ROOTSTOCK INFLUENCE ON VIGOR AND GENERATIVE POTENTIAL OF YOUNG SWEET CHERRY TREES

Gordan Zec[1], Vladimir Čolović[2], Dragan Milatović[1], Slavica Čolić[3], Todor Vulić[1], Boban Đorđević[1], Dejan Đurović[1]

[1]Faculty of Agriculture, University of Belgrade, Serbia
[2]PSS Institute Tamiš, Pančevo, Serbia
[3]Institute for Science Application in Agriculture, Belgrade, Serbia

Corresponding author: zec@agrif.bg.ac.rs

Abstract
The main goal of breeding and testing of rootstocks for sweet cherry is to obtain small and productive trees and to improve precocity. The objective of this study was to examine the influence of six rootstocks on vigor and productive characteristics of young sweet cherry trees. The experimental orchard is situated at the Experimental farm "Radmilovac", of the Faculty of Agriculture (near Belgrade). Three sweet cherry cultivars: 'Kordia', 'Karmen' and 'Regina' were grafted on six rootstocks: *Prunus mahaleb* L. seedlings, 'Colt', 'Ma×Ma 14', 'Gisela 6', 'Gisela 5' and 'Oblačinska' sour cherry. During a two-year period (2015-2016) the following characteristics were studied: scion diameter above the grafting union, rootstock diameter under the grafting union, length and diameter of shoots, height of the tree and the number of spurs per tree. The results showed different influence of rootstocks on the tree vigor, spur formation and precocity. The average diameter of the scion in all tested cultivars was the largest on the Mahaleb rootstock. The largest average number of spurs per tree in the second year was recorded on cherry trees grafted on the rootstocks 'Gisela 6' and 'Oblačinska' sour cherry (28 and 23 respectively). The lowest average number of spurs (6) was found on trees grafted on the rootstock 'Colt'.

Keywords: *Prunus avium*, clonal rootstocks, cultivar, vigor, spurs.

Introduction

Cherry production in Serbia is predominantly extensive and almost fully based on seedling rootstocks - Mazzard (*Prunus avium* L.) and Mahaleb (*Prunus mahaleb* L.). Trees have strong vigor that makes application of cultural practices, especially harvest, difficult and also decreases effectiveness of production (Milatović et al., 2011c). Furthermore, cherry trees grafted onto vigorous seedling rootstocks have slow coming into bearing. In the last decades, new low vigorous clonal rootstocks are taking dominance in cherry production since their influence on small tree habit and precocity. Intensification of sweet cherry production can be achieved by using the dwarf or moderate vigorous rootstocks such as 'Gisela 5' and 'Gisela 6'. These rootstocks induce precocity and decrease the vigor of scion. The low vigor of the 'Gisela 5' rootstock allows higher planting density, earlier coming into bearing and higher yield per unit area compared to seedling rootstocks (Lang, 2001). However, this rootstock has many negative features: requires fertile soil, irrigation and support, and is prone to over-cropping and small fruit size. In addition, cherry cultivars on this rootstock are susceptible to the freezing of flower buds during the winter (Lichev and Papachatzis, 2006; Milatović et al., 2011a). In Serbia, as a replacement for 'Gisela 5' rootstock, genotypes of 'Oblačinska' sour cherry are often used as a dwarf rootstock for sweet cherry (Milatović et al., 2011b). New achievements in the selection of rootstock that are suitable for high density orchards mostly improved cherry production (Miljković et al., 2002). The main goal of our research was the evaluation of different rootstocks on vigor and generative potential of young sweet cherry trees.

Material and methods

Trial was established in 2014 at the Experimental farm "Radmilovac", belonging to Faculty of Agriculture, situated near Belgrade. Three sweet cherry cultivars 'Kordia', 'Carmen' and 'Regina' were grafted onto six rootstocks: *Prunus mahaleb* L. seedlings, 'Colt', 'MaxMa 14', 'Gisela 6', 'Gisela 5' and 'Oblačinska' sour cherry. The central leader training system was applied. During a two-year period (2015-2016) the following characteristics were studied: scion diameter above the grafting union, rootstock diameter under the grafting union, diameter and length of shoots, height of the tree and the number of spurs per tree. Trial was established as a completely random block system and each cultivar was represented with three replications with three trees per replication. Statistical data analysis was performed using analysis of variance and LSD multiple range test at $P \leq 0.05$ to determine significance of differences between the means.

