A NINE-YEAR EVALUATION OF SEVERAL SCAB-RESISTANT APPLE CULTIVARS FOR ORGANIC FRUIT PRODUCTION

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A B S T R A C T

Suitability of nine scab-resistant or partially scab-resistant apple cultivars: Bohemia, Rubinola, Topaz, Goldstar, Pinova, Redkroft, Free Redstar, Melfree and Gold Milenium for organic orchards was evaluated during the period 2002-2010. The trial consisted of two experimental plots. In the first plot, no plant protection chemicals were applied either to the trees or to the soil. In the second plot, with limited spraying programme, only those compounds that are allowed to be used in organic fruit production in Poland were applied in order to control pests and diseases: copper products, Carpovirusine Super SC and the garlic extract Liquid Bioczos. After planting, the ground in the tree rows was mulched with agricultural spun-web, linen residue felt or sawdust in a 1.2 meter wide strip. During the years of the experiment many trees were seriously infected with apple canker (*Nectria* sp.), which caused the loss of a certain number of them. Most susceptible were 'Rubinola', 'Topaz', 'Redkroft' and 'Pinova'. The smallest necrotic lesions were observed on the trees of 'Free Redstar', 'Melfree' and 'Gold Milenium'. The various materials for mulching did not significantly affect the size of the fruit yield. The highest yields were obtained from the 'Gold Milenium', 'Free Redstar', 'Topaz' and 'Pinova'. In 2010, following a very rainy season, we observed for the first time scab potted fruits of the cultivars: Rubinola, Topaz, and Goldstar. The greatest problem was the control of aphids and apple mildew. Cutting back shoots with primary infestation was the most promising method. The 'Topaz', 'Rubinola', 'Bohemia' and 'Gold Milenium' appeared to be the most suitable for organic fruit production. In the year 2010, heavy thinning of fruitlets helped to obtain large fruits (diameter over 7.0 cm) of the cultivars: Bohemia, Topaz and Redkroft.

Key words: organic fruit production, apple, scab-resistant cultivars, susceptibility to apple canker, yielding, size of fruits

INTRODUCTION

Scab-resistant and partially scab-resistant apple cultivars are most recommended for planting when establishing new organic orchards in Poland and the European Union. The production of scab-resistant apple trees in Polish nurseries reached a level of about 148.5 thousand trees in 2010, which is 13.4% more than in 2008 and constitutes 2.4% of the total production of apple trees in nurseries. The most commonly produced cultivars are: 'Ariwa' (59.9 thousand), 'Topaz' (42.1 thousand), 'Rubinola' (18.0 thousand) and 'Rajka' (10.2 thousand). In other countries of the European Union, such as Austria and Italy, the cultivars most commonly grown in organic orchards are: 'Topaz', 'Gala', 'Braeburn' and 'Golden Delicious' (Zmarlicki, 2010). In the years to come, the share of scab-resistant and partially scab-resistant apple cultivars will increase because some of them, such as 'Topaz', 'Freedom', 'Gold Milenium', could be planted in orchards to produce fruits for processing. Other cultivars that are attractive and accepted by consumers, such as: 'Rubinola', 'Ariwa', 'Florina', 'Redkroft', 'Bohemia' and 'Šampion', could be planted in amateur home gardens with a minimal requirement for controlling diseases (Kruczyńska, 2007; 2008). The aim of this trial was to select those scab-resistant cultivars which could be recommended for organic fruit production in commercial orchards. The purpose of this confirmation of the study was the productivity and fruit quality of apples in a fully cropping period under an organic system in years 9 (2009) and 10 (2010), as well as to improve fruit size and colour grade. Additionally the year 2010 was very suitable for apple scab (*Venturia inaequalis*) infestation. Previous results from this study for the period 2002-2008 were published by Czynczyk et al. (2004, 2008, 2009). Results from this study show the advantages and disadvantages of this farming system in apple production.

