Journal of Fruit and Ornamental Plant Research Vol. 18(1) 2010: 45-50

GROWTH AND YIELD OF 'KORDIA' SWEET CHERRY TREES WITH VARIOUS ROOTSTOCK AND INTERSTEM COMBINATIONS

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(Received February 5, 2010/Accepted March 26, 2010)

A B S T R A C T

The experiment was set up at the Experimental Orchard in Dąbrowice, Poland in the spring of 2005. The experimental plant material consisted of sweet cherry trees cv. 'Kordia' planted in three rootstock and two interstem combinations. The rootstocks included 'Gisela 5', 'F12/1' and 'Colt'. The interstems were 20 cm long shoots of 'Gisela 5' grafted on 'F12/1' or 'Colt' rootstocks. All the trees were planted at the same spacing of 4.5 x 2.5 m in a random block design, in four replicates with three trees per plot. The tree training method was the Vogel Central Leader.

In the fifth year of the experiment, the sweet cherry trees growing in the combinations with the rootstocks 'F12/1' and 'Colt' showed the strongest growth, The combinations with 'Gisela 5' dwarfing rootstock grew least vigorously. In the 2009 season, the 'Kordia' trees produced fruit yields at a very good level. The trees with 'Gisela 5' interstems grafted on the rootstock 'Colt' produced the highest yields (more than 30 kg per tree).

Five years after being planted, 'Kordia' trees with 'Gisela 5' interstem grafted on 'F12/1' rootstock had the highest cumulative yield. Trees with 'Gisela 5' interstems grafted on the 'Colt' rootstock and those grafted directly on the 'Colt' rootstock produced similar yields. Trees grafted directly on the 'Gisela 5' rootstock had the lowest yields.

Kay words: sweet cherry trees, rootstock, interstem, orchard, growth, fruiting efficiency index

INTRODUCTION

For the purpose of establishing new sweet cherry orchards, dwarfing rootstocks are recommended. However, there are still only a few of them on the market in Poland. Consequently, the prices of the trees on such rootstocks are too high for Polish producers. Moreover, trees on dwarfing rootstocks are more demanding in terms of location than trees on Mazzard seedlings (Rozpara, 2005). To overcome the shortage of dwarfing rootstocks, less vigorously growing sweet cherry trees can be obtained by using a dwarfing interstem between the strongly growing rootstock and the cultivar. Stortzer and Grossmann (1988) were successful in reducing the growth vigour of sweet cherry trees by using the Czech rootstocks ‘PHL 84’ and ‘PHL 4’ as interstems. In Poland, work on interstems for sweet cherry had already begun at the beginning of the 1970s (Grzyb et al., 1985). In subsequent experiments carried out at the Research Institute of Pomology and Floriculture in Skierniewice, Poland, sour cherry ‘Northstar’ and a few types of *Prunus fruticosa* Pall. were used as interstems. The use of such interstems markedly reduced tree growth vigour and improved tree productivity (Rozpara, 1994; Rozpara et al., 1998). This experimental work resulted in a selection of an interstem named ‘Frutana®’ (Rozpara and Grzyb, 2004). The interstem was entered into the National Register and the Register of Exclusive Rights Protection.

The objective of this study was to compare the growth, yield and fruit quality of the sweet cherry cultivar ‘Kordia’ planted in three rootstock combinations and two interstem combinations (in which ‘Gisela 5’ was used as interstem), after having grown for five years in the orchard.

MATERIAL AND METHODS

The field experiment was established in the spring of 2005 in the Experimental Orchard of the Research Institute of Pomology and Floriculture at Dąbrowice, near Skierniewice (central Poland) on sandy loam podsolic soil underlaid by loam. The experimental plant material consisted of sweet cherry trees of the cultivar ‘Kordia’ grafted on three rootstocks: ‘F12/1’, ‘Colt’, or ‘Gisela 5’, and two additional combinations with ‘Gisela 5’ interstems (20 cm long) grafted on rootstocks: ‘F12/1’ or ‘Colt’ (Tab. 1). All the trees were spaced at 4.5 x 2.5 m and arranged in four randomized blocks with three trees per plot. Thus, there were 12 trees of the cultivar ‘Kordia’ growing on each rootstock and interstem combination.

