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QUALITY FEATURES OF PARTHENOCARPIC PEARS COLLECTED FROM TREES GROWN ON DIFFERENT ROOTSTOCKS

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Abstract. In countries where spring frost frequently causes damage to pear flowers, cropping is possible through natural and induced parthenocarpy. The tendency to bear parthenocarpic fruit is a genetic feature so it differs between cultivars. The goal of the study was to assess the influence of the cultivar and rootstock on the occurrence of parthenocarpy and to determine the influence of the number of seeds on the quality of fruit and the speed with which it ripens. Pears of five European cultivars were collected from trees planted in 2002 at a distance of 4 × 1.5 m. Each cultivar was grown on three different rootstocks. The experiment was conducted in 2008 and 2011. There was a spring frost during the flowering period and many flowers were killed. Nevertheless, the trees cropped, which was the reason to expect an increased occurrence of parthenocarpy. During harvest, each pear was examined in respect of: firmness, TSS, acidity, skin base colour and starch pattern. After the tests, the pears were cut and the number of seeds was counted. The number of seedless pears varied between 2.2% ('Carola') and 46.7% ('Amfora') in 2008, and between 26.7% ('Dicolor') and 84.1% ('Amfora') in 2011. The rootstock influenced the number of seedless pears of each cultivar. The largest number of parthenocarpic pears was harvested from trees grown on Quince S_1. The number of seeds influenced some quality parameters, like the mass of fruit, firmness and TSS. Parthenocarpy was also found to affect the speed in which fruit ripens, as measured by the starch disintegration and Streif indices. Only acidity and base skin colour were slightly or not at all dependent on the occurrence of parthenocarpy or on the number of seeds.

Key words: firmness, fruit mass, skin colour, TSS, Starch Index, Streif Index

INTRODUCTION

The first overview of the occurrence of parthenocarpy in various plant species was published by Gustafson in 1942. Gustafson wrote, among other things, that the lack of

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seeds in fruit was a phenomenon fairly often observed in pear cultivars originating from *Pyrus communis* L., although its frequency varied depending on cultivar. However, spontaneous parthenocarpy is very rare in Asian pear cultivars (*Purus pyrifolia* Nakai.) [Zhang et al. 2008], which provides strong evidence for the genetic background of this phenomenon. Parthenocarpy is very useful for fruit cultivation, especially in self-incompatible pear cultivars [Nishitani et al. 2012]. In the Central European climatic conditions parthenocarpic pears very frequently develop from fruit damaged by spring frost [Lech and Małodobry 2006]. Parthenocarpy is also associated with specific weather conditions prevailing during and after flowering, like low temperature and continuous rain [Madeira and Maia 2008]. Therefore, it does not occur each year. Parthenocarpic pears are longer and slightly smaller than those that develop as a result of cross-pollination. They are also more prone to falling from trees before harvest [Łysiak 2006]. As early as 1960, Luckwill described the positive influence of gibberelic acid on the stimulation of parthenocarpic fruit. The development of seedless fruit can be stimulated artificially by applying a wide range of exogenous gibberellins (GA_1, GA_3, GA_4, and GA_7) [Zhang et al. 2008, Niu et al. 2014]. Gibberellins originate in the seeds and besides regulating the fruit-setting for the next year, which is their main function, they are crucial for the development and growth of fruit [Pharis and King 1985]. If applied together, gibberellins and auxins cooperate in initiating cell division [Ferguson 1999].

The cytokinins, which are present in quite a high concentration at some stages of fruit development, play a similar key role [Gil et al. 1972, Gillaspy et al. 1993].

The lack of seeds must affect the presence of the above specified plant hormones, and this in turn should be reflected in the speed of ripening and in the quality parameters of fruit. In apples, the number of seeds is frequently correlated with the growth or with the shape and size of fruit [Ferguson 1999]. However, few studies have been carried out to investigate the effect of rootstock on parthenocarpy, and the effect of parthenocarpy on fruit quality, and no research has been carried out yet on the influence of parthenocarpy on the optimum harvest date. The objective of this study was to investigate parthenocarpy in pears, namely, the influence of rootstock on the occurrence of parthenocarpy and the influence of the number of seeds in fruit on some quality parameters and on the stage of maturity of fruit. The study was conducted on pears of five European cultivars in a year of occurrence of spring frost that was conducive to the development of parthenocarpic fruit.

MATERIALS AND METHODS

The experiment was conducted in the experimental orchard and laboratory of the Department of Pomology of the University of Life Sciences in Poznan (52°31' north latitude and 16°38' east longitude). The fruit was collected from trees planted in spring 2002 at a distance of 4 × 1.5 m. The fruit of five European pear cultivars was examined: 'Conference', 'Dicolor', 'Erika', 'Carola' and 'Amfora'. Each cultivar was grown on three different rootstocks: *Pyrus caucasica* Federov., Pyrodwarf and Quince S_1. There were 32 trees in each combination of cultivar and rootstock. The pear orchard was maintained according to the standard commercial practice for integrated fruit production.

