

EFFECT OF PRUNING TIME ON YIELDING AND FRUIT QUALITY OF SEVERAL EARLY RIPENING PLUM CULTIVARS

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Abstract. The aim of carried out research was comparing the effect of different pruning time on cropping and fruit quality of several early ripening plum cultivars. The experiment was conducted at Fruit Experimental Station – Samotwór near Wrocław in 2001–2004. Objects of studies consisted of 8 year-old plum trees of ‘Herman’, ‘Čačanska Rana’, ‘Sanctus Hubertus’ and ‘Čačanska Lepotica’ cultivars budded on ‘Myrobalan’ seedlings (*Prunus divaricata*). The experiment was established in a randomised block design in three replications with six trees per plot. In 2001–2003, time of tree pruning was differentiated. Half of trees was pruned only at the end of August (summer pruning after harvest of fruit) and the other one only at the end of March (dormant pruning before blooming time). Time of pruning had no influence on yielding and chemical composition of fruit. Soluble solids, vitamin C, magnesium, calcium, potassium and phosphorus contents in fruit were similar independently of pruning time. Mean fruit weight was significantly higher from trees with dormant pruning.

Key words: plum, summer pruning, dormant pruning, crop, fruit weight, chemical constituents

INTRODUCTION

Plum is one of the most important species in Poland. According to Polish Central Statistical Office plum is taken fifth place taking into consideration the total yields received from Polish orchards. *Prunus divaricata* Ledeb. (‘Myrobalan’ seedlings) is the most popular rootstock in Polish plum orchards. About of 80–90% trees produced in the nurseries are grafted on this rootstock [Sitarek 2001]. Defect of ‘Myrobalan’ seedlings is characterized by the high growth rate and relatively late start to cropping [Rozpara and Grzyb 1988]. This failing are very important problem in modern, intensive orchards. Pruning intervention should successfully reduce the volume of canopy, and

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visibly improve yielding of adult trees [Mika 1986]. According to actual knowledge, summer pruning is more effective in reducing tree size than dormant pruning, because promotes the growth of short shoots, able to fruiting [Mika and Piątkowski 1988]. Morgaś et al. [1998a] noticed higher yield and better quality of plum-fruits after summer pruning compare with dormant pruning.

The aim of this experiment was comparing the effect of different pruning time on yielding and fruit quality of several early ripening plum cultivars: ‘Herman’, ‘Čačanska Rana’, ‘Sanctus Hubertus’ and ‘Čačanska Lepotica’.

MATERIAL AND METHODS

The experiment was conducted at the Fruit Experimental Station in Samotwór near Wrocław in 2001–2004. The testing material included eight year-old trees of ‘Herman’, ‘Čačanska Rana’, ‘Sanctus Hubertus’ and ‘Čačanska Lepotica’ cultivars on ‘Myrobalan’ seedlings (*Prunus divaricata*) planted at a spacing of 4×3 m (833 trees per hectare). In 2001–2003, time of tree pruning was differentiated. One part of trees was pruned at the end of August (summer pruning after harvest of fruit) and the other ones at the end of March (dormant pruning before blooming time). The experiment was established in a randomised block design in three replications with three trees per plot. All of the trees were trained with a spindle canopy. Herbicide fallow was maintained in the tree rows and grassy strips between them. Plant protection was carried out in accordance to the current recommendations of the Orchard Protection Program. In 2002–2004, yield and fruit quality were estimated. The size of a fruit was estimated as a mean weight of 25 fruits per tree. Soluble solids and vitamin C contents were indicated directly after harvest in fresh weight of fruit. Chemical analyses of K, Ca, Mg and P contents were done after fruit drying.

The results of the experiment were analysed statistically, using the analysis of variance. Significant differences at $\alpha = 0.05$ were calculated using Duncan’s multiple range t-test.

RESULTS AND DISCUSSION

‘Herman’ and ‘Čačanska Rana’ cvs. yielded worse than ‘Sanctus Hubertus’ and ‘Čačanska Lepotica’ during three years of the experiment (tab. 1). Similar observation about ‘Čačanska Rana’ noticed Blažek et al. [2004]. There were no difference between dormant and summer pruning of plum trees. The only exception was the first year of the trial, in which was received higher yields after summer pruning (‘Sanctus Hubertus’). It means, that the time of pruning have no effects of yielding. Similar results received Sosna [2000b], in trial with apple trees. However, this observation is opposite to Morgaś et al. [1998a, 1998b, 2004] observation, in which summer-pruned trees yielded better than winter-pruned ones. This reaction could be caused by earlier time of pruning (in July and at the beginning of August).

Between cultivars there were noticed significant differences in mean weight of one fruit (tab. 1). ‘Čačanska Rana’ cv. had the largest fruit, whereas ‘Sanctus Hubertus’ cv.

