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USEFULNESS OF 'FRUTANA' INTERSTOCK IN THE PRODUCTION OF MAIDEN SWEET CHERRY TREES IN THE NURSERY

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Abstract. In a nursery production there are very few verified rootstocks diminishing the growth of sweet cherry trees in an orchard. An alternative solution is application of a dwarfing interstock. In the experiment the usefulness of a dwarfing interstock called 'Frutana' for the production of sweet cherry maiden trees was checked. The studies covered the following rootstocks: *Prunus avium*, and Colt and the cultivars of sweet cherry trees: 'Kordia', 'Lapins' and 'Regina'. The strongest growth of sweet cherry maiden trees was obtained on 'Colt' and the weakest on *Prunus avium* with the interstock. The best productivity was obtained on *Prunus avium*, and the worst on *Prunus avium* with the interstock. Anatomic sections that were carried out did not show any signs of physiological incompatibility between the dwarfing interstock 'Frutana' and the studied cultivars of sweet cherry trees.

Key words: rootstocks, interstock 'Frutana', growth of maiden sweet cherry trees, nursery efficiency, physiological compatibility

INTRODUCTION

Production of sweet cherry trees is very popular with nurserymen. It results from the growing interest in cultivation of trees of this species in Poland and in the world [Makosz 2007, Wociór 2008]. In nurseries, however, sweet cherry maiden trees are mostly produced on *Prunus avium* seedlings [Chełpiński 2007]. Trees produced on this rootstock ramify weakly [Stachowiak and Świerczyński 1999], and they grow too strong in an orchard [Grzyb et al. 1998, Chełpiński 2007]. It was proved that sweet cherry trees that grow on dwarf rootstocks enter their fructification period earlier and they are more fertile than trees on stronger growing rootstocks [Gruppe 1985, Trefois 1985, Edin et al. 1989, Simon et al. 2004]. However, rootstocks diminishing the power of growth of

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sweet cherry trees of GiSelA and PHL type can be efficiently propagated only by in vitro propagation [Al-Sabbagh et al. 1999, Erbenova et al. 2001, Mahdavian et al. 2011]. Also trees of some sweet cherry cultivars show some signs of incompatibility with dwarfing rootstocks for sweet cherry trees [Grzyb et al. 2004, Sitarek and Grzyb 2007]. One of the methods of restricting the vigour of growth of sweet cherry trees is the application of a dwarfing interstock in the process of production of sweet cherry maiden trees. Growth and fructification of sweet cherry trees with dwarfing interstocks in an orchard has already been checked [Hrotko et al. 1997, 1998, Grzyb et al. 2004, Rozpara and Grzyb 2004, 2006, Magyar and Hrotko 2008, Davarynejad et al. 2009, Bielicki and Rozpara 2010], however, so far, there have been no results obtained in a nursery. Unfortunately, between the interstock and the cultivar one can notice some signs of physiological incompatibility, which results in weaker health and dying of trees in an orchard [Grzyb et al. 2004, Magyar and Hrotko 2008]. Execution of anatomic cross-sections of the connections of cultivars with the rootstock makes it possible to see the presence of a layer of necrotic cells bearing witness to such incompatibility [Simons and Chu 1983, Ermel et al. 1997].

The aim of the experiment that was carried out was a comparison of growth of sweet cherry maiden trees with the dwarfing interstock 'Frutana' with the growth of trees produced directly on Colt and *Prunus avium* rootstocks. Also anatomic cross sections of the connections of budded cultivars of sweet cherry trees with the dwarfing interstock were conducted to show potential signs of physiological incompatibility.

MATERIAL AND METHODS

The experiment was carried out on the grounds of a private nursery belonging to Mr. Zaparuszewski. The experiment was located on loam soil belonging to the third valuation class. The rootstocks and maiden trees were irrigated. Fertilization and plants' protection were carried out according to the up-to-date recommendations for the nurseries of stone fruit trees. During the research no herbicides were used and the nursery was mechanically and, if needed, manually weeded.

