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**ASSESSMENT OF GROWTH AND CROPPING OF PLUM TREES  
GRAFTED ON 'WANGENHEIM PRUNE' ROOTSTOCK AND  
ORIGINATED FROM IN VITRO**

**ABSTRACT.** Growth and cropping of plum trees both originated from in vitro (TC trees) and grafted on 'Wangenheim Prune' rootstock, of seven cultivars – 'Seneca', 'Čačanska Najbolia', 'Čačanska Rodna', 'Stanley', 'Bluefre', 'Valor', 'Oneida', were compared. The orchard was established in the spring of 1995. Trees started fruiting in the third year after planting. The following parameters were compared: yield, trunk cross-sectional area (TCSA) and index of productivity. In the first and second year of cropping the highest yield was obtained from trees grafted on 'Wangenheim Prune' rootstock, while in the third and fourth year it was provided by TC trees. Total yield of four-year cropping did not statistically differ between the TC trees and those grafted on the rootstock, but the growth of the first was greater. The productivity index ( $\text{kg}\cdot\text{cm}^{-2}$ ) was higher for trees grafted on 'Wangenheim Prune' rootstock.

**Key words:** grafted trees, tree growth, crop, tissue culture trees

**INTRODUCTION.** One of the aims of fruit production research is obtaining a higher yield per unit area by increasing the number of trees per hectare. Tree growth can be controlled by the rootstock (Grzyb, 1971; Rozpara et al., 2001; Sosna, 2000). There are many available rootstocks, but their usefulness is limited due to plum pox virus (Zawadzka, 1984; Hamdorf, 1992, Marinova et al., 1995). Yet, the selection of generative rootstocks is poor: *Prunus cerasifera* Ehrh. and 'Wangenheim Prune'. The trees obtained by the traditional method differ considering numerous characters. Tissue culture (TC) trees are characterised by many good values (Borkowska, 1990; Lech i Małodobry, 1994; Małodobry, 2000; Sansavini et al., 1990). The aim of the presented investigation was to assess the usefulness TC trees of seven plum cultivars for fruit production.

**MATERIAL AND METHODS.** Growth and cropping of trees both originated from in vitro (TC trees) and growing on 'Wangenheim Prune' rootstock, of seven plum cultivars – 'Seneca', 'Čačanska Najbolja', 'Čačanska Rodna', 'Stanley', 'Bluefre', 'Valor', 'Oneida', were compared. TC trees and those grafted on 'Wangenheim Prune' rootstock were planted at a density of 2 x 4 m, in the experimental orchard of the University of Agriculture, Cracow, in the spring of 1995. The experiment was carried out in a randomised block design with four trees per plot, in four replications. Trees started cropping in the third year after planting.

The following parameters were evaluated: trunk cross-sectional area (TCSA) at the beginning and end of the experiment, increment of that area in 1997-2000, total yield in each year, total four year yield, productivity index calculated on the basis of four year yield, expressed in kg cm<sup>-2</sup> of TCSA. The results were subjected to an analysis of variance. Means were compared by Duncan's multiple-range test at P=0.05.

**RESULTS.** In 1997-2000 the mean temperature was higher than the mean for many years (8.1 °C). That fact resulted in the earlier vegetation and flowering (1998 and 1999). In the region of the experiment the mean annual precipitation is 602 mm. In 1997, 1998

and 2000 it exceeded this level and only in 1999 the total precipitation was lower.

Trunk cross-sectional area (TCSA) and its increment for the measured trees are shown in Table 1. In 1996 there was no significant difference in TCSA regardless of the method of tree production, what proves that the plant material was homogeneous. In 1997-2000 the increment of TCSA for TC trees was higher by 20% as compared to those grafted. The greatest differences were recorded in 2000. After four years of the investigation for all cultivars except 'Oneida' TCSA of TC trees was statistically higher than the same index of grafted trees. However, Sansavini et al. (1990), Lech (1996) and Rozpara and Grzyb (1994) obtained somewhat different results.

Total yield recorded in 1997-2000 is shown in Table 2. In the first year of cropping a significantly higher yield from grafted trees was obtained for cultivars 'Čačanska Najbolja', 'Čačanska Rodna' and 'Stanley'. In the successive years the differences in cropping were noted for both TC and grafted trees. After four years there was no significant difference in the yield related to tree production method.

For 'Stanley' cultivar Rozpara and Grzyb (1994) found that TC trees began to fruit later than those growing on 'Wangenheim Prune' rootstock. However, the studies carried out by Popova and Prodanova (2001) on the same cultivar showed that at both production methods the trees started fruiting at the same time. In the present study during the first four years the productivity index for TC trees was lower than for those grafted. Yet, in the fifth year after planting both the yield and productivity index for TC trees were similar to the relevant values for grafted. For 'Stanley' cultivar Lech (1996) found an increase in the yield of trees originated from in vitro.