Table 1. Yielding and mean fruit weight of 4 early ripening plum cvs. depending on time of pruning, in 2002–2004
 Tabela 1. Plonowanie i średnia masa owocu 4 wczesnych odmian śliwy w zależności od terminu cięcia, lata 2002–2004

Treatment Kombinacja	Yield, kg tree ⁻¹ Plon, kg drzewo ⁻¹				Mean fruit weight, g Śr. masa owocu, g				
	2002		2004		2002–2004		2002–2004		
	2002	2003	2003	2004	2002	2003	2004	2002–2004	
'Herman'	summer pruning – cięcie letnie	38.5 a*	9.6 a	62.6 a	110.7 a	30 a	34 a	21 a	28 a
	dormant pruning – cięcie zimowe	31.7 a	10.2 a	77.2 a	119.1 a	33 a	35 a	21 a	30 a
'Čačanska Rana'	summer pruning – cięcie letnie	43.8 a	11.5 a	64.7 a	120.0 a	53 a	53 a	38 a	48 a
	dormant pruning – cięcie zimowe	34.9 a	13.7 a	69.2 a	117.8 a	57 a	56 a	40 a	51 a
'Sanctus Hubertus'	summer pruning – cięcie letnie	73.2 b	3.5 a	102.3 a	179.0 a	21 a	33 a	19 a	24 a
	dormant pruning – cięcie zimowe	60.2 a	16.3 b	103.7 a	180.2 a	25 a	34 a	20 a	26 a
'Čačanska Lepotica'	summer pruning – cięcie letnie	53.7 a	45.2 a	72.5 a	171.4 a	29 a	34 a	29 a	31 a
	dormant pruning – cięcie zimowe	46.0 a	40.5 a	70.4 a	156.9 a	31 a	36 a	30 a	32 a
Mean for cultivar Średnia dla odmiany	'Herman'	35.1 a	9.9 a	69.9 a	114.9 a	32 b	35 a	21 a	29 b
	'Čačanska Rana'	39.4 a	12.6 a	67.0 a	119.0 a	55 c	55 b	39 c	50 d
	'Sanctus Hubertus'	66.7 c	9.9 a	103.0 b	179.6 b	23 a	34 a	20 a	25 a
	'Čačanska Lepotica'	49.9 b	42.9 b	71.5 a	164.3 b	30 b	35 a	30 b	32 c
Mean for pruning time Średnia dla terminu cięcia	summer – letnie	52.3 b	17.4 a	75.5 a	145.3 a	33 a	38 a	27 a	33 a
	dormant – zimowe	43.2 a	20.2 a	80.1 a	143.5 a	37 b	40 b	28 a	35 b

* Means followed by the same letter do not differ at P = 0.95 according to Duncan's multiple range t-test

* Średnie oznaczone tą samą literą nie różnią się istotnie między sobą przy p = 0,95 (wg testu t-Duncan)

Table 2. Soluble solids and vitamin C content in fruit of 4 early ripening plum cvs. depending on time of pruning
 Tabela 2. Zawartość ekstraktu i witaminy C w owocach 4 wczesnych odmian śliwy w zależności od terminu cięcia

Treatment Kombinacja	Soluble solids, % Ekstrakt, %				Vitamin C, mg 100g ⁻¹ of fresh weight Witamina C, mg·100g ⁻¹ świeżej masy				
	2002	2003	2004	2002-2004	2002	2003	2004	2002-2004	
'Herman'	summer pruning – cięcie letnie	12.9 b*	12.1 a	11.9 a	12.3 a	6.09 a	6.10 a	5.13 a	5.77 a
	dormant pruning – cięcie zimowe	10.6 a	13.9 b	11.3 a	11.9 a	5.03 a	7.15 a	5.62 a	5.93 a
'Čačanska Rana'	summer pruning – cięcie letnie	10.8 a	12.3 a	10.9 a	11.3 a	3.96 a	5.01 a	6.24 a	5.07 a
	dormant pruning – cięcie zimowe	11.6 a	12.7 a	12.9 b	12.4 a	5.94 b	5.74 a	5.98 a	5.89 a
'Sanctus Hubertus'	summer pruning – cięcie letnie	9.0 a	15.2 a	13.1 a	12.4 a	3.77 a	6.83 a	6.62 a	5.74 a
	dormant pruning – cięcie zimowe	11.5 b	14.4 a	13.7 a	13.2 a	4.45 a	7.51 a	6.46 a	6.14 a
'Čačanska Lepotica'	summer pruning – cięcie letnie	12.5 b	10.4 a	10.4 a	11.1 a	6.62 a	2.32 a	3.52 a	4.15 a
	dormant pruning – cięcie zimowe	11.0 a	10.2 a	10.4 a	10.5 a	6.29 a	3.17 a	4.14 a	4.53 a
Mean for cultivar Średnia dla odmiany	'Herman'	11.8 b	13.0 b	11.6 b	12.1 a	5.56 bc	6.63 c	5.38 b	5.85 a
	'Čačanska Rana'	11.2 b	12.5 b	11.9 b	11.9 a	4.95 ab	5.38 b	6.11 c	5.48 a
	'Sanctus Hubertus'	10.3 a	14.8 c	13.4 c	12.8 a	4.11 a	7.17 d	6.54 c	5.94 a
	'Čačanska Lepotica'	11.8 b	10.3 a	10.4 a	10.8 a	6.46 c	2.75 a	3.83 a	4.34 a
Mean for pruning time Średnia dla terminu cięcia	summer – letnie	11.3 a	12.5 a	11.6 a	11.8 a	5.11 a	5.06 a	5.38 a	5.18 a
	dormant – zimowe	11.2 a	12.9 a	12.1 b	12.0 a	5.43 a	5.89 b	5.55 a	5.62 a

