COMPARISON OF DISEASE OCCURRENCE AND GREEN LEAF AREA (GLA) OF WINTER WHEAT DEPENDING ON THE FORECROP AND DIFFERENTIATED FUNGICIDAL PROTECTION USED

Dariusz Wyczling[1], *Leszek Lenc*[2], *Czesław Sadowski*[2]*

[1] ProCam Polska Sp. z o.o., 30 Stycznia 37, 83-100 Tczew, Poland
[2] University of Technology and Life Sciences, Department of Phytopathology and Molecular Mycology
Ks. A. Kordeckiego 20, 85-225 Bydgoszcz, Poland

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Abstract: The effect of the forecrop and differentiated chemical plant protection on the intensity of fungal leaf diseases of winter wheat were studied from 1999–2008. Five (I–V) separate experiments were conducted in Mazury (Szestno I,), Żuławy Wiślane (Lisewo II), and Powiśle (Wielgłowy III, IV and Radostowo V). The intensity of diseases varied. Powdery mildew (*Blumeria graminis*) was noted in relatively low or trace intensity. On the other hand, there was a large amount of necrotic leaf spot complexes caused by *Mycosphaerella graminicola*, *Stagonospora nodorum, Pyrenophora tritici-repentis* and *Fusarium* spp. In 2000, 2001 and 2003 brown rust (*Puccinia recondita*) was noted in high intensity. The applied treatments were very effective in reducing fungal disease on leaves. The surface of the upper leaves (Green leaf area – GLA) with no symptoms of infection and fungicide use were significantly higher than in the control. It was also found that the GLA of crops grown after oilseed rape was higher than the GLA of crops grown after wheat.

Key words: wheat, forecrop, Green leaf area (GLA), fungicides, diseases of leaves

INTRODUCTION

One of the factors affecting yielding and yield quality are fungal pathogens. They pose a threat for plants throughout the vegetation period. The losses they generate, as stressed by many authors, can range from 10 to 50%. In the years with epidemics the losses are even greater (Jaczewska-Kalicka 2002, 2005, 2006; Kim 2004; Wyczling *et al*. 2005). Over the recent years there have been more and more frequent reports on the occurrence and continuous growth of fungi causing necrotic leaf spots. These are such fungi as: *Pyrenophora tritici-repentis, Mycosphaerella graminicola*, *Fusarium* spp. (Remlain-Starosta 1997; Schollenberger *et al*. 1999; Łukanowski and Sadowski 2002; Wakuliński 2004). The occurrence of diseases depends considerably on environmental conditions, weather, forecrop, agrotechnical practices and fertilisation. A large field area planted in wheat often makes it necessary to introduce short crop rotation or to grow wheat after wheat, which causes an even greater threat. Intensive cultivation is often accompanied by 2 or more sprayings of fungicide (Hartwick *et al*. 2001). The domestic literature identifies some discrepancies in the effect of diseases on the decrease in the yield as well as pathogens generating those losses (Zamorski and Nowicki 1996; Kurowski 2002; Wyczling *et al*. 2005). But, it seems that there is not enough research done covering the effect of the leaf healthiness on the yield, especially at the final stage of wheat development. An adequate application of fungicides makes it possible for the Green leaf area (GLA) to remain longer and, as a result, higher yields can be obtained (Gerchard and Hebermeyer 1998; Dimmock *et al*. 2000; Dimmock and Gooding 2002; Jaczewska-Kalicka 2005; Wyczling *et al*. 2005).

The aim of the experiments was to determine the intensity of the occurrence of fungal diseases and the GLA effect in winter wheat and the role that forecrop and the intensity of fungicide application play.

