PRELIMINARY EVALUATION OF THE GROWTH AND YIELD OF FOUR JAPANESE PLUM CULTIVARS (*Prunus salicina* Lindl.) GRAFTED ON WANGENHEIM PRUNE SEEDLINGS

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A B S T R A C T

Japanese plum trees of the cultivars 'Kometa', 'Najdiena', 'Skoropłodnaja' and 'Shiro' grafted on Wangenheim Prune seedlings, were planted in the spring of 2006 at the Fruit Experimental Station in Samotwór near Wrocław, Poland. As the control, trees of the 'Amers' cultivar, which belong to European plums, were used. All trees were planted at a spacing of 4.0 x 2.0 m (1250 trees per hectare). The experiment was established in a randomized block design, in four replications, with 5 trees per plot. In 2006-2009, records of vegetative growth, abundance of blooming, yield, and fruit weight were taken.

The first significant yield was achieved in the third year after planting. In 2008-2009 trees of 'Shiro' had an abundant yield (48.5 kg·tree^{-1}). 'Shiro' produced a significantly higher yield compared to other cultivars. There were no significant differences between 'Amers' (27.3 kg·tree^{-1}) and the Japanese plum cultivars 'Kometa' (29.2 kg·tree^{-1}) and 'Skoropłodnaja' (21.5 kg·tree^{-1}). Japanese plum fruits were significantly smaller compared to the European ones. The cultivar 'Amers' had the heaviest fruit (53 g). The Japanese plum trees had smaller fruits, and among the them, the cultivar 'Shiro' had the largest fruit (44 g). The observations showed that 'Shiro' produced higher yields, gave large fruits, and had intensive blooming, but the growth of the trees was very strong.

Key words: Japanese plum, *Prunus salicina*, growth, yield, blooming, weight of fruit

INTRODUCTION

Areas with Japanese plum orchards are growing rapidly in the world (Grzyb, 2002). Japanese plums (*Prunus salicina* Lindl.) are cultivated mainly in Japan and China. In addition to these countries, in the

United States, especially California, there are large areas of cultivation; mainly with the cultivars 'Larosa' and 'Santa Rosa' (Buler et al., 2006). Trees of *Prunus salicina* are also grown in South Africa. The fruits are exported to markets in Europe and the East Asian. Only cultivars which are adapted to the 3-4 week shipping time required to reach the European and East Asia markets are grown (Cook, 2007). In Europe, Japanese plum orchards are found only in the Mediterranean countries (Rozpara and Grzyb, 2006). There have also been attempts to grow Japanese plum cultivars in other parts of Europe. Some of the Japanese plums, like 'Kometa' and 'Najdiena', are hybrids of *Prunus salicina* with Myrobalan cultivars (Żurawicz, 2003). From results of the studies conducted in Hungary, it can be concluded that Japanese plums begin to blossom a week earlier than European plums. They blossom profusely and set many fruits. There have also been studies in Poland on the cultivation of these plums. Cultivars of *Prunus salicina* have a higher value than European ones because they begin to bear fruit very early and achieve a high yield. They require hand fruit thinning, but they are capable of acclimating to local conditions (Buler et al., 2006). Advantages of Japanese plums on the Polish market are: original appearance and taste, ability to transport well, and exceptional durability.

In the production of plum trees in Poland, the generative rootstock – Myrobalan (*Prunus cerasifera* var. *divaricata*) still dominates. Plum trees are also produced on Wangenheim Prune seedlings. In terms of weak tree growth and increased yield, Wangenheim Prune seedlings are considered better than Myrobalan (Sitarek, 2002). The Wangenheim Prune seedling rootstock improved fruit weight, with a range of cultivars. This rootstock also had an effect on higher yields (Blažek et al., 2005).

The aim of this study was to make a preliminary estimation of growth and yield of four Japanese plum cultivars grafted on Wangenheim Prune seedlings.

