INFLUENCE OF VEGETATIVE ROOTSTOCKS ON BIOLOGICAL AND PRODUCTION PROPERTIES OF SWEET CHERRY CULTIVAR 'REGINA' IN EARLY BEARING PERIOD

BOBAN DJORDJEVIC, DEJAN DJUROVIC, GORDAN ZEC, BOSKOV DJORDJE
University of Belgrade, Faculty of Agriculture

Keywords: sweet cherry, rootstocks, yield, fruit quality

ABSTRACT

The study researched the influence of four vegetative rootstocks on a biological and production properties of sweet cherry cultivar 'Regina'. The study was carried out during fourth and fifth growing years at an orchard located at the experimental estate "Radmilovac" of the Faculty of Agriculture in Belgrade. Cultivar 'Regina' was grafted on the following rootstocks: 'Gisela 6', 'Ma×Ma 14', 'Colt' and 'Oblačinska cherry', while trees grafted on P. mahaleb used like a control. The highest yield had trees grafted on rootstock 'Gisela 6' (6.5 kg), while the smallest yield had trees grafted on seedlings of P. mahaleb (1.4 kg). Cultivar 'Regina' had the highest number of sper fruiting branches on 'Colt' (367.2) and the smallest number was recorded on P. mahaleb (154.8), while number of lateral fruiting branches on trees of cultivar 'Regina' was between 91.6 ('MaxMa 14') and 42.2 ('Oblačinska cherry'). The highest content of soluble solid matter and sweetness in fruit were on the trees grafted on P. mahaleb.

INTRODUCTION

In European Union among summer stone fruits sweet cherries are the most popular and in same time in most cherry growing countries production has an increasing trend (Dekena et al., 2020). Also, due to the nutritional and commercial characteristics a sweet cherry is fruit species of high economic values. Satisfactory production of sweet cherry very strongly depends of fruit quality and yield (Dziedzic et al., 2019).

The key factors in sweet cherry production are the suitability of cultivar-rootstock combinations to local climate conditions, growing a newly cultivars with larger fruits, together with soil and growing technologies (Pal et al., 2017). The rootstock used for growing fruit

trees affects many traits of trees and fruits, such as fruit mass (Gratacós et al., 2008), tree vigor, flower bud induction and regular bearing (Koutinas et al., 2010), productivity index (Bielicki and Rozpara, 2010), cracking susceptibility (Brüggenwirth and Knoche, 2016) or differences in the efficiency of water usage, advance or delay of flowering and harvesting, survival of trees (Cantin et al., 2010). In the last two decades, the new dwarfing and semi-dwarfing cherry rootstocks for sweet cherry growing enables obtaining high yields of high quality fruit.

Vegetative rootstocks are used in high density orchards of sweet cherry production, and the most important of them are ‘Gisela 5’, ‘Gisela 6’, ‘PiKu 1’ (Lanauskas et al., 2012; Milatović et al., 2013). The growers prefer dwarfing rootstocks in sweet cherry production due to producing hand-picked cherries for fresh markets, which allow planting densities of up to 1.000-5.000 trees per hectare (Musacchi et al., 2015).

The sweet cherry growing in Serbia has a long tradition. But in same time, most cultivars were grafted onto vigorous seedling rootstocks (Prunus *avium* L. and P. *mahaleb* L.) and in low density orchards. In the study authors were examined the influence of different vegetative rootstocks on most important biological and production properties of sweet cherry cultivar ‘Regina’ and obtained values were compared with contents obtained on trees which grafted on seedlings of *P. mahaleb* L..

MATERIAL AND METHOD

The study was carried out at a commercial orchard located at the experimental estate “Radmilovac” of the Faculty of Agriculture in Belgrade, in two consecutive growing years (2019 and 2020). The orchard was in fourth and fifth growing seasons. The area has a temperate continental climate with an average annual rainfall of 650 mm. The orchard was established in spring 2016 with high-quality 1-year-old nursery trees. Sweet cherry cultivar ‘Regina’ was grafted on four vegetative (clonal) rootstocks (‘Colt’, ‘Gisela 6’, ‘Ma×Ma 14’ and ‘Oblačinska sour cherry’). Control trees grafted on seedlings of *P. mahaleb* L. Trees were planted at a distance of 3.5 m × 1.6 m (1.750 trees/ha).

In the study was researched the influence of different vegetative rootstocks on following properties of cultivar ‘Regina’, which separated in three groups: generative (yield per tree and yield efficiency, number of sper and lateral fruiting branches), vegetative (trunk cross-sectional area – TCSA, length of lateral fruiting branches and mass of pruning branches) and quality of fruit (mass of fruit, a diameter of fruit, soluble solids contents (SSC), total sugars (TS), total acids (TA) and sugars/acids ratio - TS/TA). The experiment was conducted by a random field with four repetitions (100 flowers buds per tree were taken from each part of the canopy and fruiting branches, five trees were taken for a one repeat). The physical properties of fruits were determined with four repetitions, and each repetition included 50 fruits. Chemical properties were determined with three repetitions. Physical properties were determined used standard morphometrics methods. SSC was determined by refractometer (Atago, pocket PAL-1. Kyoto, Japan). TA was determined by titrating 25 g of fruits with 0.1N NaOH up to pH 7.0 and expressed in %. TS, was determined by the Luff-Schoorl method and expressed in %. Analysis of variance has been done with STATISTICA 9 software package. The significant differences between means determined at $P<0.05$, were measured with the LSD test.

