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DISEASES OF PEA ON NEWLY REGISTERED CULTIVARS

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Abstract

During 2002–2005 21 pea (*Pisum sativum*) cultivars recently registered in Poland were evaluated under natural field conditions for intensity of infestation by *Peronospora viciae* f.sp. *pisi*, *Fusarium* spp. and viruses in 12 localities scattered in the main regions of the plant cultivation. Out of 14 edible cultivars 'Terno', 'Phönix', 'Zekon' and 'Bohun' proved less susceptible to downy mildew caused by *P. viciae* f.sp. *pisi*, while 'Sokolik' was the only one less infected out of seven fodder cultivars. Plants were more affected in Central and North-West Poland in growing seasons of cooler and more rainy spring of 2004 and 2005. No statistically significant differences in intensity of foot and root blight caused by *Fusarium* spp. on edible and fodder cultivars were noted. *Fusarium solani* was mainly responsible for the blight. The cultivars were the most infected in North-East part of the country in 2005. The 2004 weather conditions did not favour the foot and root blight development. Only fodder cultivars 'Wiato' and 'Zagłoba' were significantly less infected by viruses. Intensity of viral diseases was the highest in 2002, with only occasional infections in 2003. Based on symptoms *Pea enation mosaic virus* (PEMV) dominated on plants. Viral diseases occurred mainly in Central-East and some localities of Central Poland.

Key words: pea, diseases intensity, downy mildew, cultivar response, *Fusarium*, viruses, environment

Introduction

Field observation of pea (*Pisum sativum*) in the 1970-ties pointed to importance of *Fusarium* diseases in various regions of Poland (Czyżewska 1984, Filipowicz 1983, Furgał-Węgrzycka 1984). Results of these studies showed differences in susceptibility of cultivars to *Fusarium* spp. *Mycosphaerella pinodes*, *Ascochyta pisi* and *Phoma pinodella* were responsible for Ascochyta blight – a disease occurring on pea in many

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seasons (Filipowicz 1993, Marcinkowska 1997 b, 2002). Downy mildew caused by *Peronospora viciae* f.sp. *pisi* was noted more commonly in the 1990-ties (Marcinkowska 1997 a, b, 2002). Marcinkowska (1997 a) evaluated infection of pea genotypes under field conditions and found differences in their reaction to this pathogen.

Recently several Polish and foreign cultivars of pea were registered. It was of great interest to study reaction of these new cultivars to common in Poland pathogens. The objective of the study was evaluation of intensity of downy mildew, Fusarium foot and root blight and viral diseases on those cultivars under natural environment of main regions of pea cultivation.

Material and methods

Evaluation of diseases intensity was conducted in 2002–2005 at 12 experimental stations of Research Centre for Cultivar Testing at Słupia Wielka scattered in Central, Central-East, North-East, Central-West, North-West and Central-North parts of Poland (Table 1).

Two registration trials, one of 14 edible cultivars (Table 2) requiring rich soils and seven used mainly for fodder (Table 3) suitable for production on light soils, were evaluated, each at seven localities (Table 1). Eight edible cultivars were of Polish breed and registered between 1995 and 2005 (Table 2). Three bred in Germany and two from Czech Republic were registered in 2005 and 2006. Cultivar 'Hardy', of French origin, was not registered. Cultivars: 'Ramrod', 'Set', 'Tarchalska', 'Turkus' and 'Baryton' were evaluated during four growing seasons,

Table 1

Location of experiments

Part of Poland	Locality		Cultivar tested (+) in locality	
	situated near	No. and name	edible	fodder
Central-East	Biała Podlaska	1. Cicibór	+	+
North-East	Łapy	2. Krzyżewo	+	–
	Łomża	3. Marianowo	–	+
Central	Warsaw	4. Kawęczyn	+	+
	Piotrków Trybunalski	5. Sulejów	+	–
	Wieluń	6. Masłowice	–	+
	Kalisz	7. Kościelna Wieś	+	–
Central-West	Świebodzin	8. Lubinicko	–	+
North-West	Wągrowiec	9. Bobrowniki	–	+
	Chojnice	10. Wyczechy	–	+
Central-North	Bydgoszcz	11. Chrząstowo	+	–
	Tczew	12. Radostowo	+	–

Table 2

Intensity of *Peronospora viciae* f.sp. *pisi* infestation on edible pea cultivars at seven localities in 2002–2005 (means of infection degree (ID) for three factors)

