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EFFECTS OF SPRING FROSTS IN SELECTED APPLE AND PEAR ORCHARDS IN THE LUBLIN REGION IN THE YEARS 2000, 2005 AND 2007

Part I. Experiment at EF Felin
Part II. Selected production orchards

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Summary

Data concerning the effect of spring frosts on the survival of flower buds of several apple and pear cultivars, as well as on the damage caused by spring frosts to apple fruit are presented in the present paper. Observations were conducted in experimental and commercial orchards in the Lublin area in the years 2000, 2005 and 2007. The lowest temperature in spring in the consecutive years occurred on the following dates: 2000 – 3rd and 4th May, 2005 – 1st April and 22nd May, and 2007 – 2nd and 4th May. The most serious damages of buds were found in apple trees of Red Boskoop, Rubin and Jonagold cvs. grown in the experimental orchard in Felin (Lublin) (this was an average value for the years 2000 and 2007), whereas the buds of the late flowering cultivars of Golden Delicious Smoothee, Royal Gala and Ligol survived with significantly lesser damages. These observations generally confirmed those made in commercial orchards in 2005 and 2007, in which buds of cv. Elise also showed high resistance to spring frosts. Pear trees of cv. Concorde showed low damage to flower buds in 2007 and produced a reasonably good crop. Fruits of cv. Jonagold and its mutations Wilmuta, Jonica, Decosta and Rubinstar proved to be very sensitive to spring frosts, as well as fruits of cv. Lired. The positive influence of the Polish rootstock P60 on flower bud survival was observed in the year 2000. However, this was not confirmed in 2007, thus further observations are necessary to check these effects.

Key words: apple, pear, cultivar, spring frosts, flower buds

INTRODUCTION

Spring frosts – their causes, occurrence, damage they cause in orchards and methods of prevention – are the subject of numerous scientific and popular studies. Extensive information on the subject has been presented recently by Hołubowicz (2006) and Treder (2008). Spring frosts and their effects in the region of Podkarpacie have been described by Kołodziejczak and Mika (1984/1985), and in the Lublin region – by Lipecki et al. (1991) and more recently by Lipa et al. (2007). The year 2007 provided supporting evidence for the importance of the problem of spring frosts in Polish orchards (Czynczyk, 2008).

The objective of this study was to determine the effect of spring frosts on flower buds and fruits of apple and pear trees on the example of several orchards in the region of Lublin. The studies were conducted in the orchard at the Experimental Farm at Felin (Part I) as well as in several production orchards (Part II).

MATERIALS AND METHODS

Part I of the study comprised observations of damage caused by spring frosts in an experiment involving 8 apple tree cultivars (Ligol, Golden Delicious Smoothee, Rubin, Red Boskoop, Jonagold, Elstar Elshof, Šampion and Royal Gala) budded on 7 rootstocks: P2, P14, P22, P59, P60, M.9 and M.26. The trees were planted in the spring of 1995 at the EF in Felin, at 3.5 x 2 m spacing. Every cultivar x rootstock combination was represented by 12 trees. Trees of each of the cultivars grew in a separate row, with the same sequence of rootstocks (schematic 1).

Schematic 1.

Hedge

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x P60	**x P60**	**x P60**	**x P60**	**x P60**	**x P60**	**x P60**	**x P60**
x P59	**x P59**	**x P59**	**x P59**	**x P59**	**x P59**	**x P59**	**x P59**
x M.26	**x M.26**	**x M.26**	**x M.26**	**x M.26**	**x M.26**	**x M.26**	**x M.26**
x P2	**x P2**	**x P2**	**x P2**	**x P2**	**x P2**	**x P2**	**x P2**
x P14	**x P14**	**x P14**	**x P14**	**x P14**	**x P14**	**x P14**	**x P14**
x P22	**x P22**	**x P22**	**x P22**	**x P22**	**x P22**	**x P22**	**x P22**
x M.9	**x M.9**	**x M.9**	**x M.9**	**x M.9**	**x M.9**	**x M.9**	**x M.9**
Ligol	**Šampion**	**Rubin**	**Royal Gala**	**Red Boskoop**	**Jonagold**	**Elstar**	**Smoothee**

* Each cultivar x rootstock combination was represented by 12 trees.

