THE INFLUENCE OF PRODUCTION TECHNOLOGY ON THE GROWTH OF APPLE FRUIT TREES IN A NURSERY

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Abstract. *During the period 2004 - 2006 the effect of two technologies of the production of apple fruit trees 'Jonica' and 'Šampion' were compared: the production of two-year-old trees with a one-year-old crown obtained through winter grafting in hand and the production of one-year-old trees obtained through summer budding. Independently from the cultivar, the trees coming from grafting had better growth parameters than the trees produced in the process of budding. Better growth results were obtained for 'Jonica' apple fruit trees than for the trees of 'Šampion' cultivar.*

INTRODUCTION

The results of some experiments have shown that good quality nursery material affect productivity of orchard (Van Oosten 1978, Vittrup 1978, Shepherd 1979, Poldervaart 1992, Poniedziałek at al. 1993). According to foreign literature data (Van Oosten, 1978; Merezhko 1987, Poldervaart 1992 Boostma and Baart, 1990; Wertheim and Groene, 1993, 1994, Bootsma 1995) and the domestic ones (Czynczyk at al. 1997, Bielicki and Czynczyk, 1999, Jadczuk 2000, Bielicki at al., 2003,), two-year-old trees with a one-year-old crown are especially useful for the establishment of modern orchards.

On the Polish market one-year-old shoots of budded plants are offered the most often. Such material requires to be formed after its planting into the orchard ground. Of course it is connected both with additional load of labour and money and with the delay of fructification. Planting two-year-old trees with a one-year-old crown can be some kind of a solution. Such trees are a little bit more expensive but they have a formed crown and they start to fructify practically in the year they are planted.

Comparison of production methods and growth parameters of one-year-old young apple trees of 'Jonica' and 'Šampion' with the two-year-old trees with a one-year-old crown of the same cultivars was performed in the paper.

MATERIAL AND METHODS

The experiment was carried in the years of 2004 and 2005, was set up in four replications, with 50 rootstocks per plot. Virus-free rootstocks M9 and grafts of two cultivars: 'Jonica' and 'Šampion' were the plant experimental material.

In the first year of the experiment, in March, winter grafting in hand was done. Rootstocks with the diameter of 9 to 12 mm were used for this purpose. The place of grafting was situated 20 to 25 cm from the highest growing roots.

Grafted rootstocks were put diagonally in crates and covered with humid peat. Such prepared material was put aside for the period of 14 days in the temperature of about 18 C. When the buds on scions started to swallow the crates were moved into a cooling place with the temperature of 1 to 2º C. The plants were kept in such conditions till the middle of April. Later they were planted into a nursery in 90 x 30 cm spacing. After this action the nursery school was being watered. From all the buds appearing on scions only the strongest one was left. When the leading shoot grew up to a dozen or so it was tied to a bamboo picket. On the turn of June and July the foil from the grafted scion was removed.

In the second year of the running of the nursery, in March, the trees were cut on the height of 70 cm. All the shoots growing below the cut were removed and only the one that grew from the highest top bud was left. When this shoot reached the length of 20 cm it was tied to a bamboo picket. In the process of vegetation from this leading shoot, long shoots started to grow at the angle close to the right one and they finally created a crown of a tree.

The second part of the rootstocks was also planted in spring into the field in 90 x 30 cm spacing. On the turn of July and August the budding by chip budding with cultivars 'Jonica' and 'Šampion' was carried out. In spring of the second year the rootstocks were cut above the budding place, leading the shoots without plug.

In autumn, in the middle of October the following observations and measures were done: the height of the trees (cm), the thickness of the trunk at the height of 30 cm above the ground (mm), the number of long shoots (longer than 20 cm) and they length (cm)

Above mentioned parameters were checked for plants coming from two methods of production. Hundred trees from each combination were taken randomly for these measurements.

STAT program was used for all statistic calculations and to show the differences the method of two-factor variance analysis was applied (cultivar, production method). Importance of differences among the combinations was evaluated on the basis of confidence interval with the application of Duncan test for the confidence level $\alpha = 0.05$. The results presented in figures are mean values of the two series.

RESULTS

Analyzing the average height of the trees it was found out that two-year-old fruit trees with a one-year-old crown were higher than one-year-old trees (figure 1). 'Jonica' cultivar reached the average height of 182,0 cm while in a traditional cycle (as a one-year-old maiden tree) it reached only 132,2 cm. A similar tendency was observed for 'Šampion', where the two-year-old trees reached the average height of 157,8 cm and one-year-old maiden tree 124,5 cm.