No. and name	Cultivar		Locality	
	year of registration	ID	name	ID
1. 'Terno'[cz]	2006	1.10 a	Cicibór	1.32 a
2. 'Phönix'[g]	2005	1.38 ab	Kawęczyn	1.61 b
3. 'Zekon'[cz]	2005	1.51 b	Kościelna Wieś	1.69 b
4. 'Bohun'	2005	1.57 bc	Radostowo	1.69 b
5. 'Santana'[g]	2005	1.69 cde	Krzyżewo	1.74 bc
6. 'Hardy'[f]	not registered	1.72 cde	Chrząstowo	1.92 c
7. 'Baryton'[g]	2005	1.74 cde	Sulejów	2.24 d
8. 'Set'[nor]	2000	1.82 def	$LSD_{0.05}$	0.19
9. 'Tarchalska'	2004	1.86 ef	Year	
10. 'Kuroch'	2005	1.91 efg		ID
11. 'Turkus'	2001	1.95 efg	2003	1.03 a
12. 'Kolia'[nor]	1999	1.95 efg	2002	1.57 b
13. 'Wenus'	2003	2.03 fg	2004	2.11 c
14. 'Ramrod'	1995	2.16 g	2005	2.26 c
$LSD_{0.05}$		0.26	$LSD_{0.05}$	0.16

Cultivars bred in: [cz] – Czech Republic, [g] – Germany, [f] – France.
[nor] – normal-leaved (conventional) cultivar.
Homogeneous groups marked with the same letter in the same column are not significantly different at $\alpha = 0.05$.

Table 3

Intensity of *Peronospora viciae* f.sp. *pisi* infestation on fodder pea cultivars at seven localities in 2002–2005 (means of infection degree (ID) for three factors)

Cultivar			Locality		Year	
No. and name	year of registration	ID	name	ID		ID
1.'Sokolik'	2001	1.34 a	Lubinicko	1.09 a	2003	1.26 a
2. 'Pomorska'	2000	1.66 b	Masłowice	1.58 b	2002	1.67 b
3. 'Zagłoba'[nor]	2000	1.75 b	Cicibór	1.71 bc	2004	2.09 c
4. 'Milwa'	1998	1.79 bcd	Kawęczyn	1.94 cd	2005	2.17 c
5. 'Wiato'[nor]	2005	1.88 bcd	Marianowo	2.03 d	$LSD_{0.05}$	0.21
6. 'Koliber'[nor]	2005	2.05 cd	Bobrowniki	2.06 d		
7. 'Hubal'[nor]	2005	2.13 d	Wyczechy	2.19 d		
$LSD_{0.05}$		0.31	$LSD_{0.05}$	0.28		

Explanation – see Table 2.

while nine other for three years. The second group of cultivars, for fodder, were of Polish origin, registered between 1998 and 2005 (Table 3). 'Hubal', 'Wiato' and 'Zagłoba' were tested four growing seasons and four other cultivars three years.

Observations were performed by the end of blooming period – starting from the middle of June and covering the first decade of July, depending on locality. A plot of 13.86 m^2 was replicated five times for each treatment. Intensity of disease was noted on each plot.

Downy mildew was estimated in infection degrees (ID), 0–5, based on characteristic symptoms, as follows: 0 – no symptoms, 1 – a few spots, up to 10% of the leaf area of plants on a whole plot, 2 – up to 25% of the leaf area covered by spots, up to 5% pods on a plot with symptoms and up to 5% systemically infected plants on a plot, 3 – leaf area up to 50% with spots, up to 15% infected pods and up to 10% systemically infected plants, 4 – spots on leaf area up to 75%, infected pods up to 25% and systemically infected plants up to 15%, 5 – all plants showed spots covering nearly all the leaf area, up to 50% of infected pods and up to 25% of systemically infected plants (Marcinkowska 1997 b).

The reason of yellowing and drying of plants was primarily examined in fields. The plants with foot and root blight symptoms caused by *Fusarium* spp. were counted and some of them were randomly collected from each locality in order to identify in laboratory species responsible for the disease (Table 4). *Fusarium* spp. were identified according to key of Booth (1977). Plants displaying virosis-like symptoms were scored also in numbers, without testing their aetiology. Mean number of plants growing on a plot for each treatment was counted. Numbers of plants infected by *Fusarium* spp. and viruses were calculated for each plot of all treatments in percent.

Results were statistically calculated with Statgraphics Plus programme. For statistical evaluation a mean from five replications for each cultivar, at each locality and year of study was taken. Data in percent were transformed according to Bliss. Infection degrees for downy mildew and transformed percent values were subjected to the analysis of variance. P-values less than 0.05 indicated on statistical significance of a factor at the 95% confidence level. For each significant factor Multiple Range Test was used to discriminate among the means with Fisher's least sig-

Table 4

Species of *Fusarium* isolated from plants with foot and root blight

Year	Plants				
	tested	infected by			
		F. solani	*F. oxysporum*	*F. solani, F. oxysporum, F. avenaceum*	*F. solani, F. culmorum*
2002	20	12	4	3	1
2003	16	11	3	2	0
2004	25	17	2	4	2
2005	29	18	2	7	2
Total	90 (100%)	58 (64%)	11 (12%)	16 (18%)	5 (6%)

nificant differences (LSD) procedure, which allowed to identify the number of homogeneous groups. Means of the same group were not statistically significant.

