THE INFLUENCE OF THREE SEEDLING ROOTSTOCKS ON THE GROWTH AND FRUITING OF PEACH TREES IN THE FIRST YEARS AFTER PLANTING

Sławomir Świerczyński

Department of Dendrology and Nursery Production
University of Life Science in Poznań
Szamotulska 28, 62-081 Przeźmierowo, POLAND
e-mail: kdis@au.poznan.pl

(Received September 7, 2010/Accepted November 3, 2010)

A B S T R A C T

The aim of the study conducted during 2007-2009 was to estimate the growth and cropping of four peach tree cultivars growing on three vegetative rootstocks (Rakonievicka, Hui-Hun-Tao, and Minnesota seedlings). The growth of the trees in the orchard was evaluated on the basis of trunk cross-sectional area and canopy volume. In the years 2008-2009, the fruit yield and 100 fruits from each tree were weighed separately. The weakest growth of trees was observed on Minnesota seedling rootstock as well as 'Harnaś', and 'Royalvee' peach tree cultivars. A better total yield was obtained from peach trees growing on Rakonievicka and Minnesota seedling rootstocks. 'Harbinger' cultivar gave a weaker yield in comparison with other cultivars. Fruits on Minnesota seedling rootstock had a smaller mass. The highest yield efficiency was from trees growing on Minnesota seedling, except for the 'Harbinger' cultivar, which had the lowest yield efficiency.

Key words: peach, cultivars, rootstocks, growth, fruiting, orchard

INTRODUCTION

In Poland, strong winters and spring frosts damage flowers and shoots of peach trees. Therefore, a high yield in the first few years after planting is very important. It is well known that rootstocks can influence productivity and fruit quality of peach (De Salvador et al., 2002; De Salvador et al., 2007; Reighard et al., 2007). As far as peach trees are concerned, mainly those growing on stronger growing rootstocks are

planted into an orchard. They make it impossible to intensify a cultivation of this species. In many foreign centres, studies on rootstocks for peach trees have been carried out (Layne, 1974; Reighard, 2000; Reighard et al., 2001; DeJong et al., 2004; Reighard et al., 2007). Their aim is to find new, weaker growing rootstocks for peach trees. In Europe, especially in Italy, studies on intensification of the cultivation of this species by increasing the number of trees growing on one unit of an area are conducted (Bargioni et al., 1983; Loreti and Massai, 2002 b). Recently a lot of attention has been focused on new dwarf rootstocks tolerant to unfavourable soil conditions and resistant to diseases and pests (Fideghelli et al., 1998; Beckman et al., 2002; Loreti and Massai, 2002a; Reighard, 2002; Dirlewanger et al., 2004; Xiloyannis et al., 2007).

The aim of the conducted experiment was an evaluation of growth and cropping of peach trees growing on three rootstocks in an orchard, in the initial period of cultivation.

MATERIAL AND METHODS

The experiment was conducted in the years 2007-2009 in the Experimental Station in Baranowo of the University of Life Sciences in Poznań. Analyses were conducted on peach trees cultivars: 'Harnaś', 'Harbinger', Inka', and 'Royalvee' grown on Rakonievicka, Hui-Hun-Tao and Minnesota seedling rootstocks. Peach trees were planted in early spring 2007, at a spacing of 4.0 x 2.5 m (1000 trees/ha). The experiment was established in the completely randomized block design in four replications, each consisting of three trees. Weeds in the orchard were controlled with herbicides in tree rows and mechanically between rows. All trees were irrigated during periods of drought. Trees were pruned only in summer. Plant protection was carried out according to the current recommendations of the Orchard Protection Program. In the year 2009, hand thinning of the small fruits was done. In the autumn of 2009, trunk circumference (at the height of 30 cm), width and height of the canopy were measured. The tree measurements were then used to calculate trunk cross-sectional area, canopy volume and tree trunk and canopy efficiency. In the years 2008-2009, the fruit yield and 100 fruits from each tree were weighed. The obtained results were evaluated statistically using the analysis of variance. The significance of differences between means was evaluated according to Duncan's multiple range t-test at $p = 0.05$.