In the experiment the following rootstocks were compared: Colt (*Prunus avium* L. × *Prunus pseudocerasus* L.) and Mazzard type 'Al-Kavo' (*Prunus avium* L.) with the interstock and without the interstock. The experiment was set up three times in a random blocks design, in four replications with 40 rootstocks per plot. On one part of the experiment material consisted of rootstocks grafted in the winter with the use of 'Frutana' interstock, on the second, the control group of rootstocks was planted in 90 × 30 cm spacing on one field.

Later, in the first decade of August, the interstock, on the height of 50 cm, and directly the rootstock were budded with the following cultivars of sweet cherry trees: 'Kordia', 'Lapins' and 'Regina' using the 'chip budding' method.

The following parameters of maiden sweet cherry trees were measured: height of maiden trees (cm), diameter – measured 20 cm above the budding place of a cultivar (mm), length of lateral shoots (cm) and their number. Also fresh mass of maiden trees was checked (g) and their efficiency compared with the efficiency of budded rootstocks

(%). Fifteen maiden trees that were growing in turn in one row from each field were chosen randomly and they were taken for measurements.

Statistical analysis of the obtained data was carried out with the STAT program. Two-factor variance analysis of results was carried out using Duncan's test, with probability level $\alpha = 0.05$.

To find any possible physiological incompatibility between the studied cultivars of sweet cherry trees and 'Frutana' interstock anatomic cross sections of the connections were also done. Their pictures are placed in the end part of this paper.

RESULTS AND DISCUSSION

The rootstocks and cultivars that were used in a nursery had a significant influence on the height of sweet cherry maiden trees. The highest trees were obtained on 'Colt', next, as far as height is concerned, were maiden trees on *Prunus avium* (tab. 1). Significantly the lowest maiden trees were found on Colt and *Prunus avium* with 'Frutana' interstock. Also Sitarek and Grzyb [2007] noticed different heights of sweet cherry maiden trees in a nursery depending on the rootstock. In comparison with the examined results Chełpiński [2007] obtained much lower maiden trees of four cultivars of sweet cherry trees on *Prunus avium* rootstock (111.7 cm). But, in their earlier experiment [Stachowiak and Świerczyński 2009] noticed a stronger growth of 'Regina' cultivar sweet cherry trees (231.2 cm) on *Prunus avium*. Trees of 'Kordia' cultivar , independently from the applied rootstock, were the highest and those of 'Regina' cultivar the lowest (tab. 1).

The rootstocks examined in the experiment caused significant differences in the results of maiden trees' diameters. Trees of the biggest diameter were found on 'Colt' rootstock. Maiden trees on *Prunus avium* had much smaller diameters (tab. 2). However, the growth of Colt and *Prunus avium* rootstocks in the first years of nursery, ac-

Table 1. Influence of rootstock and cultivar on the height (cm) of maiden sweet cherry trees in the years 2008–2010
Tabela 1. Wpływ podkładki i odmiany na wysokość (cm) okulantów czereśni w latach 2008–2010

Rootstock – Podkładka	Kordia	Lapins	Regina	Mean value for rootstock Średnia dla podkładki
Prunus avium	193.4 ef	173.3 cd	181.8 de	182.8 b
Colt	208.3 f	206.8 f	199.2 ef	204.7 c
Prunus avium with interstock Frutana Z wstawką Frutana	125.4 a	147.3 b	125.4 a	143.7 a
Colt with interstock Frutana Z wstawką Frutana	128.7 a	155.2 b	128.7 a	152.9 a
Mean value for cultivar Średnia dla odmiany	183.7 c	170.7 b	158.8 a	

*Averages followed by the same letters are not significantly different at $\alpha = 0.05$
* Średnie oznaczone tymi samymi literami nie różnią się istotnie przy $\alpha = 0.05$

Table 2. Influence of rootstock and cultivar on the diameter (mm) of maiden sweet cherry trees in the years 2008–2010

Tabela 2. Wpływ podkładki i odmiany na średnicę (mm) okulantów czereśni w latach 2008–2010