From the west, the orchard is shielded by a single-row hedge of Mahaleb Cherry, ca. 3-4 m high. Observations of damage caused by spring frost were made in 2000 and 2007. Air temperature patterns in the periods of occurrence of spring frosts are presented in Table 1, based on data from the Meteorological Station of the Department of Agro-meteorology, University of Life Sciences, located at the Felin EF. Table 1 relates to both parts of the study. As follows from the data in the Table 1, in the spring of 2000 there were two periods with low temperatures – at the beginning of May and again on the 8th of May, during full bloom or at the end of blooming of the trees. In 2005 large drops in temperature took place on 22nd of April and again on 23rd of May, but those did not cause any damage in the orchard at Felin. In 2007 the lowest temperature occurred on 2nd May, i.e. before the blooming of the trees; spring frosts were also observed at the end of April. The orchard at the Felin EF lies on an almost flat terrain. Damage caused by low winter temperatures and spring frosts are not particularly extensive, e.g. during the extremely severe winter of 1986/1987 not a single apple tree was lost in the orchard due to frosts.

In both of those years, inflorescences were collected in mid-May, from the same side of the successive trees growing in a row, from a height of ca. 100 cm, taking 20 inflorescences from each cultivar x rootstock combination. In total, estimations were made for 5604 flowers in 2000 and 5336 in 2007. The results were expressed in percentages of frozen flowers and processed statistically using analysis of variance and estimating the differences between the cultivars and rootstocks by means of Duncan's test at 5% error probability. The results are presented in Tables 2, 3 and 4.

Part II is concerned with observations made in 2 production orchards in the region of Lublin – in Rudnik, located at a distance of about 5 km from Felin, and in Stryjno, about 30 km from Felin. The studies

Table 1
Temperature at Felin EF on days with frost in the years 2000, 2005 and 2007 (°C).

Date of frost	2000		Date of frost	2005		Date of frost	2007	
	at 5 cm	at 2 m		at 5 cm	at 2 m		at 5 cm	at 2 m
2.V	-2.8	2.2	1.IV	-6.2	-2.6			
3.V	-9.5	0.0	2.IV	-2.2	-1.3	30.IV	-1.6	0.6
4.V	-7.2	2.5	3.IV.	-0.8	-0.4	1.V	-3.3	-1.3
5.V	-4.5	5.5	4.IV	-0.5	0.7	2.V	-6.1	-2.2
6.V	-1.0	6.2	21.IV	-3.0	-1.6	3.V	-0.5	4.3
7.V	-3.5	6.0	22.IV	-6.8	-3.2	4.V	-3.6	-0.1
8.V	-4.5	4.5	23.IV	-2.1	-1.2	5.V	-1.0	3.0
13.V	-3.5	-3.0	24.IV	-4.8	-3.3			

were conducted in the years 2005 and 2007, for numerous cultivars of apple and pear trees (the latter only in Rudnik, in 2007), taking into account the relief of the terrain, but not the rootstocks (dominant were M.9 and M.26). The trees were at full fruit-bearing, ca. 10 years old, and only in the case of new cultivars the trees were younger. Estimations were made based on at least 50 inflorescences, collected at a height of about 150 cm. During the harvest in 2005, in the same orchards, observations were conducted of damage to apples caused by spring frost, on the basis of at least 200 random-selected fruits. The results were not processed statistically.

RESULTS

Part I

In 2000 the highest rate of frozen flower buds was recorded for cv. Jonagold, followed by Golden Delicious Smoothee and Elstar, and flower buds of cv. Ligol turned out to be the most resistant. The lowest numbers of frozen flower buds were found on trees of all the cultivars inoculated on rootstock P60. This could have been an effect of the location of the trees growing on that rootstock (schematic 1), however, the same cultivars growing on rootstock P59, the next row, displayed the most extensive frost damage. The results are given in Table 2.