MATERIALS AND METHODS

From 1999–2004 as well as in 2008 five separate experiments were done in Mazury (Szestno 53°55'N, 21°18'E), Powiśle (Wielgłowy, 54°01'N 18°44E') and Żuławy Wiślane (Lisewo 54°05'N, 184°9'E) and in 2008 at Radostowo (Powiśle 53°59'N, 18°43'E). We investigated the effect of a various fungicides on the leaf healthiness of winter wheat grown after winter oilseed rape and wheat. From 1999–2001 in Szestno (Experiment I), the reaction of 'Kobra' and 'Roma' wheat grown after oilseed rape and of 'Kobra' and 'Roma' wheat grown after wheat was investigated. At Wielgłowy (Experiment II) the reaction of 'Flair', also after two forecrops, was studied. At Lisewo (Experiment III) the reaction of Sakwa and Elena after oilseed rape was studied. Various fungicide protection was

*Corresponding address:
sadowski@utp.edu.pl

applied. At Szestno and Wielgłowy, 2 variants of fungicide protection were used: a single treatment (kresoxim methyl + epoxyconazole at a dose of 1.0 l/ha) made at the flag leaf-tillering phase (BBCH 39–49) and two other treatments; the first one (kresoxim methyl + epoxyconazole at a dose of 0.8 l/ha) at the 1–2 node phase (BBCH 32), and the second one (tridemorph + epoxyconazole at a dose of 1.0 l/ha) at the beginning to full tillering phase (BBCH 51–55). At Lisewo a combination of the two treatments was applied.

From 2002–2004, the experiment at Wielgłowy (Experiment IV) was continued with Flair wheat and the following disease variants: the first treatment with kresoxim methyl + epoxyconazole + fenpropimorph (Juwel TT 483 SC) at a dose of 1.0 l/ha, made at the flag leaf-tillering phase (BBCH 39–49) and then tridemorph + epoxyconazole (Tango Star 334 SE) at a dose of 1.0 l/ha or dimoxystrobin + epoxyconazole (Swing Top 183 SC) at a dose of 1.0 l/ha at the beginning to full tillering phase (BBCH 51–55). In the control combinations the plants were watered. In the first experimental cycle the sowing material was dressed with guazatine acetate (Panoctine 300 LS) and in the second experimental cycle – with guazatine acetate + triticonasol (Premis Total 325 FS).

In 2008, experiment V covered different programs of fungicide plant protection. At the BBCH 30–32 phase the following combinations were used:

I. The control.
II. Epoxyconazole, kresoxim methyl, fenpropimorph (Juwel TT 483 SC) at a dose of 0.7 l/ha + fenpropimorph, epoxyconazole, metrafenone (Capalo 337.5 SE) at a dose of 0.7 l/ha.
III. Prothioconazole and spiroxamine (Input 460 EC) at a dose of 1.0 l/ha.
IV. Cyprodinil (Unix 75 WG) at a dose of 1.0 kg/ha.
V. Fenpropimorph, epoxyconazole, metrafenone (Capalo 337.5 SE) at a dose of 1.5 l/ha.
VI. Prochloraz (Prorok 450 EC) 1.0 l/ha + proquinazid (Talius 200 EC) at a dose of 0.1 l/ha.
VII. Flusilazole, carbendazim (Escudo Forte 375 CS) at a dose of 0.8 l/ha.

At the BBCH 61–65 phase, in all the fungicide combinations (II–VII), the following fungicides were applied: azoxystrobin, chlorotalonil (Olympus 480 SC) at a dose of 1.2 l/ha + prochloraz, tebuconazole (Zamir 400 EW) at a dose of 0.6 l/ha.

The sowing rate based on 1 000-seed weight and the plant density per 1 m^2 was compliant with the agrotechnical guidelines. The sowing rate was optimal for the respective regions. Sowing was done at Szestno in the third week of September and at Wielgłowy, Lisewo and Radostowo at the end of September. The soil was cultivated without any simplifications, in a conventional way, with pre-sow plough following the agrotechnical guidelines and the application of post-harvest and pre-sowing measures. Potassium and phosphorus fertilisation was applied depending on the soil richness following the Regional Station for Chemical Analyzes in Agriculture guidelines in Gdańsk. Nitrogen was applied in these ways: in combination with the fungicides at a dose of 160 kg/ha, at three doses and in the control combination 120 kg/ha, and at two doses. The experiments were set up in the randomized complete block design, in 4 reps on plots of 20 m^2.