Rootstock – Podkładka	Kordia	Lapins	Regina	Mean value for rootstock Średnia dla podkładki
Prunus avium	17.8 cd *	16.3 bc	19.1 d	17.7 c
Colt	18.7 d	18.6 d	19.0 d	18.8 d
Prunus avium with interstock Frutana Z wstawką Frutana	15.3 ab	13.7 a	13.8 a	14.3 a
Colt with interstock Frutana Z wstawką Frutana	17.9 cd	15.9 b	16.1 bc	16.6 b
Mean value for cultivar Średnia dla odmiany	17.4 b	16.1 a	17.0 ab	

*For explanation, see table 1, * Wyjaśnienie, patrz tabela 1

Table 3. Influence of rootstock and cultivar on the number of lateral shoots of maiden sweet cherry trees in the years 2008–2010

Tabela 3. Wpływ podkładki i odmiany na liczbę pędów bocznych okulantów czereśni w latach 2008–2010

Rootstock – Podkładka	Kordia	Lapins	Regina	Mean value for rootstock Średnia dla podkładki
Prunus avium	4.2 gh *	1.2 ab	4.7 h	3.7 c
Colt	3.9 f-h	2.3 cd	3.8 fg	3.3 c
Prunus avium with interstock Frutana Z wstawką Frutana	1.7 bc	0.4 a	0.9 ab	1.0 a
Colt with interstock Frutana Z wstawką Frutana	3.2 ef	0.9 ab	2.9 de	2.3 b
Mean value for cultivar Średnia dla odmiany	1.2 a	3.3 b	3.1 b	

*For explanation, see table 1, * Wyjaśnienie, patrz tabela 1

cording to Baryła and Kapłan [2005] did not differ significantly. In the experiment carried out in an orchard [Perry et al. 1996] observed a stronger growth of sweet cherry trees on 'Colt' in comparison with *Prunus avium*. Wociór [2008] did not notice any difference in the power of growth of young sweet cherry trees of 'Kordia' cultivar on the two considered rootstocks. The diameter of maiden trees obtained by Chełpiński [2007] on *Prunus avium* (11.8 mm) was smaller than on the examined one. This author, however, conducted the experiment in years with much lower precipitation than in the experiment that is being discussed. Stachowiak and Świerczyński [2009] obtained much bigger diameters of maiden sweet cherry trees of 'Regina' cultivar (20.9 cm) on *Prunus avium*. Maiden trees with 'Frutana' interstock had smaller diameters than trees produced

directly on the rootstocks. Out of two rootstocks with 'Frutana' interstock a bigger diameter was found in case of trees of 'Colt' rootstock (tab. 2). Also in the experiment of Rozpara and Grzyb [1999] significantly weaker growth of 'Kordia' cultivar with 'Frutana' interstock was noticed in comparison with trees growing on *Prunus avium.*

Budded cultivar of sweet cherry trees influenced the growth of maiden trees. Maiden trees of 'Kordia' had much bigger diameters of their trunks than trees of 'Lapins' cultivar (tab. 2). Results obtained by Stachowiak and Świerczyński [2009] confirmed the influence of the budded cultivar of sweet cherry trees on the height of maiden trees, but not on their diameters. In both experiments, however, different cultivars of sweet cherry trees were examined, except 'Regina' cultivar.

The results of the number of lateral shoots of sweet cherry maiden trees differed much under an influence of the applied rootstocks and cultivars. Maiden trees on Colt and *Prunus avium* created a bigger number of lateral shoots. Among the trees with 'Frutana' interstock more lateral shoots were obtained on 'Colt', fewer on *Prunus avium* (tab. 3). Trees of 'Lapins' and 'Regina' cultivars had genetic conditions to form a bigger number of lateral shoots than 'Kordia' cultivar. In the earlier experiments Stachowiak and Świerczyński [2001, 2009] obtained also a differentiated number of lateral shoots dependent on the budded cultivar of sweet cherry trees. It was also confirmed in case of maiden apple trees [Poniedziałek et al. 1997, Wociór et al. 1998, Stachowiak and Świerczyński 2011].

Maiden trees produced on 'Colt' had a much bigger mean length of lateral shoots than the trees on the remaining rootstocks. Also Pannel et al. [1983] observed that 'Colt' rootstock stimulated ramification of sweet cherry trees after their planting into an orchard. 'Regina' cultivar was characterized by a tendency to create shorter lateral shoots than the two remaining cultivars (tab. 4). Much better results of the mean length of lateral shoots of 'Regina' cultivar (67.9) were obtained by Stachowiak and Świerczyński [2009].