The experiment was carried out in 2008 and 2011. In both years, there was a spring frost: at the beginning of the flowering period in 2008 and during full bloom in 2011. In 2008, the lowest spring frost temperature was recorded in the morning of 22 April – it amounted to -5°C (fig. 1). All open flowers were killed. The evaluation of a sample of 200 flowers carried out two days later showed that for all cultivars the share of dead flowers varied between 75% and 92%. Nevertheless, the trees cropped quite well, which was the reason to expect an increased occurrence of parthenocarpy. In 2011, the spring frost was more severe – the lowest temperature was recorded on 5 May and amounted to -5.6°C. Because of lower spring frost temperature and a more advanced stage of flowering as compared to 2008, two cultivars ('Carola' and 'Erika') bore no fruit and the crop from trees of another cultivar ('Dicolor') grown od two rootstocks was not sufficient to be included in the experiment. Other trees produced a smaller crop than in 2008.

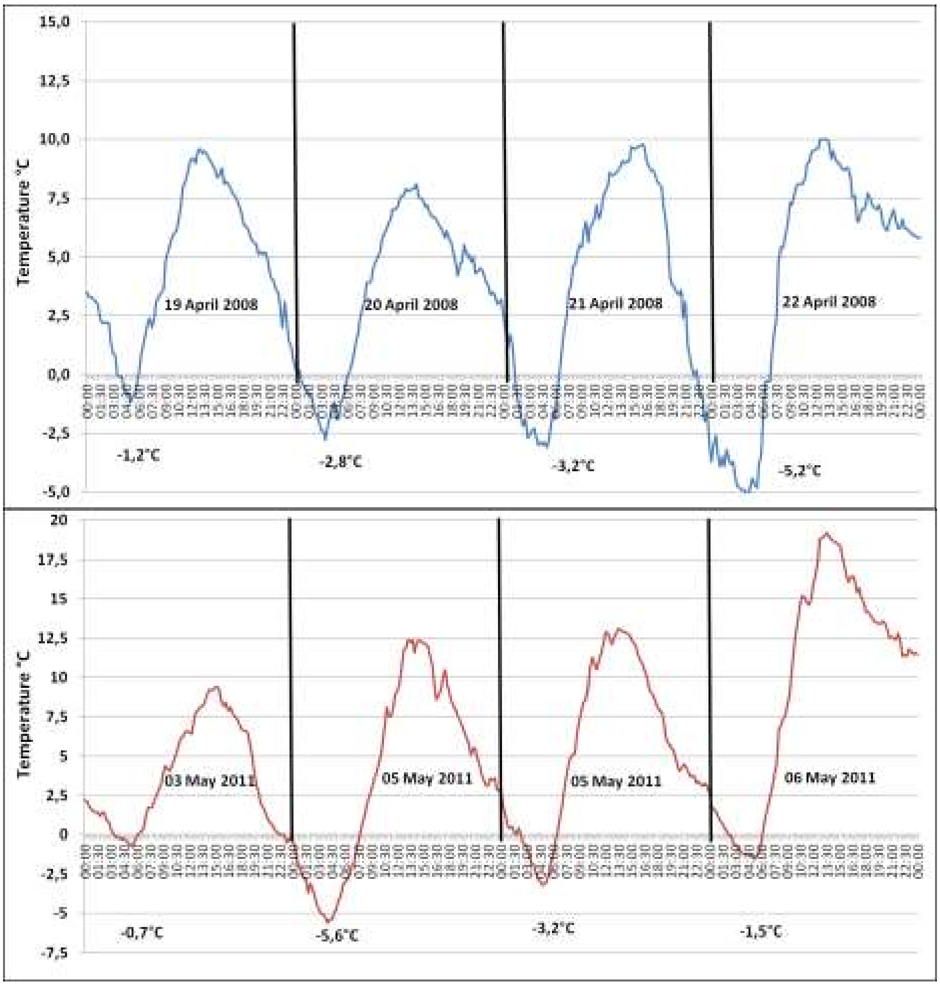

Fig. 1. Air temperature measured in tree crown at 2 meter height

Pears were collected for examination on the optimum harvest date determined using the Streif Index [Łysiak 2006]. In doing this, 240 pears in 2008 and 120 pears in 2011 (due to a low crop) were collected from each cultivar-rootstock combination. The samples per each cultivar-rootstock combination were so large in 2008 because it was rather unlikely that similar weather conditions would occur and allow repeating the experiment in the following years. The pears were numbered. Each fruit was weighed with an accuracy of up to 0.1 g and examined in respect of: firmness twice on opposite sides with a Penetrometer Effegi FT 327, total soluble solids (TSS) with an Atago Palette digital refractometer PR 101, skin base colour with a Konica-Minolta Colour Reader CR-10, and starch pattern with Lugol's iodine (measured according to a 10-point scale where 10 is no starch on the pear cross section) [Brookfield et al. 1997]. After all the tests were completed, the pears were cut and the number of seeds was counted. Juice was extracted from the pieces of fruit with the same number of seeds and its titrable acidity (TA) was measured (titration with 0.1 n NaOH to 8.1 pH, mval/100 ml).