MATERIAL AND METHODS

The experiment was set up in the spring of 2002 in the experimental orchard in Dąbrowice, belonging to the Research Institute of Pomology and Floriculture near Skierniewice, situated in central Poland. Nine scab-resistant or partially scab-resistant apple cultivars were included in the trial. The evaluated cultivars were: 'Bohemia', 'Rubinola', 'Topaz', 'Goldstar', 'Pinowa', 'Redkroft', 'Free Redstar', 'Melfree' and 'Gold Milenium'. After planting, the first six cultivars were mulched with agricultural spun-web, linen residue felt or sawdust in a 1.2 meter-wide strip. The last three cultivars were mulched only with agricultural spun-web.

The trial was set up in a randomized block pattern with four replications and three trees per plot. Two-year-old trees grafted on M.9 rootstock were planted in podsolic soil overlaying light clay, where for over fifty years fruit trees had been grown. All the trees were planted 3.40 x 1.35 meter apart and trained

as slender spindles. The experimental field was divided in two parts. In the first one, no chemicals were applied either to the trees or to the soil. In the second part, in the years 2002-2008 only a limited spraying programme was applied, and only with plant protection compounds which are allowed to be used in Poland for organic fruit production to control pests and diseases. In the last two years (2009-2010), the following chemicals were used: copper products – three times in early spring, Carpovirusine Super SC and the garlic extract Liguid Bioczos – once, and Madex 515 SC – twice. Young shoots infected with apple mildew and infested with aphids were cut back to limit the spread of these agrophages. In 2006, all of the trees were fertilized with farmyard manure in the previously mulched rows. Grass was allowed to grow between the rows and was regularly mown. Weeds, if any happened to appear in the rows, were also regularly mown. No mineral fertilization was ever applied to any part of the orchard. The yields obtained in the first years were low, if they were compared with the standard management programme in an integrated orchard (Żurawicz et al., 2004; Czynczyk et al., 2005). The purpose of this continuation of the previous study was to obtain a good quality crop, after heavy hand-thinning of fruitlets, with a space of about 18 cm left between one fruit and another. The following measurements were taken: number of trees infected with *Nectria* sp. and their size, tree trunk circumference measured at 30 cm above ground level and converted to trunk cross-sectional area, fruit yield per tree, mean fruit weight and percentage of fruit with a blush over more than 50% of skin surface. All fruits were taken from 1 representative tree in each plot to evaluate the mean fruit weight. Fruit weight and size were assessed using an electronic sorting machine manufactured by Greef. The results were statistically evaluated with an analysis of variance, followed by Duncan's multiple range test at $p = 0.05$.

RESULTS AND DISCUSSION

Tree health. During the nine-year period (2002-2010) of growth, there was no loss of trees caused by winter frost either affecting the root system or the part of tree above ground. In the same period, some trees died due to serious apple tree canker (*Nectria* sp.) infection that occurred on trunks and branches. The number of trees infected with canker was very similar in both plots. The highest number of lost trees was recorded among the cultivars: Rubinola, Topaz and Redkroft. The 'Topaz', 'Pinova', 'Goldstar', 'Bohemia' and 'Rubinola' also had the largest mean size of necrotic lesions on branches and stems. Among the cultivars Free Redstar, Melfree and Gold Milenium no losses were recorded. These cultivars also had the smallest size of necrotic lesions on trunks and brunches (Tab. 1). The high susceptibility of 'Topaz' and 'Rubinola' to canker confirms the results obtained earlier by Błażek

Table 1. The number of lost and infected trees (out of 36) due to apple canker (*Nectria* sp.) and mean size of bark necrosis in 2010 after 9 years of growing

Cultivar	Number of trees lost due to infection with canker		Number of infected trees		Mean size of necrosis on infected trees [cm^2]	
	no protection	limited protection	no protection	limited protection	no protection	limited protection
Bohemia	1	1	12	14	114.6	97.9
Rubinola	6	6	10	9	197.1	112.3
Topaz	5	4	13	14	248.4	184.6
Goldstar	5	1	11	17	69.5	122.8
Pinova	3	0	15	15	132.7	67.9
Redkroft	8	2	9	11	96.1	100.3
Free Redstar*	0	0	2	4	44.0	40.8
Melfree*	0	0	4	3	62.5	223.7
Gold Milenium*	0	0	4	4	87.3	89.5

*The results for the cultivars: Free Redstar, Melfree and Gold Milenium are based on 12 trees only

(2004), Jönson and Tahir (2004) and Czynczyk et al. (2008 and 2009). Low susceptibility of scab-resistant cultivars to apple canker must be taken into consideration when planting trees in orchards with organic fruit production.