* Explanations, see table 1 – Objaśnienia jak w tabeli 1

Table 3. Effect of pruning time on K and Ca content in fruit of 4 early ripening plum cvs.
Tabela 3. Wpływ terminu cięcia na zawartość K i Ca w owocach 4 wczesnych odmian śliwy

Treatment Kombinacja	K, g kg ⁻¹ dry matter K, g kg ⁻¹ sucha masa		Ca, g kg ⁻¹ dry matter Ca, g kg ⁻¹ sucha masa			
	2002	2003	2002	2003		
'Herman'	summer pruning – cięcie letnie	24.3a*	12.6 a	13.3 b		
	dormant pruning – cięcie zimowe	22.6 a	12.9 a	9.1 a		
'Čačanska Rana'	summer pruning – cięcie letnie	23.9 a	11.9 a	13.9 b		
	dormant pruning – cięcie zimowe	25.2 a	21.1 a	10.1 a		
'Sanctus Hubertus'	summer pruning – cięcie letnie	20.4 a	16.5 a	16.5 a		
	dormant pruning – cięcie zimowe	20.6 a	13.8 a	17.1 a		
'Čačanska Lepotica'	summer pruning – cięcie letnie	20.8 a	15.3 a	10.0 a		
	dormant pruning – cięcie zimowe	20.3 a	15.8 a	10.9 a		
Mean for cultivar Średnia dla odmiany	'Herman'	23.4 b	23.6 c	11.2 c		
	'Čačanska Rana'	24.5 b	21.4 b	19.3 b		
	'Sanctus Hubertus'	20.5 a	16.7 a	16.8 a		
	'Čačanska Lepotica'	20.6 a	15.5 a	15.3 a		
Mean for pruning time Średnia dla terminu cięcia	summer – letnie	22.4 a	19.2 a	17.8 a		
	dormant – zimowe	22.1 a	19.4 a	11.1 b		
			2002–2004	2004	2002–2004	2004
			20.1 a	6.5 a	12.9 a	6.5 a
			19.7 a	6.3 a	13.8 a	6.3 a
			19.2 a	8.5 a	16.8 a	8.5 a
			19.5 a	8.7 a	14.5 a	8.7 a
			16.5 a	7.0 a	18.8 a	7.0 a
			17.1 a	6.9 a	17.6 a	6.9 a
			15.3 a	5.1 a	20.3 a	5.1 a
			15.3 a	5.1 a	18.8 a	5.1 a
			19.9 b	6.4 b	13.3 a	6.4 b
			19.3 b	8.6 d	15.7 b	8.6 d
			16.8 a	6.9 c	18.2 c	6.9 c
			15.3 a	5.1 a	19.5 c	5.1 a
			17.8 a	6.8 a	17.2 a	6.8 a
			17.9 a	6.7 a	16.2 a	6.7 a

* Explanations, see table 1 – Objaśnienia jak w tabeli 1

Table 4. Effect of pruning time on Mg and P content in fruit of 4 early ripening plum cvs.
 Tabela 4. Wpływ terminu cięcia na zawartość Mg i P w owocach 4 wczesnych odmian śliwy