Results and discussion

The largest average diameter of the rootstock, as well as height, length and diameter of the shoot was found in cherry trees of the cultivar 'Carmen' on the Mahaleb rootstock (Table 1). These trees had statistically significantly higher values of the diameter of the rootstock (in both years) and the length of the shoot (in 2015) compared to other rootstocks. Hrotko et al. (2009) examined the vigor of the 'Carmen' cultivar on several rootstocks and concluded that the trees grafted on the Mahaleb had a significantly higher value of the diameter of the trunk than trees on the 'Colt' rootstock. The values obtained in this study are in accordance with these results. All investigated parameters of vigor had the least average values on the 'Carmen' trees grafted on the 'Gisela 5' rootstock. The values of rootstock diameter, tree height and shoot length on the rootstocks 'Gisela 5', 'Gisela 6' and 'Oblačinska' sour cherry in 2016 were statistically significantly lower compared to other three rootstocks, indicating their lower vigor.

Table 1. Values of tested parameters on the trees of the cultivar 'Carmen'

Year	Rootstock	Rootstock diameter (mm)	Scion diameter (mm)	Height of tree (cm)	Length of shoot (cm)	Diameter of shoot (mm)	Number of spurs
2015	*P. mahaleb*	38.7	29.3	168.7	33.0	5.9	1.7
	Colt	23.3	21.3	152.3	20.0	4.9	1.7
	Ma x Ma 14	30.0	29.0	160.0	20.7	6.0	3.7
	Gisela 6	25.7	29.3	116.3	21.3	6.0	12.0
	Gisela 5	22.7	25.0	98.3	16.7	4.7	8.3
	Oblačinska	29.0	30.3	145.3	21.7	5.8	13.3
	LSD 0.05	5.6	2.1	16.8	2.8	0.9	2.5
2016	*P. mahaleb*	63.7	56.3	266.7	68.3	9.5	11.3
	Colt	47.3	39.7	220.3	62.3	9.8	9.3
	Ma x Ma 14	52.3	40.0	217.3	60.0	9.4	10.3
	Gisela 6	31.0	28.7	124.3	35.7	8.4	15.3
	Gisela 5	22.0	25.0	113.7	29.3	7.3	13.7
	Oblačinska	25.7	27.7	163.3	45.0	9.4	15.0
	LSD 0.05	6.9	5.5	32.5	9.8	1.4	2.8

Highest average number of spurs in the 'Carmen' cultivar in 2015 was recorded on 'Oblačinska' sour cherry (13.3) and in 2016 on the 'Gisela 6' rootstock (15.3). In both years, trees of this cultivar on rootstocks 'Gisela 6', 'Oblačinska' sour cherry and 'Gisela 5' had statistically significantly higher number of spurs than trees on other rootstocks (except for Mahaleb in the second year). The smallest average number of spurs in both years was recorded on the 'Colt' rootstock (1.7 and 9.3). All investigated parameters of vigor (except the shoot diameter) in the 'Kordia' cultivar showed highest average values on the Mahaleb rootstock (Table 2). The values of the Mahaleb rootstock diameter were statistically significantly higher compared to rootstocks 'Gisela 5', 'Gisela 6' and

'Oblačinska' sour cherry. Comparing the trunk cross-sectional area of trees on Mazzard with that on 'Gisela 5' and 'Gisela 6' rootstocks after 7 seasons, Whiting et al. (2005) found lower values for 45% and 20% respectively. The results obtained in our study are in accordance with the above data. The highest average number of spurs in the first year (11) was recorded on the 'Kordia' cultivar on the 'Gisela 6' rootstock. In the second year the number of spurs was highest on the 'Oblačinska' sour cherry rootstock (23). This is in line with states of Milatović et al. (2011b) that the rootstocks 'Gisela 5', 'Gisela 6', and 'Oblačinska' sour cherry affect the precocity and increase the productive potential of grafted sweet cherry trees. The smallest average number of spurs in the first year was found on the 'Colt' rootstock (2.3), and in the second year on the 'MaxMa 14' rootstock (6.3).

Table 2. Values of tested parameters on the trees of the cultivar 'Kordia'

Year	Rootstock	Rootstock diameter (mm)	Scion diameter (mm)	Height of tree (cm)	Length of shoot (cm)	Diameter of shoot (mm)	Number of spurs
2015	*P. mahaleb*	34.0	32.0	167.0	47.7	6.5	3.0
	Colt	24.7	24.7	139.0	44.0	6.9	2.3
	Ma x Ma 14	25.0	22.3	155.7	39.3	6.3	3.0
	Gisela 6	23.3	24.3	163.7	34.0	6.0	11.0
	Gisela 5	20.7	22.0	136.3	25.0	5.7	10.3
	Oblačinska	24.7	25.3	163.7	30.0	6.3	10.3
	LSD 0.05	2.8	2.6	14.5	2.7	0.4	1.8
2016	*P. mahaleb*	62.3	57.0	286.7	80.3	10.1	14.3
	Colt	48.0	42.3	227.0	62.3	9.1	9.3
	Ma x Ma 14	49.7	45.7	239.0	71.3	10.1	6.3
	Gisela 6	34.3	41.0	210.3	58.3	8.6	16.3
	Gisela 5	36.0	36.0	182.7	47.7	7.7	20.0
	Oblačinska	47.7	52.0	243.0	65.3	9.9	23.0
	LSD 0.05	5.1	7.1	55.8	10.0	1.4	4.1

