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EFFECT OF SPACING, TREES CROWN SHAPE AND THE WAY OF PLANTING ON GROWTH AND YIELDING OF TWO CULTIVARS OF PEACHES

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Abstract. One of the factors, determining early bearing of peach trees is planting them in high density. But it is difficult, because of the use of generative, strong growing rootstock. However the intensive growth of peach trees can be modified by planting in ridges and changing the shape of crown. The experiment was conducted in conditions of Lower Silesia Region. The experiment involved the assessment of trees on Manchurian peach rootstock, of 'Suncrest' and 'Cresthaven' cultivars, planted in the spring 2006, in: 3.5 × 1 m spacing (vertical axis) 3.75 × 2 m (spindel crown) and 4.25 × 3 m (open vase crown). Half of the trees following 3.5 × 1 m spacing were planted in a traditional way, while half of them, in ridges. The aim of research was determination of possibilities regarding the maintenance of the peach orchard on a seedling rootstock, with the use of a vertical axis crown form and the way of planting trees in ridges, as compared to trees planted traditionally and trained as spindle and an open vase crown. Summary yields from the first three years of yielding point to the possibility of obtaining high yield of peaches at dense trees planting in comparison to traditional model of peach orchard. The lowest yielding level characterized trees of both examined varieties planted in 4.25 × 3 m spacing and trained in the form of an open vase crown. The most intensive growth featured the trees trained in the form of an open vase crown and planted in 4.25 × 3 m spacing. Planting in ridges did not cause any significant diversity regarding peaches growth and yielding in high density of trees trained as vertical axis.

Key words: *Prunus persica*, density of planting, productivity index, planting in ridges

INTRODUCTION

The growth and yielding of peaches, to a high degree, depend on climatic conditions. Severe winters and spring frost have still been the most significant factor reducing cultivation of this species. In spite of this risk, resulting from peaches cultivation in

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unfavorable weather conditions, in recent years there has been recorded gradually increasing area of peaches orchards. In the regions advantageous for the mentioned cultivation (Lower Silesia, regions of Tarnów, Sandomierz) there has been changing not only the size of cultivation area, but also the appearance of peaches orchards, resulting from alterations in technologies and production intensity regarding these attractive fruits. The changes are connected with the search for new possibilities of increasing yield level obtained from an area unit and the basic factor conditioning this increase can become the choice of spacing and the way of training trees.

The most popular form of tree crown in peaches cultivation is an open vase crown, which requires 4–5 × 3–4 m spacing. This form provides truly satisfactory light access to fruits, although it requires at least a three – year period of forming to ensure optimum filling of the space between the trees in the row. As a result, some part of a young orchard is not utilized in terms of yielding and shortening an investment period. Italian experiments prove that only diminishing a tree size allows to better filling of an orchard space [Caruso et al. 1999, Scorza et al. 2000]. Moreover, according to Szewczuk [2001], at traditionally maintained peaches orchard, even providing more advantageous conditions for vegetative growth through irrigation or mulching, does not translate into high level of yielding in the first two years of fruiting.

Considerable distances between the trees result not only from meeting the requirements of an open vase crown form, but also from application of intensively growing generative rootstock. The growth of peach trees can be modified, to a significant degree, by pruning and introduction of trees crowns conduction, e.g. a spindel crown or a vertical axis, which allow trees to be planted every 2 m. Then an additional inhibition of tree growth can be achieved, brought about by a mutual competition between above – ground plant parts [Rieger and Myers 1996)]. In the conditions of reduced growth, connected with densely planted trees and introduction of a vertical axis, it is possible to obtain high yields from young trees [Szewczuk and Licznar-Małańczuk 2004]. DeJong et al. [1999] claimed that at higher density of peaches, from 299 to 1196 trees per one hectare there does increase fruit yield harvested from an area unit. Elevated productivity values for trees planted densely and featuring poorer growth were also reported by Furakava [1998] who compared vigor and yielding of densely planted trees, i.e. 2500 trees per ha and 1250. According to Loreti and Massai [2005], the number of peaches per an hectare should amount from 700 to 1500, depending on the form of tree crown which, in turn, should be adjusted to soil conditions. In the opinion by Salwador and Fideghelli [1993], at the same number of trees per one hectare – 1388, in peaches orchard there can be applied two types of tree crowns: system V and a spindel crown. Also Caruso et al. [1999] reported that training peaches in the form of Y makes it possible to densely plant trees in a row and, as a result, leads to obtaining higher yields from an area unit, at poorer trees growth. However dense planting causes worse light access to trees crowns and, therefore, trees of crown conduction require more intensive pruning, which increases layouts regarding maintenance of spindle and vertical axis crowns as compared to open-vase crowns and those of Y shape [Caruso et al. 1998, Szewczuk and Licznar-Małańczuk 2004].