Table 2
Effect of cultivar and rootstock on the percentage of frozen flower buds – Felin EF, 2000.

Cultivars	Rootstocks							
	M.9	P22	P14	P2	M.26	P59	P60	Mean
Ligol	14.3	32.0	8.4	11.7	19.4	19.6	3.0	15.5 a
Šampion	53.0	40.7	20.0	39.1	36.1	35.5	4.4	32.7 b
Rubin	40.4	42.7	32.6	30.9	42.2	37.2	8.5	33.5 b
Gala Royal	35.2	21.6	29.4	52.4	51.8	38.7	2.7	33.1 b
Red Boskoop	38.6	62.9	34.9	47.7	44.1	83.3	3.8	45.0 bc
Jonagold	43.5	56.3	68.1	62.9	67.3	68.3	40.2	58.1 c
Elstar	52.9	66.7	63.2	63.5	54.8	53.2	23.6	54.0 c
Golden Delicious*	61.2	49.5	53.9	72.4	54.4	63.7	33.3	55.5 c
Mean	42.4 b	46.6 b	38.8 b	47.6 b	46.3 b	49.9 b	14.9 a	

*'Smoothee'; Note: mean values followed by the same letter do not differ significantly at 5% error probability acc. to Duncan`s test.

The results of observations made in 2007 did not support those of 2000. No significant effect of the rootstocks on flower bud damage was found, and the difference between the best (M.26) and the worst (P2) rootstock was 6.1%. It should be emphasized, however, that rootstock P60 was inferior to M.26 by only 0.5%. A comparison of the cultivars showed that in 2007 the least frost damage was sustained by flower buds of cv. Golden Delicious Smoothee, and the differences between that cultivar and the remaining ones were significant, with the exception of cv. Gala. The most frozen flower buds were observed on the trees of cv. Red Boskoop which differed significantly from all other cultivars with the exception of cv. Rubin (Tab. 3).

Table 3
Effect of cultivar and rootstock on the percentage of frozen flower buds – Felin EF, 2007.

Cultivars	Rootstocks							
	M.9	P22	P14	P2	M.26	P59	P60	Mean
Ligol	12.1	15.7	27.6	30.8	33.3	26.9	38.1	26.4 de
Šampion	13.3	14.1	14.7	11.0	13.6	23.8	22.9	16.2 bc
Rubin	55.0	33.7	29.7	42.2	15.7	44.4	15.5	33.7 ef
Gala Royal	7.8	10.2	4.6	5.4	7.1	11.0	13.4	8.5 ab
Red Boskoop	57.3	49.0	43.3	34.4	37.4	43.8	16.1	40.2 f
Jonagold	18.1	29.4	17.8	33.3	20.4	24.5	19.0	23.2 cd
Elstar	16.3	19.4	12.2	33.3	10.1	8.7	19.1	17.0 bc
Golden Delicious *	1.8	0.9	0.0	0.0	3.6	0.0	1.7	1.1 a
Mean	22.7a	21.6a	18.7a	23.8a	17.7a	22.9a	18.2a	

In terms of mean values for the two years, the least damage was sustained by flower buds of the cultivars Royal Gala and Ligol, and the greatest – by those of the cultivars Red Boskoop and Jonagold; the differences between these cultivars were proven. The percentage of frozen flower buds was the lowest on the trees growing on rootstock P60 (average for both years and all cultivars), and the differences relative to the other rootstocks were significant. The poorest results were obtained on rootstock P59, but the difference between that rootstock and the other ones (except for P60) was not statistically proven (Tab. 4).

Table 4
Effect of cultivar and rootstock on the percentage of frozen flower buds – Felin EF, mean for 2000 and 2007.

