0.001$, only with regard to the parameters average number of roots (64.35%) and roots with thickness > 2 mm (69.16%). The interaction between the two factors (Y $\times$ C) was weak and unproven for all the other parameters (Table 2).

The main parameter that characterized the production of vine planting material was the percentage of first-class rooted vines. A higher average yield of premium rooted vines was obtained from the variant grafted on Monticola rootstock (38.76%), which exceeded the variant grafted onto SO4 rootstock (24.32%) by 14.4%. The difference between the two variants was statistically proven, at $\alpha = 0.5$. In the initial development of the grafts in the Experimental nursery for grapevine rootings, cases of drying up, necrosis of callus tissue at the grafting site were observed, with final result – a low percentage of first-class rooted vines – 24.32% (Fig. 2).

MIHAYLOV and POPOV [16] considered that the vegetative development of the underground and above-ground parts of the grafted rooted vines were of great importance for the production of first-class rooted vines, and DYAKOVA et al. [17] found that the lower yield of rooted vines obtained from rootstocks was largely due to the characteristics of the rootstock itself.

Conclusions. Monticola rootstock was characterized by a well-developed root system, with a very good root formation, better growth and maturing of the increment in the production of vine planting material compared to vines grafted on SO4. The influence of Monticola rootstock on the growth vigour and the development of the root system of Tangra variety was significant and statistically proven.

When determining the level of influence of the factors year and rootstock, and the interaction between them, mathematically proven differences were defined only

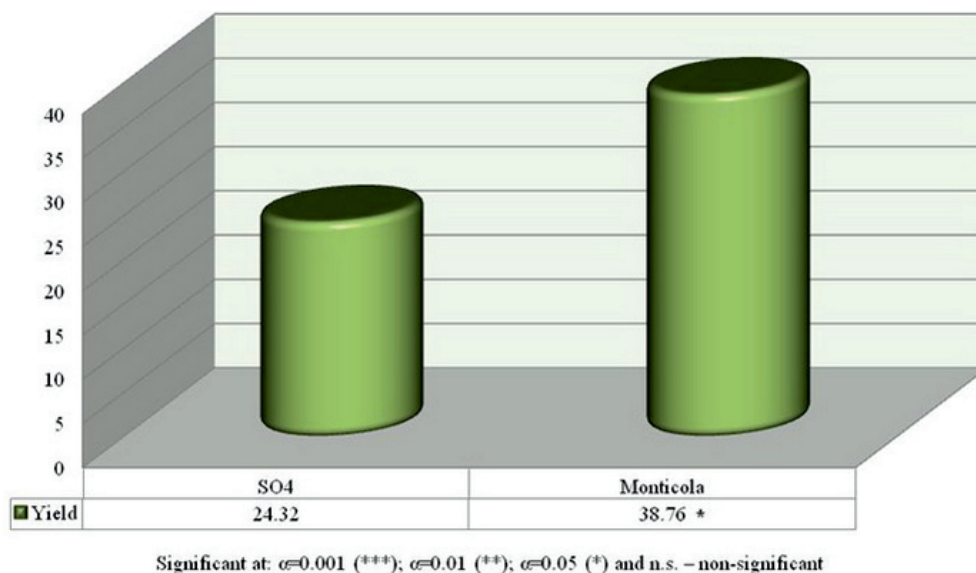


Fig. 2. Average yield of rooted vines, % compared to grafted cuttings, average for the period 2018–2021

in factor rootstock, which affected the variations of the agrobiological parameters, characterizing the growth and development of the grafted rooted vines.

Monticola rootstock can be recommended as the suitable one for grafting of Tangra dessert grape variety.

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