In the spring of 2005, immediately after planting, the shaping of tree crowns began. The trees planted in the form of branched trees had their leaders shortened at a height of about 40 cm above the sylleptic shoot, whereas the trees without lateral shoots were cut back at a height of about 100 cm above the ground. The lateral shoots growing from the leader were bent horizontally by means of wooden clips and toothpicks.

Table 1. Tree size (expressed as TCSA and canopy volume), yield and mean fruit weight of 'Kordia' sweet cherry trees grafted on various rootstocks and interstem combinations after 5 years of growth in the orchard

Rootstock + interstem	TCSA	Canopy volume in 2009	Yield in 2009	Cumulative yield 2006-2009	Fruiting efficiency index		Mean fruit weight
	[cm^2]	[m^3]	[kg $tree^{-1}$]		[kg cm^{-2}]	[kg m^{-3}]	[g]
F12/1	129.9d*	15.1c	18.2a	36.4a	0.30a	2.5a	9.7 a
Colt'	111.8cd	14.6c	23.6ab	40.5b	0.37ab	2.8ab	9.5 a
Gisela 5 (control)	59.2a	6.7a	19.6ab	33.7a	0.58c	5.1c	9.4 a
F12/1 rootstock + Gisela 5 (20 cm)	103.1bc	12.6b	31.7c	42.2b	0.43b	3.3ab	8.8 a
Colt rootstock + Gisela 5 (20 cm)	89.1b	11.8b	25.6b	38.0b	0.43b	3.3ab	9.5 a

*Means marked with the same letter in a column do not differ significantly at p = 0.05 according to Duncan's multiple range test

The tree training method was that of Vogel Central Leader. Weeds in the tree rows were controlled with herbicides. The inter-rows were grassed over in the second year after planting. Fertilization, plant protection and other agro-technical treatments were applied according to the standard recommendations for commercial sweet cherry orchards in Poland. The trees were drip-irrigated from the first year after planting.

In the course of the experiment, the following observations and measurements were recorded: the health status of the trees, trunk circumference (measured at 30 cm above ground level in the case of trees grafted directly on rootstocks, and at 10 cm above interstems, in the case of trees with interstems), yield (determined every year, separately for each tree) and fruit quality (samples were taken from each replication). Statistical analyses involved variance analyses and Duncan's multiple range test at $p = 0.05$.

RESULTS AND DISCUSSION

After the first five years of the experiment, the 'Gisela 5' rootstock induced the weakest growth of 'Kordia' trees. These results correspond with the information obtained earlier by Franken-Bembenek (1998), Sitarek et al. (2005) and other authors. The size of the trees on the 'Gisela 5' rootstock was the smallest. Among the rootstock/interstem combinations, the trees on 'Gisela 5' interstems grafted on the 'Colt' rootstock were smaller than the trees on 'Gisela 5' interstems grafted on the 'F12/1' rootstock. But the size of the trees with 'Gisela 5' as interstem was significantly smaller than of those on the standard 'F12/1' and 'Colt' rootstocks. Similar results with different interstems for cherry trees were obtained by Rozpara and Grzyb (2006), Magyar and Hrotko (2005) and by Stortzer and Grossmann (1988).

Rozpara (1994) and Rozpara and Grzyb (2004) proved that sweet cherry trees with interstems began to bear fruit earlier, compared to the trees grafted on Mazzard seedlings. Similar observations were made in the present experiment. The trees with 'Gisela 5' interstems yielded already in the second year after planting, whereas the trees on 'F12/1' started to bear fruit a year later.

In the 2009 season, the 'Kordia' trees produced fruit yields at a very good level. The highest yields were obtained from the trees on 'Gisela 5' dwarfing interstems grafted on the 'F12/1' rootstock (more than 31 kg per tree). The lowest yields were produced by the trees on the 'Gisela 5' and 'F12/1' rootstocks.

The highest cumulative yield (2006-2009) was recorded for the 'Kordia' trees with 'Gisela 5' interstem grafted on the 'F12/1' rootstock. Trees grafted on 'Gisela 5' interstems grafted on the 'Colt' rootstock and those grafted directly on the 'Colt' rootstock produced similar yields. However, there were no significant differences in the total yield among the trees with 'Gisela 5' interstems and the trees on the 'Colt' rootstock. The lowest yield was obtained from the trees on the ‘Gisela 5’ and ‘F12/1’ rootstocks in comparison with the yield obtained from the trees on the ‘Colt’ rootstock and the trees with interstems.