Results

The most common disease was downy mildew since it occurred on each test plot. Fusarium blight was noted each year but for the majority of plots only on single plants. Intensity of virus diseases was also low. Ascochyta blight appeared only occasionally.

The 21 recently registered cultivars were infected by *Peronospora viciae* f.sp. *pisi*, but the intensity of downy mildew was different for three studied factors: cultivars, localities and years (Tables 2 and 3). No interaction between factors was found.

Infection degrees (ID) of 14 edible cultivars were very differentiated and seven homogeneous groups were estimated (Table 2). The highest level of the disease was found on 'Ramrod' (ID = 2.16), the oldest Polish cultivar, the lowest – on 'Terno' (ID = 1.10), a Czech cultivar, and 'Phönix' (ID = 1.38), a German one, both semileafless, from the same homogeneous group. The latter cultivar belonged also to next homogeneous group together with the Czech cultivar 'Zekon' (ID = = 1.51) and the Polish 'Bohun' (ID = 1.57), both semileafless.

Intensity of infection in localities was covered by four homogeneous groups (Table 2). The highest infection was noted in Sulejów (ID = 2.24), where precipitation was usually much higher in May and June, e.g. in 2002 – 155 mm and 105 mm, respectively, as compared to 63 mm and 59 mm in Cicibór (the lowest ID = 1.32; Fig. 1). Also air temperature in May and June 2002 were a little higher in Cicibór (16.8°C and 17.4°C, respectively) than in Sulejów (16.5°C and 17.1°C, respectively).

The lowest intensity of downy mildew was observed in 2003 (ID = 1.03; Table 2), when precipitation in spring, particularly in May, ranged from 38 mm in Chrząstowo to 62 mm in Sulejów (Fig. 1). The second homogeneous group in 2002 had ID = 1.57. The best development of downy mildew was noted in 2004 – ID = 2.11 and 2005 – ID = 2.26 from the same homogeneous group. The years 2004 and 2005 were cooler in every locality, especially in May (11.1–11.9°C and 12.0–13.6°C, respectively) and June (14.6–15.9°C and 14.6–16.5°C, respectively).

Among seven fodder cultivars, all bred in Poland, 'Sokolik', semileafless, showed the lowest infection degree: ID = 1.34, the only one beyond the four homogeneous groups (Table 3). It was followed by 'Pomorska': ID = 1.66, also semileafless, 'Zagłoba': ID = 1.75 of normal-leaved or conventional, 'Milwa': ID = = 1.79 and 'Wiato': ID = 1.88 from the same homogeneous group. Normal-leaved 'Hubal', ID = 2.13, was the most infected one.

Differences in infection degrees at various localities were significant (Table 3). The lowest level of infection was noted in Lubinicko: ID = 1.09, the only locality beyond four homogeneous groups. The highest level of infection was in Wyczechy: ID = 2.19, Bobrowniki: ID = 2.06, and Marianowo: ID = 2.03, from the same homogeneous group. In these localities air temperature in May and June was slightly