The data were ordered according to the number of seeds and analysed for significant statistical differences using the Duncan's test.

RESULT AND DISCUSSION

The summary statistics for the influence of the rootstock on parthenocarpy and the number of seeds are listed in Table 1 and Table 2. From among all cultivars, the most of the parthenocarpic pears were harvested from trees grown on the Quince S_1 rootstock. The above regularity was not statistically proven only for 'Carola' pears in 2008, although a strong tendency in that direction was observed. Parthenocarpic pears developed most easily on the Czech cultivar 'Amfora', which originates from the crossing of 'Conference' (a cultivar considered to easily bear parthenocarpic fruits) with the Czech cultivar 'Holenicka' [Łysiak 2006]. However, 'Conference' trees bore significantly less parthenocarpic pears. In the remaining cultivars the number of parthenocarpic pears was low regardless of the rootstock on which the trees were grown and amounted to 1.8% for 'Erika', 2.1% for 'Carola' and only 1.1% for 'Dicolor'. The above data show that a rootstock, by affecting the hormone distribution in a tree, affects at the same time its capability to bear parthenocarpic fruit. Trees grown on the Quince S_1 rootstock produced the highest crop. This had already been found out in other studies conducted in Poland [Sosna and Kordylewska 2013]. At the same time, a large number of parthenocarpic fruit identified during the experiment allows the conclusion that the increase in the crop of the cultivars grown on the Quince S_1 rootstock is caused to a large extent by a strong tendency to parthenocarpy of threes grown on this rootstock. The cultivar which developed the most pears with multiple seeds was 'Dicolor', 63.5% pears of which had six and more seeds (more than one per carpel), whereas 'Amfora' had the smallest number of pears with multiple seeds (3.3%). The experiment repeated in 2011 showed the same relationships as those described above, and because of a stronger stimulation of parthenocarpy by spring frost the two cultivars which were found to be more likely to bear parthenocarpic fruit ('Amfora' and 'Conference') had almost no fruit with more than one seed per carpel (0.2 and 0.6% respectively).

Table 1. Influence of rootstock on share in percent of parthenocarpic fruits and with specific number of seeds in 2008

Cultivar	Rootstock	Number of seeds													Mean
		0	1	2	3	4	5	6	7	8	9	10	11	12	
Conference	Quince S_1	15.9 de	18.2 e	24.7 f	11.6 cd	12.8 cd	8.3 bc	6.5 b	0.0 a	0.0 a	0.0 a	0.0 a	0.0 a	0.0 a	4.1 A
	Pyrus caucasica	3.3 c	6.7 d	23.9 g	20.0 f	17.6 ef	16.7 e	6.7 d	1.7 b	3.2 c	0.0 a	0.0 a	0.0 a	0.0 a	4.7 AB
	Pyrodwarf	8.3 d	9.9 de	18.2 f	13.0 e	21.5 f	11.5 de	9.9 de	4,9 c	1.7 b	0.0 a	0.0 a	0.0 a	0.0 a	5.0 B
	mean	8.4 C	11.2 D	22.2 F	14.7 D	17.1 E	11.9 D	7.6 C	1.4 B	1.1 B	0.0 A	0.0 A	0.0 A	0.0 A	–
Dicolor	Quince S_1	3.3 bc	8.2 e	14.9 g	5.4 d	8.1 e	9.9 ef	5.0 cd	11.6 f	9.9 ef	11.6 f	8.3 e	3.0 b	0.0 a	4.8 A
	Pyrus caucasica	0.0 a	1.6 b	0,0 a	6.6 c	4.9 c	6.5 c	13.2 e	11.6 de	14.2 e	9.9 d	27.2 f	1.6 b	1.7 b	5.8 B
	Pyrodwarf	1.4 b	3.2 c	3.2 c	6.6 d	5.3 d	12.9 f	12.1 ef	9.6 e	14.9 f	10.0 e	18.2 g	1.7 b	0.0 a	6.3 B
	mean	1.1 B	3.9 C	3.6 C	6.2 D	6.0 D	9.6 E	9.7 E	10.9 E	12.9 E	10.5 E	17.2 F	2.1 B	0.2 A	–
Erika	Quince S_1	4.9 c	8.3 e	11.7 f	6.7 d	8.1 e	13.3 g	16.3 h	13.9 g	10.4 f	4.6 c	1.7 b	0.0 a	0.0 a	5.2 A
	Pyrus caucasica	0.0 a	1.6 b	0.0 a	6.7 c	5.0 c	6.6 c	10.4 d	11.6 d	13.3 d	12.7 d	28.1 e	1.7 b	1.7 b	6.6 B
	Pyrodwarf	3.3 bc	4.8 de	19.0 h	12.8 g	13.2 g	6.2 e	10.4 f	18.3 h	5.2 de	4.2 cd	2.3 b	0.0 a	0.0 a	5.9 AB
	mean	1.8 B	4.5 C	6.9 C	8.6 D	8.4 D	8.4 D	12.2 E	14.9 E	9.3 D	6.7 C	7.7 CD	0.2 A	0.3 A	–
Carola	Quince S_1	3.1 c	8.5 e	20.2 g	19.8 g	18.5 g	11.7 f	5.0 cd	6.4 de	1.6 b	4.5 cd	0.0 a	0.0 a	0.0 a	5.0 A
	Pyrus caucasica	2.1 b	7.3 d	13.2 e	17.2 f	12.6 e	18.2 f	17.5 f	6.9 d	0.0 a	3.8 c	1.0 b	0.0 a	0.0 a	5.3 A
	Pyrodwarf	1.4 c	4.2 d	4.9 d	9.9 e	13.9 f	11.8 f	17.4 g	14.5 f	16.6 g	4.6 d	0.8 b	0.0 a	0.0 a	5.7 A
	mean	2.1 B	6.5 B	12.0 D	15.4 D	14.9 D	13.7 D	12.5 D	8.9 C	3.2 B	4.3 B	0.4 A	0.0 A	0.0 A	–
Amfora	Quince S_1	56.7 e	9.2 d	10.4 d	13.5 d	4.7 c	2.8 b	2.5 b	0.0 a	0.0 a	0.0 a	0.0 a	0.0 a	0.0 a	3.4 A
	Pyrus caucasica	40.0 g	20.2 f	19.7 f	8.2 e	5.1 d	3.3 c	1.9 b	1.5 b	0.0 a	0.0 a	0.0 a	0.0 a	0.0 a	3.9 B
	Pyrodwarf	46.7 j	12.6 h	14.4 i	11.2 g	5.6 f	2.7 d	4.4 e	1.1 c	0.7 b	0.0 a	0.7 b	0.0 a	0.0 a	4.3 C
	mean	47.8 E	12.7 D	14.6 D	10.9 D	5.1 C	2.9 C	2.8 C	0.6 B	0.2 A	0.0 A	0.6 B	0.0 A	0.0 A	–