On the basis of statistic analysis for the average thickness of the tree trunks significant differences were observed for the advantage of two-year-old trees, independently from the cultivar (figure 2). The average thickness of the tree trunks of 'Jonica' cultivar respectively reached the values of 19,5 mm and 12,4 mm (for one-year-old maiden tree). For 'Šampion ' the values were respectively: 20,3 mm and 12,9 mm – for one-year-old maiden tree.

Two-year-old trees with a one-year-old crown significantly differed with the number of long shoots from the maiden trees produced in a traditional way. Their average number for 'Jonica' was 9,8 and only 3,5 for maiden tree. Smaller average values, but also significantly different, were obtained for 'Šampion' cultivar.
On two-year-old trees there were 7,4 long shoots while on one-year-old maiden tree only 2,5.

On the basis of the analysis of the length of long shoots it was found out that the biggest increment was observed for the trees of 'Jonica' – 52,8 cm (37,9 one-year-old maiden tree). Exceptionally, the trees of 'Šampion', coming from a budding method had longer increments of long shoots (38,1 cm) but not significantly different from the increments of the two-year-old trees (36,2 cm).

DISCUSSIONS

High costs of establishing of 1 hectare of an intensive orchard make nurserymen seek less expensive methods of the production of high quality material. Orchard men look for branchy trees, which are easier to be formed and which fructify in the second year after being planted. One of the ways is planting two-year-old trees with a one-year crown, consisting the most often of 5 to 10 shoots. Such trees are obtained in the same time as one-year-old shoots of a budded plant but their quality is incomparably higher. An orchard established from such a material gives a guarantee of a quick return of costs. Production of two-year-old trees with a one-year-old crown is a direction leading to the restriction of not ramified material, which is offered for sale in a nursery turnover.

On the basis of the obtained results one can find out that the method of production of two-year-old trees by winter grafting in hand, the method, which is presented here, has a very positive influence on the quality of the trees in comparison with one-year-old maiden tree obtained in a traditional budding method. The quality of the obtained nursery material, defined on the basis of growth parameters taken into consideration, was really better for winter grafting in hand. It is supported by the fact that both the height and the thickness of the trees as well as the number and length of the long shoots. The only exception was the parameter of length of long shoots, which was similar for 'Šampion' cultivar in two different production methods.

In the discussed experiment, two-year-old trees with a one-year-old crown of 'Jonica' cultivar had an average height of 182 cm. In experiments with the production of two-year-old trees of 'Jonica' cultivar on M9 rootstock Bielecki at al. (1998) and Czarnecki (1998) obtained almost the same height of trees (177,3 cm). However the diameter of trees obtained by the above-mentioned authors was smaller (14,0 mm) comparing to the considering experiment (19,5 mm). Such difference can be explained by both: application of different kind of 'Jonagold' cultivars in the compared experiments and by application of virus-free plant material (rootstocks and scions) in our experiment. This fact is not mentioned by the above authors.

Two-year-old trees with a one-year-old crown of 'Jonica' cultivar were significantly higher from the analogous trees of 'Šampion' cultivar. This difference in height could be caused by the fact that 'Szampion' is a weaker growing cultivar in comparison with 'Jonica'.

The method of winter grafting in hand, discussed in this paper, as a production method had a positive influence on long shoots growing, on average 9,8 pieces for 'Jonica' and 7,4 for 'Šampion'. Bigger number of long shoots for 'Jonica' can testify for the difference in easiness of ramification in both cultivars. Similarly, a better result in ramification of 'Jonica' comparing to 'Šampion' was observed by Sadowski and Dąbrowski (1998). The results of ramification of 'Jonica' trees in our experiment are better from those obtained by Bielecki at al. (1998) and Czarnecki (1998), who obtained only 7 offshoots on average.

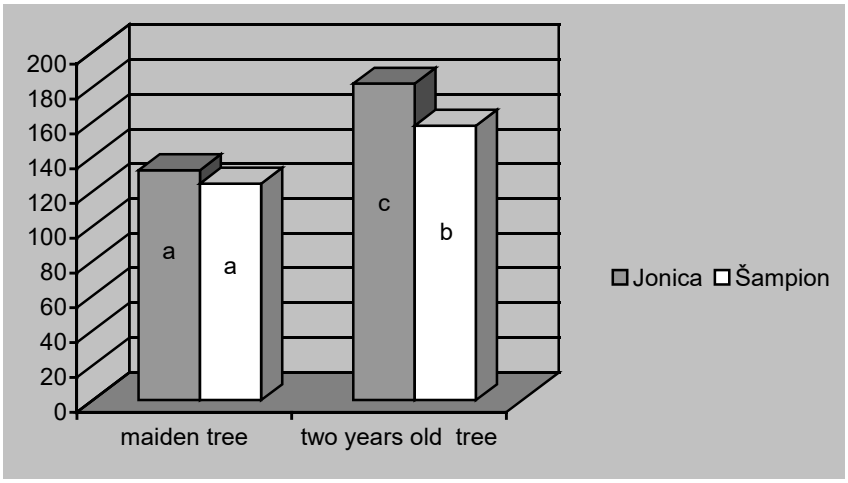

Figure 1. Average height of apple fruit trees depend on method of production (cm)