MATERIAL AND METHODS

The experiment was conducted at the Fruit Experimental Station, in Samotwór near Wrocław. The paper presents the results of the first four years of the trial. The research was carried out on 'Kometa', 'Najdiena', 'Skoropłodnaja' and 'Shiro' Japanese plum trees grafted on Wangenheim Prune seedlings. Trees of the cultivar 'Amers', which belong to European plums, on the same rootstock, were used as the control. In spring 2006, one-year old maidens were planted at a spacing of 4.0 x 2.0 m (1250 trees per hectare). The experiment was established in a randomized design in four replications, with 5 trees per plot. Tree canopies were kept almost natural, with minimum pruning only during the summer. Trees were not irrigated and fruitlets were annually hand thinned. From the first year, there was herbicide fallow in the rows and sward

between them. Plant protection was carried out according to the current recommendations for plum orchards.

In 2006-2009, records of vegetative growth, abundance of blooming, yield, and fruit weight were taken. Obtained results were statistically elaborated by multifactorial analysis of variance. The significance of differences between means was evaluated by Duncan's t-test at $p = 0.05$.

RESULTS AND DISCUSSION

There were differences between cultivars in total number of shoots per tree (Tab. 1). 'Amers' and 'Skoropłodnaja' had almost the same total number of shoots, and had the lowest number of annual shoots. 'Kometa' and 'Shiro' had a significantly higher total number of shoots, respectively. Trees of 'Najdiena' had substantially more annual shoots compared to the other cultivars. The cultivar had an influence on the total length of annual shoots per a tree. Japanese plums had higher total length of shoots than the European plum cultivar 'Amers'. However, from among the Japanese plum cultivars, 'Najdiena' and 'Shiro' had significantly longer annual shoots. 'Skoropłodnaja' had a substantially higher mean length of shoots. There were no significant differences in that respect between the 'Amers', 'Kometa', 'Najdiena' and 'Shiro' trees. Buler et al. (2006) proved that 'Kometa' and 'Najdiena' tend to produce spreading crowns with numerous short shoots. Their crowns are naturally made up of a long, upright leader with numerous, weak shoots.

Some differences were observed in trunk cross-sectional area increment (TCAI). 'Najdiena', 'Skoropłodnaja' and 'Kometa' had the smallest TCAI but there was no significant difference between 'Kometa' and 'Amers' (Tab. 2). 'Shiro' trees had a significantly higher TCSA. From the description of 'Shiro', it appears that it grew strong or even very strong (Grzyb, 2002). Trees of 'Amers' grew weakly or medium strongly. In the experiment conducted at the Experimental Orchard in Skierniewice in 1990-1998, important differences were observed in TCSA (autumn 1998). In the Skierniewice experiment, 'Amers' on the Wangenheim Prune seedlings, had the smallest TCSA (45.4 cm^2) compared to trees of other cultivars on *Prunus cerasifera* var. *divaricata* (Rozpara and Grzyb, 1999).

Blooming intensity depended heavily on weather conditions (Tab. 3). A long warm period occurred in January 2006/2007, then by February, the temperature dropped to about -15 ºC. The result was frozen flower buds. As a consequence, in spring 2007, only single flowers appeared on trees of the studied cultivars. There were some differences in blooming intensity. In spring 2008, Japanese plums blossomed significantly better than 'Amers'. The next year, 'Kometa' had the least amount of blossoms.

The tested varieties gave the first substantial crop in the third growing season after planting (Tab. 4). Buler et al. (2006), observed Japanese plum trees which started bearing in

Table 1. Number and length of annual shoots

Cultivar	Total number of shoots per tree (2006-2008)	Total length of shoots (2006-2008) [cm tree^{-1}]	Mean shoot length [cm]
Amers	95.4 a*	2851 a	29.9 a
Kometa	130.7 b	4044 b	30.9 a
Najdiena	201.6 d	5450 c	27.0 a
Skoropłodnaja	92.5 a	4061 b	43.9 b
Shiro	183.2 c	5652 c	30.9 a