The leaf healthiness was evaluated based on EPPO guidelines. Three top leaves for every 100 stems sampled from each plot were analyzed. This procedure defined the percentage of the area of leaf blades with disease symptoms. At the shooting phase (BBCH 30–32), at the tillering phase – beginning of flowering (BBCH 59–61) and at the milk stage (BBCH 75) the following were determined: the occurrence of powdery mildew (*B. graminis*), brown rust (*Puccinia recondita*) and necrotic leaf spots. At the BBCH 85 phase, the GLA of the three top leaves was determined. To define the agents of the spot, leaves were placed on Petri dishes which had moistened filter paper. The thermostat was set at the temperature of 25°C and after about 5 days determination was made with a microscope.

The results of disease symptoms were converted into Disease index (DI) following the Townsend and Heuberger formula (Wenzel 1948) and then they were exposed to the analysis of variance. The mean values were tested with the Tukey's test.

RESULTS

In the first experimental cycle (1999–2001) at all the locations, powdery mildew (*B. graminis*) occurred at a low intensity. At Szestno at the phase BBCH 30–32 the average DI for 3 years for Kobra was 2.3%, and Roma – 1.8%. Similarly a few symptoms were observed in Sakwa and Elena at Lisewo. In 2000 a slightly greater intensity of powdery mildew occurred at the BBCH 59 phase, however, more symptoms were observed on the plants grown after oilseed rape than after wheat. The differences, although relatively small, were significant (average DI – respectively, 4.5 and 3.6%). A similar effect of the forecrop on the occurrence of powdery mildew was observed at Wielgłowy in Flair where, despite low intensity, there were always more symptoms reported in the combination after oilseed rape. The application of fungicides almost totally limited the disease development. In successive years (2002–2004) when the experiment was continued, the disease occurred at a greater intensity in Flair. More symptoms, however, were observed in the crop after oilseed rape. The applied treatments considerably limited the intensity of the symptoms, but the effectiveness of the spraying combinations was at the same level (Table 1).

Brown rust occurred on the plant leaves of the control plots at Szestno in 2001. The forecrop did not affect its occurrence, however more symptoms were clearly observed in Roma (29.0%) than in Kobra (6.4%). The applied fungicides completely protected the leaves from the development of the pathogen, however the total effect was reported already after using just a single treatment. The same occurrence was reported at Lisewo in Sakwa and Elena where brown rust also occurred in 2001 at a high intensity and the applied fungicide treatments were totally effective. At Wielgłowy the reaction of Flair was investigated (III and IV). The observations were carried out for 6 years. Rust occurred in three of those years (2000, 2001,

Table 1. Powdery mildew (*B. graminis*) occurrence on leaves of the wheat cv. Flair depending on which forecrop (A) and fungicide application (C) was used in Wielgłowy 2002–2004 (DI in %)

Forecrop	Phase 59				Phase 75			
	K[1]	J-T[2]	J-S[3]	mean	K	J-T	J-S	mean
Oilseed rape	12.7	3.0	4.0	6.6	20.3	6.0	7.0	11.1
Wheat	10.0	3.0	3.0	5.3	17.7	3.7	4.0	8.4
Mean	11.3	3.0	3.5	5.9	19.0	4.8	5.5	9.8
LSD α = 0.05	A = 0.30		C x A = 0.58		A = 0.34		C x A = 0.65	
	C = 0.41		A x C = 0.53		C = 0.46		A x C = 0.59	

[1] control, [2] Juwel–Tango, [3] Juwel–Swing

Table 2. Occurrence of necrotic spots on leaves of winter wheat (DI in %) in Szestno (1999–2001) depending on which forecrop (A), cultivar (B) and number of treatments (C) were used