RESULT AND DISCUSSION

The obtained results concerning the vigour of the growth of peach trees growing in an orchard on three studied rootstocks differed quite a bit (Tab. 1). The weakest growth, measured by trunk cross-sectional area and canopy volume, was observed on Minnesota seedling rootstock. Trees

Table 1. Influence of rootstock and cultivar on growth and yield efficiency of peach trees

Cultivar	Rootstock	Vigour of growth expressed by		Yield efficiency per	
		TCSA in 2009 [cm^2]	canopy volume [m^3]	TCSA [kg cm^{-2}]	canopy volume [kg m^{-3}]
Harbinger	Hui-Hun-Tao	35.8 g*	6.5 f	0.6 a	5.5 a
	Rakonievicka	33.9 f	5.5 e	0.7 ab	6.2 ab
	Minnesota	27.9 e	5.3 e	0.8 b	5.3 a
Harnaś	Hui-Hun-Tao	22.1 c	3.3 bc	1.5 d	10.1 e
	Rakonievicka	21.2 c	3.0 b	1.7 e	11.9 f
	Minnesota	15.4 a	2.2 a	2.1 f	14.8 g
Royalvee	Hui-Hun-Tao	23.9 d	3.6 c	1.4 d	9.1 de
	Rakonievicka	23.9 d	3.6 c	1.5 d	10.0 e
	Minnesota	18.0 b	3.2 bc	2.0 f	11.5 f
Inka	Hui-Hun-Tao	29.5 e	4.5 d	1.1 c	7.0 bc
	Rakonievicka	29.3 e	4.3 d	1.2 c	8.3 cd
	Minnesota	23.6 d	3.6 c	1.7 e	11.6 f

*Means followed by the same letters, in the columns do not significantly differ at p = 0.05

on Rakonievicka seedling and Hui-Hun-Tao grew much stronger. Świerczyński and Sękowska (2004) also noticed a strong growth of peach trees on Hui-Hun-Tao rootstock. On the other hand, Hołubowicz and Bojar (1998) observed a stronger growth of 'Reliance' peach tree on Minnesota seedling rootstocks compared with Hui-Hun-Tao. In the experiment, the obtained growth of 'Inka' cultivar trees on Minnesota seedling rootstock was similar to the one obtained by Szewczuk and Gudarowska (2009) on Pumiselect rootstock. These results show the similar power of growth of these two rootstocks. Among the studied peach tree cultivars, the trees of the 'Harbinger' cultivar grew the strongest. 'Inka' was the next, and the weakest were 'Royalvee' and 'Harnaś'. This is in agreement with the results obtained earlier in a nursery (Świerczyński and Stachowiak, 2009), where maiden peach trees of the 'Harbinger' cultivar grew significantly stronger than 'Royalvee'. In the first years that the trees were cultivated, Wociór (2009) also obtained a much stronger growth of 'Harbinger' cultivar than of 'Inka'.

The peach trees began yielding very early. The sum of yields from the first two years of fruiting, for the studied peach tree cultivars, was similar to Rakonievicka and

Table 2. Influence of rootstock and cultivar on the yielding and fruit quality of peach trees

Cultivar	Rootstock	Weight of 100 fruits [kg]	Total crop in kg per tree 2008-2009 [kg]
Harbinger	Hui-Hun-Tao	6.5 b*	21.5 a
	Rakonievicka	6.8 b	24.5 b
	Minnesota	6.0 a	23.2 ab
Harnaś	Hui-Hun-Tao	9.7 d	33.1 cd
	Rakonievicka	10.5 e	36.2 e
	Minnesota	8.4 c	32.2 c
Royalvee	Hui-Hun-Tao	9.5 d	32.4 c
	Rakonievicka	9.8 d	35.5 de
	Minnesota	8.4 c	36.3 e
Inka	Hui-Hun-Tao	15.5 g	31.7 c
	Rakonievicka	16.5 h	35.0 de
	Minnesota	14.5 f	41.3 f

*Explanation: see Table 1

Minnesota seedlings and a bit smaller for the Hui-Hun-Tao rootstock (Tab. 2). Also Hołubowicz and Bojar (1998) obtained a better yield for the 'Reliance' cultivar growing on Minnesota seedling rootstock than on Hui-Hun-Tao. On the other hand, in an earlier experiment carried out on Hui-Hun-Tao rootstock, Świerczyński and Sękowska (2004) noted high yields of peach trees in the initial period of tree growth. Among the evaluated cultivars 'Harnaś', 'Royalvee' and 'Inka' gave much bigger yields than 'Harbinger'. These results show the big yield potential of the three above mentioned peach tree cultivars. The sum of the fruit yield for the second and third year of growth of 'Harbinger' and 'Inka' cultivars was similar to the one noted by Wociór (2009) in the third and fourth year after planting.

