www.czasopisma.pan.pl www.journals.pan.pl

JOURNAL OF PLANT PROTECTION RESEARCH Vol. 50, No. 4 (2010)

DOI: 10.2478/v10045-010-0084-3

OCCURRENCE OF SHARP EYESPOT IN SPRING CEREALS GROWN IN SOME REGIONS OF POLAND

*Grzegorz Lemańczyk**

University of Technology and Life Sciences, Department of Phytopathology and Molecular Mycology
Kordeckiego 20, 85-225 Bydgoszcz, Poland

Received: April 26, 2010
Accepted: November 2, 2010

Abstract: Occurrence of sharp eyespot was determined in the period 2006–2008, on commercial fields of spring cereals, localized in northern and central Poland. Percent of infected stems, and the disease index were evaluated. Occurrence of sharp eyespot on spring cereals, especially on oat, was low. Slight infection was mostly observed. In some farm fields, disease symptoms were not observed. A significant difference in the occurrence of sharp eyespot on barley in respective years was noted. On commercial farms, the effect of previous crop and fungicidal treatment on occurrence of sharp eyespot was not observed. Significant variation of the infection was noted only for barley. Presence of *Rhizoctonia cerealis* and *R. solani* in the damaged tissues was confirmed by mycological analysis as well as PCR assay.

Key words: sharp eyespot, *Rhizoctonia cerealis*, *R. solani*, spring cereals, barley, oat, wheat, triticale, occurrence, PCR

INTRODUCTION

The main agent of sharp eyespot is considered to be *Rhizoctonia cerealis* (Boerema and Verhoeven 1977). The pathogen can also cause seedling rot (Cromey *et al.* 2005). *R. solani* is especially dangerous at the emergence stage. Due to the higher rate of mycelium growth of that pathogen, compared to *R. cerealis*, it is considered to be a potentially more dangerous pathogen of seedlings (Wiese 1987; Gill *et al.* 2001). Usually it infects roots and less considerably – the stem base. It demonstrates a wider range of hosts than *R. cerealis*. Despite cereals, the fungus can infect numerous plant species from different families. Sometimes it is reported that *R. solani* does not demonstrate pathogenicity towards cereals or that it is considered to be poor pathogen (Sneh 1996).

There is a constant presence of fungi of *Rhizoctonia* genus in soil, making the protection of cereals from fungi difficult (Żółtańska 1996). The fungi can survive in soil developing saprotrophically on plant residue and, additionally, they produce sclerotium, which often constitute the main source of primary infection. The literature presents reports on the samples of chemical control of *Rhizoctonia* spp. in cereals, however, results do not show high effectiveness (Kataria *et al.* 1991; Kataria and Gisi 1996). There are currently no registered means of cereal protection from these pathogens.

Commonly it is considered that sharp eyespot occurs at small intensity and that it does not cause considerable losses in cereal yield. In the papers on the occurrence of root and foot rot diseases in spring cereals, the disease is most often disregarded. Currently on some winter cereal fields there is an observed increase in the importance of sharp eyespot. However, there is no coverage on its occurrence in spring cereal production fields.

The aim of the present observations was to determine the intensity of the occurrence of sharp eyespot on spring cereals grown in production fields, depending on the previous crop, fungicide protection, and the cultivar.

MATERIALS AND METHODS

Observations of the occurrence of sharp eyespot were performed over the time period of 2006–2008, on production fields of spring cereals. We evaluated a total of 58 barley samples, 41 oat samples, 35 wheat samples and 12 triticale samples, derived from fields located in 6 provinces, mainly the Kujawy-Pomerania Province (96) and the Pomerania Province (37), as well as the Wielkopolska Province (8), the Łódź Province (2), West Pomerania Province (2) and Mazovia Province (1). Detailed data concerning the origin of plant samples are given in Tables 1–4. At the milk stage of grain (75–77 according to the BBCH scale), along the diagonal of the field, random samples were taken. One sample, consisting of 100 plants, was taken from each farm field. In the laboratory, samples were washed and the ear-bearing shoots were torn off. Then, the percentage of stems with symptoms of sharp eyespot were evaluated. The degree of the intensity of sharp eyespot was determined, applying the 0–4° scale. The degrees of infection were transformed into the Disease index (DI) according to the Townsend and Heuberger modification (Wenzel 1948).

*Corresponding address:
Grzegorz.Lemanczyk@utp.edu.pl

The numerical data obtained were exposed to statistical analysis with the use of the statistical calculation package Statistica v. 9 (StatSoft Polska), to the single-variance analysis of variance ANOVA, with random component, assuming the significance level at $\alpha = 0.05$. Prior to calculations, data defining the number of infected treatments, expressed as percentage, were transformed into Bliss angular degrees. The occurrence of the disease was tested depending on the year, previous crop, fungicide protection and the cultivar.