Forecrop	Cultivar	Growth phase A x B		
		59	75	85
Oilseed rape	Kobra	5.0	19.5	49.9
	Roma	2.7	12.9	31.6
	mean	3.8	16.2	40.8
Wheat	Kobra	6.6	23.2	54.9
	Roma	3.3	11.7	37.9
	mean	5.0	17.5	46.4
Mean	Kobra	5.8	21.3	52.4
	Roma	3.0	12.4	34.8
Mean for years		4.4	16.8	43.6
Cultivar	Treatment	B x C		
Kobra	no treatment	10.9	34.7	83.5
	1 treatment	4.0	15.4	38.6
	2 treatments	2.4	13.9	34.9
	mean	5.8	21.3	52.3
Roma	no treatment	5.5	22.8	58.1
	1 treatment	2.4	7.8	24.7
	2 treatments	1.0	6.5	21.5
	mean	3.0	12.4	34.8
Mean	no treatment	8.2	28.7	70.8
	1 treatment	3.2	11.6	31.7
	2 treatments	1.7	10.2	28.2
Mean for years		4.4	16.8	43.6
Treatment	Forecrop	C x A		
No treatment	oilseed rape	7.2	27.7	67.2
	wheat	9.2	29.9	74.5
	mean	8.2	28.8	70.8
1 treatment	oilseed rape	2.7	11.3	29.6
	wheat	3.7	12.0	33.7
	mean	3.2	11.6	31.7
2 treatments	oilseed rape	1.5	9.8	25.5
	wheat	2.0	10.6	31.0
	mean	1.7	10.2	28.2
Mean	oilseed rape	3.8	16.2	40.8
	wheat	5.0	17.5	46.4
Mean for years		4.4	16.8	43.6
LSD α=0.05/for:				
A and B		0.20	0.43	0.54
B x A and A x B		0.28	0.60	0.76
C		0.27	0.57	0.72
C x A and C x B		0.38	0.81	1.02
A x C and B x C		0.34	0.74	0.93

Table 3. Occurrence of necrotic spots on leaves of winter wheat (DI in %) in Lisewo (1999–2001) depending on the cultivar (B) and the treatments (C) used

Cultivar	Growth phase								
	59			75			85		
	C[1]	2x[2]	mean	C	2x	mean	C	2x	mean
Sakwa	5.9	0.7	3.3	25.1	5.9	15.5	74.7	15.9	45.3
Elena	4.5	0.5	2.5	18.7	5.3	12.0	58.6	14.0	36.3
Mean	5.2	0.6	2.9	21.9	5.6	13.8	66.7	15.0	40.8
LSDα=0.05	B = 0.29 C = 0.29		C x B = 0.41 B x C = 0.41	B = 0.68 C = 0.68		C x B = 0.96 B x C = 0.96	B = 0.66 C = 0.66		C x B = 0.94 B x C = 0.94

[1] control, 2x[2] – 2 treatments

Table 4. Occurrence of necrotic spots on leaves of the winter wheat cv. Flair (DI in %) in Wielgłowy (1999–2001) depending on the forecrop (A) and number of treatments used (C)

Forecrop	Treatment	Growth phase		
		59	75	85
Oilseed rape	no treatment	4.7	22.3	42.0
	1 treatment	2.2	7.3	19.7
	2 treatments	0.5	5.8	19.0
	mean	2.4	11.8	26.9
Wheat	no treatment	6.0	27.7	55.1
	1 treatment	3.2	8.5	22.3
	2 treatments	1.1	6.6	21.2
	mean	3.4	14.2	32.9
Mean	no treatment	5.3	25.0	48.5
	1 treatment	2.7	7.9	21.0
	2 treatments	0.7	6.2	20.1
mean for years		2.9	13.0	29.9
LSDα=0.05		A = 0.27 C = 0.36 C x A = n.s. A x C = n.s.	A = 0.45 C = 0.61 C x A = 0.78 A x C = 0.78	A = 0.83 C = 0.83 C x A = 1.44 A x C = 1.44

Table 5. Brown leaf spot (*D. tritici-repentis*) on leaves of the winter wheat cv. Flair (DI in %) depending on the forecrop (A) and fungicide application (C), Wielgłowy 2002–2004

Forecrop	Phase 73–75				Phase 85			
	C[1]	J-T[2]	J-S[3]	mean	C	J-T	J-S	mean
Oilseed rape	4.2	1.2	0.0	1.8	6.2	2.7	0.3	3.1
Wheat	5.5	0.8	0.0	2.1	9.9	3.4	0.7	4.7
Mean	4.9	1.0	0.0	2.0	8.1	3.0	0.5	3.9
LSDα = 0.05	A = n.s. C = 0.28		C x A = 0.40 A x C = n.i.		A = 0.23 C = 0.31		C x A = 0.44 A x C = 0.41	