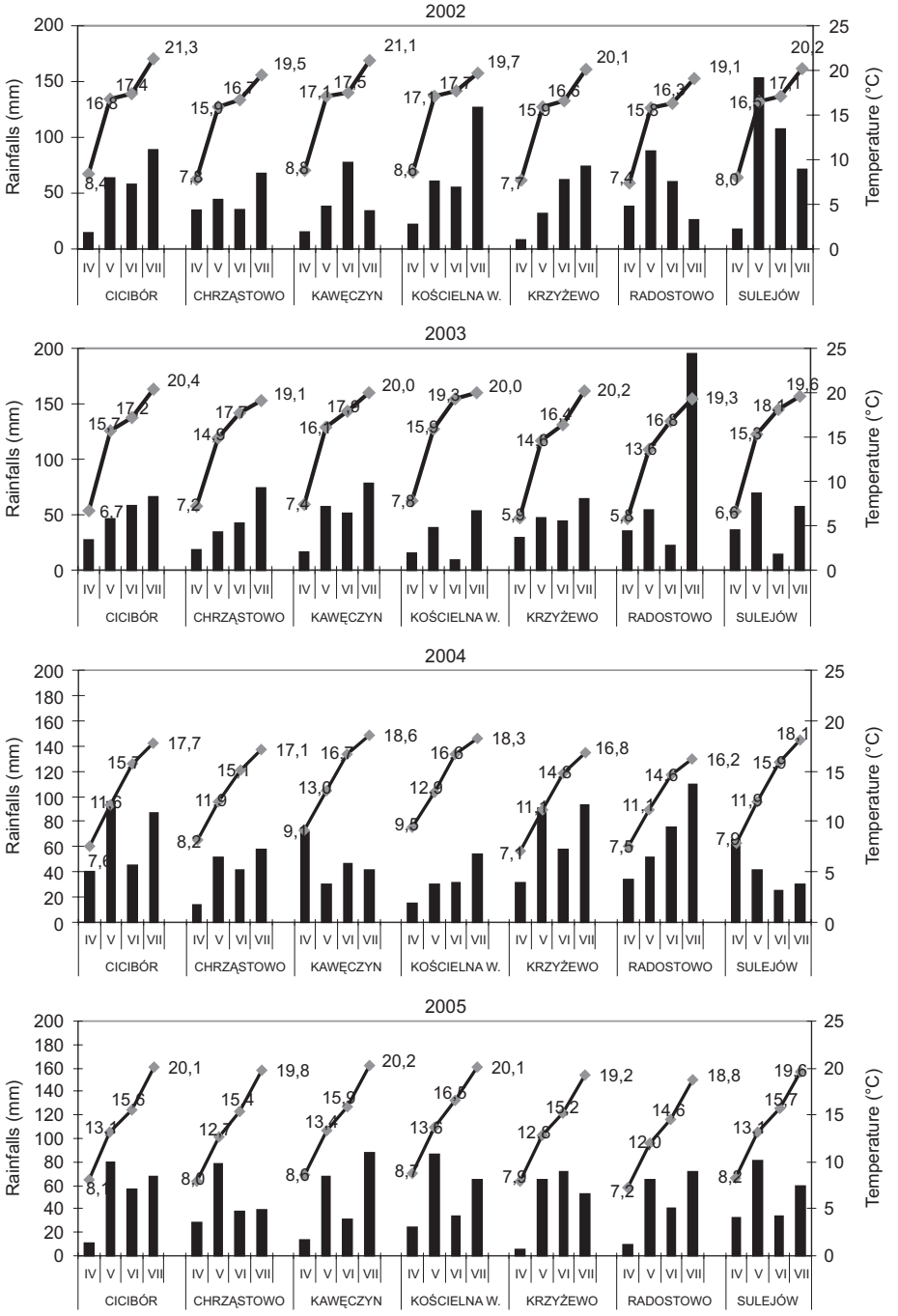

Fig. 1. Meteorological data at different localities, where edible cultivars were planted during 2002–2005 from April to July