* – means are separated by Duncan's test, different letters in the same row indicate significant differences at $p = 0.05$, mean values marked with capital letters were subjected to two-ways ANOVA

Table 2. Influence of rootstock on share in percent of parthenocarpic fruits and with specific number of seeds in 2011**

Cultivar	Rootstock	Number of seeds													Mean
		0	1	2	3	4	5	6	7	8	9	10	11	12	
Conference	Quince S_1	82.6 c	10.7 b	4.1 b	2.5 b	0.0 a	0.0 a	0.0 a	0.0 a	0.0 a	0.0 a	0.0 a	0.0 a	0.0 a	1.9 A
	Pyrus caucasica	45.8 f	25.0 e	12.5 d	7.5 c	4.2 c	3.3 c	1.7 b	0.0 a	0.0 a	0.0 a	0.0 a	0.0 a	0.0 a	3.4 B
	Pyrodwarf	51.7 e	12.5 d	11.7 d	9.9 d	5.8 c	5.8 c	2.5 b	0.0 a	0.0 a	0.0 a	0.0 a	0.0 a	0.0 a	3.6 B
	mean	62.7 E	13.9 D	9.0 D	6.2 c	2.2 B	2.0 B	0.9 B	0.0 A	0.0 A	0.0 A	0.0 A	0.0 A	0.0 A	–
Dicolor	Quince S_1	26.7 d	14.1 c	1.5 b	16.7 c	18.3 c	12.4 c	7.5 b	7.4 b	0.0 a	0.0 a	0.0 a	0.0 a	0.0 a	–
Amfora	Quince S_1	84.1 e	10.8 d	4.0 c	1.6 b	0.0 a	0.0 a	0.0 a	0.0 a	0.0 a	0.0 a	0.0 a	0.0 a	0.0 a	1.9 A
	Pyrus caucasica	75.0 e	10.0 d	4,2 c	3.3 c	3.3 c	2.5 c	1.7 b	0.0 a	0.0 a	0.0 a	0.0 a	0.0 a	0.0 a	2.9 B
	Pyrodwarf	72.5 d	12.4 c	5.7 b	4.0 b	2.6 b	2.5 b	0.0 a	0.0 a	0.0 a	0.0 a	0.0 a	0.0 a	0.0 a	2.7 B
	mean	76.4 F	11.4 E	4.9 C	2.9 C	1.3 B	1.B C	0.2 A	0.0 A	0.0 A	0.0 A	0.0 A	0.0 A	0.0 A	–