Evaluation of the health status of plants was supplemented by mycological analysis. From the shoots demonstrating symptoms of sharp eyespot, pieces were randomly cut out in order to confirm the agent. The material was disinfected in 1% $AgNO_3$ solution and placed on the potato dextrose agar (PDA) medium with streptomycin added. The fungal isolates were exposed to preliminary determination according to the mycological keys. In order to define the fungi of *Rhizoctonia* genus down to the species, hyphae were tinted following the method of Bandoni (1979).

In order to confirm the species representation of the *Rhizoctonia* isolates, reaction PCR with the use of specific primers SCAR Rc2 F/R type for *R. cerealis* (Nicholson and Parry 1996) and ITS1/GMRS-3 for *R. solani* (Johanson *et al.* 1998) was additionally performed. The research was performed on selected isolates which, with the use of traditional methods, were determined as *Rhizoctonia*. The isolation of the complete DNA was made following the modified method by Doyle and Doyle (1990). PCR reactions were made with the Core Kit (QIAGEN).

RESULTS AND DISCUSSION

Few symptoms of sharp eyespot were observed in spring cereals grown in production fields. Most stems with disease symptoms were found on wheat – 1.9% (DI = 0.51%), less on triticale – 1.6% (DI = 0.4%), even less on barley – 1.5% (DI = 0.39%), and least – 0.7% on stems (DI = 0.17) (Table 5). Symptoms of sharp eyespot were noted on only 38.9% of the oat fields, and in the case of triticale – it was on 75.6% of fields.

There were noted significant differences in the occurrence of sharp eyespot in respective years on spring barley. Most infected stems were noted in 2007 in which it occurred, on the average, on 2.9%, and least in 2006 – on 0.6%. The intensity of the disease varied across the fields. On barley most symptoms were seen at Szewce where 18% of stems were infected, and DI was 5.0% (Table 1). On oat, sharp eyespot occurred the maximum, on 5% of stems (DI = 1.25%) (Table 2), wheat – 8% of stems (DI = 2.0%) (Table 3), triticale – 4% of stems (DI = 1.0%) (Table 4).

Kurowski and Adamiak (2007), based on their strict experiments, report on *R. cerealis* infecting mostly winter cereals, and much less considerably – spring cereals. The constant source of infection is soil, so the length of the plant growing period is important. In the case of spring cereals the period in which infection can occur is too short and disease symptoms occurred at greater intensity (Wiese 1987). Weber and Zdziebkowski (1989) report on oat being the cereal least susceptible to infection, which is confirmed by my own observations. The occurrence of sharp eyespot on oat was already reported in 1950 by Glynne, claiming *R. solani* to be the agent. However, she noted that the disease can occur at greater intensity only sporadically.

The level of agrotechnical practices slightly affected the occurrence of sharp eyespot. There was noted no significant variation depending on the previous crop and the fungicide protection applied (Tables 6, 7). Matusinsky *et al.* (2008), using the PCR method, did not observe any variation in the intensity of occurrence of *R. cerealis* in wheat grown after different previous crops either. According to Żółtańska (2006), the infection by that pathogen is enhanced by cultivating cereals after cereals. Kurowski (2002) more often isolated *R. cerealis* and *R. solani* when cereals were grown after cereals. Non-cereal plants can also be infected by *R. cerealis*. Weber and Zdziebkowski (1989) found that the pathogen, in addition to cereals and some grasses, can also infect rape and potato. Priyatmojo *et al.* (2001) point to the possibility of infection of sugar beet as well. A much greater range of hosts is reported for *R. solani* which can infect more than half of the different plant genera. Within the *R. solani* species, however, there occurs very high variation and not all the anastomosis groups of that pathogen infect cereals (Sneh *et al.* 1991).

Significant variation in the intensity of sharp eyespot depending on the barley cultivar was observed. The highest DI value was reported for the Orthega cultivar – 5.0% (Table 8). For the other cereals, no variation in the infection across cultivars was found. Nicholson *et al.* (2002) claim that resistance breeding of cultivars is a basic method of inhibiting infection with *R. cerealis*. Cromey *et al.* (2005) report that by growing resistant cultivars, one can considerably limit yield losses caused by that pathogen.