Tree growth. After nine years of growth, 'Rubinola', 'Bohemia', 'Topaz' and 'Gold Milenium' proved to be the most vigorous cultivars. The weakest growing trees were 'Goldstar and 'Free Redstar' (Tab. 2 and 3). The successiveness of growth vigour of these cultivars was similar to that reported earlier by Czynczyk et al., 2004 and 2008; Kruczyńska et al., 1999; Lewandowski and Żurawicz, 2007. Growth vigour of these cultivars tested in the two plots with different spraying programmes was similar. All of the cultivars grown in the soil mulched with the various materials: agricultural spun-web, linen residue felt and sawdust had a quite similar size of trunk cross-sectional area (TCSA), (Tab. 2 and 3). An exception was the 'Rubinola' grown in the soil mulched with agriculture spun-web whose TCSA was significantly larger in comparison with the trees grown in the soil mulched with linen residue felt. Also the 'Bohemia', grown in the soil mulched with sawdust was significantly larger in comparison with the trees grown in the soil mulched with linen residue felt. The obtained differences were not regular. Applied different product material for mulching have not effect after mineralization (Mika et al., 1998; Szewczuk and Gudarowska, 2004).

Yielding. The yields obtained in the last two years (2009-2010) were reduced by severe spring frost in 2009. High yields expected in 2010 after the trees had blossomed successfully were also decreased by heavy hand-thinning of fruitlets. One fruit was left separated from another by a distance of about 18 cm.

Table 2. Trunk cross-sectional area, yield and yielding efficiency index of six scab-resistant cultivars grown under two protection programmes involving various mulching materials