Another factor reducing densely – planted peaches growth can be planting trees in ridges. The planting procedure involves placing trees on the surface of ground and hil-

ling their root system using soil, thus forming a ridge. The ridge inhibits the growth of a root system in its upper part [Szewczuk et al. 2009] and can affect absorption of nutrients, especially by young trees. It is believed that in this way it is possible to weaken trees growth, which is recommended for modern orchards cultivation [Sosna and Szewczuk 1998]. However, observations dealing with trees growing in ridges are not univocal. Sako and Laurinen [1986] proved that trees trained in that way characterized more intensive growth than control trees, planted in a traditional way. In research by Treder and Mika [2001] poorer growth of trees planted in ridges was observed as late as since the third year after planting. In the conditions of replanting trees, initially, there was obtained more intensive trees growth, yet in subsequent years the growth of trees planted in ridges was slightly poorer than that of traditionally planted trees [Bootsma 1995].

The purpose of investigation was determination of possibilities of maintaining the peach orchard on a seedling rootstock, with using of a vertical axis and planting trees in ridges, in comparison to two commonly used orchard types with trees trained as spindle and an open vase crown.

MATERIAL AND METHODS

The experiment was conducted in Research – Development Station belonging to Wroclaw University of Environmental and Life Sciences. Its aim was to assess peaches of 'Suncrest' and 'Cresthaven' cultivars planted in the spring 2006, in different spacing. The number of trees per hectare with particular form of a tree crown was as follows: 3.5 × 1 m spacing – 2857 trees per ha (vertical axis); 3.75 × 2 m spacing – 1333 trees per ha (spindle crown); 4.25 × 3 m spacing – 784 trees per ha (open crown).

The trees were improved on Manchurian peach seedling rootstock, in four replications, with 3 trees on one plot. Half of trees growing in 3.5 × 1 m spacing were planted in a traditional way and half was planted in ridges. The latter procedure involved placing trees on the ground surface, fixing them to wires stretched along rows and hilling their root systems by soil. Trees of a spindle and a vertical axis crowns were tied to a special construction to ensure a vertical character of a conductor growth.

Two – factorial experiment was established according to the split-plot method, where the first factor was a model of peaches orchard diversified as to the sparing, form of a tree crown and the way of planting. The second factor was the cultivar of peach trees. There was determined the effect of the examined factors on peaches yielding, as well as mean weight of one fruit and trees growth measured as trunk – cross sectional area. The results were subjected to statistical analysis with the use of analysis of variance and significance of differences was assessed according to T-Student test, at significance level 5%.

RESULTS AND DISCUSSION

Trees of two examined peaches cultivars began fruiting since the third year after planting (tab. 1). In their second year after planting, in 2007, the trees did not fruit as flower buds were damaged by frost. In the first year of fruiting the trees of 'Cresthaven',

Table 1. Yielding of 'Cresthaven' and 'Suncrest' cvs. in depending on the spacing, type of crown and method of planting, kg·drzewo^{-1}

Tabela 1. Plonowanie odmian 'Cresthaven' i 'Suncrest' w zależności od rozstawy, formy korony oraz sposobu sadzenia, kg·tree^{-1}

Cultivar Odmiana	Kombinacja Treatment		Yield, kg·tree^{-1} Plon, kg·drzewo^{-1}			
	spacing rozstawa	form of crown – forma korony method of planting – metoda sadzenia	2008	2009	2010	total yield suma z lat 2008–2010
Cresthaven	3.5 × 1	vertical axis – osiowa ridges – redliny	14.1 a*	16.5 b	14.2 b	44.8 b
	3.5 × 1	vertical axis – osiowa traditional planting sadzenie tradycyjne	17.9 b	20.4 c	8.7 a	47.0 bc
	3.75 × 2	spindle – wrzecinowa	22.1 c	36.9 e	14.6 b	73.6 d
	4.25 × 3	open vase – kotłowa	26.3 d	48.5 f	24.2 c	99.0 e
Suncrest	3.5 × 1	vertical – axis osiowa ridges – redliny	13.4 a	12.1 a	7.5 a	33.0 a
	3.5 × 1	vertical axis – osiowa traditional planting sadzenie tradycyjne	16.5 ab	11.5 a	9.1 a	37.1 a
	3.75 × 2	spindle – wrzecinowa	26.3 d	16.5 b	10.2 a	53.0 c
	4.25 × 3	open vase – kotłowa	35.3 e	24.9 d	10.0 a	70.2 d