RESULTS AND DISCUSSIONS

The vegetative rootstocks had a significant effect on the generative parameters of the ‘Regina’ variety (Table 1). The highest yield had trees grafted on rootstock ‘Gisela 6’ (6.5 kg), while the smallest yield had trees grafted on seedlings of P. mahaleb (1.4 kg). Also, trees on ‘Gisela 6’ had the highest values of yield efficiency. Compared to the control trees only two rootstocks had significant higher values of this parameter. The highest yield efficiency of trees grafted on and ‘Gisela 6’ rootstocks was due to its low trunk cross-sectional area (Cantin et al., 2010; Rubauskis *et al*. 2014. Also, Hrotko et al. (2009) recorded that trees with higher values of TCSA had significantly lower values of yield efficiency, which confirmed in our results.

Table 1. Generative parameters of sweet cherry cv 'Regina' grafted on different rootstocks (average 2019-2020).

Rootstock	Yield per tree (kg)	Yield efficiency (kg/cm^2)	Number of lateral branches	Number of sper branches
'Colt'	2.2 b	0.03 c	77.2 b	367.2 a
'Gisela 6'	6.5 a	0.10 a	59.0 c	301.0 ab
'Ma×Ma 14'	2.4 b	0.02 c	91.6 a	281.8 ab
'Oblacinska cherry'	6.1 a	0.07 ab	42.2 d	255.0 b
P. mahaleb	1.4 b	0.01 c	77.6 b	150.8 c
Lsd, p<0.05	2.1	0.03	12.4	102.3

Cultivar 'Regina' had the highest number of sper fruiting branches on 'Colt' (367.2) and the smallest number was recorded on P. mahaleb (154.8). All rootstocks had significant affects to increase values of this parameter compared to control rootstock. The number of lateral fruiting branches on trees of cultivar 'Regina' was between 91.6 ('MaxMa 14') and 42.2 ('Oblačinska cherry'). Compared to control rootstock only trees grafted on rootstock 'MaxMa 14' had higher values. The highest values of TCSA had trees grafted on rootstock 'MaxMa 14' (152.5 cm^2) and the lowest had trees grafted on 'Gisela 6' (65.0 cm^2). Also, compared to control trees only trees grafted on 'Gisela 6' had a smaller value.

Table 2. Vegetative parameters of sweet cherry cv 'Regina' grafted on different rootstocks (average 2019-2020).

Rootstock	TCSA (cm^2)	Length of lateral branches (cm)	Mass of pruning branches (kg)
'Colt'	78.5 bc	51.2 a	2.0 b
'Gisela 6'	65.0 c	39.3 b	1.4 b
'Ma×Ma 14'	152.5 a	42.3 ab	3.0 a
'Oblacinska cherry'	88.2 b	45.3 ab	1.5 b
P. mahaleb	136.3 ab	48.9 ab	2.3 ab
Lsd, p<0.05	21.5	10.2	0.9

The highest length of lateral fruiting branches had trees grafted on rootstock 'Colt' and P. mahaleb, 51.2 cm and 48.9 cm, respectively. A significantly lower value had trees of cultivar 'Regina'

grafted on rootstock ‘Gisela 6’. Nevertheless, mass of pruning part of canopy was significantly lower when trees grafted on this rootstock (average 1.4 kg).

The regarding the influence of the rootstock on fruit mass did not recorded significant differences (Table 3). Cultivar ‘Regina’ had the highest average fruit mass on P. mahaleb (11.6 g), as well as the largest fruit diameter (28.0 mm). The smallest fruits diameter was found on trees grafted on ‘Gisela 6’ and ‘Ma×Ma14’. The trees grafted on a dwarfing rootstocks had strong tendency to overcrop, resulting in a much lower leaf-to-fruit ratio, and subsequently smaller fruit size (Whiting et al., 2005). The highest fruit hardiness was recorded on trees on P. mahaleb (3.8 kg/cm^2), while the lowest average value was recorded on ‘Gisela 6’ (3.2 kg/cm^2).

Table 3. Fruits quality of sweet cherry cv 'Regina’ grafted on different rootstocks (average 2019-2020).