Cultivar	Chemical protection	Mulching material	Trunk cross-section area in 2010 [cm^2]	Yield [kg/tree]				Yielding efficiency in 2010 [kg/cm^2TCA]
				2002-2006	2007-2008**	2009-2010**	2002-2010	
Bohemia	none	spun-web	40.1 ab*	10.9 b	13.7 b	21.8 b	46.4 b	1.2 b
		linen-felt	36.2 ab	7.6 ab	9.7 a	17.7 ab	34.9 ab	0.9 ab
		sawdust	36.6 ab	5.5 a	10.2 a	22.2 b	37.9 ab	1.1 b
	limited	spun-web	40.3 ab	14.5 b	12.1 a	20.9 ab	47.0 b	1.2 b
		linen-felt	33.1 a	9.3 ab	11.0 a	14.6 a	34.9 ab	1.1 b
		sawdust	44.8 b	5.6 a	8.6 a	17.1 ab	31.3 a	0.7 a
Rubinda	none	spun-web	57.7 ab	11.3 b	15.8 a	17.3 a	45.1 b	0.8 ab
		linen-felt	48.4 ab	6.2 a	12.0 a	12.7 a	31.7 a	0.6 a
		sawdust	44.8 ab	7.7 ab	11.6 a	15.9 a	35.1 ab	0.8 ab
	limited	spun-web	58.7 b	11.0 a	11.5 a	18.6 a	41.9 ab	0.7 ab
		linen-felt	44.2 a	10.1 a	13.6 a	15.0 a	38.9 ab	0.9 b
		sawdust	49.8 ab	10.1 a	12.0 a	16.4 a	38.4 ab	0.8 ab
Topaz	none	spun-web	37.6 a	10.4 a	15.8 a	10.6 a	36.8 a	1.0 a
		linen-felt	35.0 a	10.9 a	12.9 a	10.9 a	35.8 a	1.0 ab
		sawdust	40.7 a	13.3 a	16.3 a	11.4 a	41.3 a	1.0 ab
	limited	spun-web	39.4 a	21.9 a	14.6 a	12.0 a	47.5 a	1.3 b
		linen-felt	42.0 a	15.4 a	15.9 a	13.4 a	46.4 a	1.1 ab
		sawdust	37.6 a	16.8 a	13.0 a	14.8 a	43.6 a	1.2 ab
Goldstar	none	spun-web	16.9 a	8.3 b	3.3 a	5.6 a	17.2 a	1.0 a
		linen-felt	18.0 a	5.0 a	5.0 ab	6.3 a	16.5 a	0.9 a
		sawdust	20.5 a	5.3 ab	7.1 b	9.4 a	21.9 a	1.0 a
	limited	spun-web	20.9 a	7.2a	6.2 a	7.9 a	20.3 a	1.0 a
		linen-felt	19.3 a	5.7 a	5.5 a	8.3 a	21.0 a	1.0 a
		sawdust	23.5 a	8.2 a	7.2 a	10.8 a	26.0 a	1.2 a
Pinova	none	spun-web	25.6 a	14.0 b	8.5 a	9.5 a	32.7 a	1.2 a
		linen-felt	25.9 a	8.8 a	9.5 a	9.9 a	28.2 a	1.1 a
		sawdust	27.7 a	8.9 a	11.0 a	10.2 a	30.4 a	1.1 a
	limited	spun-web	32.0 a	24.8 a	8.2 a	19.0 b	52.0 b	1.6 b
		linen-felt	30.0 a	18.6 a	10.1 ab	22.0 b	50.8 b	1.7 b
		sawdust	31.3 a	19.7 a	11.4 b	22.4 b	53.5 b	1.7 b
Redkroft	none	spun-web	27.7 a	10.7 a	9.0 a	11.9 a	32.9 ab	1.2 a
		linen-felt	24.8 a	11.6 a	7.0 a	11.8 a	32.0 a	1.3 ab
		sawdust	30.8 a	13.9 a	9.3 a	11.5 a	34.7 ab	1.2 a
	limited	spun-web	28.0 a	18.4 a	9.2 a	13.6 a	41.3 b	1.5 b
		linen-felt	27.6 a	13.9 a	8.4 a	12.2 a	34.5 ab	1.3 ab
		sawdust	31.2 a	17.0 a	7.5 a	12.1 a	36.7 ab	1.3 ab

*Averages followed by the same letter do not differ significantly at p = 0.05 (Duncan's multiple range test)
**In 2007 and 2009 trees produced very low yields because flowers had been seriously damaged by spring frost

Table 3. Trunk cross-sectional area, yield and yielding efficiency index of scab-resistant apple cultivars grown in soil mulched with agricultural spun-web under two protection programmes

Cultivar	Chemical protection	Trunk cross-section area in 2010 [cm^2]	Yield [kg/tree]				Yielding efficiency in 2010 [kg/cm^2 TCA]
			2002-2006	2007-2008**	2009-2010**	2002-2010	
Free Redstar	none	21.3 a*	16.2 a	13.5 a	14.4 a	44.0 a	2.0 a
	limited	22.3 a	19.2 a	14.8 a	11.9 a	45.9 a	2.2 a
Melfree	none	25.7 a	13.4 a	9.7 a	15.7 a	38.8 a	1.6 a
	limited	25.4 a	21.4 b	13.5 b	15.1 a	49.9 b	2.0 b
Gold Milenium	none	42.7 a	16.3 a	20.6 b	19.9 a	56.8 a	1.4 a
	limited	35.8 a	28.0 b	14.0 a	18.1 a	60.1 a	1.7 b

*Explanation: see Table 2

The aim of this thinning was determined by the desire to obtain good quality (size) of fruits that would be accepted by consumers. The low vigour of most trees with pale green leaves was due to the easily visible symptoms of nitrogen deficiency. These quality trees could not produce good yields with a high percentage of fruits with diameter over 7.0 cm. In the last two years of growth (2009-2010), the 'Topaz', 'Goldstar', 'Pinova' and 'Redkroft' grown under the limited spraying programme had a tendency to produce higher yields in comparison with the trees under the no-spraying programme.