*Means followed by the same letter do not differ at p = 0.05 according to Duncan's multiple range t-test

Table 2. Trunk cross-sectional area (TCSA) and crop efficiency index (CEC)

Cultivar	TCSA autumn 2009 [cm^2]	TCSA increment 2007-2009 [cm^2]	CEC 2006-2009 [kg cm^{-2}]
Amers	24.8 b*	15.0 b	1.10 a
Kometa	23.5 b	12.7 ab	1.24 a
Najdiena	21.3 ab	11.5 a	1.56 b
Skoropłodnaja	18.0 a	10.5 a	1.19 a
Shiro	37.5 c	22.2 c	1.29 a

*Explanations, see Table 1

Table 3. Blooming intensity on a 0-5 scale (0 – tree without flowers; 5 – very abundant blooming tree)

Cultivar	2007	2008	2009
Amers	0.0 a*	3.4 a	4.0 b
Kometa	1.1 c	4.6 c	3.2 a
Najdiena	0.3 b	4.7 c	4.4 c
Skoropłodnaja	1.0 c	4.6 c	4.7 c
Shiro	1.0 c	4.0 b	4.5 c

*Explanations, see Table 1

Table 4. Yield and mean fruit weight

Cultivar	Yield [kg tree^{-1}]		Cumulative yield 2008-2009 [kg tree^{-1}]	Mean fruit weight 2008-2009 [g]
	2008	2009		
Amers	8.7 b*	18.6 ab	27.3 ab	53 d
Kometa	10.0 bc	19.2 ab	29.2 ab	33 b
Najdiena	8.0 b	25.2 b	33.2 b	27 a
Skoropłodnaja	3.9 a	17.6 a	21.5 a	25 a
Shiro	12.2 c	36.3 c	48.5 c	44 c

*Explanations, see Table 1

the second growing season. In the first year of cropping, there were no significant differences in the level of the yield of the plum trees: 'Amers', 'Kometa' and 'Najdiena'. The yield per tree of 'Skoropłodnaja' was substantially lower than the yield per tree of the European plums. 'Shiro' obtained the highest yield per tree (12.2 kg). In the experiment of Buler et al. (2006) the first crop of *Prunus salicina* was higher than in the European plum cultivars. In our experiment, the level of the yield of 'Kometa' and 'Najdiena', in the third year after planting, was similar to that obtained in the experiment conducted by Buler et al. (2006).

In the second year of cropping, yield per tree was significantly lower in the cultivars 'Skoropłodnaja', 'Amers', Najdiena' and 'Kometa'. The yield per tree of 'Amers', 'Kometa' and 'Najdiena', however, were not significanty different. 'Shiro' trees were heavily cropping (36.3 kg·tree^{-1}).

Important differences were observed in cumulative yield. Trees of 'Shiro' were characterized by the highest production in the first four years after planting (48.5 kg·tree^{-1}). 'Skoropłodnaja', 'Kometa' and 'Amers' had a significantly lower cumulative yield. Cultivars 'Amers', 'Kometa' and 'Najdiena' were cropping on the same level. 'Amers' was counted among the group of the best yielding plum trees in the first year of fruiting (Rozpara et al., 2000). Grzyb (2002) states that 'Shiro' and 'Kometa' yield a good crop.

In spite of fruit thinning, Japanese plums formed smaller fruits compared to European plums, in this experiment. 'Skoropłodnaja' and 'Najdiena' produced fruit which were of similar weight (25 and 27 g), respectively. Fruit of 'Skoropłodnaja' and 'Najdiena' were significantly lighter than fruit of other cultivars. Among the Japanese plums, 'Shiro' had the heaviest fruits (44 g). But according to Grzyb (2002), mean fruit weight for this cultivar is 35 grams. 'Amers' had the highest mean fruit weight (53 g). Similar results were obtained by Grzyb and Sitarek (2003) on 'Amers' (52.3 g), however their trees were grafted on seedlings of *Prunus cerasifera* var. *divaricata* Led. Fruit weight of about 30 grams is optimal for 'Kometa' and 'Najdiena' (Buler et al., 2006).