Table 4. Influence of rootstock and cultivar on average length of lateral shoots of maiden sweet cherry trees in the years 2008–2010

Tabela 4. Wpływ podkładki i odmiany na średnią długość pędów bocznych okulantów czereśni w latach 2008–2010

Rootstock – Podkładka	Kordia	Lapins	Regina	Mean value for rootstock Średnia dla podkładki
Prunus avium	54.1 ab *	49.2 ab	46.0 a	49.8 a
Colt	67.9 d	66.0 cd	51.0 ab	61.6 b
Prunus avium with interstock Frutana Z wstawką Frutana	45.0 a	45.2 a	49.0 ab	46.4 a
Colt with interstock Frutana Z wstawką Frutana	58.0 bc	49.5 ab	46.1 a	51.2 a
Mean value for cultivar Średnia dla odmiany	52.5 b	56.3 b	48.0 a	

*For explanation, see table 1, * Wyjaśnienie, patrz tabela 1

Table 5. Influence of rootstock and cultivar on the fresh mass (g) of maiden sweet cherry trees in the years 2008–2010

Tabela 5. Wpływ podkładki i odmiany na świeżą masę (g) drzewka czereśni w latach 2008–2010

Rootstock – Podkładka	Kordia	Lapins	Regina	Mean value for rootstock Średnia dla podkładki
Prunus avium	819.6 d *	713.3 bc	823.5 d	785.5 c
Colt	802.1 cd	742.2 b-d	823.5 d	789.3 c
Prunus avium with interstock Frutana Z wstawką Frutana	710.0 bc	570.1 a	598.9 a	626.3 a
Colt with interstock Frutana Z wstawką Frutana	778.5 cd	650.7 ab	713.3 bc	714.2 b
Mean value for cultivar Średnia dla odmiany	669.1 a	777.6 b	739.8 b	

*For explanation, see table 1 – * Wyjaśnienie, patrz tabela 1

Table 6. Influence of rootstock and cultivar on the efficiency (%) of maiden sweet cherry trees in the years 2008–2010

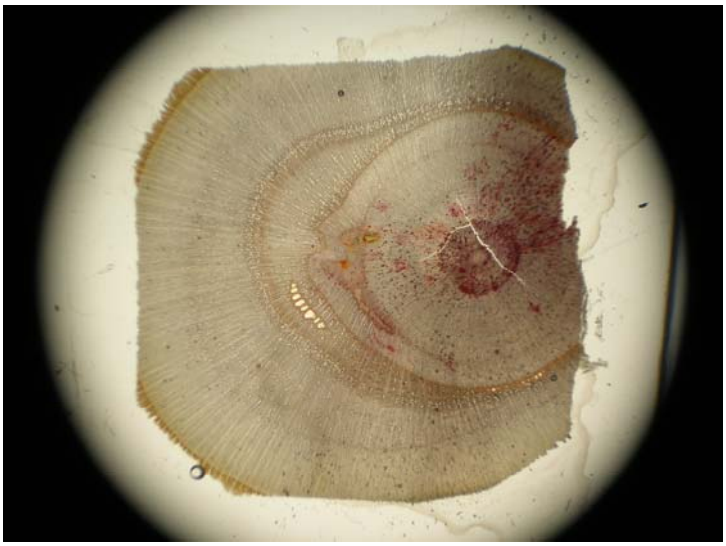
Tabela 6. Wpływ podkładki i odmiany na wydajność (%) okulantów czereśni w latach 2008–2010

Rootstock – Podkładka	Kordia	Lapins	Regina	Mean value for rootstock Średnia dla podkładki
Prunus avium	60.3 cd *	72.3 ef	83.0 g	72.3 d
Colt	49.2 ab	50.7 bc	81.4 g	61.2 b
Prunus avium with interstock Frutana Z wstawką Frutana	39.7 a	65.1 de	48.3 ab	51.1 a
Colt with interstock Frutana Z wstawką Frutana	56.7 b-d	65.2 de	77.2 fg	66.7 c
Mean value for cultivar Średnia dla odmiany	63.5 b	51.5 a	73.3 c	