After nine years of growth (2002-2010), the 'Topaz', 'Goldstar', 'Pinova', 'Redkroft', 'Free Redstar', 'Melfree' and 'Gold Milenium' grown under the limited spraying programme had a tendency to produce higher yields in comparison with the trees under the no-spraying programme. The 'Gold Milenium, 'Free Redstar' and 'Melfree' grown in the soil mulched with agricultural spun-web, and 'Topaz' and 'Pinova' grown in the soil mulched with the various materials had the highest cumulative yields. The 'Goldstar' and 'Redkroft' grown in the soil mulched with the various materials gave the lowest yields (Tab. 2 and 3). These results are in agreement with earlier reports by Czynczyk et al. (2004, 2008 and 2009), and Sosna (2003). It should be emphasized that the yields of the scab-resistant cultivars 'Gold Milenium', 'Melfree' and 'Free Redstar' obtained in this experiment were much lower than the yields of these cultivars obtained under the integrated management programme (Lewandowski and Żurawicz, 2007). In the USA, Reganold et al. (2001) and Peck et al. (2006) presented results with similar yield values obtained from an organic orchard with 'Gala' trees in comparison with an orchard with an integrated system. The low yielding of some cultivars grown in the soil mulched with sawdust and linen residue-felt resulted probably from nitrogen deficiency in the mulching substrate. Microorganisms breaking up sawdust and linen residue felt absorb a lot of nitrogen from the soil (Mika et al., 1998). A higher productivity of some apple trees grown in the soil

mulched with agricultural spun-web was also found by Mika et al. (1998) and Szewczuk and Gudarowska (2004).

The yielding efficiency index, expressed in kg per 1 cm^2 of trunk cross-section area (TCA), was for the 'Bohemia', 'Rubinola', 'Topaz', 'Goldstar' 'Redkroft' and 'Free Redstar' quite similar for both plots under the limited spraying programme compared with the unsprayed plot. The 'Pinova', 'Melfree' and 'Gold Milenium' had a significantly higher yielding efficiency index in the plots under the limited spraying programme in comparison with the unsprayed plots. The lowest yielding efficiency index in both programmes had the 'Rubinola'.

The mean size and fruit weight of the tested cultivars depended much on the heavy thinning of fruitlets and on the climatic conditions during the growing season. After heavy thinning in 2010, the largest were the fruits of 'Bohemia', 'Topaz' and 'Redkroft'. The smallest fruits were produced by the 'Pinova', 'Free Redstar', 'Gold Milenium' and 'Melfree' (Tab. 4 and 5). The size of the fruits of all the cultivars was too small to satisfy the preferences of Polish consumers. The observed deficit of nitrogen had an enormous effect on fruit quality. These results agree with earlier reports presented by Kühn et al. (2003) and Czynczyk et al. (2004, 2008 and 2009).

Apple scab (*Venturia inaequalis*) was not observed during the first six years. In the seventh year we observed a few scabbed fruits of the 'Pinova' and 'Bohemia'. In 2010, following a very rainy season, we observed for the first time scabbed fruits of the 'Rubinola', 'Topaz' and 'Goldstar'. These results agree with report presented in the same year by Bryk (2010) Fruits of the new scab-resistant cultivars obtained at the Research Institute of Pomology and Floriculture such as: 'Free Redstar', 'Melfree' and 'Gold Milenium' were free from scab infection. The highest number of scabbed fruits was observed in the 'Pinova' and 'Bohemia', partly resistant to apple scab (Tab. 4 and 5). Spraying with Carpovirusine Super SC (once) and Madex 515 SC (twice) limited the percentage of apples damaged by codling moths (*Cydia pomonella*) (Tab. 4 and 5). Powdery mildew (*Podosphaera leucotricha*) was easily controlled by cutting back the infected shoots. Most symptoms of mildew were observed on shoots of the cultivar 'Redkroft'. The greatest problem was aphids (*Dysaphis plantaginea*) control. Cutting back shoots at an early stage of aphid infestation was the most promising method.

