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STUDY OF THE NEW CLONAL CHERRY ROOTSTOCK HYBRIDS 20-192 AND 20-181 IN NURSERY

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Abstract

Studies have been conducted in the fruit tree nursery of Agricultural Experiment Station - Khan Krum between 2013 and 2016. Research subjects were the selected cherry rootstock hybrids 20-181 and 20-192 as clonal rootstocks grafted with cultivars Kossara, Trakiiska hrushtyalka and Van. Prunus mahaleb seedlings were used as a reference. The aim of the study was to investigate the growth characteristics, quality of planting material, and compatibility of the rootstocks with commercial cultivars. The average success rate of grafting reported in the autumn of the analyzed cultivar-rootstock combinations varied as follows: P. mahaleb (89-92%), hybrid 20-192 (85-89%), and hybrid 20-181 (81-86%). The clonal rootstock 20-192 induces relatively weaker growth than the Mahaleb. The weakest growth characterizes hybrid 20-181. Both tested rootstock hybrids, obtained by the crossing of 'Polevka'×'Compact Van', produce planting material with standard trunk diameter and tree height.

Key words: *sweet cherry, Prunus mahaleb, rootstocks, cultivars, hybrids.*

INTRODUCTION

The rootstock plays an increasingly important role in the application of new technologies and the development of modern fruit growing.

In the last 20 years, both new technologies and many newly selected rootstocks have entered cherry production (Lichev et al., 2020). The selection of new cherry rootstocks is related to the creation of intensive plantings, the introduction of new training systems, and the production of higher yield and better quality (Lang, 2000; Hrotko et al., 2007; Hrotko, 2009; Hrotko, 2010; Lichev, 2015; Pal et al., 2017; Kaplan et al., 2018).

The search for less vigorous cherry rootstocks began relatively late in the 1960s after it had already been demonstrated in pome fruit species the advantage of week-growing trees and the greater density of plantations (Webster, 1989). As a result of targeted selection activity over the last 20 years of the past century, a relatively large number of rootstocks with moderate and even weak growth have been created throughout the world (Trefois, 1989; Schimmelpfeng, 1993; Sansavini & Lugli, 1996; Franken-Bembenek & Ystaas, 1998; Quero-García et al., 2017). As a result of targeted selection activity, a relatively large number of rootstocks with moderate and even low growth were created in the last 20 years of the past century (Franken-Bembenek., 1996; Lichev, 2015; Quero-García et al., 2017; Lichev et al., 2020).

In Bulgaria, the fastest spreading in practice are the rootstocks from the series 'GiSelA®', mainly 'GiSelA 5' and 'GiSelA® 6'.

According to Manolova & Kolev (2012), the 'GiSela 5' rootstock is the most economically efficient in establishing new orchards but requires a high level of agrotechnical orchard management and if it is not provided, good economic results cannot be expected. And for container growing Akova (2022) recommends GiSela 6 rootstock to be planted in containers with a volume that does not exceed 5 l.

The analysis of the state of the problem reveals that data on the Bulgarian selection of cherry rootstocks with weak vigor is very scarce. The aim of the present study is to test cherry rootstocks selected in Bulgaria with weak vigor and to compare them with the rootstock most used in Bulgaria rootstock for the production of planting material.

MATERIALS AND METHODS

The trial was set in the fruit tree nursery of the Experimental Agriculture Station - Khan Krum. The rootstocks used in the evaluation were the new clonal rootstock hybrids from the Fruit Growing Institute - Plovdiv - hybrids 20-181 and 20-192 with *Prunus mahaleb* seedlings as reference.

T-budding was performed at the beginning of August in the first year, and each of the three rootstocks was budded with cultivars 'Van', 'Kossara', and 'Trakiiska hrushtyalka'.

The two hybrids 20-181 and 20-192, being tested as rootstocks for sweet cherry cultivars, are obtained from the parental combination ('Polevka'×'Compact Van') producing a population of 31 hybrids, out of them the two were selected for their weak growth and drought and pest resistance. The cultivars 'Kossara' and 'Trakiiska hrushtyalka' were obtained also as a result of the breeding program of the Fruit Growing Institute - Plovdiv - 'Kossara' from crossing 'Ranna cherna' × 'Bigarreau Burlat', and 'Trakiiska hrushtyalka' from open pollination of 'Van' (Zhivondov, 2012; Malchev, 2016).