The main agent of sharp eyespot, observed on spring cereals, was *R. cerealis*, which was confirmed with the traditional method, involving the fungal isolation on artificial media. From the stems with symptoms, *R. solani* was also isolated. Boerema and Verhoeven (1977), as well as Weber and Zdziebkowski (1989), considered *R. cerealis* to be the main agent of sharp eyespot, but they noted that it can also be caused by *R. solani*. Pląskowska (2005) more often isolated *R. cerealis* than *R. solani* from spring wheat stems. Kurowski and Adamiak (2007) obtained only *R. cerealis* from spring barley stems and oat.

Fungi of the *Rhizoctonia* genus were not always isolated from stems with symptoms of sharp eyespot. Frequently *Fusarium* spp. was isolated, especially *Fusarium avenaceum* and *F. culmorum*. Infected tissues were also infested by fungi commonly considered to be saprotrophic towards cereals, from such genera as *Penicillium*, *Trichoderma* and *Aspergillus*. Łacicowa and Wagner (1989) reported that sometimes, despite visible disease symptoms characteristic for a specific pathogen, other species secondarily infesting the infected tissues or taking part in the mixed infection, including also *Fusarium* spp. are isolated. Żółtańska (1996) noticed the relationship between *Rhizoctonia* spp. and *Fusarium* spp. The more *Fusarium* is isolated from tissues, the less *Rhizoctonia* spp. is obtained. *R. cerealis* as a pathogen specialized in the infection of ce-

Table 1. Occurrence of sharp eyespot on farm fields of barley in the years 2006–2008

Location	Cultivar	DI[1]	[%][2]	PCR[3]
the Kujawy-Pomerania province				
2006				
Chrząstowo	Justina	0.50	2	Rs
Dąbrowa	Antek	0.50	2	
Kończewice	Stratus	0.00	0	
Miastowice	Antek	0.00	0	
Minikowo	Stratus	0.00	0	
Żerniki	Rudzik	0.00	0	
2007				
Chrząstowo	Antek	0.00	0	
Dąbrowa	Stratus	1.00	4	Rc
Jerzanowo	Tokado	0.50	2	
Kruszwica	Antek	0.75	3	
Minikowo	Antek	1.00	4	
Piołunowo	Rudzik	0.25	1	
Sobiejuchy	Johan	1.50	5	
	Antek	1.75	7	Rc
Tryszczyn	Antek	0.00	0	
Wałdówko	Antek	0.00	0	
Wierzchucin Królewski	Antek	2.25	9	Rc
2008				
Bielawy	Rudzik	0.00	0	
Biskupin	Stratus	0.00	0	
Bralewnica	Refren	1.75	7	
Brzuchowo	Refren	0.00	0	
Buk Pomorski	Nagradowicki	0.50	2	
Chełmża	Toucan	0.00	0	
Chrząstowo	Antek	0.00	0	
Drożdżenica	Antek	0.00	0	
Jeleńcz	Sebastian	0.00	0	
Kaźmierzewo	Stratus	0.00	0	
Mały Mędromierz	Refren	0.25	1	
	Refren	0.00	0	
Mamlicz	Extaza	0.00	0	
Mokre	Rudzik	0.50	2	
Nakło	Jersey	0.00	0	
Nowa Wieś	Stratus	0.00	0	
Olszewka	Justina	0.00	0	
	Justina	0.50	2	
Pęchowo	Justina	0.00	0	
Pręczki	Brenda	0.00	0	
Pruszcz	Stratus	0.00	0	
	Antek	0.00	0	
Wichowo	Brenda	0.00	0	
Wiewiórki	Tocada	0.00	0	
Zamarte	Blask	0.50	2	
the Pomerania province				
2006				
Dębina	Antek	0.00	0	
Leśno	Antek	0.25	1	
2007				
Dębina	Eunova	0.75	3	Rs
Kończewo	Antek	0.50	2	
Radostowo	Stratus	0.75	3	
2008				
Debrzno	Antek	0.00	0	
Jerzkowice	Antek	0.00	0	
Konarzyny	Rudzik	0.00	0	
Zielona Huta	Stratus	0.00	0	
the Wielkopolska province				
2006				
Jeziorki Kosztowskie	Prestige	0.00	0	
2007				
Budzisław Kościelny	Stratus	0.25	1	
2008				
Polanowo	Antek	0.25	1	
Szydłowo	Brenda	0.00	0	
the West Pomerania province (2008)				
Krąpiel	Justina	0.00	0	
Suchań	Stratus	0.25	1	
the Mazovia province (2008)				
Szewce	Orthega	5.00	18	Rc

[1] DI – Disease index; [2] % – percentage of stems with sharp eyespot symptoms; [3] PCR – presence of *R. cerealis* (Rc) or *R. solani* (Rs) confirmed by the PCR assay