During the nine seasons of the experiment the 'Topaz', 'Rubinola', 'Bohemia' and 'Gold Milenium' appeared to be the most suitable for organic fruit production in modern orchards. 'Free Redstar' is also promising for organic orchards. The 'Redkroft' bore large fruits, but the trees were very susceptible to mildew (*Podosphaera leucotricha*). The 'Goldstar' also bore large fruits, but they were susceptible to bitter pit. The 'Pinova' and 'Melfree' grown on the light soil bore fruits which were too small to meet the consumers expectations.

Table 4. Mean fruit weight and the percentage of fruit in terms of fruit size, blush area, damage by codling moth and scab infection in six scab-resistant cultivars grown under two protection programmes involving various mulching materials in 2010

Cultivar	Chemical protection	Mulching material	Mean weight of 100 fruits/kg	Fruits > 7cm Diameter [%]	Percentage of fruits with blush >50% of skin surface	Percentage of fruits with damage by codling moth	Percentage of scabbed fruits
Bohemia	none	spun-web	16.6 a*	76.4 a	80.0 b	2.5	6.5
		linen-felt	15.2 a	69.2 a	80.8 b	6.1	14.4
		sawdust	15.3 a	65.9a	83.0 b	3.8	6.6
	limited	spun-web	16.1 a	72.7 a	81.5 b	2.3	2.9
		linen-felt	16.1 a	69.5 a	80.5 b	6.1	14.4
		sawdust	13.8 a	55.7 a	65.2 a	4.3	8.5
Rubinda	none	spun-web	13.3 a	40.9 a	75.3 a	3.3	0.4
		linen-felt	14.1 ab	51.3 a	81.9 a	2.9	0.2
		sawdust	14.4 ab	50.7 a	68.3 a	2.9	0.0
	limited	spun-web	14.4 ab	50.4 a	75.3 a	4.1	0.0
		linen-felt	15.6 b	61.8 a	75.4 a	4.1	0.0
		sawdust	15.3 b	63.0 a	62.9 a	4.0	0.0
Topaz	none	spun-web	16.0 b	53.2 b	98.6 a	1.9	0.8
		linen-felt	15.3 ab	42.0 ab	98.1 a	2.0	0.3
		sawdust	17.3 b	57.8 b	99.5 a	0.4	0.0
	limited	spun-web	14.9 ab	45.5 ab	94.5 a	0.7	0.5
		linen-felt	13.2 a	23.9 a	93.1 a	0.5	0.2
		sawdust	15.2 ab	44.0 ab	94.3 a	1.5	0.2
Goldstar	none	spun-web	12.7 a	37.4 a	98.8 a	0.4	0.0
		linen-felt	15.2 a	56.8 a	99.4 a	1.2	0.0
		sawdust	15.7 a	63.7 a	99.5 a	0.9	0.0
	limited	spun-web	14.3 a	42.1 a	94.8 a	0.3	0.3
		linen-felt	15.7 a	57.2 a	96.1 a	0.9	0.3
		sawdust	14.6 a	41.6 a	94.3 a	0.4	0.0
Pinova	none	spun-web	9.9 a	14.0 a	98.8 d	0.0	16.8
		linen-felt	10.2 a	12.7 a	93.1 c	0.0	14.2
		sawdust	11.3 ab	20.8 ab	98.4 d	0.5	17.0
	limited	spun-web	12.8 c	38.5 c	90.2 bc	0.4	7.4
		linen-felt	11.9 bc	20.5 ab	82.5 ab	0.5	10.6
		sawdust	12.8 c	34.1 bc	78.0 a	0.9	7.2
Redkroft	none	spun-web	16.5 a	86.5 a	99.7 a	0.7	1.1
		linen-felt	15.2 a	81.3 a	99.8 a	1.6	1.2
		sawdust	13.5 a	73.0 a	98.3 a	0.0	1.3
	limited	spun-web	15.3 a	87.8 a	99.9 a	0.0	0.0
		linen-felt	14.3 a	80.3 a	99.7 a	0.5	0.0
		sawdust	13.9 a	73.0 a	98.7 a	0.3	0.3