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WSTĘPNE WYNIKI OCENY WZROSTU I PLONOWANIA CZTERECH ODMIAN ŚLIWY JAPOŃSKIEJ (*Prunus salicina* Lindl.) ZASZCZEPIONYCH NA SIEWKACH WĘGIERKI WANGENHEIMA

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

Doświadczenie prowadzono w Stacji Doświadczalnej Uniwersytetu Przyrodniczego w Samotworze koło Wrocławia. Wiosną 2006 roku posadzono jednoroczne okulanty śliwy japońskiej odmian ‘Kometa’, ‘Najdiena’, ‘Skoropłodnaja’ i ‘Shiro’ na podkładce Węgierka Wangenheima. Jako odmiany kontrolnej użyto europejskiej śliwy – ‘Amers’, również zaszczepionej na tej samej podkładce. Drzewa prowadzono w formie korony prawie naturalnej z minimalnym cięciem w okresie letnim w rozstawie 4,0 x 2,0 m (1250 drzew·ha^{-1}). Doświadczenie założono metodą losowanych bloków, w czterech powtórzeniach, po 5 drzew na każdym poletku doświadczalnym. Celem badań była ocena wzrostu, kwitnienia, plonowania i jakości owoców śliwy japońskiej w pierwszych czterech latach prowadzenia doświadczenia.

Badane odmiany pierwszy istotny plon wydały w trzecim roku po posadzeniu. W latach 2008-2009 najobficiej plonowała odmiana ‘Shiro’ (48,5 kg·drzewo^{-1}), dając istotnie wyższy plon w porównaniu z pozostałymi odmianami. Nie wykazano różnic

statystycznych między odmianą kontrolną ‘Amers’ (27,3 kg·drzewo^{-1}) a odmianami śliwy japońskiej ‘Najdiena’ (33,2 kg·drzewo^{-1}), ‘Kometa’ (29,2 kg·drzewo^{-1}) i ‘Skoropłodnaja’ (21,5 kg·drzewo^{-1}). Śliwy japońskie wytwarzały istotnie mniejsze owoce w porównaniu ze śliwami europejskimi. Masa owocu odmiany ‘Amers’ wynosiła 53 g, natomiast owoce odmian śliwy japońskiej uzyskiwały masę w granicach od 25 g do 44 g, wśród których największe miała odmiana ‘Shiro’. Różnice między odmianami występowały też w sile wzrostu drzew mierzonej polem przekroju poprzecznego pnia. W latach 2007-2009 najsilniej rosły drzewa odmiany ‘Shiro’ (22,2 cm^2). Drzewa odmiany ‘Skoropłodnaja’ charakteryzowały się słabszym wzrostem niż drzewa odmiany ‘Amers’ (15,0 cm^2). Intensywność kwitnienia zależała w dużej mierze od warunków pogodowych. W 2007 roku odmiany bardzo słabo kwitły, a odmiana ‘Amers’ nie rozwinęła żadnych kwiatów. Analizując lata 2008-2009 zauważono, że odmiany śliwy japońskiej charakteryzowały się wyższą intensywnością kwitnienia niż odmiana kontrolna. Z obserwacji wynika, że odmiana ‘Shiro’ obficie owocowała wytwarzając dość duże owoce. Jednak drzewa tej śliwy rosły bardzo silnie. Odmiany ‘Kometa’, ‘Najdiena’ i ‘Skoropłodnaja’ plonowały porównywalnie z odmianą europejską, chociaż wytwarzały drobne owoce. Charakteryzowały się słabszym wzrostem i intensywniejszym kwitnieniem niż drzewa odmiany ‘Amers’.

Słowa kluczowe: śliwa japońska, *Prunus salicina*, wzrost, plon, kwitnienie, masa owocu