Cultivars	Rootstocks							
	M.9	P22	P14	P2	M.26	P59	P60	Mean
Ligol	13.2	23.8	18.0	21.2	26.3	23.2	20.5	20.9 a
Šampion	33.1	27.4	17.3	25.0	24.8	29.6	13.6	24.4 ab
Rubin	47.7	38.2	31.1	36.5	28.9	40.8	12.0	33.6 bc
Gala Royal	21.5	15.9	17.0	28.9	29.4	24.8	8.0	20.8 a
Red Boskoop	48.0	56.0	39.1	41.0	40.7	63.5	10.0	42.6 c
Jonagold	30.8	42.8	42.9	48.1	43.8	46.4	29.6	40.6 c
Elstar	34.6	43.0	37.7	48.4	32.4	30.9	21.3	35.5 bc
Golden Delicious *	31.5	25.2	26.9	36.2	29.0	31.8	17.5	28.3 ab
Mean	32.6 b	34.0 b	28.7 b	35.7 b	31.9 b	36.4 b	16.6 a	

* Golden Delicious Smoothee

Table 5

Percentage of frozen flower buds and damaged apples in relation to orchard location. Rudnik.

Cultivars	2005				2007	
	% of frozen flower buds		% of damaged fruits		% of frozen flower buds	
	valley	hill	valley	hill	valley	hill
Ariwa		29.3		19.3		
Cameo						30.3
Cortland		28.5				87.3
Decosta		32.1	87.7	40.4		23.2
Delbarestivale		6.0		5.6		30.2
Delikates				59.6		
Discovery		14.9				
Elise		16.9				23.4
Elstar Elshof		21.4		36.7		23.1
Fuji B.S						12.9
G. Delicious Reinders		18.2		33.3		5.1
Gala Must		15.3		14.3		23.7
Gala		17.5				
Galaxy		10.8		39.0		51.3
Gloster		1.4		61.4		52.7
Granny Smith		9.2		23.1		
Honeycrisp						11.4
Jester		12.2		12.1		
Jonagold						41.5
Jonica		19.8				
Ligol		5.5		10.2		27.7
Lired	85.7	26.0		57.0		47.2
Lobo	19.7		35.5	9.5	83.3	50.0
Lodel		30.0		7.4		51.8
Melodie		5.2		23.9		
Odra				18.2		
Paulared		29.9	38.1	16.5	90.1	60.1
Pilot		14.8		78.4		
Pinova		22.7		36.0		
Primegold				43.2		
Rubin		41.5		34.7		63.4
Rubinette		3.7				
Rubinstar		34.5				51.9
Šampion		19.5		13.6		73.6
Summerred				55.7		
Topaz	69.2	37.6	30.3			58.2
Wilmuta		28.7				60.7

Part II

2005, Rudnik

The highest percentage of damaged flower buds was recorded in the case of the cultivars from the Jonagold group (Decosta, Wilmuta and Rubinstar), as well as cv. Rubin. Fewer damaged buds were observed for the cultivars Šampion, Golden Delicious Reinders, Elise and Jester, and the least – for Gloster and Ligol. Among the new or little known cultivars, a relatively low rate of frost damage was observed for Gala and its mutations – Galaxy and Must, and for the cultivars Delbarestivale, Rubinette and Melodie, and notably greater in the case of the cultivars Topaz, Ariwa, and also Pinova. A high percentage of damaged flower buds was observed among the cultivars considered to be resistant to low temperatures (Lobo, Paulared, Cortland). There would also a notable effect of ground relief on the rate of frost damage to flower buds of the cultivars Topaz, Lired, Jonagold Decosta, Paulared and Lobo – on the trees growing in the valley, the damage rate was much higher than on the trees growing on the hill. This was confirmed by analysis of frost damage to fruits: on the trees growing at low-positioned stands the percentage of russeted fruits varied depending on the cultivar, from 9.5 (Lobo) to 57.0 (Lired). Fruits of the cultivars Šampion, Ligol, Delbarestivale, Jester, Gala Must, Ariwa and Odra proved to be the most resistant to frost, Rubin, Elstar Elshof, Golden Delicious Reinders, Pinova and Galaxy turned out to be more sensitive, and Jonagold Decosta and Lired – the most. A high percentage of frost damaged fruits were found on the trees of cv. Gloster. Apples of cv. Elise were more strongly russeted than in other years, but the damage was not localized within the stalk pit, but was found on various parts of the fruit. A similar phenomenon was also observed in the case of cv. Primgold.