The index of productivity is shown in Table 3. Excluding 'Oneida', for most cultivars this value was higher for trees growing on 'Wangenheim Prune' rootstock.

The results obtained proved a high usefulness of in vitro culture for the propagation of recommended plum cultivars. However, trees obtained this way should be planted at a greater density than those grafted on 'Wangenheim Prune'.

Table 1. Trunk cross-sectional area (TCSA) in 1996 and 2000 and its increment (1997-2000) of seven plum cultivars depending on tree production method (sum of four trees)

Cultivar	TCSA [cm <sup>2</sup> /tree] 1996		Increment of TCSA [cm <sup>2</sup> /tree]								TCSA [cm <sup>2</sup> /tree] 2000	
			1997		1998		1999		2000			
	TC trees	grafted trees	TC trees	grafted trees	TC trees	grafted trees	TC trees	grafted trees	TC trees	grafted trees	TC trees	grafted trees
'Seneca'	66.7	55.3	67.4 c*	47.1 b	61.2	44.8	65.7 e	44.5 c	120.4 e	69.6 cd	381.5 e	261.3cd
'Č.Najbolja'	67.1	72.5	70.4 c	52.5 b	46.0	38.1	65.2 e	64.8 e	112.7 e	68.9 cd	361.6 e	296.8 d
'Č. Rodna'	57.3	53.7	54.9 b	26.6 a	38.2	18.8	61.4 de	41.7 c	80.8 d	30.2 a	292.7 d	171.1 a
'Stanley'	67.5	69.3	71.2 c	46.5 b	47.7	27.0	50.5 cd	40.1 c	108.1e	48.4 abc	345.1 e	231.4 bc
'Valor'	61.8	50.0	73.2 c	50.9 b	35.3	18.8	51.4 cd	45.9 c	62.1 cd	28.5 a	283.8d	194.2 ab
'Bluefre'	55.8	54.2	52.0 b	29.3 a	34.3	23.3	26.2 b	11.4 a	56.9 bcd	35.5 ab	225.2 bc	153.6 a
'Oneida'	57.8	56.6	51.6 b	49.8 b	47.7	49.6	63.4 e	67.5 e	68.5 cd	59.1 bcd	289.0 d	282.6 d
Mean value	62.0	58.8	62.9 b	43.2 a	44.3 b	31.5 a	54.8 b	45.1a	87.1 b	48.6 a	311.3 b	227.3 a

\* Means with the same letter do not differ significantly at P=0.05 according to Duncan's t - test

Table 2. Yield [kg] of seven plum cultivars in 1997-2000 and total four year yield, depending on tree production method

Cultivar	1997		1998		1999		2000		Total 4 year yield	
	TC trees	grafted trees	TC trees	grafted trees	TC trees	grafted trees	TC trees	grafted trees	TC trees	grafted trees
'Seneca'	0.0 a*	4.1 ab	3.3	22.4	13.8 ab	20.0 abc	24.5 a	25.8 a	41.6	72.3
'Č.Najbolja'	11.9 bc	33.3 d	62.3	74.7	80.7 f	58.3e	113.4 cd	127.1 cd	268.4	293.4
'Č. Rodna'	6.8 abc	35.1 d	52.3	70.1	32.3 bcd	41.9 de	122.3 cd	113.8 cd	213.8	260.9
'Stanley'	16.0 c	49.7 e	59.7	74.0	118.0 g	94.9 f	116.7 cd	91.1 bc	310.4	309.7
'Valor'	9.5 abc	11.7 bc	61.5	75.6	38.5 cd	42.1 de	176.8 e	144.0 d	286.3	273.4
'Bluefre'	12.2 bc	16.2 c	42.9	63.6	140.4 h	119.8 g	101.7 cb	76.4 b	297.1	276.0
'Oneida'	11.3 bc	18.2 c	19.2	20.8	22.8 abcd	8.2 a	100.7 bc	40.5 a	154.1	87.7
Mean	9.7 a	24.0 b	43.0 a	57.3 b	63.8 b	55.0 a	108.0 b	88.4 a	224.5	224.8

\* Explanation – see Table 1

Table 3. Productivity index of seven plum cultivars depending on tree production method

Cultivar	Productivity index [kg cm <sup>-2</sup> ]	
	TC trees	grafted trees
'Seneca'	0.1 a*	0.3 ab
'Č.Najbolja'	0.7 d	1.0 e
'Č.Rodna'	0.7 d	1.5 g
'Stanley'	0.9 de	1.3 f
'Valor'	1.0 e	1.4 fg
'Bluefre'	1.3 f	1.8 h
'Oneida'	0.5 c	0.3 b
Mean	0.7 a	1.1 b

\* Explanation – see Table 1

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