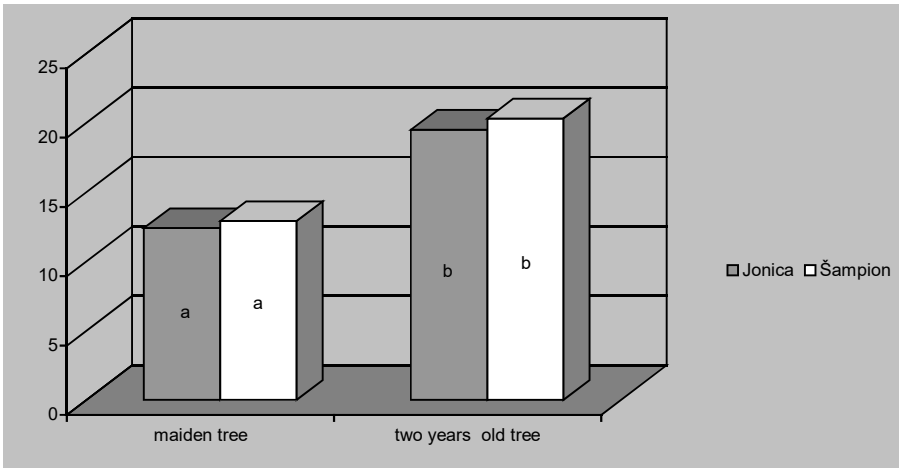

Figure 2. Average thickness of apple fruit trees depend on method of production (mm)

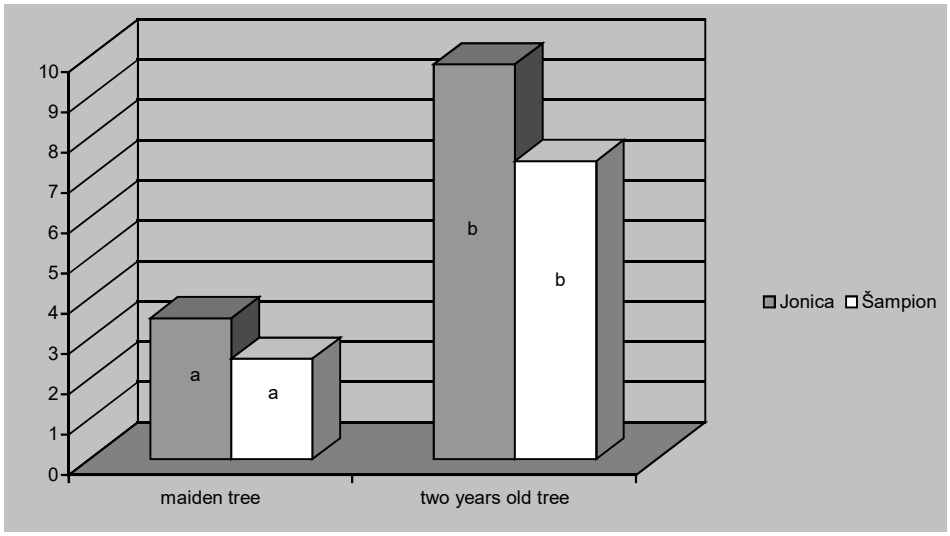

Figure 3. Average number of long shoots of apple fruit trees depend on method of production