The observations were carried out in the period between 2013 and 2016 in first- and second-year nursery. The planting distances in the nursery were 80/12 cm.

During the vegetation, growth dynamics were recorded every 10 days/from 20.05 to 18.9/. The trunk thickness was measured at 15 cm from the soil surface with a micrometer. The nursery is under irrigated conditions and standard cultivation techniques. The statistical analysis of the data was carried out according to the Dunkan MRT (De Mendiburu, 2021).

On the basis of the presented Table 1 meteorological data for the four-year period, we can draw the conclusion that precipitation during the growing seasons of the trial is unevenly distributed, and average monthly temperatures have large amplitudes in individual years.

Table 1. Mean monthly air temperature ^{0}C and precipitations totals in 2013-2016 relative to the long-term means

	Temperature (^{0}C)					Precipitation (mm)				
Month	2013	2014	2015	2016	Long-term mean	2013	2014	2015	2016	Long-term mean
January	0.8	2.8	2.0	2.3	4.0	32.5	50.3	38.0	80.0	35.0
February	3.1	4.0	3.2	3.6	2.5	57.9	40.3	61.0	21.4	28.0
March	5.4	9.2	5.7	9.2	7.1	42.0	51.2	61.0	60.8	31.0
April	14.8	12.8	11.7	14.3	10.9	37.4	53.1	55.0	41.0	41.0
May	18.3	15.8	19.5	14.8	16.7	81.5	158.2	26.0	75.5	64.0
June	23.9	20.3	21.1	21.5	21.6	34.0	169.5	39.0	44.0	75.0
July	22.6	24.5	25.8	23.0	23.4	135.0	31.0	27.0	70.0	60.0
August	24.4	24.8	25.8	22.2	22.3	46.9	84.1	68.0	63.0	53.5
September	19.2	19.3	19.2	18.7	17.9	43.2	142.5	89.5	0	3.0
Oktober	14.3	12.7	12.8	10.1	12.9	56.4	75.2	68.0	43.0	78.5
November	8.8	11.4	7.3	6.3	6.8	57.7	89.2	45.0	67.0	51.0
December	1.2	3.4	4.6	-0.4	1.8	6.8	133.9	38.0	16.3	57.0

RESULTS AND DISCUSSIONS

Table 2 presents data on the average success rate for the autumn and spring T-budding of the Cultivars 'Kossara', 'Trakiiska hrushtyalka' and 'Van' during the period 2013-2016. Autumn bud success rate ranged from 90.0 to 98.0% for the different scion/rootstock combinations.

The values obtained during spring reporting are relatively lower than those obtained in autumn. The highest percentage of successful budding in spring was found in the three varieties bred on *P. mahaleb* seedlings (89.6-92%).

Table 2. Percentage of T-budding success rate (average for the period 2013-2016)

Cultivar/Rootstock	Autumn Reporting, %	Spring Reporting, %
Kossara / *P. mahaleb*	98.0 a	89.6 ab
Kossara / hy. 20-192	94.0 cd	85.1 bcd
Kossara / hy. 20-181	90.0 e	81.0 d
Trakiiska hrushtyalka/*P. mahaleb*	97.0 ab	92.0 a
Trakiiska hrushtyalka /hy. 20-192	92.0 de	87.4 abc
Trakiiska hrushtyalka hy. 20-181	91.5 de	83.0 cd
Van / *P. mahaleb*	93.6 cd	90.2 ab
Van / hy. 20-192	95.2 bc	89.3 ab
Van / hy. 20-181	90.1 e	86.1 abcd

**different letters in the same column mean a significant difference at P = 0.05

The cultivars 'Van', 'Kossara' and 'Trakiiska hrushtyalka' grafted on the rootstock hybrid 20-192 are characterized by a relatively high success rate (85.1-89.3%). Successful budding using the clonal rootstock hybrid 20-181 was relatively low (81-86.1%).

The resulting rate is good, but slightly lower than the results shown on the *P. mahaleb* seedlings and hybrid 20-192. This can be explained by the weaker growth of the rootstocks and the slower reaching of the thickness necessary for grafting a dormant bud.

The data presented in Figure 1 show the growth dynamics of the cultivars 'Van', 'Kossara' and 'Trakiiska hrushtyalka' budded on the clonal hy. 20-181, hy. 20-192 and *P. mahale*b seedlings.

'Kossara' cultivar scions on the Mahaleb rootstock are comparatively the strongest growing. The first peak of height growth is observed from 30 May to 19-July, and the second from 19 July until 08 September.