Table 2. Occurrence of sharp eyespot on farm fields of oat in the years 2006–2008

Location	Cultivar	DI[1]	[%][2]
the Kujawy-Pomerania province			
2006			
Chrzastowo	Deresz	0.00	0
Gostycyn	Deresz	0.00	0
Miastowice	Deresz	0.00	0
Minikowo	Bohun	1.00	4
Sobiejuchy	Flämingsprofi	0.00	0
2007			
Chrząstowo	Rajtar	0.00	0
Minikowo	Borowiak	0.25	1
Sobiejuchy	Breton	0.25	1
Tryszczyn	Bohun	0.00	0
2008			
Brodnica	Bajka	0.25	1
Brzuchowo	Deresz	0.00	0
Choceń	Deresz	0.50	2
Chrząstowo	Breton	0.25	1
	Krezus	0.00	0
Kaźmierzewo	Cwał	0.00	0
Kęsowo	Rajtar	0.00	0
Minikowo	Kasztan	0.00	0
Obkas	Bajka	0.00	0
Papowo Biskupie	Deresz	0.00	0
Pręczki	Krezus	0.00	0
Sobiejuchy	Breton	1.25	5
Stary Radziejów	Cwał	0.00	0
	Kasztan	0.25	1
Szewce	Borowiak	0.00	0
Wichowo	Bohun	0.00	0
Wiewiórki	Bajka	0.00	0

Location	Cultivar	DI	[%]
the Pomerania province			
2006			
Dębina	Bohun	0.00	0
2007			
Dębina	Breton	0.25	1
	Furman	0.25	1
2008			
Debrzno	Szakal	0.00	0
Jerzkowice	Deresz	0.00	0
Leśno	Deresz	0.00	0
Lipienice	Bajka	0.00	0
Lubnia	Deresz	0.00	0
Swornegacie	Kasztan	0.00	0
Wolental	Deresz	0.25	1
Zielona Huta	Breton	0.00	0
the Wielkopolska province			
2007			
Łąkie	Borowiak	0.50	2
2008			
Dąbrowa	Hetman	0.00	0
Huta	Polar	0.50	2
Witrogoszcz	Bajka	0.25	1
Witrogoszcz	Bajka	0.25	1

[1] DI – Disease index; [2] % – percentage of stems with sharp eyespot symptoms

Table 3. Occurrence of sharp eyespot on farm fields of wheat in the years 2006–2008

Location	Cultivar	DI[1]	[%][2]	PCR[3]
the Kujawy-Pomerania province				
2006				
Chrząstowo	Nawra	0.75	3	
	Vinjet	0.00	0	
Gruczno	Jasna	0.25	1	
Minikowo	Monsun	0.25	1	
Mochełek	Monsun	0.75	3	Rc
2007				
Biskupice	Koksa	0.00	0	
Chrząstowo	Nawra	1.00	4	
Kończewice	Nawra	2.00	8	
	Zadra	1.00	4	
Minikowo	Nawra	0.00	0	
Mochełek	Nawra	0.50	2	Rs
Sobiejuchy	Bombona	0.75	3	
	Dublet	1.00	4	
2008				
Chełmża	Parabola	0.50	2	
Chrząstowo	Nawra	0.25	1	
Kaźmierzewo	Tybalt	0.00	0	
Kończewice	Nawra	0.25	1	
Olszewko	Cytra	1.00	4	
Pruszcz	Nawra	0.00	0	
Sobiejuchy	Bombona	1.75	6	
Wiewiórki	Hewilla	0.00	0	

Location	Cultivar	DI	[%]	PCR
the Pomerania province				
2006				
Brusy	Nawra	1.75	4	
Dębina	Bombona	0.00	0	
Lisewo Malborskie	Nawra	0.00	0	
2007				
Dębina	Bombona	0.25	1	Rc
Lisewo Malborskie	Bombona	0.75	3	
Radostowo	Nawra	0.50	2	
2008				
Debrzno	Jasna	0.00	0	
Lipienice	Monsun	0.75	3	
Lubnia	Nawra	0.00	0	
Radostowo	Bombona	0.00	0	
Zielona Huta	Tybalt	0.75	3	
	Tybalt	0.00	0	
the Łódź province				
2008				
Wroczyny	Hewilla	0.50	2	
	Nawra	0.00	0	

[1] DI – Disease index; [2] % – percentage of stems with sharp eyespot symptoms; [3] PCR – presence of *R. cerealis* (Rc) or *R. solani* (Rs) confirmed by the PCR assay

Table 4. Occurrence of sharp eyespot on farm fields of triticale in the years 2006–2008