* – means are separated by Duncan's test, different letters in the same row indicate significant differences at p = 0.05
** – there were no 'Erika' and 'Carola' pears, and 'Dicolor' pear were only from trees grafted on Quince S1 rootstock

Table 4. Influence of the number of seeds on some maturity indices in 2011

Cultivar	Feature	Number of seeds												
		0	1	2	3	4	5	6	7	8	9	10	11	12
Conference	Streif Index	0.102b	0.099b	0.096ab	0.096ab	0.090ab	0.087a	0.083a	–	–	–	–	–	–
	Starch Index	3.7 a	3.7 a	4.2 a	4.2 a	4.4 a	5.0 b	4.9 b	–	–	–	–	–	–
	colour L*	50.7 a	48.9 a	53.0 a	47.5 a	51.4 a	52.6 a	50.2 a	–	–	–	–	–	–
	colour a*	-13.4 a	-14.7 a	-14.0 a	-11.1 a	-10.9 a	-9.3 a	-10.1 a	–	–	–	–	–	–
	colour b*	34.3 a	36.8 a	36.5 a	36.8 a	38.1 a	41.2 a	35.3 a	–	–	–	–	–	–
Dicolor	Streif Index	0.082b	0.087b	0.082b	0.082b	0.074a	0.071a	0.071a	0.072a	–	–	–	–	–
	Starch Index	6.1 a	6.3 a	6.2 a	6.0 a	7.1 b	7.2 b	7.5 b	7.0 b	–	–	–	–	–
	colour L*	56.4 a	52.1 a	51.6 a	53.0 a	53.5 a	55.5 a	50.6 a	52.8 a	–	–	–	–	–
	colour a*	-5.7 b	-5.2 b	-5.1 b	-3.6 ab	-3.7 ab	-3.1 a	-3.6 ab	-3.7 ab	–	–	–	–	–
	colour b*	31.9 a	31.5 a	33.8 a	33.0 a	32.3 a	32.3 a	29.4 a	33.6 a	–	–	–	–	–
Amfora	Streif Index	0.111b	0.101b	0.089a	0.093ab	0.094ab	0.085a	0.081a	–	–	–	–	–	–
	Starch Index	5.1 a	5.7 ab	5.7 ab	6.4 b	6.6 b	6.3 b	6.7 b	–	–	–	–	–	–
	colour L*	45.4 a	45.2 a	47.1 a	45.5 a	46.4 a	43.3 a	42.1 a	–	–	–	–	–	–
	colour a*	-6.8 b	-7.7b	-3.5 ab	-3.3 a	-2.2 a	-3.0 a	-4.8 ab	–	–	–	–	–	–
	colour b*	27.9 a	23.6 a	25.9 a	28.7 a	25.3 a	25.1 a	24.8 a	–	–	–	–	–	–

Table 4. Influence of the number of seeds on some maturity indices in 2011

Cultivar	Feature	Number of seeds												
		0	1	2	3	4	5	6	7	8	9	10	11	12
Conference	Streif Index	0.102b	0.099b	0.096ab	0.096ab	0.090ab	0.087a	0.083a	–	–	–	–	–	–
	Starch Index	3.7 a	3.7 a	4.2 a	4.2 a	4.4 a	5.0 b	4.9 b	–	–	–	–	–	–
	colour L*	50.7 a	48.9 a	53.0 a	47.5 a	51.4 a	52.6 a	50.2 a	–	–	–	–	–	–
	colour a*	-13.4 a	-14.7 a	-14.0 a	-11.1 a	-10.9 a	-9.3 a	-10.1 a	–	–	–	–	–	–
	colour b*	34.3 a	36.8 a	36.5 a	36.8 a	38.1 a	41.2 a	35.3 a	–	–	–	–	–	–
Dicolor	Streif Index	0.082b	0.087b	0.082b	0.082b	0.074a	0.071a	0.071a	0.072a	–	–	–	–	–
	Starch Index	6.1 a	6.3 a	6.2 a	6.0 a	7.1 b	7.2 b	7.5 b	7.0 b	–	–	–	–	–
	colour L*	56.4 a	52.1 a	51.6 a	53.0 a	53.5 a	55.5 a	50.6 a	52.8 a	–	–	–	–	–
	colour a*	-5.7 b	-5.2 b	-5.1 b	-3.6 ab	-3.7 ab	-3.1 a	-3.6 ab	-3.7 ab	–	–	–	–	–
	colour b*	31.9 a	31.5 a	33.8 a	33.0 a	32.3 a	32.3 a	29.4 a	33.6 a	–	–	–	–	–
Amfora	Streif Index	0.111b	0.101b	0.089a	0.093ab	0.094ab	0.085a	0.081a	–	–	–	–	–	–
	Starch Index	5.1 a	5.7 ab	5.7 ab	6.4 b	6.6 b	6.3 b	6.7 b	–	–	–	–	–	–
	colour L*	45.4 a	45.2 a	47.1 a	45.5 a	46.4 a	43.3 a	42.1 a	–	–	–	–	–	–
	colour a*	-6.8 b	-7.7b	-3.5 ab	-3.3 a	-2.2 a	-3.0 a	-4.8 ab	–	–	–	–	–	–
	colour b*	27.9 a	23.6 a	25.9 a	28.7 a	25.3 a	25.1 a	24.8 a	–	–	–	–	–	–