'Kossara' plants on rootstock hy. 20-192 have comparatively lower values than those grown on Mahaleb, characterized by a fast initial growth rate in the period from 29 June
until 19 July (30.0-63.5 cm).

The rootstock hybrid 20-181 induces the scion ('Kossara') a relatively slow growth rate in height. The cultivar grafted on it grows most intensively from 19-July to 18 August (35.0-80.7 cm). In the period from 18 August to 08 September, the oculants reach a height of 80.7 to 97.1 cm. The last two measurements are characterized by stunted and very weak growth. Strong growth is observed in cultivar 'Trakiiska hrushtyalka' budded on Mahaleb rootstock. Compared to the 'Kossara' cultivar, 'Trakiiska hrushtyalka' is distinguished by a stronger growth rate that is maintained from the beginning to the end of the vegetation (08-September). In the period from 09 June to 09 July, the scions grow to a height of 25.1 to 78.5 cm. On 19 July, plant height of 100.4 cm was recorded, which is a good indicator of the quality of the planting material. The second peak of growth is observed from 19 July to 08 September.

Budded on a rootstock 20-192 hybrid, the cultivar 'Trakiiska hrushtyalka' has relatively smaller trees than those budded on Mahaleb. The selected rootstock hybrid 20-192 induces 'Trakiiska hrushtyalka' moderate to vigorous growth. A rapid rate of growth of the scions was observed in the period from 09 June to 28 August, with the plants reaching a height of 153.2 cm.

Clonal rootstock hybrid 20-181 induces relatively weak growth to 'Trakiiska hrushtyalka' scions. When using 20-181 as a rootstock, standard trees with a height of 103.5 cm can be obtained.

The standard cultivar 'Van' is still widespread in production in Bulgaria. When using a *P. mahaleb* seedlings as rootstocks, a rapid rate of growth in height is reported in the period from 16 June to 08 September (30.3-156.3 cm). The resulting planting material is characterized as strong growing compared to the other rootstocks 20-192 and 20-181. When using the selected hybrid 20-192, the most intensive increase in height was observed in the period from 09-June to 08 September (28.1-140.3 cm). As with other scion/rootstock combinations, rootstock 20-192 induces 'Van' scions moderate to vigorous growth. Examining the data obtained from the cultivar 'Van' budded on rootstock 20-181, it is evident that the scion is characterized by moderate growth without significant growth from 20 May to 29 July. A peak in height growth is observed from 18 August to 18 September (83.3-110.2 cm).

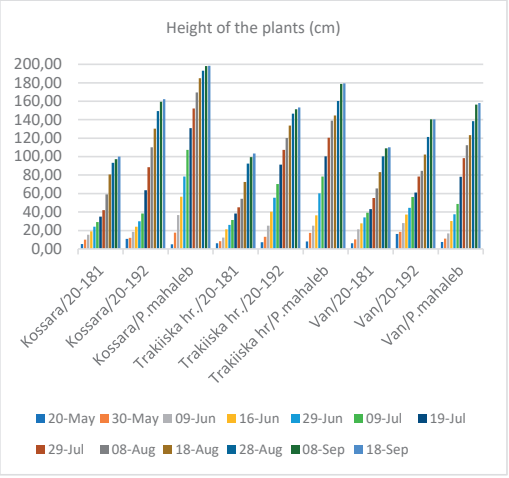

Figure 1. Growth dynamics of the cultivars 'Van', 'Kossara' and 'Trakiiska hrushtyalka' budded on the clonal hy. 20-181, hy. 20-192 and *P. mahaleb* seedlings

Figure 2 presents the data on scion thickness growth of the studied scion/rootstock combinations.

The data presented reveals that the scion/rootstock combination Kossara/*P. mahaleb* is distinguished by the highest values compared to the others. On 09 July, it reached a scion thickness of 10.6 mm.

'Kossara' budded on hybrid 20-192 demonstrated moderate growth in the period from 30 May to 19 July when scion thickness of 1.2 to 6.4 mm was reported. The period from 19 July to 18 September is characterized by a rapid growth rate, increasing the thickness from 6.4 to 16.2 mm.

The same trend is observed in cultivar 'Trakiiska hrushtyalka', as the Mahaleb rootstock induces strong growth, hybrid 20-192 is characterized by strong to moderate scion thickness, and the rootstock hybrid 20-181 induces the scion with weak growth.