Treatment Kombinacja	Mg, g kg ⁻¹ dry matter Mg, g kg ⁻¹ sucha masa		P, g kg ⁻¹ dry matter P, g kg ⁻¹ sucha masa		
	2002	2003	2002	2003	
'Herman'	summer pruning – cięcie letnie	1.6 a	1.3 a	1.6 a	4.2 a
	dormant pruning – cięcie zimowe	1.7 a	1.1 a	1.5 a	3.9 a
'Čačanska Rana'	summer pruning – cięcie letnie	1.9 a	1.7 a	1.7 a	5.4 a
	dormant pruning – cięcie zimowe	1.6 a	1.3 a	1.5 a	5.7 a
'Sanctus Hubertus'	summer pruning – cięcie letnie	1.9 a	1.2 a	1.6 a	5.4 a
	dormant pruning – cięcie zimowe	1.7 a	1.6 a	1.5 a	5.1 a
'Čačanska Lepotica'	summer pruning – cięcie letnie	1.8 a	1.1 a	1.6 a	5.2 a
	dormant pruning – cięcie zimowe	1.8 a	1.2 a	1.6 a	5.3 a
Mean for cultivar Średnia dla odmiany	'Herman'	1.8 a	1.2 a	1.5 a	4.1 a
	'Čačanska Rana'	1.8 a	1.5 b	1.6 a	5.5 c
	'Sanctus Hubertus'	1.8 a	1.7 ab	1.6 a	5.2 b
	'Čačanska Lepotica'	1.8 a	1.9 b	1.6 a	5.2 b
Mean for pruning time Średnia dla terminu cięcia	summer – letnie	1.9 b	1.3 a	1.6 a	5.0 a
	dormant – zimowe	1.7 a	1.2 a	1.5 a	5.0 a
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produced the smallest ones. These results are similar to mean fruit weight from ‘Herman’, ‘Čačanska Rana’ and ‘Sanctus Hubertus’ trees received by Mika et al. [1999]. Mean fruit weight in this trial was also similar to obtained by Sosna [2000a]. Small fruits in 2004 can be explained by high productivity of plum trees in this season. Otherwise, in comparing time of pruning and mean fruit weight there was draw a distinction. Fruits from dormant-pruned trees were significantly heavier than those from trees pruned at the end of August. On the contrary, in Morgaś et al. experiments [1998a, 1998b, 2004], summer pruning had more often good influence on mean fruit weight.

In this experiment did not observed clear differences between soluble solids, vitamin C, magnesium, calcium and phosphorus content in fruits (tab. 2, 3 and 4). Taking into consideration means of three years study, the content of chemical constituents were no depended on cultivar and time of pruning. The only exception was lower P content in ‘Herman’ fruit. Soluble solids oscillated between 10.8% with ‘Čačanska Lepotica’ to 12.8% with ‘Sanctus Hubertus’. Received results are similar to those noticed by Mika et al. [1999], but lower in comparison to content of soluble solids obtained by Lipecki et al. [2001]. Amounts of potassium showed sustainable differences between tested cultivars. ‘Herman’ and ‘Čačanska Rana’ plum trees contained more potassium than ‘Sanctus Hubertus’ and ‘Čačanska Lepotica’. These results suggest that potassium content is connected with level of yielding.

CONCLUSIONS

1. Taking into consideration means of three years study, time of pruning had no influence on yielding and chemical constituents of fruit. Soluble solids, vitamin C, magnesium, calcium, potassium and phosphorus contents in fruit were similar independently of pruning time.

2. Potassium content was lower in fruit of these cultivars which yielded better. The fruit of ‘Herman’ cultivar was significantly lower in phosphorus content.

3. Pruning time had influence on mean fruit weight. Fruits picked from dormant pruning trees were significantly heavier with summer pruning ones. ‘Čačanska Rana’ had the largest fruit, whereas ‘Sanctus Hubertus’ produced the smallest ones.

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WPLYW TERMINU CIĘCIA NA PLONOWANIE I JAKOŚĆ OWOCÓW KILKU WCZEŚNIE DOJRZEWAJĄCYCH ODMIAN ŚLIWY

Streszczenie. Celem przeprowadzonych badań było porównanie wpływu zróżnicowanych terminów cięcia na plonowanie i jakość owoców kilku wczesnych odmian śliwy. Doświadczenie prowadzono w latach 2001–2004 w Sadowniczej Stacji Badawczej w miejscowości Samotwór pod Wrocławiem. Przedmiotem badań były ośmioletnie drzewa śliw ‘Herman’, ‘Čačanska Rana’, ‘Sanctus Hubertus’ i ‘Čačanska Lepotica’ okulizowane na siewkach ałyczy. Doświadczenie założono metodą losowanych bloków, w 3 powtórzeniach, po 6 drzew na poletku. W latach 2001–2003 zróżnicowano terminy cięcia drzew. Połowę z nich (3 szt.) cięto tylko pod koniec sierpnia (cięcie letnie po zbiorach owoców), natomiast drugą połowę tylko pod koniec marca (cięcie zimowe przed kwitnieniem). Termin cięcia nie miał wpływu na plonowanie i skład chemiczny owoców. Zawartość ekstraktu, witaminy C, magnezu, wapnia, potasu i fosforu była zbliżona, niezależnie od czasu cięcia. Owoce bardziej plennych odmian miały niższą zawartość potasu. Średnia masa owocu była istotnie wyższa u drzew ciętych pod koniec marca.

Słowa kluczowe: śliwa, cięcie letnie, cięcie zimowe, plon, masa owocu, związki chemiczne

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