*Averages marked with the same letter do not differ significantly (5%) according to Student's t-test
*Średnie oznaczone tą samą literą nie różnią się istotnie (5%) w porównaniu z testem t-Studenta

trained in the form of an open vase and a spindle crown, featured lower yield size values with comparison to trees of 'Suncrest' which followed the same type of training. However, within two subsequent years 'Cresthaven' cv. characterized higher yield, also when there was applied 3.5 × 1 m spacing and a vertical axis, as compared to 'Suncrest' cv. In the first three years of fruiting, the trees of 'Cresthaven' planted in 4.25 × 3 m spacing and trained in the form of an open vase crown, provided significantly higher yield from one tree in relation to trees planted in 3.75 × 2 m spacing and trained as a spindle crown. The lowest yield size values were obtained from trees planted in 3.5 × 1 m spacing and following a vertical axis shape. Similar correlations were recorded for 'Suncrest' cv., although only in the first two years of their fruiting. In the third year of fruiting yield size for that cultivar did not depend on spacing or the form of a tree crown. The factor influencing yield size obtained from 'Cresthaven' cv., densely planted and trained to form vertical axis, was the way of trees planting. In the course of the first two years of fruiting the yield from trees trained in that way and planted in ridges was significantly lower in comparison to trees planted traditionally. The mentioned relations were not recorded in the case of 'Suncrest' cv.

An important element regarding the assessment of yielding of peaches, at diversified spacing, is yield size obtained from an area unit. Summary fruit yield harvested from experimental trees within the first three years of fruiting point to the possibility of ob-

taining high yields of peaches fruits at densely planted trees as compared to traditional model of planting and training of peach orchard (tab. 2). Elevated number of trees, from 784 to 2857 per one hectare, provided, in spite of lower unitary yield from one tree, the increase in summary yield size from one hectare by 30 ('Suncrest') to 59 tons ('Cresthaven'). Significantly higher of 'Cresthaven' cv. yields from one hectare were also achieved by cultivation of 1333 trees per an area unit and training them in the form of a spindel crown. As far as 'Suncrest' cv. was concerned, significantly higher yields from one hectare were obtained by traditional trees planting and cultivating them in a small spacing.

Table 2. Yielding of 'Cresthaven' and 'Suncrest' cvs. in depending on the spacing, type of crown and method of planting, t ·ha^{-1}

Tabela 2. Plonowanie odmian 'Cresthaven' i 'Suncrest', w zależności od rozstawy, formy korony oraz sposobu sadzenia, t ·ha^{-1}

Cultivar Odmiana	Treatment Kombinacja		Yield, t·ha^{-1} Plon, t·ha^{-1}			
	spacing rozstawa	form of crown – forma korony method of planting – metoda sadzenia	2008	2009	2010	total yield suma z lat 2008–2010
Cresthaven	3.5 × 1	vertical axis – osiowa ridges – redliny	40.1 cd	47.2 c	40.5 f	127.8 e
	3.5 × 1	vertical axis – osiowa traditional planting sadzenie tradycyjne	51.1 e	58.4 d	24.9 de	134.4 e
	3.75 × 2	spindle – wrzecinowa	29.4 b	49.2 c	17.6 bc	96.2 c
	4.25 × 3	open vase – kotłowa	18.5 a	38.0 b	19.0 bcd	75.5 b
Suncrest	3.5 × 1	vertical axis – osiowa ridges – redliny	38.3 c	34.6 b	21.3 cde	94.2 c
	3.5 × 1	vertical axis – osiowa traditional planting sadzenie tradycyjne	47.3 de	33.0 b	26.1 e	106.4 d
	3.75 × 2	spindle – wrzecinowa	35.0 bc	22.0 a	13.6 ab	70.6 ab
	4.25 × 3	open vase – kotłowa	18.5 a	38.0 b	7.9 a	64.4 a