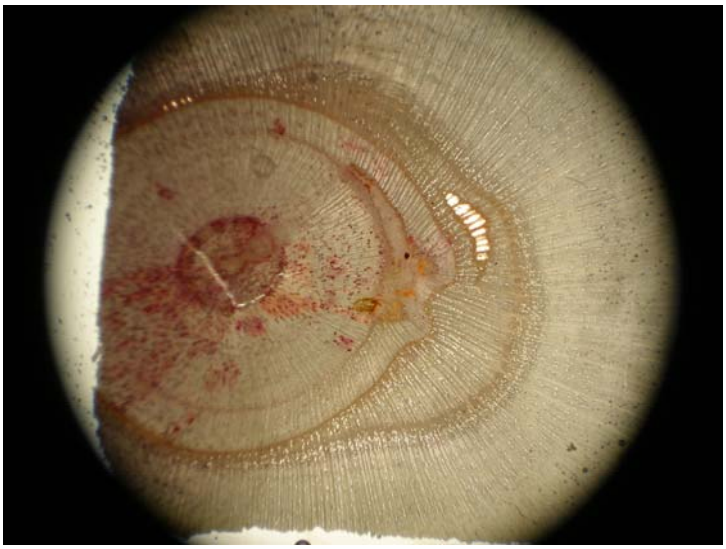
*For explanation, see table 1 – * Wyjaśnienie, patrz tabela 1

The rootstocks and cultivars used in the experiment had a significant impact on fresh mass of sweet cherry trees. The heaviest trees were obtained on Colt and *Prunus avium*, significantly lighter ones on Colt on 'Frutana' interstock and the lightest on *Prunus avium* with 'Frutana' interstock. A bigger fresh mass was noticed for maiden trees of 'Lapins' and 'Regina' in comparison with 'Kordia' cultivar (tab. 5). In the experiment carried out by Sitarek and Sas-Paszt [2005] 'Lapins' and 'Regina' cultivars did not modify the size of the root system of trees growing on different rootstocks, which is consistent with the obtained results of these cultivars' maiden trees' mass.

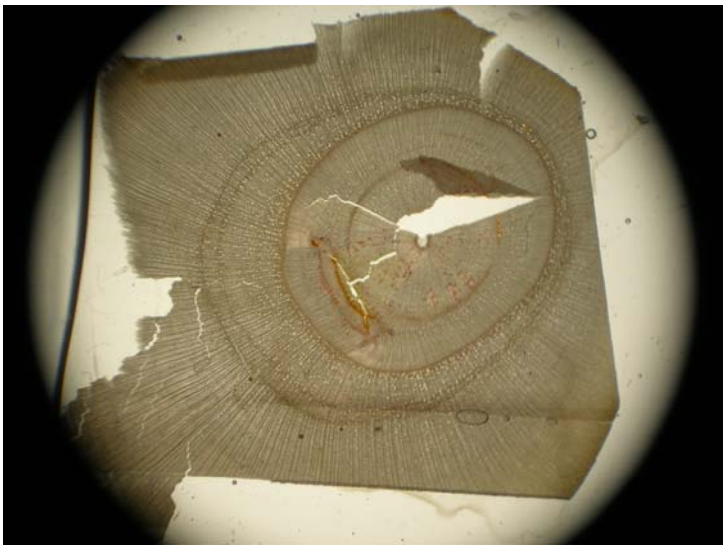
Significantly the biggest number of sweet cherry maiden trees was obtained on *Prunus avium*, next on 'Colt' with 'Frutana' interstock. A fewer number of maiden trees was produced on *Prunus avium*, and the fewest on *Prunus avium* with 'Frutana' in-



Phot. 1. The anatomical section of interstock 'Frutana' and 'Kordia' cultivar connection, magnification 20×, (phot. S. Świerczyński)
Fot. 1. Przekrój anatomiczny połączenia wstawki 'Frutana' z odmianą 'Kordia', powiększenie 20×, (fot. S. Świerczyński)