Location	Cultivar	DI[1]	[%][2]	PCR[3]
the Kujawy-Pomerania province				
2006				
Chrząstowo	Dublet	0.25	1	Rs
	Migo	0.25	1	Rs
Minikowo	Dublet	0.25	1	
2007				
Chrząstowo	Migo	0.25	1	
Minikowo	Migo	0.00	0	
2008				
Chrząstowo	Migo	1.00	4	
Minikowo	Dublet	0.25	1	

Location	Cultivar	DI	[%]	PCR
the Pomerania province				
2006				
Dębina	Dublet	0.00	0	
Swornegacie	Kargo	0.00	0	
2007				
Dębina	Dublet	1.00	4	
2008				
Jerzkowice	Mieszko	1.00	4	Rc
Swornegacie	Wanad	0.25	1	

[1] DI – Disease index; [2] % – percentage of stems with sharp eyespot symptoms; [3] PCR – presence of *R. cerealis* (Rc) or *R. solani* (Rs) confirmed by the PCR assay

Table 5. Occurrence of sharp eyespot in years

Specification	Years	Barley	Oat	Wheat	Triticale
Number of evaluated fields	2006	9	6	8	5
	2007	15	7	11	3
	2008	34	28	16	4
	2006–2008	58	41	35	12
Percentage of fields with sharp eyespot	2006	33.3	16.7	62.5	60.0
	2007	80.0	71.4	81.8	66.7
	2008	26.5	28.6	50.0	100.0
	2006–2008	46.6	38.9	64.8	75.6
Disease index [%]	2006	0.14	0.17	0.47	0.15
	2007	0.75	0.21	0.70	0.42
	2008	0.28	0.13	0.36	0.63
	2006–2008	0.39	0.17	0.51	0.40
	F	n.s.[1]	n.s.	n.s.	n.s.
	p	n.s.	n.s.	n.s.	n.s.
Percentage of stems with sharp eyespot symptoms	2006	0.6	0.7	1.5	0.6
	2007	2.9	0.9	2.8	1.7
	2008	1.1	0.5	1.4	2.5
	2006–2008	1.5	0.7	1.9	1.6
	F	6.893	n.s.	n.s.	n.s.
	p	0.002	n.s.	n.s.	n.s.

[1] n.s. – not significant; F – ratio; p – value

Table 6. Occurrence of sharp eyespot depending on previous crop

Previous crop	Barley			Oat			Wheat			Triticale		
	n[1]	DI[2]	[%][3]	n	DI	[%]	n	DI	[%]	n	DI	[%]
Cereals	25	0.45	1.8	28	0.12	0.5	1	0.44	1.8	1	0.25	1.0
Maize	8	0.75	2.8	–	–	–	1	0.00	0.0	1	0.25	1.0
Legume	2	0.25	1.0	4	0.19	0.8	6	0.83	3.3	4	0.44	1.8
Brassicas	7	0.25	1.0	7	0.25	1.0	5	0.45	1.6	4	0.31	1.3
Root crops	15	0.15	0.6	2	0.13	0.5	19	0.43	1.6	1	0.00	0.0
Others	1	0.25	1.0	–	–	–	–	–	–	1	1.00	4.0
Sum/Mean %	58	0.38	1.5	41	0.17	0.6	32	0.54	2.0	12	0.40	1.5
F		n.s.[4]	n.s.		n.s.	n.s.		n.s.	n.s.		n.s.	n.s.
p		n.s.	n.s.		n.s.	n.s.		n.s.	n.s.		n.s.	n.s.

[1] n – number of farm fields; [2] DI – Disease index; [3] % – percentage of stems with sharp eyespot symptoms
[4] n.s. – not significant; F – ratio; p – value

Table 7. Occurrence of sharp eyespot depending on fungicide protection

Fungicide protection	Barley			Oat			Wheat			Triticale		
	n[1]	DI[2]	[%][3]	n	DI	[%]	n	DI	[%]	n	DI	[%]
Untreated	15	0.35	1.4	14	0.21	0.9	9	0.64	2.2	5	0.20	0.8
Protection in T1[4]	9	0.28	1.1	3	0.08	0.3	11	032	1.2	5	0.45	1.8
Sum/Mean %	24	0.32	1.3	17	0.19	0.8	20	0.46	1.7	10	0.33	1.3
F		n.s.[5]	n.s.		n.s.	n.s.		n.s.	n.s.		n.s.	n.s.
p		n.s.	n.s.		n.s.	n.s.		n.s.	n.s.		n.s.	n.s.