Highest average values of the vigor parameters were recorded on trees of the 'Regina' cultivar on the Mahaleb rootstock, while they were lowest on 'Gisela 5' rootstock (Table 3). The values of the rootstock diameter and the length of shoot in this cultivar on the rootstocks 'Gisela 5', 'Gisela 6' and 'Oblačinska' sour cherry were statistically significantly lower compared to rootstocks Mahaleb and 'MaxMa 14', which confirms their lower vigor. Baryła et al. (2014) examined the influence of Mazzard, Mahaleb and 'Gisela 5' on the vigor of the 'Regina' cultivar in the nursery. The study showed a significant effect of rootstocks on the trunk diameter of maiden sweet cherry trees. This cultivar had a significantly smaller diameter on 'Gisela 5' rootstock. This is in line with results of our study. The highest average number of spurs in the second year was recorded in the 'Regina' cultivar on the 'Gisela 6' rootstock (28). In both years, the number of spurs in the this cultivar was statistically significantly higher on rootstocks 'Gisela 6' and 'Oblačinska' sour cherry in comparison with other rootstocks. The smallest average number of spurs in both years of study was recorded on the 'Colt' rootstock (4 and 6 respectively). The trees of all three cultivars on rootstocks 'Gisela 5', 'Gisela 6' and 'Oblačinska' sour cherry had a larger diameter of the scion than that of the rootstock, which also classifies them as a weak to moderate vigorous.

The average number of spurs in all cultivars was smaller on the 'Gisela 5' rootstock compared to rootstocks 'Gisela 6' and 'Oblačinska' sour cherry. This can be explained with the smallest length and the smallest diameter of the shoot that was recorded in both years on this dwarf rootstock. Low vigor expressed through short and thin shoots is mostly genetically determined, but it may also be the result of inadequate soil properties and cultural practices. This is in accordance with the observation of Bassi et al. (2016) that the rootstock 'Gisela 5' performs well in good pedoclimatic conditions, while in suboptimal conditions it does not perform well, therefore it is advisable to use the 'Gisela 6' rootstock for such locations.

Table 3. Values of tested parameters on the trees of the cultivar 'Regina'

Year	Rootstock	Rootstock diameter (mm)	Scion diameter (mm)	Height of tree (cm)	Length of shoot (cm)	Diameter of shoot (mm)	Number of spurs
2015	*P. mahaleb*	41.3	37.7	191.0	47.7	6.8	11.0
	Colt	24.3	23.0	165.7	33.0	5.8	4.0
	Ma x Ma 14	31.7	30.3	173.0	32.7	5.9	11.0
	Gisela 6	25.7	28.7	167.7	30.3	5.9	20.0
	Gisela 5	23.7	25.7	138.0	27.3	5.3	11.3
	Oblačinska	26.0	28.3	173.0	31.3	5.9	23.0
	LSD 0.05	2.3	2.5	18.4	7.5	0.5	2.3
2016	*P. mahaleb*	62.0	59.0	297.3	72.7	9.5	12.0
	Colt	51.7	49.0	246.0	58.3	8.7	6.0
	Ma x Ma 14	56.3	53.3	245.7	64.7	9.0	12.3
	Gisela 6	45.3	54.0	226.0	53.0	8.1	28.0
	Gisela 5	38.3	46.3	182.0	43.0	8.1	20.0
	Oblačinska	43.3	49.3	210.0	51.0	8.1	20.7
	LSD 0.05	6.8	7.5	43.5	10.8	1.0	3.4

Conclusions

The vigor of the tested sweet cherry cultivars was under significant influence of the rootstock. It was highest on the Mahaleb rootstock, and lowest on 'Gisela 5' rootstock. The largest number of spurs in all cultivars was recorded on rootstocks 'Gisela 6' and 'Oblačinska' sour cherry. The obtained results indicate that the trees on rootstocks 'Gisela 6' and 'Oblačinska' sour cherry had a medium vigor and good initial generative potential. 'Oblačinska' sour cherry rootstock showed very good initial results that should encourage further examination of selected clones in multi-year trials. The smallest number of spurs, and therefore the lowest initial generative potential in all cultivars was found on the 'Colt' rootstock. The very low vigor, short and thin shoots resulted in poor initial generative potential of studied cultivars on the 'Gisela 5' rootstock.

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