For explanation, see table 2 – Objaśnienia w tabeli 2

Both spacing and the type of training applied did affect the quality of harvested fruit of the examined peaches cultivars (tab. 3). Fruit featuring the highest weight were harvested from trees trained in the form of an open vase and spindle crown. The lowest mean weight of fruit was recorded for trees of 'Suncrest' cv., planted densely and trained as a vertical axis. However, recorded lower weight of one fruit was connected with higher level of yielding obtained from an area unit for trees densely planted. It should be also noted that fruit size of 131–134 g, resulting from the mentioned combination, remains in agreement with mean fruit weight of that peach cultivar provided by standard pomological descriptions.

Table 3. Mean weight of fruit from trees of 'Cresthaven' and 'Suncrest' cvs. in depending on the spacing, type of crown and method of planting, g

Tabela 3. Średnia masa owoców odmian 'Creasthaven' i 'Suncrest', w zależności od rozstawy i formy korony, g

Cultivar Odmiana	Kombinacja Treatment		Średnia masa owocu, g Mean weight of fruit, g			
	spacing rozstawa	form of crown – forma korony method of planting – metoda sadzenia	2008	2009	2010	średnia masa owocu mean weight of fruit 2008–2010
Cresthaven	3.5 × 1	vertical axis – osiowa ridges – redliny	128 c*	182 cd	155 ab	155 bc
	3.5 × 1	vertical axis – osiowa traditional planting sadzenie tradycyjne	109 b	173 bc	162 bc	148 b
	3.75 × 2	spindle – wrzecinowa	144 d	172 bc	171 cd	162 cd
	4.25 × 3	open vase – kotłowa	149 d	162 ab	201 e	171 d
Suncrest	3.5 × 1	vertical axis – osiowa ridges – redliny	112 b	149 a	142 a	134 a
	3.5 × 1	vertical axis – osiowa traditional planting sadzenie tradycyjne	82 a	163 b	148 a	131 a
	3.75 × 2	spindle – wrzecinowa	110 b	189 de	178 d	159 bc
	4.25 × 3	open vase – kotłowa	112 b	197 e	183 d	164 cd

For explanation, see table 2 – Objaśnienia w tabeli 2

Trees growth, measured by trunk – cross sectional area, depended on a distance between trees in a row. Significantly most intensive growth featured trees, trained in the form of an open vase crown and planted in 4.25 × 3 m spacing. Planting trees in ridges did not cause any evident diversity regarding the growth of trees grown in 3.5 × 1 m spacing and trained in the form of a vertical axis.

In the experiment, significantly higher fertility indices were recorded for trees of 'Cresthaven' cv., trained as a spindle and an open vase crown, as compared to the remaining combinations (tab. 4).

Results obtained in this experiment can be confirmed by research by Szewczuk and Licznar-Małańczuk [2004] who also reported the possibility of gaining high yields from densely planted peaches, trained in the form of a vertical axis. The same authors stressed increased layouts connected with forming and maintaining a vertical axis shape [Szewczuk and Licznar-Małańczuk 2004]. In the conditions of Italy, less labor-consuming form of a tree crown and providing better yielding, proved to be Y – shaped crown [Caruso et al. 1998], as well as V system. According to Salwador and Fideghelli [1993], at the same number of trees – 1388 per hectare labor consumption connected with training a spindel crown was by 6% higher, at lower by 14 $t \cdot ha^{-1}$ summary yield from five years of fruiting in comparison to V system. Kanwar and Singh [2004] explain higher yielding of trees densely planted and trained in the form of Y by better

Table 4. Trunk cross–sectional area of 'Cresthaven' and 'Suncrest' cvs. in depending on the spacing, type of crown and method of planting, cm^2

Tabela 4. Pole przekroju poprzecznego pnia odmian 'Cresthaven' i 'Suncrest' w zależności od rozstawy i formy korony, cm^2