[1] n – number of farm fields; DI – Disease index; [3] % – percentage of stems with sharp eyespot symptoms
[4] T1 – fungicide application at 30–31 according to BBCH growth stage scale; [5] n.s. – not significant; F – ratio; p – value

Table 8. Occurrence of sharp eyespot depending on cultivar

Barley				Oat				Wheat				Triticale			
Cultivar	n[1]	DI[2]	[%][3]	cultivar	n	DI	[%]	cultivar	n	DI	[%]	cultivar	n	DI	[%]
Antek	18	0.40	1.6	Bajka	5	0.10	0.4	Bombona	6	0.58	2.2	Bombona	6	0.58	2.2
Blask	1	0.50	2.0	Bohun	4	0.25	1.0	Cytra	1	1.00	4.0	Cytra	1	1.00	4.0
Brenda	3	0.00	0.0	Borowiak	3	0.25	1.0	Dublet	1	1.00	4.0	Dublet	1	1.00	4.0
Eunova	1	0.75	3.0	Breton	5	0.40	1.6	Hewilla	2	0.25	1.0	Hewilla	2	0.25	1.0
Extaza	1	0.00	0.0	Cwał	2	0.00	0.0	Jasna	2	0.13	0.5	Jasna	2	0.13	0.5
Jersey	1	0.00	0.0	Deresz	10	0.08	0.3	Koksa	1	0.00	0.0	Koksa	1	0.00	0.0
Johan	1	1.50	5.0	Flämingsprofi	1	0.00	0.0	Monsun	3	0.58	2.3	Monsun	3	0.58	2.3
Justina	5	0.20	0.8	Furman	1	0.25	1.0	Nawra	13	0.54	1.9	Nawra	13	0.54	1.9
Nagradowicki	1	0.50	2.0	Hetman	1	0.00	0.0	Parabola	1	0.50	2.0	Parabola	1	0.50	2.0
Orthega	1	5.00	18.0	Kasztan	3	0.08	0.3	Tybalt	3	0.25	1.0	Tybalt	3	0.25	1.0
Prestige	1	0.00	0.0	Krezus	2	0.00	0.0	Vinjet	1	0.00	0.0	Vinjet	1	0.00	0.0
Refren	4	0.50	2.0	Polar	1	0.50	2.0	Zadra	1	1.00	4.0	Zadra	1	1.00	4.0
Rudzik	5	0.15	0.6	Rajtar	2	0.00	0.0								
Sebastian	1	0.00	0.0	Szakal	1	0.00	0.0								
Stratus	11	0.20	0.8												
Tocada	3	0.17	0.7												
Sum/Mean	58	0.38	1.47		41	0.15	0.6		32	0.54	2.03		32	0.54	2.03
F (16, 41)		5.801	n.s.[2]	F (13, 27)		n.s.	n.s.	F (11, 23)		n.s.	n.s.	F (4, 7)		n.s.	n.s.
p		0.000	n.s.	p		n.s.	n.s.	p		n.s.	n.s.	p		n.s.	n.s.

[1] n – number of farm fields; [2] DI – Disease index; [3] % – percentage of stems with sharp eyespot symptoms
[4] n.s. – not significant; F – ratio; p – value

reals. On artificial media it grows relatively slow and it is often overgrown by *Fusarium* spp. and saprotrophic fungi (Bateman and Kwaśna 1999).

The reaction PCR performed with the use of primers Rc2 F/R made it possible to confirm the representation of selected *R. cerealis* isolates, giving the expected product of amplification 850 base pairs in length (Fig. 1). With the molecular method, it was confirmed that on 7 production fields of spring cereals *R. cerealis* must have occurred. The reaction PCR with the use of primers ITS1/GMRS-3 also confirmed the occurrence of *R. solani* on 5 fields, giving the expected product of amplification 550 bp long. Applying specific primers type SCAR, Turner *et al.* (2001) and Matusinsky (2008) also confirmed the presence of *R. cerealis* and *R. solani* in plant tissues of cereals. Nicholson and Parry (1996) found the presence of *R. cerealis* on single cereal stems, despite a lack of symptoms, however, clear disease symptoms did not always confirm the occurrence of that pathogen.