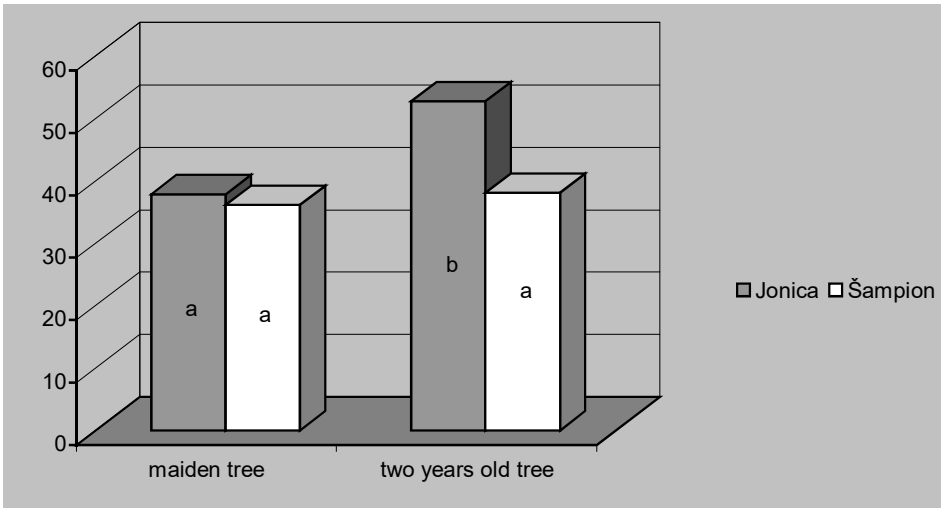

Figure 4. Average long of long shoots of apple fruit trees depend on method of production (cm)

CONCLUSIONS

1. The method of winter grafting in hand was found to be especially effective for the production of two-year-old trees with a one-year-old crown.

2. The trees obtained from grafting had better parameters of growth in comparison with the trees coming from a budding method.

3. The technique of winter grafting gave better results for the trees of 'Jonica' cultivar than for 'Šampion' one.

REFERENCES

1. **Bielicki P., Czynczyk A.,** 1999 **-** *Drzewka jabłoni do nowoczesnych sadów XXI wieku.* Nowe technologie w sadownictwie w ostatnich latach XX wieku. Zesz. Nauk. AR Krak. 66: 59-65.
2. **Bielicki P., Czynczyk A., Jaroń Z., 1998** - *Możliwości modelowania jakości drzewek dwuletnich z jednoroczną koronką*. XXXVII Ogólnop. Nauk. Konf. Sad.: 174-177.
3. **Bielicki P.**, **Czynczyk A., Nowakowski S**., **2003 -** *Wpływ jakości materiału szkółkarskiego na wzrost i owocowanie jabłoni odmiany „Jonagored" na podkładce M9*. suplement Folia Hort., T. 2: 143-145.
4. **Bootsma J.**, 1995 - *Plantmaterial appel*. Voorsprongmettweejarigebomen. Fruitteelt – Den-Haag. 85, 47: 16-17.
5. **Boostma J., Baart J.,** 1990 **-** *Choice of half-produced trees is not right*. Fruitteelt – Den-Haag. 80, 47: 22-23.
6. **Czarnecki B**., **1998** - *Wpływ wysokości przycięcia drzewek na ich jakość*. Zesz. Nauk. AR Kraków 57: 411- 414.
7. **Czynczyk A., Bartosiewicz B., Bielicki P.,** 1997 - *Drzewka jabłoni o podwyższonej jakości*. Ogólnop. Zjazd Hod. Roślin Ogrod.: 187-190.
8. **Jadczuk E., 2000 -** *Wzrost i owocowanie jabłoni w zależności od podkładki i rodzaju sadzonych drzewek* Rocz. AR Poznań 31,2: 87-91
9. **Merezhko I.M.,** 1987 - *Vozrast sazhentsev yabloni i produnost nasazhdenii.* Plodoovoshchnoe Khozyaistvo. 12: 25-26.
10. **Poldervaart G.** *1992 - Zakładanie i prowadzenie sadu jabłoniowego.* I Spotkanie Sadownicze. 30-34.
11. **Poniedziałek W.**, Nosal K., Porębski S. 1993 - Wpływ rozgałęziania się drzewek jabłoni w szkółce na ich wzrost i owocowanie w sadzie. Zesz. Nauk. AR Kraków. 21: 59-67.
12. **Sadowski A., Dąbrowski M.,** 1998 - *Jakość rozgałęzionych okulantów jabłoni przy różnych sposobach oczyszczania pni*. XXXVII Ogólnop. Nauk. Konf. Sad.: 182-185.
13. **Shepherd H.R.** 1979 - *Effect of tree quality at planting time on orchard performance.*Ann. Rep. East Malling Res. Sta. for 1978: 40.
14. **Wertheim S.J., Groene J.M.,** 1993 - *Types of plant material*. Ann. Rep. 1993. Res. Sta. for fruit growing. Wilhelminadorp: 23-29
15. **Wertheim S.J., Groene J.M.,** 1994 - *National trial with apple plant material*. Ann. Rep. 1994. Res. Stat. for fruit growing, Wilhelminadorp: 16-29.
16. **Van Oosten H.J.,** 1978 - *Effect of initial tree quality on yield*. Acta Hortic. 65 : 123-125.
17. **Vittrup J. 1978 -** *Plant materiale til plantagebrung*. Frugttavleren 7, 4: 164-166.