Most of the basic fruit quality parameters depended on the number of seeds. Hopping [1976] discovered that inadequate pollination of kiwifruit resulted in distortion, and that a curvilinear relationship emerged between the seed number and the fruit weight. Similarly to the findings of Weinbaum at al. [2001], parthenocarpic fruit was considerably smaller than fruit with seeds. The average mass of fruit with 7–8 seeds was larger than that of parthenocarpic fruit (0–1 seed) by 16.5%. With respect to each cultivar, this difference amounted to 11.9%, for 'Erika', 15.3% for 'Dicolor', 15.9% for 'Carola', 17.2 for 'Conference' and 22.1% for 'Amfora' (fig. 2). In many pears, the shape was an indicator of the lack of seeds (fot. 1).

Fot. 1. 'Conference' pears: the left one with seeds, the right one parthenocarpic

Janes as early as 1941 described that the lack of seeds in the tomato increased soluble solids content, but Krezdorn [1973] showed the opposite tendency for citrus fruit. Except for reports from the beginning of the twentieth century [Evert 1907 and Müller-Thurgau 1908 cited in Gustafson 1942], who wrote that parthenocarpic fruit was sweeter than fruit with seeds, there is no information in the literature about the influence of parthenocarpy on the sugar content in pears. In this study, the presence (or the lack) and the number of seeds influenced the total soluble solids of the examined pears (figs 2 and 2a). In 2008, the highest content of soluble solids in all cultivars was found in fruit with no seeds or with only one seed ('Amfora'). The content of soluble solids decreased along with the increase in the number of seeds in fruit. The biggest decrease was noticed for 'Carola' (23%) and for 'Erika' (28.2%). In 2011, the decrease in the content of soluble solids between the fruit with the highest and the lowest number of seeds was found to be smaller, but the TSS data for both years are incomparable because there was no fruit with more than seven seeds in 2011. Still, the TSS in 'Conference' fruits decreased by a noteworthy 20%.