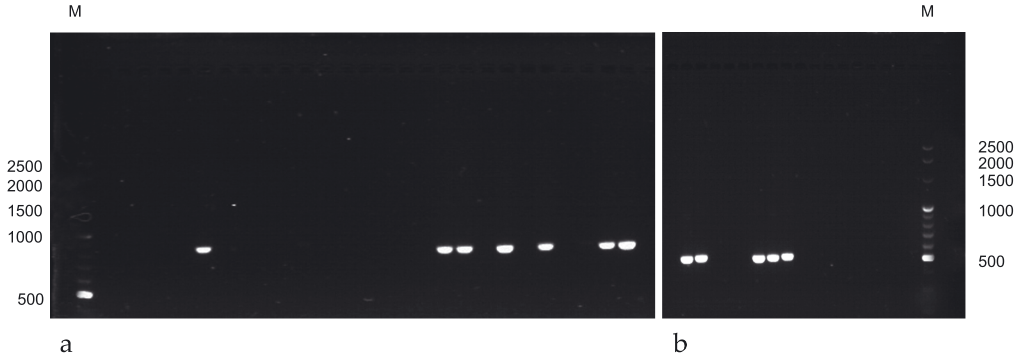

Fig. 1. Confirmation of *R. cerealis* (a) and *R. solani* (b) with a PCR assay

CONCLUSIONS

1. Sharp eyespot in spring cereals, especially oat, occurred on an inconsiderable number of stems, the infection of which was low. No disease was reported on a substantial part of the fields.
2. Significant variation was found in the intensity of sharp eyespot in respective years of growing barley.
3. Under production conditions, there was found no significant effect of the previous crop and the fungicide protection applied on the occurrence of sharp eyespot in spring cereals. Significant variation in the infection of spring cereals cultivars was reported only for barley.
4. The sharp eyespot symptoms on spring cereals were mainly caused by *R. cerealis* as well as by *R. solani*, which was confirmed with the traditional and molecular methods.

ACKNOWLEDGEMENTS

This work was supported by the State Committee for Scientific Research, Poland, grant no. 0842/P06/2005/28.

REFERENCES

Bandoni R.J. 1979. Safranin O as a rapid nuclear stain for fungi. Mycologia 71 (4): 873–874.

Bateman G.L., Kwaśna H. 1999. Effects of number of winter wheat crops grown successively on fungal communities on wheat roots. Appl. Soil Ecol. 13 (3): 271–282.

Boerema G.H., Verhoeven A.A. 1977. Check-list for scientific names of common parasitic fungi. Series 26: Fungi on field crops: cereals and grasses. Neth. J. Plant Pathol. 83 (5): 165–204.

Cromey M.G., Butler R.C., Munro C.A., Shorter S.C. 2005. Susceptibility of New Zealand wheat cultivars to sharp eyespot. N. Z. Plant Protect. 58: 268–272.

Doyle J.J., Doyle J.L. 1990. Isolation of plant DNA from fresh tissue. Focus 12: 13–15.

Gill J.S., Sivasithamparam K., Smettem K.R.J. 2001. Effect of soil moisture at different temperatures on *Rhizoctonia* root rot of wheat seedlings. Plant Soil 231 (1): 91–96.

Glynne M.D. 1950. Sharp eyespot as a severe disease of oats. Nature 166, p. 232.

Johanson A., Turner H.C., McKay G.J., Brown A.E. 1998. A PCR-based method to distinguish fungi of the rice sheath-blight complex, *Rhizoctonia solani, R. oryzae* and *R. oryzae-sativae*. FEMS Microbiol. Lett. 162 (2): 289–294.

Kataria H.R., Gisi U. 1996. Chemical control of *Rhizoctonia* species. p. 537–547. In: "*Rhizoctonia* Species: Taxonomy, Molecular, Biological, Ecological, Pathology, and Disease Control" (B. Sneh, S. Jabaji-Hare, S. Neate, G. Dijst, eds.). Kluwer Academic Publishers, Dordrecht, The Netherlands, 584 pp.

Kataria H.R., Hugelshofer U., Gisi U. 1991. Sensitivity of *Rhizoctonia* species to different fungicides. Plant Pathol. 40 (2): 203–211.

Kurowski T.P. 2002. Studia nad chorobami podsuszkowymi zbóż uprawianych w wieloletnich monokulturach. Rozpr. Nauk. UW-M, Olsztyn 56, 86 pp.

Kurowski T.P., Adamiak E. 2007. Occurrence of stem base diseases of four cereal species grown in long-term monocultures. Pol. J. Nat. Sci. 22 (4): 574–583.

Łacicowa B., Wagner A. 1989. Grzyby towarzyszące *Gaeumannomyces graminis* w tkankach pszenicy i pszenżyta. Zesz. Prob. Post. Nauk Rol. 374: 243–255.

Matusinsky P., Mikolasova R., Klem K., Spitzer T., Urban T. 2008. The role of organic vs. conventional farming practice, soil management and preceding crop on the incidence of stem-base pathogens on wheat. J. Plant Dis. Protect. 115 (1): 17–22.