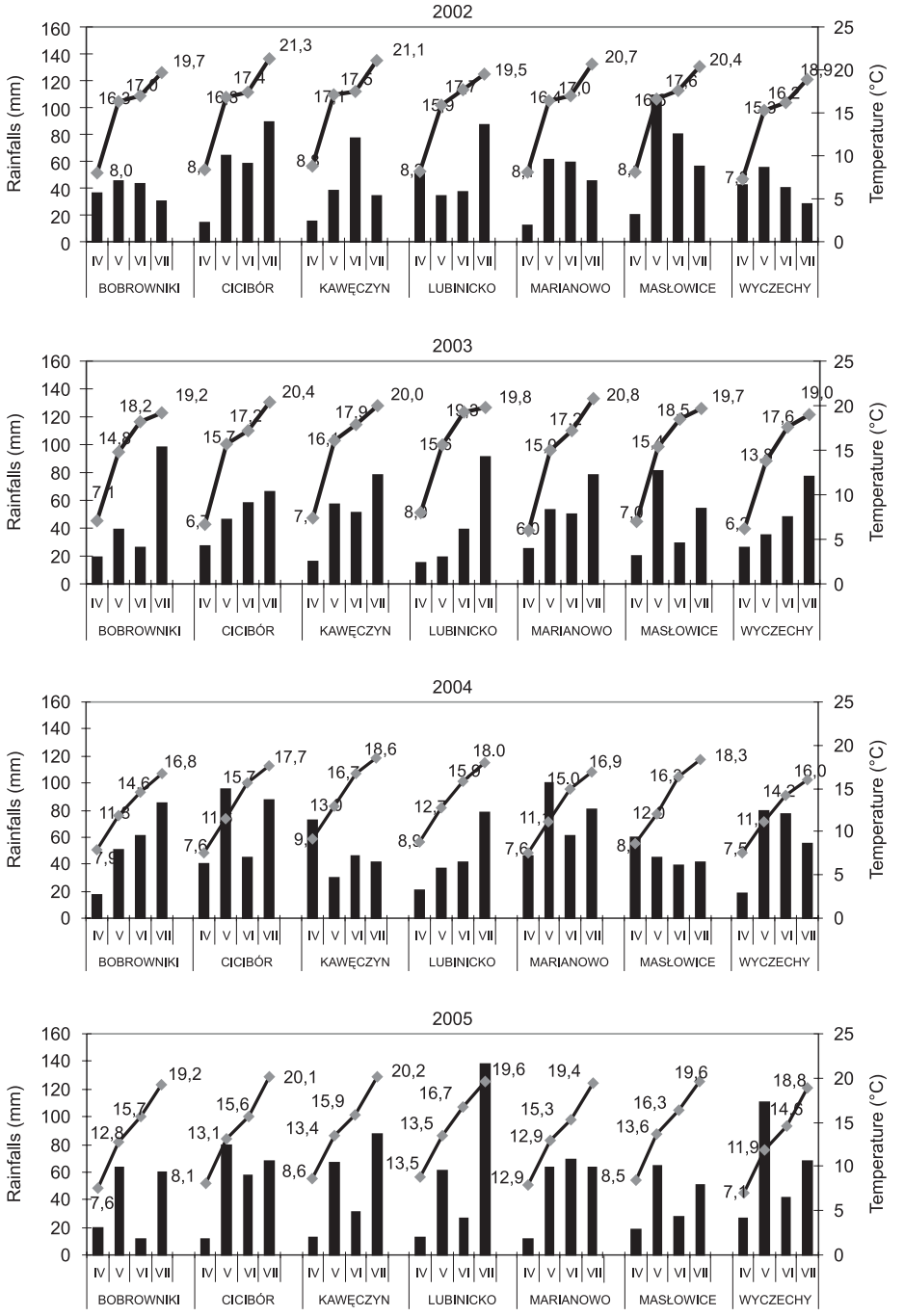

Fig. 2. Meteorological data at different localities, where animal fodder cultivars were planted during 2002–2005 from April to July

lower, for example in 2004, respectively, at Wyczechy 11.1°C and 14.2°C, at Bobrowniki 11.8°C and 14.6°C, at Marianowo 11.1°C and 15.0°C (Fig. 2). Temperature at Lubinicko in the same time was higher: 12.7°C and 15.9°C. Precipitation in May and June of 2004 was higher in Wyczechy: 80 mm and 79 mm, Bobrowniki: 52 mm and 62 mm, Marianowo: 98 mm and 60 mm, compare to Lubinicko: 39 mm and 42 mm (Fig. 2).

Genotypes for fodder were the most infected by *P. viciae* f.sp. *pisi* in 2004: ID = = 2.09 and 2005: ID = 2.17 (Table 3). Both years were cooler and more wet, like it was at Cicibór. Temperature and precipitation in May and June of 2004 were respectively 11.6°C and 95 mm, 15.7°C and 80 mm. In those months of 2005 were 13.1°C and 44 mm and 15.6°C and 58 mm, respectively (Fig. 2). Temperature 15.7°C in May and 17.2°C in June of 2003 at the same locality and precipitation 48 mm and 59 mm, respectively, decreased the intensity of downy mildew. It resulted in the lowest ID = = 1.26 in 2003, the only year from beyond three homogeneous groups.

The development of downy mildew was better both on edible and fodder cultivars in the same years, 2004 and 2005, as compared to 2002 and 2003.

Foot and root blight was mostly caused by *Fusarium solani* (64% plants infected; Table 4). *Fusarium oxysporum* infected 12% of plants. The mixture of those species and *F. avenaceum* was isolated from 18% of plants. *Fusarium culmorum* mixted with *F. solani* was obtained from 6% of plants.

Intensity of Fusarium foot and root blight differed depending on localities, years and cultivars but was generally low. Differences in intensity of the disease on edible and fodder cultivars were not significant (Table 5). Significant differences were found for localities and years. No interaction between cultivars, localities and years was proved.

The level of cultivar infection was low, 1.08 transformed percent (TP; Bliss transformation) for 'Terno' to 3.76 TP for 'Hardy', and 0.86 TP for 'Koliber' to 1.47 TP for 'Milwa', respectively for edible and fodder ones (Table 6). Edible cultivars were the most infected by *Fusarium* spp. at Krzyżewo: TP = 5.02, the only locality beyond the five homogeneous groups. The lowest infection was noted at Chrząstowo: TP = = 0.93. It was followed by Cicibór and Kawęczyn from the same homogeneous group.