Yield efficiency, for peach trees of the studied cultivars that was obtained on Minnesota seedling rootstock, was significantly higher than those obtained on Rakonievicka seedling and Hui-Hun-Tao, except for the 'Harbinger' (Tab. 1). These results are in agreement with the results of Hołubowicz and Bojar (1998), who obtained a 1/3 bigger yield efficiency on Minnesota seedling rootstock than on Hui-Hun-Tao. Świerczyński and Sękowska (2004) obtained a higher yield efficiency for 'Reliance' and 'Redhaven' cultivars growing on Hui-Hun-Tao than in the present experiment. The best yield efficiency was found for 'Harnaś' cultivar, next 'Royalvee' and 'Inka',

and the smallest one was for 'Harbinger'. Also Wociór (2009) noted a better yield efficiency for 'Inka' in comparison with 'Harbinger'.

In the conducted experiment, rootstock had a significant influence on the mass of 100 fruits (Tab. 2). The value of this feature was higher when Rakonievicka seedling and Hui-Hun-Tao were rootstocks. However, Minnesota seedling diminished the size of fruits. It was the only disadvantage of this rootstock observed in the experiment. Among the studied peach cultivars 'Inka' had the biggest fruits and 'Harbinger' had the smallest. The size of fruits from the 'Harbinger' cultivar, obtained by Wociór (2009) was higher and the size of 'Inka' fruits was similar to the size of those in the described experiment. The results of this experiment confirmed the view of Wociór (2009) on the considerable usefulness of 'Inka' for planting in the warmer regions of Poland.

CONCLUSIONS

1. The Minnesota seedling rootstock restricted the growth of peach trees the most, and was characterized by the biggest yield efficiency. This rootstock diminished the size of fruits.
2. Among the studied cultivars, 'Harnaś' and 'Royalvee' were characterized by a weaker growth and a higher yield efficiency.

REFERENCES

Bargioni G., Loreti F., Pisani P.L 1983. Performance of peach and nectarine in a high density system in Italy. HORTSCIENCE 18(2): 143-146.

Beckman T.G., Okie W.R., Nyczepir A.P. 2002. Influence of scion and rootstock on incidence of peach tree short life. ACTA HORT. 592: 645-648.

De Salvador F.R., Giglio L. Di Tommaso G., Ondradu G., Scales B. 2002. Horticultural behaviour of different species and hybrids as rootstocks for peach. ACTA HORT. 592: 317-322.

De Salvador F.R., Giovannini D., Liverani A. 2007. Effects of crop load and rootstock on fruit quality in 'Suncrest' peach cultivar. ACTA HORT. 732: 279-283.

DeJong T.M., Johnson R.S., Doyle J.F., Weibel A., Solari L., Marsal J., Basile B., Ramming D., Bryła D. 2004. Growth, yield and physiological behaviour of size-controlling peach rootstocks developed in California. ACTA HORT. 658: 449-455.

Dirlewanger E., Kleinhenth M., Laigret F., Gomez-Aparisi J., Rubio-Cabetas M.J., Claverie M., Bosselut N., Voisin R., Esmenjaud D., Xiloyannis C., Dichio B., Poessel J.L., Vito M. di, Arus P., Howad W. 2004. Breeding for a new generation of *Prunus* rootstocks based on marker-assisted selection: a European initiative. ACTA HORT. 663: 829-833.

Fideghelli C., Della Strada G., Grassi F., Morico G. 1998. The peach industry in the world; present situation and trend. ACTA HORT. 465: 29-40.

Hołubowicz T., Bojar K. 1998. Wpływ podkładki na wzrost, plonowanie i mrozoodporność brzoskwini odmiany 'Reliance'. ZESZ. NAUK AR KRAKÓW 333 (57): 435-438.

Layne R.E.C. 1974. Breeding peach rootstocks for Canada and the north-

ern United States. HORTSCIENCE 9 (4): 364-366.

Loreti F., Massai R. 2002a. MIPAF targeted project for evaluation of peach rootstocks in Italy: results of six years of observations. ACTA HORT. 592:117-124.