Nicholson P., Parry D.W. 1996. Development and use of a PCR assay to detect *Rhizoctonia cerealis*, the cause of sharp eyespot in wheat. Plant Pathol. 45 (5): 872–83

Nicholson P., Turner A.S., Edwards S.G., Bateman G.L., Morgan L.W., Parry D.W., Marshall J., Nuttall M. 2002. Development of stem-base pathogens on different cultivars of winter wheat determined by quantitative PCR. Eur. J. Plant Pathol. 108 (2): 163–177.

Pląskowska E. 2005. Zdrowotność pszenicy jarej uprawianej w siewie czystym i w mieszaninach odmian. Rozpr. Nauk. AR we Wrocławiu, Rozprawa CCXXXVI, 528, 142 pp.

Priyatmojo A., Yamauchi R., Kageyama K., Hyakumachi M. 2001. Grouping of binucleate *Rhizoctonia* anastomosis group D (AG-D) isolates into subgroups I and II based on whole-cell fatty acid compositions. J. Phytopathol. 149 (7–8): 421–426.

Sneh B. 1996. Non-pathogenic isolates of *Rhizoctonia* (np-R) spp. and their role in biological control. p. 473–483. In: "*Rhizoctonia* Species: Taxonomy, Molecular, Biological, Ecological, Pathology, and Disease Control" (B. Sneh, S. Jabaji-Hare, S. Neate, G. Dijst, eds.). Kluwer Academic Publishers, Dordrecht, The Netherlands, 584 pp.

Sneh B., Burpee L., Ogoshi A. 1991. Identification of *Rhizoctonia* Species. The APS Press, St. Paul, MN, USA, 578 pp.

Turner A.S., Nicholson P., Edwards S.G., Bateman G.L., Morgan L.W., Todd A.D., Parry D.W., Marshall J., Nuttall M. 2001.

Evaluation of diagnostic and quantitative PCR for the identification and severity assessment of eyespot and sharp eyespot in winter wheat. Plant Pathol. 50 (4): 463–469.

Weber Z., Zdziebkowski T. 1989. Podatność zbóż, rzepaku i ziemniaka na *Rhizoctonia cerealis* i *R. solani*. Materiały 29. Sesji Nauk. Inst. Ochr. Roślin, cz. 2: 99–103.

Wenzel H. 1948. Zur Erfassung des Schadenausmasses in Pflanzenschutzversuchen. Pflanzenschutz-Ber. 15: 81–84.

Wiese M.V. 1987. Compendium of Wheat Diseases. 2nd ed. The APS Press, St. Paul, MN, USA, 112 pp.

Żółtańska E. 1996. Ocena możliwości ochrony pszenicy przed grzybami *Rhizoctonia cerealia* V.D. Hoeven i *Rhizoctonia solani* Kuhn. przez stosowanie drobnoustrojów antagonistycznych. Prog. Plant Protection/Post. Ochr. Roślin 36 (2): 171–173.

Żółtańska E. 2006. The effect of soil moisture and temperature on efficacy of seed dressing preparations Biochikol 020 PC and Baytan Universal 19,5 WS in control of *Rhizoctonia* fungi on wheat. J. Plant Protection Res. 46 (3): 261–267.

POLISH SUMMARY

WYSTĘPOWANIE OSTREJ PLAMISTOŚCI OCZKOWEJ W ZBOŻACH JARYCH UPRAWIANYCH W WYBRANYCH REGIONACH POLSKI

Obserwacje występowania ostrej plamistości oczkowej przeprowadzono w latach 2006–2008, na polach produkcyjnych zbóż jarych (jęczmieniu, owsie, pszenicy i pszenżycie), położonych w północnej i środkowej Polsce. Określano procent porażonych źdźbeł i indeks chorobowy. Na zbożach jarych, zwłaszcza na owsie, ostra plamistość oczkowa występowała na niewielkiej liczbie źdźbeł, które najczęściej ulegały porażeniu w stopniu słabym. Na znacznej części pól nie obserwowano objawów tej choroby. W przypadku jęczmienia stwierdzono istotne zróżnicowanie w poszczególnych latach obserwacji. W warunkach produkcyjnych nie stwierdzono istotnego wpływu przedplonu i zastosowanej ochrony fungicydowej na występowanie ostrej plamistości oczkowej. Istotne zróżnicowanie w porażeniu odmian stwierdzono tylko w przypadku jęczmienia. Analiza mikologiczna oraz metoda PCR potwierdziły, że *Rhizoctonia cerealis*, a także *R. solani* były sprawcami obserwowanych zmian chorobowych w zbożach jarych.