*Explanation: see Table 2

Table 5. Mean fruit weight and the percentage of fruit in terms of fruit size, blush area, damage by codling moth and scab infection in six scab-resistant cultivars grown in soil mulched with agriculture spun-web in 2010

Cultivar	Chemical protection	Mean weight of 100 fruits/kg	Fruits >7cm Diameter [%]	Percentage of fruits with blush > 50% of skin surface	Percentage of fruits with damage by codling moth	Percentage of scabbed fruits
Free Redstar	none	11.4 a*	15.1 a	80.7 a	3.6	0.0
	limited	13.4 a	38.6 a	73.7 a	2.6	0.0
Melfree	none	13.7 a	45.2 a	92.5 a	3.7	0.0
	limited	13.6 a	45.3 a	87.8 a	2.6	0.0
Gold Milenium	none	12.6 a	32.4 a	0.1 a	2.8	0.0
	limited	13.2 a	41.4 a	0.0 a	1.8	0.0

*Explanation: see Table 2

REFERENCES

Blażek J. 2004. Response to diseases in new apple cultivars from the Czech Republic. J. FRUIT ORNAM. PLANT RES. 12;241-250.

Bryk H. 2010. Badanie ekologicznych metod ochrony drzew owocowych przed chorobami. Sprawozdanie za rok 2010 z tematu „Dobór odmian dla ekologicznych sadów i doskonalenie ekologicznej ochrony roślin sadowniczych przed chorobami i szkodnikami", s. 33-43.

Czynczyk A., Bielicki P., Mika A., Krawiec A. 2004. Evaluation of apple cultivars for sustainable fruit production. J. FRUIT ORNAM. PLANT RES. 12 (Special ed.): 252-256.

Czynczyk A., Bielicki P., Mika A., Krawiec A. 2005. Growth and yielding of six resistant apple cultivars grafted on three dwarfing rootstocks in integrated production. J. FRUIT ORNAM. PLANT RES. 13: 19-23.

Czynczyk A., Mika A., Bielicki P., Krawiec A. 2008. Suitability evaluation of several apple cultivars for organic fruit production. J. FRUIT. ORNAM. PLANT. RES. 16: 7-15.

Czynczyk A., Bielicki P., Mika A., Krawiec A. 2009. Przydatność trzech rodzajów ściółki do uprawy ekologicznej. Zeszyty Problemowe Postępów Nauk Rolniczych. Proekologiczna uprawa znanych i mniej znanych roślin sadowniczych. 536: 61-71.

Jönsson A, Tahir J. 2004. Evaluation of scab resistant apple cultivars in Sweden. J. FRUIT. ORNAM. PLANT RES. (Special ed.) 12: 223-232.

Kühn B.F., Andersen T.T., Pedersen H.L. 2003 Evaluation of 14 old unsprayed apple varieties. BIOL. AGR. HORT. 20: 301-310.

Kruczyńska D., Czynczyk A., Omiecińska B., Kołodziejek H. 1999. Ocena sadownicza jabłoni polskiej hodowli tolerancyjnych na parcha (*Venturia inaequalis* Che.). VIII Ogólnopolski Zjazd Naukowy – Hodowla roślin ogrodniczych u progu XXI wieku. Lublin, 4-5 lutego 1999, pp. 405-408.

Kruczyńska D. 2007. Odmiany jabłoni i gruszy przydatne do sadów ekologicznych. Ogólnopolska Konferencja Sadownicza. Odmiany i podkładki roślin sadowniczych do upraw ekologicznych. ISK Skierniewice, 21 listopada 2007, pp. 19-23.