An analysis of tree productivity, expressed by the yield efficiency index, showed that the trees on both rootstocks: ‘F12/1’ and ‘Colt’ were equally productive. The trees grafted on ‘Gisela 5’ had the highest yield efficiency indices: the first – the total yield efficiencies (in kg per cm^2 of the trunk cross-sectional area) (kg cm^{-2}), and the second – expressed as a ratio of total yield to canopy volume (kg cm^{-3}). The trees with ‘Gisela 5’ interstem grafted on either rootstock had similar yield efficiency indices. Those trees were more productive than the trees grafted on the ‘F12/1’ rootstock.

In 2009, fruit weight was similar for trees grafted on all the rootstocks and for the trees with ‘Gisela 5’ dwarfing interstems grafted on the ‘F12/1’ and ‘Colt’ rootstocks. It is important to note that other authors (Grzyb et al., 1998; Sitarek et al., 2005) reported negative effects of dwarfing rootstocks on fruit quality.

CONCLUSIONS

1. The rootstock ‘Gisela 5’ induced the weakest growth of ‘Kordia’ sweet cherry trees.
2. Trees with ‘Gisela 5’ dwarfing interstems grafted on the ‘Colt’ and ‘F12/1’ rootstocks were significantly smaller than the trees growing directly on ‘Colt’ and ‘F12/1’ rootstocks.
3. ‘Kordia’ trees with ‘Gisela 5’ dwarfing interstems grafted on the ‘F12/1’ rootstock produced the highest cumulative yield.
4. ‘Kordia’ trees growing on the rootstock ‘Gisela 5’ had the highest yield efficiency indices.
5. The trees with ‘Gisela 5’ dwarfing interstems grafted on the ‘Colt’ and ‘F12/1’ rootstocks had a similar yield efficiency index.
6. The selected fruit quality parameter (fruit weight) appeared to be unaffected by the rootstock or interstem.

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WZROST I OWOCOWANIE CZEREŚNI 'KORDIA' SZCZEPIONYCH NA KILKU PODKŁADKACH I WSTAWCE SKARLAJĄCEJ

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STRESZCZENIE

Doświadczenie założono wiosną 2005 roku w Sadzie Doświadczalnym w Dąbrowicach, należącym do Instytutu Sadownictwa i Kwiaciarstwa w Skierniewicach. Badane były drzewa czereśni 'Kordia' posadzone w pięciu kombinacjach z podkładkami i wstawką. Zastosowano trzy podkładki: 'Gisela 5', 'F12/1' i 'Colt' i wstawkę – pędy podkładki karłowej 'Gisela 5' o długości 20 cm. Wszystkie drzewa posadzono w rozstawie 4,5 x 2,5 m. Drzewa prowadzone były według metody Vogla (Vogel Central Leader).

W piątym roku badań najsilniejszy wzrost drzew obserwowano w kombinacji czereśni rosnącej na podkładce F12/1, a najsłabszy na podkładce karłowej 'Gisela 5'. Drzewa na wstawce skarlającej szczepione na podkładkach 'Colt' i 'F12/1' rosły słabiej w porównaniu z drzewami szczepionymi bezpośrednio na tych podkładkach. W sezonie 2009 drzewa 'Kordia' plonowały na bardzo dobrym poziomie. Najobfitsze plony zebrano z drzew ze wstawką 'Gisela 5' szczepionych na podkładce 'Colt' (ponad 31 kg owoców z drzewa), a najsłabsze z drzew rosnących bezpośrednio na podkładkach 'Gisela 5' i 'F12/1'. Jakość zebranych owoców obu odmian czereśni była dobra, bez względu na podkładkę i zastosowaną wstawkę. Po pięciu latach badań największe sumaryczne plony uzyskano z drzew ze wstawką 'Gisela 5' szczepionych na podkładce 'F12/1' oraz rosnących bezpośrednio na podkładce 'Colt'. Najwyższe wskaźniki plenności w przeliczeniu na pole powierzchni pnia (kg cm^{-2}) oraz na objętość korony (kg m^{-3}) miały drzewa szczepione bezpośrednio na podkładce 'Gisela 5'.

Słowa kluczowe: czereśnia, podkładka, wstawka skarlająca, sad, wzrost, wskaźnik plenności