2005, Stryjno

Here, the results of observations were largely consistent with those obtained in the orchard at Rudnik. The effect of ground relief was observable in the case of the cultivars Jonagold, Jonagold Decosta, Bohemia, and to a lesser extent – Šampion and Ligol. Flower buds of the cultivars Boskoop, Early Geneva and Topaz sustained frost damage in a notable percentage, those of Golden Delicious Reinders and McIntosh to a lesser extent, and to the least– those of Gloster, Šampion, Pinova, Elise, Idared, and also Mutsu (Tab. 6). Damage to apples was less pronounced than in Rudnik (Tab. 5), but it was also most noticeable on fruits of the Jonagold group of cultivars. Russeting on apples of cv. Gloster, Golden Delicious Reinders, Bohemia and Elise varied within the range of about a dozen percent, with the lowest presence on fruits of cv. Gala, Lobo, Pinova and Šampion.

2007, Rudnik

The studies performed at the end of April showed the highest rate of frost damage in the case of pear trees cv. Klapsa, Konferencja and Bera Hardy (ca. 80% of damaged flower buds), and the lowest for the cultivars Concorde and Lukasówka. Following the frost on 2nd May, the percentage of damaged flower buds of sensitive cultivars increased only slightly, while frost damage notably greater than before was observed in the case of flower buds of cv. Lukasówka. No such observations were repeated for trees of cv. Concorde, but their fruit-bearing was nearly normal and the fruits did not display any damage, even though the frost occurred during the full blooming period of the trees of that cultivar. Data concerning pears are not included in the tables.

At the end of April, the highest percentage of frozen flower buds was recorded in the case of apple trees cv. Cortland and Lobo growing in a depression, and of cv. Šampion, but primarily in the case of Topaz. The lowest rate of damage – among the cultivars examined on that date – was observed for cv. Ligol.

Following the frost of 2nd May, flower bud damage reaching 80-90% was found in the case of the cultivars Cortland, Paulared and Lobo (all growing in a depressed area), losses in the range of 60-70% - for the cultivars Paulared (on a hill), Rubin, Šampion and Jonagold Wilmuta, within the range of 50-60% – for Lodel, Lobo (on a hill), Gloster and Galaxy. The lowest number of damaged flower buds was observed in the case of Golden Delicious Reinders, somewhat greater (ca. 20%) – for Elise, Ligol, Gala Must and Jonagold Decosta, followed by Delbarestivale. A low damage rate was also noted on the trees of new cultivars (in the 2nd year after planting): Fuji Beni Shogun and Honeycrisp.

Damage to fruits was not studied; it was relatively rare, even in the case of the very frost-sensitive cultivar Lired, and appeared sporadically on apples from the Jonagold group of cultivars, in the form of russeting around the calyx.

2007, Stryjno

On average, the rate of damage caused by spring frosts was lower here than in Rudnik. The favourable effect of orchard location on a hill rather than in a valley was confirmed for almost all the cultivars grown there. The notable exception was cv. Braeburn Hillwell, but those were trees in the 2nd year after planting. On

Table 6
Percentage of frozen flower buds and damaged apples in relation to orchard location. Stryjno.

Cultivars	2005				2007	
	% of frozen flower buds		% of damaged fruits		% of frozen flower buds	
	valley	hill	valley	hill	valley	hill
Bohemia	44.2	11.7	11.7		45.0	
Boskoop		45.2				87.7
Braeburn Hillwell					24.2	37.9
Braeburn Helena					19.9	16.9
Decosta	36.5	9.1	24.4	22.1	59.1	26.7
Early Geneva		38.1			73.1	48.7
Elise		6.3		19.7	11.6	5.8
G. Delicious Reinders		20.8		19.5	26.5	5.1
Gala		17.1		3.1		
Gloster		5.3		15.7		26.0
Idared		10.4			70.0	54.1
Jonagold	33.6	10.9	27.7	19.6	24.3	9.9
Jonagored		12.2				
Jonica		9.5		24.5	26.9	25.2
Ligol	14.9	4.2	12.0		19.9	13.1
Lobo		6.9		5.4	46.4	29.5
McIntosh		21.0				69.4
Mutsu		13.5			24.1	13.6
Pinova		7.1		2.1		21.4
Rubinstar		17.6				8.5
Šampion	9.9	8.0	9.8	8.2	29.8	21.3
Topaz		36.2				51.2