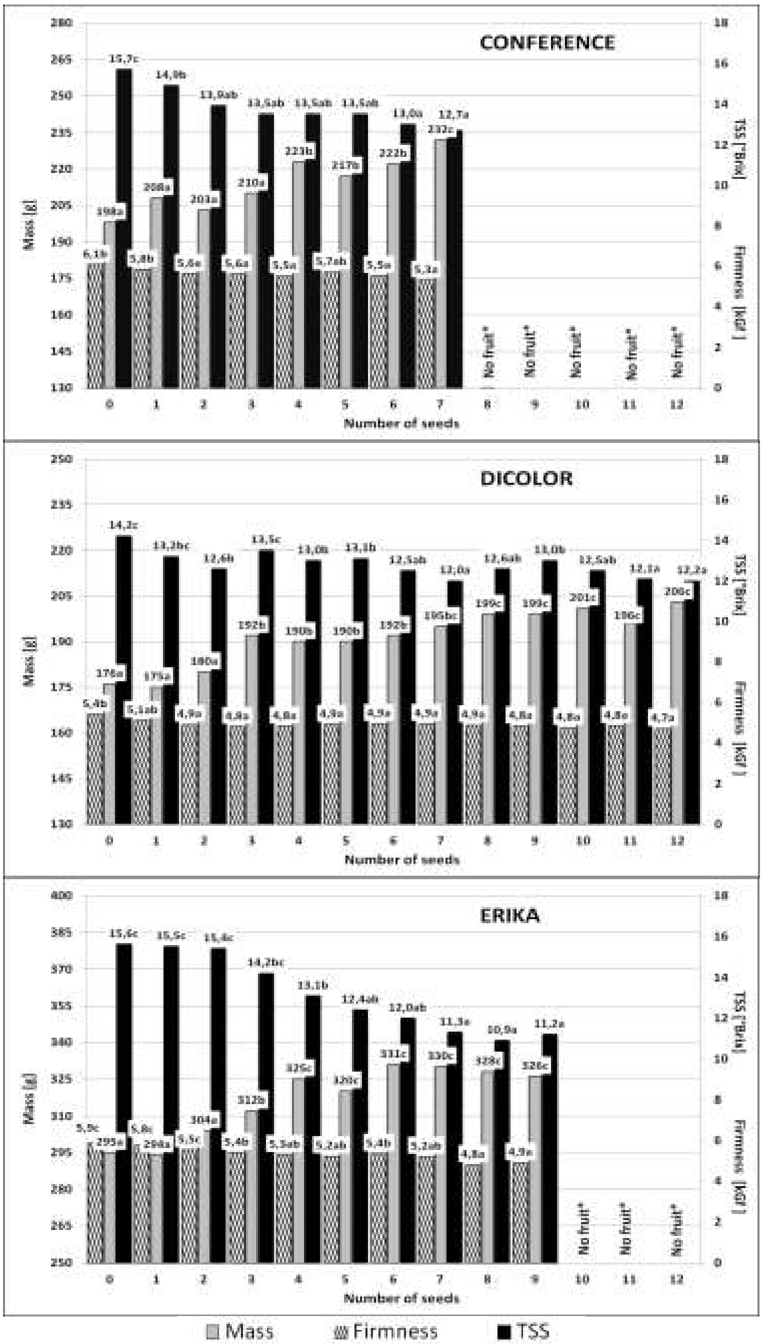

Fig. 2–4. Influence of the number of seeds on mass of fruit, firmness and total soluble solids

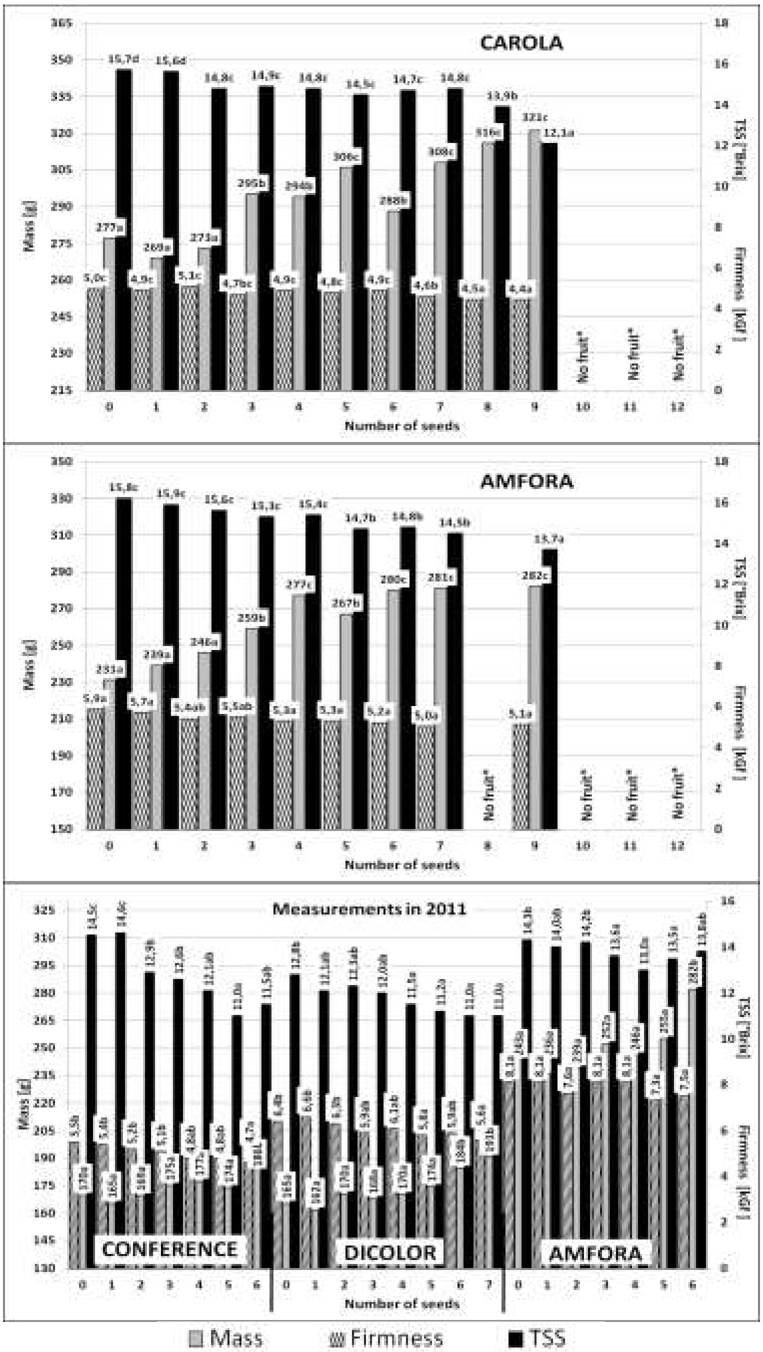

Fig. 5–7. Influence of the number of seeds on mass of fruit, firmness and total soluble solids

The firmness changed in the same way as the content of soluble solids (figs 2 and 2a). The larger was the number of seeds, the lower was the firmness. This relationship was most apparent in 'Conference' and 'Amfora'. Only 'Carola' pears did not seem to be visibly affected. 'Conference' pears with 8 seeds were softer than parthenocarpic pears by 13.1%. The biggest decline in firmness was observed for 'Erika' (16.9%) and the smallest for 'Carola' (12.0%), but the pears of the latter cultivar were the softest during harvest anyway.