[1] control, [2] Juwel-Tango, [3] Juwel-Swing; n.s. – not significant

Table 6. Green leaf area (GLA in %) of wheat in the BBCH 85 phase, Wielgłowy and Lisewo 1999–2001

Lisewo				Wielogłowy				
cultivar	control	2x	mean	forecrop	control	1x	2x	mean
Sakwa	15.0	49.7	32.4	Oilseed rape	7.9	44.3	50.1	34.1
Elena	17.7	62.7	40.2	Wheat	9.4	43.3	48.2	33.7
Mean	16.3	56.2	36.3	Mean	8.7	43.8	49.2	33.9
LSDα = 0.05	B = 0.83 C = 0.83		C x B = 1.17 B x C = 1.17	LSD α = 0.05	A = n.s. C = 1.19		C x A = 1.68 A x C = 1.53	

Table 7. Green leaf area (GLA in %) of the wheat cv. Flair in the BBCH 85 phase depending on the forecrop (A) and fungicidal treatments used (C), Wielgłowy 2002–2004

Forecrop	Control	J-T	J-S	Mean
Oilseed rape	34.0	60.3	68.7	54.3
Wheat	31.7	59.3	69.3	53.4
Mean	32.8	59.8	69.0	53.9
LSD α = 0.05	A = n.s. C = 0.91		C x A = 1.28 A x C = 1.16	

n.s. – not significant

Table 8. Disease symptoms (DI in %) and green leaf area (GLA in %) of wheat in BBCH 85 phase depending on the applied protection programs, Radostowo 2008

Combination	Powdery mildew	Brown rust	Brown leaf spot	*Septoria* leaf blotch	Green leaf area
I	2.0	25.2	8.0	8.5	20.2
II	0	4.8	2.5	2.0	45.5
III	0	3.0	2.0	2.2	45.5
IV	0	1.0	2.2	2.0	39.8
V	0	1.0	2.5	2.2	40.0
VI	0	2.2	2.2	2.0	39.8
VII	0	4.0	2.0	2.5	35.0
LSD α = 0.05	1.87	11.64	4.67	3.61	19.09

2003). The applied fungicides totally protected Flair from the pathogen development.

At relatively high wheat intensity, disease changes on leaves in the form of spot were observed. Due to some difficulties in determining the disease agent, the symptoms were generally referred to as leaf spot. Randomized microscope analyses (filter paper test) demonstrated that they were mainly caused by *Stagonospora nodorum, P. tritici-repentis, M. graminicola* and *Fusarium* spp. The changes had already been observed starting from phase 30–32. At Szestno, for 3 years the spot symptoms covered, on the average, 1.5% of the leaf area on the plots where oilseed rape was the forecrop, and 3.1% of the area on the plants grown after wheat.

As the plants grew the percentage of the leaf area with spot symptoms increased, but there were still fewer disease symptoms in the combinations after oilseed rape. For a 3 year period on the control plots, the symptoms at phase 59 covered, respectively, 7.2 and 9.2% of the leaf area, however these figures varied considerably throughout all the observation years. The application of the fungicide protection decreased the spot intensity. Interestingly, a good effect had been reported after a single treatment (DI = 3.2%). Further observations demonstrated further spot increase**.** At phase 75 in particular, many symptoms occurred in 2001. In the last observation (85) of each year, high spot intensity on the leaves was reported. For all the control combinations in the 3 year period, the symptoms accounted for, on the average, 70.8% of the leaf area. The symptoms were still significantly greater in number on the plots after wheat. Kobra had shown a greater leaf infection than Roma. The treatments applied limited the spot occurrence very clearly. A very high inhibition was reported after even a single treatment (Table 2).

Very good effects were recorded for inhibiting spot with the use of fungicides at Lisewo (II) where the symptoms on leaves had intensified each year after the BBCH 31 phase (Table 3).

At Wielgłowy, like at Szestno, the forecrop affected the spot occurrence on leaves where symptoms occurred every year at high intensity, but the fungicide protection applied was unusually effective. Very good effects were already recorded after a single treatment (Table 4).