Table 5

Analysis of variance of *Fusarium* spp. infestation on pea cultivars at seven localities in 2002–2005 (means of transformed percent (TP) for three factors)

Edible cultivars				Fodder cultivars			
source of variance	degree of freedom	mean square	P-value	source of variance	degree of freedom	mean square	P-value
Cultivar[1]	13	8.97	0.1279	Cultivar[1]	6	1.02	0.3063
Locality[2]	6	89.82	0.0000	Locality[2]	6	12.51	0.0000
Year[3]	3	67.14	0.0303	Year[3]	3	6.18	0.0001

Calculated as mean infection over: 1 – localities and years, 2 – cultivars and years, 3 – cultivars and localities.

Table 6

Intensity of *Fusarium* spp. infestation on pea cultivars at seven localities in 2002–2005 (means of transformed percent (TP) for three factors)

Edible cultivars		Animal fodder cultivars	
Locality			
name	TP	name	TP
Chrząstowo	0.93 a	Masłowice	0.01 a
Cicibór	1.22 ab	Kawęczyn	0.69 b
Kawęczyn	1.52 abc	Bobrowniki	0.84 b
Radostowo	1.99 bc	Cicibór	0.91 b
Kościelna Wieś	2.32 cd	Wyczechy	1.57 c
Sulejów	3.29 d	Lubinicko	1.82 cd
Krzyżewo	5.02 e	Marianowo	2.25 d
$LSD_{0.05}$	1.02	$LSD_{0.05}$	0.53
Year			
2002	1.40 a	2004	0.83 a
2004	1.57 a	2003	0.86 a
2003	3.02 b	2005	1.29 b
2005	3.33 b	2002	1.64 b
$LSD_{0.05}$	0.70	$LSD_{0.05}$	0.43
Means TP for cultivars from the lowest to the highest values			
1.08 for 'Terno' – 3.76 for 'Hardy'		0.86 for 'Koliber' – 1.47 for 'Milwa'	

Homogeneous groups marked with the same letter in the same column are not significantly different at $\alpha = 0.05$.

Differences in intensity of foot and root blight on edible cultivars were not significant in hotter year 2002 (TP = 1.40), and cooler 2004 (TP = 1.57). Air temperature in June at Cicibór was 17.4°C and 15.7°C, respectively for 2002 and 2004 (Fig. 1). Temperature in the same month of 2005 and locality was 15.6°C, like in 2004, but the level of infection TP = 3.33 differed significantly, since was covered by the second homogeneous group together with 2003: TP = 3.02 of hotter June with temperature 17.2°C.

The fodder cultivars were infected very seldom on fields in Masłowice: TP = = 0.01, the only one locality beyond four homogeneous groups (Table 6). The best development of foot and root blight on those cultivars was noted at Marianowo: TP = 2.25 and Lubinicko: TP = 1.82.

There were no significant differences in level of infection of *Fusarium* spp. on fodder cultivars between 2004 (TP = 0.83) and 2003 (TP = 0.86), cooler (15°C) and hotter (17.2°C), respectively, as it was in June at Marianowo (Fig. 2). The second homogeneous group consisted of data of 2002 and 2005. Fusarium foot and root blight developed better in 2002 (TP = 1.64) and 2005 (TP = 1.29), hotter (17°C) and cooler (15.3°C) years, for the same month and locality. On edible cultivars the disease was also better developed (TP = 3.33) in 2005, while in 2002 decreased to the lowest level (TP = 1.40).

Table 7

Analysis of variance of virus infestation on pea cultivars at seven localities in 2002–2005 (means of transformed percent (TP) for three factors)

Edible cultivars				Fodder cultivars			
source of variance	degree of freedom	mean square	P-value	source of variance	degree of freedom	mean square	P-value
Cultivar[1]	13	2.85	0.9757	Cultivar[1]	6	16.79	0.0205
Locality[2]	6	142.8	0.0000	Locality[2]	6	42.26	0.0000
Year[3]	3	1404.9	0.0000	Year[3]	3	1223.97	0.0000

Calculated as mean infection over: 1 – localities and years, 2 – cultivars and years, 3 – cultivars and localities.

Intensity of Fusarium foot and root blight was mainly influenced by local conditions caused by environmental factors and year. Plant infection by viruses was very differentiated (Table 7), in some fields considerably high as compared to single cases on others. Based on symptoms, mainly *Pea enation mosaic virus* (PEMV) was observed (Fiedorow 2001). Differences in intensity of the disease on edible cultivars were not significant, while they were significant on the fodder ones (Table 7). Significant differences for viral infection on edible and fodder cultivars were found between localities and years. Interaction between cultivars, localities and years was not proved.

When intensity of PEMV on edible cultivars was estimated three homogeneous groups were noted for the localities (Table 8). The lowest infection occurred at Kościelna Wieś (TP = 1.09), Krzyżewo (TP = 1.32) and Chrząstowo (TP = 1.54), from the same homogeneous group. The most infected were plants at Cicibór (TP = 4.99) and Kawęczyn (TP = 5.28). The level of infection significantly differed between years. The lowest was in 2003 (TP = 0.17), the highest in 2002 (TP = = 9.30). The third homogeneous group covered data for 2004 (TP = 1.05) and 2005 (TP = 1.39).