In apples and pears starch disintegration is one of best indictors of the stage of fruit maturity [Kingston 1992]. The analysis of the starch pattern of the fruit cross section shows that fruit ripens with a different speed depending on the number of seeds (tabs 3 and 4). Parthenocarpic fruit of each cultivar had more starch than fruit with seeds. The difference in starch decomposition between seedless pears and pears with the largest number of seeds varied from 0.9 point ('Erika') to 1.9 points ('Amfora'), which corresponds to 9–19% of starch. By analyzing the Streif index value (tabs 3 and 4), it is possible to find a similar relationship, which proves that seeds accelerate the speed of fruit development and maturation. Maturation is regulated by the amount and the dynamic interplay between phytohormones [McAtee et al. 2013]. Two phytohormones – ethylene and abscisic acid (ABA) – which are responsible for fruit ripening are produced mainly in seeds, so their presence or absence is probably the cause behind such a visible difference in both maturity indices.

There was only a slightly significant influence of parthenocarpy on the fruit skin colour measured using the CIE 1976 (L*, a*, b*) colour space, and no influence on the acidity of the fruit juice. The only significant difference in colour was observed in 'Carola' during the measurement of the a* coordinate (showing colour changes from green and yellow), which may reflect fruit maturity [Łysiak et al. 2014]. This is all the more probable as this change is similar to the changes in the Streif and starch indices.

Some inconsistent results obtained for the quality parameters of the pears with a high number of seeds in 2008 might result from differences in the number of repetitions of such pears in each cultivar-rootstock combination. There were no 'Conference' pears with over 8 seeds and no 'Erika', 'Carola' and 'Amfora' pears with over 10 seeds. Due to the very small number of pears with a high number of seeds, the results of the statistical analysis obtained for pears with over eight seeds should be treated with caution.

CONCLUSIONS

Based on the results of the study the following conclusions can be drawn:

1. There are considerable differences between the examined cultivars in terms of the tendency to parthenocarpy. The Quince S_1 rootstock stimulates parthenocarpy more strongly than the pear seedling and the Pyrodwarf rootstock.

2. An increased number of seeds was positively correlated with the mass of pears and negatively with the total soluble solids and the firmness of pears.

3. Parthenocarpy slows down the speed of maturation measured by starch decomposition and Streif index.

4. There was no significant influence of parthenocarpy on the fruit skin colour measured using the CIE 1976 (L*, a*, b*) colour space and on acidity of fruit juice.

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CECHY JAKOŚCIOWE GRUSZEK PARTOKAPICZNYCH ZEBRANYCH Z DRZEW ROSNĄCYCH NA RÓŻNYCH PODKŁADKACH

Streszczenie. W krajach, w których przymrozki wiosenne często powodują niszczenie kwiatów grusz, naturalna i indukowana partenokarpia pozwala na uzyskanie plonu owoców. Skłonność do partenokarpii poszczególnych odmian jest uwarunkowana genetycznie. Celem badań była ocena wpływu odmiany i podkładki na powstawanie owoców partenokarpicznych oraz poznanie wpływu liczby nasion na jakość owoców oraz ich tempo dojrzewania. Owoce pięciu odmian gruszy europejskiej zebrano z drzew posadzonych w 2002 r. w rozstawie 4 × 1,5 m. Każda odmiana była uprawiana na trzech różnych podkładkach. Doświadczenie przeprowadzono w latach 2008 i 2011. W obu latach wystąpił przymrozek w okresie kwitnienia i wiele kwiatów zostało zniszczonych. Pomimo tego drzewa owocowały, co pozwalało spodziewać się dużego udziału owoców partenokarpicznych. W okresie zbioru oceniono ich jędrność, zawartość ekstraktu, kwasowość, barwę skórki oraz zawartość skrobi. Po testach owoce pokrojono i policzono liczbę nasion. Udział owoców beznasiennych wahał się od 2,2 (‘Carola’) do 46,7% (’Amfora‘) w 2008 r. i od 26,7 (‘Dicolor’) do 84,1% (‘Amfora’) w 2011 r. Podkładka wpłynęła na liczbę owoców beznasiennych u każdej z badanych odmian. Najwięcej owoców partenokarpicznych zebrano z drzew uprawianych na podkładce pigwa S1. Liczba nasion oddziaływała na takie cechy jakościowe jak masa owoców, jędrność i zawartość ekstraktu. Partenokarpia wpływała także na tempo osiągania dojrzałości oceniane za pomocą indeksu skrobiowego oraz indeksu Streifa. Tylko kwasowość oraz barwa podstawowa skórki nie były lub były nieznacznie zależne od liczby nasion lub partenokarpii.

Słowa kluczowe: jędrność, masa owocu, barwa skórki, TSS, indeks skrobiowy, indeks Streifa

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