Loreti F., Massai R. 2002b. The high density peach planting system: present status and perspectives. ACTA HORT. 592: 377-390.

Reighard G.L. 2000. Peach rootstocks for the United States: are foreign rootstocks the answer? HORT TECHNOLOGY 10:714-718.

Reighard G. 2002. Current directions of peach rootstock programs worldwide. ACTA HORT. 592: 421-427.

Reighard G.L., Andersen J., Andersen W.R., Autio W.R., Beckman T., Baker T., Belding R., Brown G., Byers P., Cowgill W., Deyton D., Durner E., Erb A., Ferree D.C., Gaus A., Godin R., Hayden R., Hirst P., Kadir S., Kaps M., Larsen H., Lindstrom T., Miles N., Morrison F., Myers S., Quellette D.R., Rom C., Shane W., Taylor B., Taylor K., Walsh C., Warmund M. 2007. Growth and yield of 'Redhaven' peach on nineteen rootstocks at twenty North American locations. ACTA HORT. 732: 271-278.

Reighard G.L., Andersen R., Andersen J.L., Autio W.R., Beckman T., Baker T., Belding R., Brown G., Byers P., Cowgill W., Deyton D., Durner E., Erb A., Ferree D.C., Gaus A., Hirst P., Kaps M., Miles N., Morrison F., Myers S., Perry R., Rom C., Shane W., Taylor B., Taylor K., Walsh C., Warmund M. 2001. Five-year performance of 19 peach rootstocks at 20 sites in North America. ACTA HORT. 557: 97-102.

Szewczuk A., Gudarowska E. 2009. Growth of peach trees on Pumiselect rootstock, in the first years after planting. J. FRUIT ORNAM. PLANT RES. 17(1): 61-66.

Świerczyński S., Sękowska J. 2004. Wpływ dwóch podkładek na wzrost i plonowanie brzoskwini odmiany 'Redhaven' i 'Reliance'. FOLIA UNIV. AGRIC. STETIN. AGRICULTURA 240(96): 193-196.

Świerczyński S., Stachowiak A. 2009. The usefulness of four rootstocks for the production of maiden peach trees. J. FRUIT ORNAM. PLANT RES. 17(1): 39-48.

Wociór S. 2009. Growth and cropping of two cultivars of peach and nectarine in the conditions of the Sandomierska Plateau. FOLIA HORT. 21(1): 73-80.

Xiloyannis C., Dichio B., Tuzio A.C., Kleinhentz M., Salesses G., Gomez-Aparisi J., Rubio-Cabetas M.J., Esmenjaud D. 2007. Characterization and selection of *Prunus* rootstocks resistant to abiotic stresses: water logging, drought and iron chlorosis. ACTA HORT. 732: 247-251

WPŁYW TRZECH PODKŁADEK GENERATYWNYCH NA WZROST I OWOCOWANIE DRZEW BRZOSKWINI W PIERWSZYCH LATACH PO POSADZENIU

Sławomir Świerczyński

S T R E S Z C Z E N I E

Celem badań przeprowadzonych w latach 2007-2009 była ocena wzrostu i plonowania czterech odmian brzoskwini rosnących na trzech podkładkach (Siewka Rakoniewicka, Hui-Hun-Tao i Siewka Minnesota). Wzrost drzew w sadzie oceniono na podstawie pola przekroju poprzecznego pnia i objętości korony. W latach 2008-2009 ważono plon owoców i 100 owoców z każdego drzewa osobno. Najsłabszy wzrost drzew zaobserwowano na podkładce Siewka Minnesota oraz odmian brzoskwini 'Harnaś' i 'Royalvee'. Lepszym sumarycznym plonem charakteryzowały się drzewa brzoskwini na podkładkach Siewka Rakoniewicka i Siewka Minnesota. Słabiej od pozostałych plonowały drzewa odmiany 'Harbinger'. Mniejszą masę miały owoce na podkładce Siewka Minnesota. Najwyższymi współczynnikami plenności charakteryzowały się drzewa na podkładce Siewka Minnesota, z wyjątkiem odmiany 'Harbinger', która miała najniższe współczynniki plenności.

Słowa kluczowe: brzoskwinia, odmiany, podkładki, wzrost, plonowanie, sad