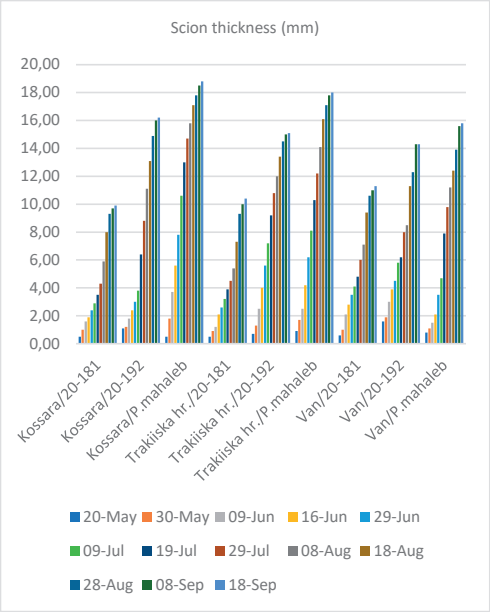

Figure 2. Scion thickness growth o of the cultivars 'Van', 'Kossara' and 'Trakiiska hrushtyalka' budded on the clonal hy. 20-181, hy. 20-192 and *P. mahaleb* seedlings

The reference cultivar 'Van' budded on *P. mahaleb* seedlings and rootstocks from the newly selected hybrid 20-192 has weak vigour during the period from 20 May to 19

July, after which intense scion thickening begins from 19 July to 18 September. The scion/rootstock combination Van/20-192 reached a thickness greater than 10 mm on 18-August and the combination Van/*P. mahale*b reached the same thickness earlier on 08 August. The last two measurements are characterized by decrease of the rate of the scion thickening. Noteworthy is the rate of thickening of the scion of 'Van' cultivar on rootstock 20-181. In the period from 30 May to 08 August, it is moderate and no large amplitudes are observed. A rapid rate of scion thickening was observed from 08 August to 08 September when values increased from 7.1 to 11.0 mm.

Table 3. Sizes of the obtained trees in the second-year nursery (average for the period 2013-2016)

Cultivar/rootstock	Van	Trakiiska hrushtyalka	Kossara
Height [cm]			
P. mahaleb	158.0 b	179.3 a	198.4 a
Hy. 20-192	140.3 b	153.2 b	162.3 ab
Hy. 20-181	110.2 c	103.5 c	100.0 c
Thickness [mm]			
P. mahaleb	15.8 ab	18.0 a	18.8 a
Hy. 20-192	14.3 b	15.1 b	16.2 ab
Hy. 20-181	11.3 c	10.4 c	9.9 c

**different letters in the same column mean a significant difference at P = 0.05

Table 3 presents the height and thickness data of the planting material (fruit trees) obtained in the second-year nursery.

From the obtained results it is evident that the cultivars 'Van', 'Kossara' and 'Trakiiska hrushtyalka' produce the tallest trees when budded on a *P. mahaleb* seedlings (158.0- 198.4 cm). The same tendency is observed in the thickness of the scion (15.8-18.8 mm). The values for cultivars 'Van', 'Kossara' and 'Trakiiska hrushtyalka' on the newly selected rootstock hybrid 20-192 were relatively lower, respectively 140.3-162.3 cm for the height and 14.3-16.2 mm for the thickness. Rootstock hybrid 20-181 induces scions with the weakest growth and scion thickening and is of interest both in the production of planting material and in the establishment of intensive cherry orchards.

CONCLUSIONS

The highest success rate in spring was reported in the three cultivars budded on *P. mahaleb* seedlings (89.6-92%). The cultivars 'Van', 'Kossara', and 'Trakiiska hrushtyalka' budded on the rootstock hybrid 20-192 are characterized by a relatively high success rate (85.1-89.3 %). The success rate when using rootstock hybrid 20-181 was the lowest (81-86.1 %).

A trend is observed in the cultivars 'Van', 'Kossara', and 'Trakiiska hrushtyalka' budded on *P. mahaleb* seedlings to have strong growth and thickening of the scion, while hybrid 20-192 is characterized by strong to moderate growth and scion thickening, whereas hybrid 20-181 induces the scions the weakest growth.

The resulting fruit trees obtained when using the three rootstocks in combination with the tested cultivars meet the requirements for standard planting material in the country.

The rootstocks hybrids 20-192 and 20-181 deserve attention and would find their place in the establishment of intensive cherry plantations.

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