The differences in intensity of PEMV on fodder cultivars were significant (Table 9). 'Wiato' (TP = 2.25) and 'Zagłoba' (TP = 2.32) showed the lowest level of infection and 'Hubal' (TP = 3.68) and 'Koliber' (TP = 3.85), from the same homogeneous group. The highest infection was noted on 'Milwa' (TP = 4.77), 'Pomorska' (TP = 4.50) and 'Sokolik' (TP = 4.26), from the second homogeneous group. The differences in infection at localities were very variable and four homogeneous groups were distinguished. The lowest infection was found at Marianowo (TP = = 1.84) and the highest at Cicibór (TP = 5.95) and Kawęczyn (TP = 4.99) from the same homogeneous group. In those two localities the highest percent of plants infected by viruses (Tables 8 and 9) was also observed on edible cultivars.

Infection level on plants in 2003 was very low (TP = 0.22) in comparison to 2002 (TP = 12.35), the only year from beyond three homogeneous groups. Intensity of virus infection in the years was similar on edible and fodder cultivars (Tables 8 and 9). It was highest in 2002, the one with higher temperatures in June, like at Kawęczyn and Cicibór: 17.5°C and 17.7°C, respectively. The temperatures in the

Table 8

Intensity of virus infestation on edible cultivars at seven localities in 2002–2005 (means of transformed percent (TP) for three factors)

Locality		Year	
name	TP		TP
Kościelna Wieś	1.09 a	2003	0.17 a
Krzyżewo	1.32 a	2004	1.05 b
Chrząstowo	1.54 a	2005	1.39 b
Radostowo	2.80 b	2002	9.30 c
Sulejów	3.82 b	$LSD_{0.05}$	0.77
Cicibór	4.99 c		
Kawęczyn	5.28 c	Means TP for cultivars from the lowest to the highest value	
$LSD_{0.05}$	1.11	2.52 for 'Santana' – 3.76 for 'Baryton'	

Explanation – see Table 6.

Table 9

Intensity of virus infestation on cultivars for animal feeding at seven localities in 2002–2005 (means of transformed percent (TP) for three factors)

Cultivar		Locality		Year	
name	TP	name	TP		TP
'Wiato'	2.25 a	Marianowo	1.84 a	2003	0.22 a
'Zagłoba'	2.32 a	Bobrowniki	2.45 ab	2005	1.00 ab
'Hubal'	3.68 ab	Masłowice	3.20 ab	2004	1.51 b
'Koliber'	3.85 ab	Lubinicko	3.53 bc	2002	12.35 c
'Sokolik'	4.26 b	Wyczechy	3.66 bc	$LSD_{0.05}$	1.15
'Pomorska'	4.50 b	Kawęczyn	4.99 cd		
'Milwa'	4.77 b	Cicibór	5.95 d		
$LSD_{0.05}$	1.65	$LSD_{0.05}$	1.53		

Explanation – see Table 6.

same month and locality in 2003 were nearly the same: 17.9°C and 17.2°C, respectively, but the intensity of PEMV was the lowest. Independently on cultivar type in growing season of 2002, and at fields of Kawęczyn and Cicibór the highest number of plants infected by viruses were noted.

Discussion

The observations confirmed earlier information on Fusarium foot and root rot being a common disease in Poland (Czyżewska 1984, Filipowicz 1983, Furgał-Węgrzycka 1984). Czyżewska (1984) noted on green pea and Filipowicz

(1983) on dry pea that Fusarium foot and root rot was very important disease, caused mainly by *Fusarium oxysporum*. However, they also isolated *F. solani*, less frequently, while Marcinkowska (1992, 2005) found the latter species prevailing and the main cause of Fusarium blight on dry pea. The data obtained for *F. solani* were in agreement with the results noted by Kerr (1963) in Australia and Clarkson (1978) in England. The intensity of Fusarium foot and root rot occurrence depended in the study on fields (localities) and years, however, the influence of weather on the disease development was not clear. The dependence of regions and years was already stated by Czyżewska (1978, 1984) and Filipowicz (1983). The researchers also found differences in the disease intensity on cultivars, like it was observed in Canada (Tu 1991).

The presented results confirm the common occurrence of *Peronospora viciae* f.sp. *pisi* on field pea in Poland observed earlier by Marcinkowska (1997 a, b, 2002). According to Dixon (1981) the pathogen required lower temperature and high humidity for infection and downy mildew development. Data of this study proved the best disease development in the seasons of lower temperatures and higher precipitation, especially in May and June, the period of primary symptoms appearance and occurrence of consecutive secondary infections on young plants. The results are in agreement with those obtained by Hagedorn (1974), Dixon (1981), Marcinkowska (1997 a, b), Xue et al. (1997) and Marcinkowska and Kuczkowski (2006).