Kruczyńska D. 2008. Nowe odmiany jabłoni. Hortpress Sp. z o.o., pp. 214.
Lewandowski M., Żurawicz E. 2007. Plonowanie nowych parchodpornych odmian jabłoni hodowli Instytutu Sadownictwa i Kwiaciarstwa w Skierniewicach na różnych typach podkładek. Rocz. Akademii Rolniczej w Poznaniu. CCCLXXXIII Ogrodnictwo. 41: 333-337.
Mika A., Krzewińska D., Olszewski T. 1998. Effects of mulches, herbicides and cultivation as orchard groundcover management system in young apple orchard. J. FRUIT ORNAM. PLANT RES. 6: 1-13.
Peck G.M., Andrew P.K., Reganold J.P., Fellman J.K. 2006. Apple orchard productivity and fruit quality under organic, conventional, and integrated management. HORT. SCI. 41(1): 99-107.
Reganold J.P., Glover J.D., Andrew P.K., Himman H.K. 2001. Sustainability of three apple production system. NATURE 410: 926-930.
Sosna J. 2003. Growth and cropping of some scab resistant apple cultivars on four rootstocks. FOLIA HORT. ANN. 15/2: 125-129.
Szewczuk A., Gudarowska E. 2004. The effect of different types of mulching on yield, size, color and storability of 'Jonagored' apples. J. FRUIT ORNAM. PLANT. RES. 12: 207-214.
Zmarlicki K. 2010. Produkcja i spożycie owoców z upraw ekologicznych w wybranych krajach świata, stan obecny i perspektywy. XLVI Ogólnopolska Naukowa Konferencja Sadownicza – Nauka Praktyce. Mat. Konf., Ref., pp. 115-118.
Żurawicz E., Lewandowski M., Broniarek-Niemiec A., Rutkowski K. 2004. Preliminary results on the production value of scab-resistant apple cultivars bred at the Research Institute of Pomology and Floriculture (RIPF), Skierniewice, Poland. ACTA HORT. 663: 879-882.

DZIEWIĘCIOLETNIE WYNIKI OCENY PARCHOODPORNYCH ODMIAN JABŁONI DO EKOLOGICZNEJ UPRAWY

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

Dziewięć odmian jabłoni odpornych lub częściowo odpornych na parcha jabłoni: 'Bohemia', 'Rubinola', 'Topaz', 'Goldstar', 'Pinova', 'Redkroft'. 'Free Redstar', 'Melfree' i 'Gold Milenium' szczepione na podkładce M.9 posadzono wiosną 2002 roku w SD w Dąbrowicach w celu określenia przydatności do uprawy ekologicznej.

Kwaterę podzielono na dwie części. W jednej części uprawiano jabłonie bez ochrony chemicznej i herbicydów, a w drugiej stosowano ograniczone zwalczanie szkodników i chorób środkami dopuszczonymi do ekologicznej produkcji owoców w Polsce. Po posadzeniu drzewek glebę wzdłuż rzędów o szerokości 1,2 m wyściółkowano agrowłókniną, płatami lnianymi i trocinami. W okresie 9 lat stwierdzono silne porażenie pni i konarów drzew przez raka drzew owocowych (z rodzaju *Nectria* sp.). Z tego powodu wypadło i porażonych zostało wiele drzew. Najbardziej podatne okazały się 'Rubinola', 'Topaz', 'Redkroft', i 'Pinova'. Najmniejsze nekrozy stwierdzono u drzew 'Free Redstar', 'Melfree' i 'Gold Milenium'. Różne rodzaje ściółki nie wywierały wpływu na wielkość plonów. Największe plony zebrano z drzew odmian Free Redstar, Topaz i Pinova. W 2010 roku po bardzo deszczowym sezonie po raz pierwszy stwierdzono objawy parcha na owocach 'Rubinola', 'Topaz' i 'Goldstar'. Najtrudniejsze do zwalczania okazały się mszyce i mączniak jabłoni. Wczesne wycinanie porażonych pędów skutecznie zabezpieczało drzewa. Odmiany Topaz, Rubinola, Bohemia i Gold Milenium okazały się najbardziej przydatne do uprawy w sadach ekologicznych. W 2010 roku silne przerzedzenie zawiązków odmian Bohemia, Topaz i Redkroft sprzyjało uzyskiwaniu dobrze wyrośniętych owoców o średnicy powyżej 7,0 cm.

Słowa kluczowe: ekologiczna produkcja owoców, jabłka, odmiany parchoodporne, wrażliwość na raka drzew owocowych, wielkość drzew, owocowanie