Cultivar Odmiana	Treatment Kombinacja		Trunk cross-sectional area, cm^2 Pole przekroju poprzecznego pnia, cm^2		
	spacing rozstawa	form of crown – forma korony method of planting – metoda sadzenia	2008	2009	2010
Cresthaven	3.5 × 1	vertical axis – osiowa ridges – redliny	25.9 b*	34.4 cd	40.8 cd
	3.5 × 1	vertical axis – osiowa traditional planting sadzenie tradycyjne	23.6 ab	30.6 bc	36.9 bc
	3.75 × 2	spindle – wrzecinowa	27.2 b	36.5 de	44.7 d
	4.25 × 3	open vase – kotłowa	35.1 c	50.6 f	65.6 e
Suncrest	3.5 × 1	vertical axis – osiowa ridges – redliny	19.4 a	23.3 a	30.4 a
	3.5 × 1	vertical axis – osiowa traditional planting sadzenie tradycyjne	24.1 b	28.3 b	34.4 ab
	3.75 × 2	spindle – wrzecinowa	28.3 b	36.3 de	43.6 d
	4.25 × 3	open vase – kotłowa	37.0 d	40.0 e	64.9 e

For explanation, see table 2 – Objaśnienia w tabeli 2

access to light. However, according to Robinson et al. [2006], the yielding of trees maintained in the systems not requiring intensive pruning after planting is higher in comparison to the systems involving considerable amount of pruning. In research by Szewczuk and Gudarowska [2007], the growth and yielding of peaches, planted in different spacing and trained in V form, depended on cultivar of peach trees. Planting trees of 'Inka ' cv. every 2 m did result in increased yield from an area unit by 43% in relation to those following 3 m spacing and by 93% as compared to 4 m distance between trees. For 'Early Redhaven' cv. more advantageous proved to be introduction of 3 m distance between trees trained in V form. According to Radajewska and Andrzejewski [2004], tree crown did not affect trees growth and yielding, while a decisive factor occurred to be a rootstock. However in presented experiment, planting trees in 3.5 × 1 m spacing and training them in the form of a vertical axis resulted in apparent reduction of trees growth, measured by trunk – cross sectional area (44–47%) in relation to trees planted in 4.25 × 3 m spacing and trained to form an open vase. Similarly, in the experiment by Szewczuk and Licznar-Małańczuk [2004], the conditions of Lower Silesia, diminishing the distance between peaches trees led to, regardless peaches cultivar, inhibition of vegetative growth measured as the increase in trunk – cross sectional area, as well as by the number of shoots and the sum of one – year increase in area mentioned above [Szewczuk and Gudarowska 2009].

Results obtained indicate the effect of trees planting density and the form of a tree crown on mean fruit weight. Previous experiments by Szewczuk and Licznar-Małań-

Table 5. Productivity index (kg·cm^{-2}) from years 2008–2010 for trees of 'Cresthaven' and 'Suncrest' cvs. in depending on the spacing, type of crown and method of planting

Tabela 5. Współczynnik plenności za lata 2008–2010 odmian 'Cresthaven' i 'Sunrcrest' w zależności od rozstawy i formy korony, kg·cm^{-2}

Cultivar Odmiana	Treatment Kombinacja		Productivity index, kg·cm^{-2} Współczynnik plenności, kg·cm^{-2}			
	spacing rozstawa	form of crown – forma korony method of planting – metoda sadzenia	2008	2009	2010	mean from years średnia z lat 2008–2010
Cresthaven	3.5 × 1	vertical axis – osiowa ridges – redliny	0.55 a*	0.48 a	0.35 b	0.46 a
	3.5 × 1	vertical axis – osiowa traditional planting sadzenie tradycyjne	0.76 bc	0.67 c	0.25 ab	0.56 ab
	3.75 × 2	spindle – wrzecinowa	0.83 c	1.05 d	0.33 b	0.74 c
	4.25 × 3	open vase – kotłowa	0.68 b	1.00 d	0.36 b	0.68 bc
Suncrest	3.5 × 1	vertical axis – osiowa ridges – redliny	0.75 bc	0.60 bc	0.27 ab	0.54 a
	3.5 × 1	vertical axis – osiowa traditional planting sadzenie tradycyjne	0.71 b	0.43 a	0.28 ab	0.47 a
	3.75 × 2	spindle – wrzecinowa	0.95 d	0.47 a	0.16 a	0.53 a
	4.25 × 3	open vase – kotłowa	0.96 d	0.53 ab	0.17 a	0.55 a

For explanation, see table 2 – Objaśnienia w tabeli 2

czuk [2004] did not indicate the worsening of quality involving fruits originating from densely planted trees, trained in V form. According to Caruso et al. [1998], trees trained in a spindel crown shape produced bigger peach fruits in their lower part of a crown, while those trained to form Y shape – in their middle part. Fruit coming from trees of two leaders also characterized more favorable colors. Summing up, it can be stated that investigation confirmed the possibility of obtaining high field size of peaches through their dense planting and training to form a vertical axis, at permissible level of worsening fruits quality.