Higher temperature favours viral diseases development, since mites, main vectors of viruses, disseminate them very well at dryer and warmer weather. The influence was proved here as the highest occurrence of virus infected plants was noted in the warmest season and dryer localities.

Infection of pea by different pathogens under natural environment was strongly influenced by weather conditions of particular field during growing season (Chang et al. 2005, Marcinkowska 2002, Xue et al. 1997). Such influence may be avoided when tests are conducted at least for three–four years on replicated plots, like it was done by some researchers (Tu 1991, Stegmark 1988, Marcinkowska 1997 a) and in the presented study. The intensity of downy mildew in growing seasons of 2002–2005 allowed to distinguish differences in the reaction of tested cultivars to *P. viciae* f.sp. *pisi*, similarly as it was done by Stegmark (1988), Marcinkowska (1997 b) and Marcinkowska and Kuczkowski (2006). Cultivars 'Terno', 'Phönix', 'Zekon', 'Bohun' and 'Sokolik' were less infected by *P. viciae* f.sp. *pisi*. A similar reaction of these cultivars was observed towards *Fusarium* and viruses. The differences were not, however, significant.

The level of plant infection expresses resistant or susceptible response of a genotype to a pathogen. The response depends on various traits of a cultivar. One of them may be plant architecture, since normal-leaved plants lodged very easily and changed canopy structure contributing to higher infection (Wang et al. 2006). The influence of canopy structure on plant foliage infection was already noted for different plants and pathogens, like beans and *Sclerotinia sclerotiorum* (Blad et al. 1978) or peas and *Mycosphaerella pinodes* (Wang et al. 2006). These studies support the above cited since normal-leaved cultivars were usually more infected than semi-leafless.

Marcinkowska (1997 a) did not find any genotype less susceptible to *P. viciae* f.sp. *pisi* than the standard cultivars. 'Agra' was the best, what was also noted later (Marcinkowska and Kuczkowski 2006). The data presented also indicated a lack of new Polish cultivars of lower susceptibility to the pathogen, since only one of domestic breeding out of four edible cultivars showed the lowest level of infection.

Streszczenie

CHOROBY GROCHU NA NOWO ZAREJESTROWANYCH ODMIANACH

Obserwacje prowadzono w latach 2002–2005 na 21 ostatnio zarejestrowanych odmianach w 12 stacjach doświadczalnych COBORU rozmieszczonych w rejonach uprawy grochu (*Pisum sativum*) w Polsce. Oceniano w warunkach naturalnych porażenie przez *Peronospora viciae* f.sp. *pisi, Fusarium* spp. i wirusy w okresie największego nasilenia chorób, od połowy czerwca do połowy lipca. Na podstawie różnic w nasileniu mączniaka rzekomego wywoływanego przez *P. viciae* f.sp. *pisi* na 14 odmianach wymagających gleb żyznych, określanych jako jadalne, stwierdzono, iż 'Terno', 'Phönix', 'Zekon' – odmiany zagraniczne i polska 'Bohun' wyróżniły się najmniejszym porażeniem. Z siedmiu odmian paszowych (wszystkie polskie), uprawianych na glebach słabszych, najsłabiej porażony był 'Sokolik'. Większe nasilenie mączniaka rzekomego zaobserwowano w środkowej i północno-zachodniej Polsce w sezonach wegetacji o chłodniejszej i bardziej dżdżystej wiośnie lat 2004 i 2005.

Różnice w nasileniu zgorzeli podstawy łodyg i korzeni wywoływanej przez *Fusarium* spp. nie zostały statystycznie udowodnione ani na odmianach jadalnych, ani na paszowych. Zgorzel była powodowana przede wszystkim przez *Fusarium solani*. Warunki atmosferyczne w 2004 roku nie wpływały korzystnie na rozwój zgorzeli podstawy łodyg i korzeni. Choroba ta wystąpiła najsilniej w północno-wschodniej Polsce w 2005 roku.

Nasilenie chorób wirusowych było największe w 2002 roku, w 2003 zaś rośliny ulegały porażeniu sporadycznie. Na podstawie objawów chorobowych uznano, że dominował wirus ostrej mozaiki grochu (PEMV). Wirozy wystąpiły przede wszystkim w środkowo-wschodniej części kraju i niektórych miejscowościach środkowej Polski. Jedynie odmiany paszowe 'Wiato' i 'Zagłoba' były istotnie mniej porażone przez wirusy.

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