Phot. 2. The anatomical section of interstock 'Frutana' and 'Regina' cultivar connection, magnification 20×, (phot. S. Świerczyński)
Fot. 2. Przekrój anatomiczny połączenia wstawki 'Frutana' z odmianą 'Regina', powiększenie 20×, (fot. S. Świerczyński)



Phot. 3. The anatomical section of interstock 'Frutana' and 'Lapins' cultivar connection, magnification 20×, (phot. S. Świerczyński)
Fot. 3. Przekrój anatomiczny połączenia wstawki 'Frutana' z odmianą 'Lapins', powiększenie 20×, (fot. S. Świerczyński)

terstock. Comparing two rootstocks Colt and *Prunus avium* Baryła and Kapłan [2006] observed a similar productivity of sour cherry maiden trees in a nursery. Much worse results of the maiden trees' productivity of four cultivars of sweet cherry trees on *Prunus avium* (43.0%) were obtained by Chełpiński [2007], but similar ones for 'Regina' cultivar by Stachowiak and Świerczyński [1999], (71.2%). The budded cultivar of sweet cherry trees also influenced the productivity of the nursery. Significantly the biggest number of maiden trees was found for 'Regina' cultivar and the smallest for 'Lapins' (tab. 7). Also in their previous experiments Stachowiak i Świerczyński [2009] obtained better productivity of maiden trees of 'Regina' cultivar among the four budded sweet cherry trees cultivars.

The previous results [Stachowiak and Świerczyński 2009], as well as the discussed ones fully confirm a stronger growth of sweet cherry maiden trees growing on Colt and *Prunus avium* rootstocks. However, maiden trees produced on rootstocks with 'Frutana' interstock were characterized by a weaker growth, especially on *Prunus avium*. In this combination, however, the smallest productivity of maiden trees was observed.

Anatomic cross sections of the connections of budded sweet cherry trees' cultivars with 'Frutana' interstock did not show any sign of physiological incompatibility (photo 1, 2, 3). Also Sitarek and Grzyb [2007] did not observe any symptoms of physiological incompatibility while carrying out such sections for 'Heidegger' sweet cherry cultivar budded in a nursery on P-HL A, P-HL B and GiSelA 5 rootstocks. However, premature yellowing of leaves took place in a nursery and next high mortality of trees was observed in an orchard.

CONCLUSIONS

1. The strongest growth of sweet cherry maiden trees was fund on 'Colt' rootstock and the weakest on *Prunus avium* with 'Frutana' interstock.

2. The biggest productivity of sweet cherry maiden trees was obtained on *Prunus avium*, and the smallest on *Prunus avium* with 'Frutana' interstock.

3. No noticeable symptoms of physiological incomapatibility of the examined sweet cherry trees' cultivars with 'Frutna' interstock were found on the basis of anatomic sections of their connections.

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PRZYDATNOŚĆ WSTAWKI 'FRUTANA' DO PRODUKCJI OKULANTÓW CZEREŚNI W SZKÓŁCE

Streszczenie. W produkcji szkółkarskiej mało jest sprawdzonych podkładek zmniejszających wzrost drzew czereśni w sadzie. Alternatywnym rozwiązaniem jest zastosowanie wstawki skarlającej. W przeprowadzonym doświadczeniu sprawdzono przydatność wstawki skarlającej 'Frutana' do produkcji okulantów czereśni w szkółce. Badaniami objęto następujące podkładki: *Prunus avium*, i Colt oraz odmiany czereśni: 'Kordia', 'Lapins' and 'Regina'. Najsilniejszy wzrost okulantów czereśni uzyskano na podkładce Colt, a najsłabszy na podkładce *Prunus avium* z wstawką. Najlepszą wydajność okulantów otrzymano na podkładce *Prunus avium*, a najgorszą na *Prunus avium* z wstawką. Wykonane przekroje anatomiczne nie uwidoczniły oznak niezgodności fizjologicznej pomiędzy wstawką 'Frutana' a badanymi odmianami czereśni.

Słowa kluczowe: podkładki, wstawka skarlająca 'Frutana', wzrost okulantów czereśni, wydajność szkółki, zgodność fizjologiczna

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