CONCLUSIONS

1. Application of smaller spacing when planting trees, accompanied by training trees in the form of a vertical axis, provides the possibility of obtaining high yields from an area unit in comparison to traditional model of planting and training peaches.

2. Dense training of peaches in the form of a crown with leader, leads to worsening of fruit quality. However, recorded lower quality of mean weight of one fruit was connected with higher level of yielding that featured densely planted trees.

3. Planting spacing, as well as the form of peaches crown growing on a generative rootstock determines trees growth to a considerable degree. Planting trees in 3.5 × 1 m

spacing and training them to form a vertical axis brought about apparent reduction in trees growth, measured by trunk – cross sectional area (44–47%), in relation to trees planted in 4.25 × 3 m spacing and trained in the form of an open crown.

4. The way of planting trees in ridges, at the same spacing and tree crown form did not affect peaches yielding and vegetative growth of both examined peaches cultivars. The only exception was 'Suncrest' cultivar featuring lower summary yield from an area unit, provided by trees planted in ridges.

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WPŁYW ROZSTAWY, FORMY KORONY I SPOSOBU SADZENIA DRZEW NA WZROST I PLONOWANIE DWÓCH ODMIAN BRZOSKWINI

Streszczenie. Jednym z czynników określających wczesność brzoskwini jest sadzenie drzew w dużej rozstawie. Jest to trudne z uwagi na zastosowanie generatywnych, silnie rosnących podkładek. Intensywny wzrost drzew brzoskwini może być modyfikowany poprzez sadzenie na redlinach oraz zmianę kształtu korony. Doświadczenie przeprowadzono w Stacji Badawczo-Dydaktycznej w Samotworze należącej do Uniwersytetu Przyrodniczego we Wrocławiu. W doświadczeniu oceniono drzewa na podkładce siewka brzoskwini Mandżurskiej, odmian: 'Suncrest' i 'Cresthaven' posadzone wiosną 2006 r., w rozstawie: 3,5 × 1 m (korona osiowa), 3,75 × 2 m, (korona wrzecionowa), 4,25 × 3 m (korona kotłowa). Część drzew w rozstawie 3,5 × 1 m została posadzona w sposób tradycyjny, a część posadzono „w redliny", które polegało na ustawieniu drzewek na powierzchni gruntu i obsypaniu systemu korzeniowego. Celem przeprowadzonych badań było określenie możliwości prowadzenia sadu założonego z drzew brzoskwini na siewce przy zastosowaniu osiowej formy korony i sposobu sadzenia „w redliny" na tle dwóch powszechnie stosowanych modeli sadu z drzewami prowadzonymi w formie korony wrzecionowej i kotłowej. Suma plonów z trzech pierwszych lat owocowania wskazuje na możliwość uzyskania wysokich plonów brzoskwini przy gęstym sadzeniu drzew w porównaniu z tradycyjnym modelem sadzenia i prowadzenia drzew brzoskwini. Najniższym poziomem plonowania charakteryzowały się drzewa obu badanych odmian posadzone w rozstawie 4,25 × 3 m i prowadzone w formie korony kotłowej. Wzrost drzew mierzony polem przekroju poprzecznego pnia zależał od odległości sadzenia drzew w rzędzie. Wyraźnie najsilniej rosły drzewa prowadzone w formie korony kotłowej i sadzone w rozstawie 4,25 × 3 m. Sadzenie drzew „w redliny" nie spowodowało wyraźnego zróżnicowania w plonowaniu i wzroście drzew posadzonych w rozstawie 3,5 × 1 m i prowadzonych w formie korony osiowej. Na podstawie przeprowadzonych badań można postawić wniosek, że wybór rozstawy i formy korony decyduje o poziomie plonowania drzew brzoskwini w pierwszych latach po posadzeniu.

Słowa kluczowe: *Prunus persica*, gęstość sadzenia, sadzenie w redliny, współczynnik plenności

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