average, for both orchard locations, the lowest rate of frost damage was found for flower buds of the following cultivars: Elise (8.3%), Golden Delicious Reinders (15.8%), Ligol (16.4%), Jonagold (17.1%) and Mutsu (18.8%), and the highest – for Idared (62.5%), Early Geneva (61.4%) and Bohemia (45.8%). Good results were obtained for cv. Braeburn – the mean percentage of damaged flower buds, for both locations and mutations, was 24.7. Noteworthy is the varied response of the cultivars from the Jonagold group – the lowest rate of frost damage was displayed by the standard Jonagold (17.1%), followed by Jonica (26.0%), and the highest was recorded for Decosta (42.9%). Flower buds of the cultivars Pinova (on the hill) and Gloster (in the valley) withstood frost well, while McIntosh and Boskoop, both in the valley, performed notably worse.

DISCUSSION

Flower buds or flowers of various fruit tree cultivars that begin their vegetation late and are late to bloom are less exposed to spring frost damage than early-blooming cultivars (Krzewińska et al. 2003, Hołubowicz, 2006; Treder, 2008, Aygun and San, 2005). This was confirmed by the observations made at the Felin EF in 2000 and 2007: on average, for both the years (Tab. 4), the lowest rate of frost damage was observed for trees with medium-late blooming acc. to Kruczyńska (2002), such as Golden Delicious Smoothee and Royal Gala, and the highest for earlier blooming cultivars (Red Boskoop, Rubin). Flower buds of cv. Golden Delicious Smoothee, with the late spring frost of 2000, sustained extensive damage, and in 2007 they showed nearly zero losses (blooming of that cultivar began after 4th May). Aygun and San (2005) also observed low sensitivity of that cultivar to spring frost, attributing it to its late blooming time. Flower buds of cv. Ligol (with medium-early blooming) sustained more extensive frost damage in 2007, when spring frost occurred earlier than in 2000. Perhaps the reason was the individual response of flower buds of that cultivar to the date of spring frost occurrence. Kruczyńska (2002) reports that flowers of cv. Gala have naturally low sensitivity to spring frost, which was confirmed by the results obtained in this study. Hołubowicz and Skowroński (1987) demonstrated seasonal variability of frost hardiness of flower buds of the cherry tree cv. Łutówka, and Gonkiewicz (2007) observed slight differences in the response of flower buds of plum tree cultivars to low temperatures in the winter season. Noteworthy is the high sensitivity to spring frost of flower buds of one of the main apple cultivars in Poland – Jonagold. The results obtained in this study are largely in conformance with preliminary estimations of losses caused by spring frost in 2007 in various regions of Poland (Czynczyk, 2008).

The effect of ground relief on the extent of damage caused by spring frosts is also consistent with the references (Hołubowicz, 2006; Treder, 2008).

The effect of rootstocks on the level of frost damage is arguable and the present study did not provide explicit results. Rootstock P60 did have a significantly favourable effect on the resistance of flower buds to spring frost in 2000, but that could have been a result of the positioning of the trees growing on that rootstock within the orchard (schematic 1) and was not confirmed in 2007. Szczygieł and Czynczyk (2002), under the conditions of the Podkarpacie region, did not find any effect of rootstocks P2, P60 abd P22 on the rate of frost damage to flowers of apple tree cultivars Ligol, Jonica and Fiesta, but the rate of that damage was low and concerned only 2.3 – 12.0% of flower buds. Jakubowski (1997) reports that rootstock P2 delays the blooming of cultivars grafted on it, so it may cause an increase in their frost hardiness, but that was not supported by the results obtained in this study. The effect of rootstocks on frost hardiness of apple tree shoots (cv. Jonagold, among others) was slight (Gruca, 1999), similarly to that observed in the study by Quamme and Brownlee (1997). Kurlus (2005) demonstrated an effect of rootstocks on spring frost damage to cherry ovaries, but he did not find any effect of rootstocks on the time and course of blooming, like Kamio et al. (2006) in the case of peach trees and Lang et al. (1997) in the case of cherry trees.