Rootstock	Mass of fruits (g)	Diameter of fruits (mm)	Soluble solids (%)	Total sugars (%)	Total acids (%)	Swtnss	Fruit hardiness (kg/cm^2)
‘Colt’	10.7 b	27.3 ab	17.8 a	13.3 a	0.8 b	16.6 ab	3.8 a
‘Gisela 6’	10.8 b	26.9 b	17.7 a	13.2 a	0.7 b	17.9 a	3.2 b
‘Ma×Ma 14’	11.6 a	26.9 b	17.4 a	13.1 a	1.3 a	10.4 c	3.5 ab
‘Obl.cherry’	10.8 b	27.4 ab	16.3 b	12.2 b	0.7 b	16.5 b	3.5 ab
P. mahaleb	11.6 a	28.1 a	17.9 a	13.2 a	0.8 b	17.9 a	3.8 a
Lsd, p<0.05	0.6	1.1	0.5	0.4	0.4	1.3	0.3

The highest content of soluble solid matter in fruit was on the trees grafted on P. mahaleb (17.9%), and the lowest on trees grafted on ‘Oblačinska cherry’ (16.3%). The content of total acids in fruits ranged between 0.7% (trees on ‘Gisela 6’) and 1.3% (tress on ‘MaxMa 14’). The highest sweetness index had fruits from trees on P. mahaleb, while cultivar ‘Regina’ had the lowest fruit sweetness value on ‘Ma×Ma 14’.

CONCLUSIONS

Based on the results obtained in this study, the following conclusions were recorded:

• Regina grafted on 'Gisela 6' rootstock had higher values of yield and chemical quality of fruits compared to other rootstocks. In addition, Regina trees grown on the 'Oblačinska cherry' rootstock had satisfactory values for the examined yield parameters.

• The highest fruit mass was recorded in Regina trees grown on rootstock P. mahaleb. Also, on this rootstock, cultivar 'Regina' had the largest fruit diameter.

• In terms of vegetative properties, Regina trees on 'Gisela 6' had the lowest values.

• In general, cultivar 'Regina' grafted on rootstock 'Gisela 6' had the best values of the examined biological and production traits.

BIBLIOGRAPHY

1. Bielicki, P., Rozpara, E. 2010. *Growth and yielding of Kordia sweet cherry trees with various rootstock and interstem combinations*. Journal of Fruit and Ornamental Plant Research, 18 (1): 45-50.
2. Brüggenwirth, M., Knoche, M. 2016. *Mechanical properties of skins of sweet cherry fruit of differing susceptibilities to cracking*. Journal of the American Society of Horticultural Science, 141: 162–168.
3. Cantin, C.M., Pinochet, J., Gogorcena, Y., Moreno, M.A. 2010. *Growth, yield and fruit quality of Van and Stark Hardy Giant sweet cherry cultivars as influenced by grafting on different rootstocks*. Scientia Horticulturae, 123: 329-33.
4. Deķena, D., Feldmane, D., Laugale, V. 2020. *Preliminary results of rootstock evaluation for Estonian sweet cherry cultivar 'Anu'*. Agronomy Research, 18(S4): 2693–2700.
5. Dziedzic, E., Bieniasz, M., Kowalczyak, B. 2019. *Morphological and physiological features of sweet cherry floral organ affecting the potential fruit crop in relation to the rootstock*. Scientia Horticulturae, 251: 127-135.
6. Gratacos, E., Cortes, A., Kulczewski, B.M. 2008. *Flowering, production and fruit quality of eleven sweet cherry cultivars in central Chile.* Acta Horticulturae, 795: 331-338.

7. Hrotkó, K., Magyar, L., Gyevik, M. 2009. *Effect of rootstocks on growth and yield of 'Carmen'sweet cherry*. Bulletin UASVM Horticulture, 66(1): 143-148.
8. Koutinas, N., Pepelyankov, G., Lichev, V. 2010. *Flower induction and flower bud development in apple and sweet cherry*. Biotechnology & Biotechnological Equipment, 24: 1549–1558.
9. Lanauskas, J., Uselis, N., Kviklys, D., Kviklienė, K., Buskienė, L. 2012. *Rootstock effect on the performance of sweet cherry cv. Lapins*. Horticultural Science (Prague), 39(2): 55–60.
10. Milatović, D., Đurović, D., Đorđević, B., Vulić, T., Zec, G. 2013: *Rodnost novijih sorti trešnje na podlozi Gizela 5*. Voćarstvo, 47 (181-182): 39-45.
11. Musacchi, S., Gagliardi, F., Serra, S. 2015. *New training systems for high-density planting of sweet cherry*. HortiScience*,* 50(1): 59-67.
12. Pal, M.D., Mitre, I., Asanica, A.C., Sestras, A.F., Peticila, A.G., Mitre, V. 2017. *The influence of rootstock on the growth and fructification of cherry cultivars in a high density cultivation system*. Notulae Botanicae Horti Agrobotanici *Cluj-Napoca*, 45(2): 451–457.
13. Rubauskis, E., Skrivele, M., Ruisa, S., Feldmane, D. 2014. *Growth and yield of two sweet cherry cultivars on vegetatively propagated rootstocks*. Acta Horticulturae, 1058: 657-661.
14. Whiting, M.D., Lang, G., Ophardt, D. 2005. *Rootstock and training system affect sweet cherry growth, yield and fruit quality*. HortScience, 40(3): 582-586.