CONCLUSIONS

1. In the orchard at the Felin EF, significant differentiations were found among the cultivars in the response of flower buds to spring frost. The differences resulted from individual resistance of the cultivars to temperature drops, as well as from differences in their time of blooming and in the time of occurrence of spring frost. On average, in the years 2000 and 2007, the lowest rate of frost damage to flower buds was observed in the case of the cultivars Ligol and Royal Gala, and the highest – for the cultivars Red Boskoop and Jonagold.
2. Flower buds and fruits on trees growing on hills were less prone to frost damage than on trees growing in lower-positioned stands.
3. In the production orchards, the cultivars least damaged by spring frost included Ligol, Gala, Golden Delicious, Elise and Gloster, and the most damaged – Boskoop, Bohemia, Rubin and Topaz. Flower buds and fruits of cv. Šampion proved to be fairly tolerant of spring frost effect, and notably greater damage was observed on apples of cv. Jonagold and its mutations, and on flower buds of cv. Idared. The response of flower buds and fruits of cv. Jonagold mutations to spring frost was notably differentiated.
4. In 2007, in the orchard in Rudnik, frost damage to certain pear tree cultivars (e.g. Concorde) was slight, even though the spring frost occurred during full bloom of that cultivar; other pear tree cultivars were frost damaged to a degree similar to that of apple trees.
5. The determination of the effect of rootstocks on damage caused by spring frost requires further observations; the specific positioning of the trees of 8 cultivars in the Felin orchard on rootstock P60 does not permit the formulation of any explicit conclusions.

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Przymrozki wiosenne w sadach jabłoniowych i gruszowych w rejonie Lublina w latach 2000, 2005 i 2007

Streszczenie

W pracy przedstawiono wyniki obserwacji uszkodzeń pąków kwiatowych i owoców niektórych odmian jabłoni i gruszy, przez przymrozki wiosenne w latach 2000, 2005 i 2007 w sadzie doświadczalnym w GD Felin i w sadach produkcyjnych. Najniższe temperatury występowały w końcu kwietnia lub w początku maja: 2000 roku w dniu 3 i 4 maja, 2005 – 1 kwietnia i 22 maja, 2007 – 2 i 4 maja.

Obserwacje w sadzie GD Felin prowadzono w doświadczeniu stacjonarnym, założonym w roku 1994. Średnio za lata 2000 i 2007 (w roku 2005 uszkodzeń praktycznie nie było) najwrażliwsze okazały się pąki odmian Red Boskoop, Rubin i Jonagold, a najmniej uszkodzeń stwierdzono w przypadku później kwitnących odmian Golden Delicious Smoothee, Rogal Gala, a także Ligol. Obserwacje wykonane w sadach produkcyjnych w latach 2005 i 2007 ogólnie potwierdziły powyższe wyniki; stwierdzono ponadto małe uszkodzenia przymrozkowe pąków odmiany Elise. Odmiana gruszy Concorde, która podczas przymrozku w roku 2007 była w pełni kwitnienia, plonowała prawie normalnie, dając nie uszkodzone owoce. Jabłka odmian Jonagold i jego mutacji (Wilmuta, Jonica, Decosta, Rubinstar) oraz Lired okazały się najbardziej wrażliwe na wiosenny przymrozek, wykazując silne ordzawienia. Pozytywny wpływ podkładki P60 na odporność pąków na przymrozek stwierdzony w roku 2000, nie został potwierdzony w roku 2007, wobec czego problem ten wymaga dalszych obserwacji.