In the years 2002–2004 the spot symptoms were definitely fewer. Due to a lower intensity and fewer experimental combinations, the occurrence of septoriosis and brown leaf spot were analysed separately. There was not a considerable intensity of septoriosis occurring at later phases and the applied fungicide protection completely protected the leaves from further disease development.

Brown spot on the control plants at the BBCH 73–75 phase occurred on 4.2 to 5.5% of the leaf area and at the BBCH 85 phase – from 6.2 to 9.9%. The applied fungicides very clearly limited the disease process (Table 5). In the second treatment, the application of fungicide with the active substances tridemorph + epoxyconazol (Swing Top 183 SC) was more effective than dimoxystrobin + epoxyconazol (Tango Star 334 SE).

The effectiveness of the treatments applied is well defined by the GLA at the BBCH 85 phase. On the control plots at Szestno a three-year average GLA for Kobra accounted for 3.3% and in Roma – 12.0%, while on the sprayed plots, depending on the number of treatments – for 27.6 and 31.6% (Kobra) and, respectively, 52.7 and 61.2% (Roma). Both in the control combinations and after the application of fungicides, the plants grown after oilseed rape demonstrated a greater percentage of GLA compared with those grown after wheat. A very high effectiveness was also reported at Lisewo and Wielgłowy

(Table 6). Interestingly, it was reported already after a single treatment.

From 2002–2004 the treatments applied significantly inhibited the leaf wilting process and increased the GLA percentage (Table 7). The tridemorph + epoxyconazole (Swing Top 183 SC) applied in the second treatment was more effective than dimoxystrobin + epoxyconazole (Tango Star 334 SE).

In the experiment performed in 2008 at Radostowo, at the BBCH 75 phase the disease symptoms occurred at low intensity and only on the leaves of the control (brown rust – 3.5%, brown leaf spot – 4% and septoria leaf blotch – 1.5%).

Higher disease intensity was observed at the BBCH 85 development phase. In the control, 25% of the leaf blade area had brown rust symptoms, 8.5% had septoria leaf blotch and 8.0% had symptoms of brown leaf spot. All the fungicide protection programmes applied inhibited their development significantly (Table 8).

DISCUSSION

The location of the experiments in the regions of high rainfall resulted in relatively high disease intensity. It was shown that the healthiness of winter wheat leaves depended on different factors, most importantly the cultivar, forecrop and the fungicides application.

The intensity of powdery mildew varied. More symptoms were observed at earlier plant development phases. In later phases, due to very high temperatures and frequent rainfall, the intensity was low. Frahm *et al.* (1998) also reported that the weather played an important role on how intense the symptoms of the pathogen, powdery mildew would be. The applied fungicides very clearly limited its development, especially when applying the treatment at an earlier phase. The need to perform the treatment at the occurrence of the first disease symptoms is stressed by many authors (Klingenhagen 1998; Gerhard *et al*. 1998).

A greater intensity of that disease in the combinations used after oilseed rape but not after wheat forecrop could have been due to greater soil richness with nitrogen. Oilseed rape requires high nitrogen fertilisation which often is not totally used up**.** At a greater nitrogen dose the intensity of powdery mildew in wheat grown after oilseed rape is greater.

Many necrotic spot symptoms were found on leaves during the whole research period. A rapid increase in symptoms was reported from the BBCH 59 phase, especially during the years with frequent rainfall. Starting from the BBCH 59 phase to the BBCH 85 phase (about 15 days) the intensity of symptoms increased 50–150% depending on the year, cultivar and the forecrop. A similar phenomenon was observed by Eyal (1999), Schollenberger *et al*. (1999), Mirzwa-Mróz *et al*. (1999), Wyczling *et al*. (2005). The microscopic analysis showed that the main agents of those spots were the following fungi: *M. graminicola, P. tritici-repentis* and *Fusarium* spp. An increase in the occurrence of those species on leaves over the recent years was reported by Zamorski and Nowicki (1996), Remlain-Starosta (1997), Schollenberger *et al*. (1999), Deval *et al*. (2000), Wyczling *et al*. (2005). The fungicide treatments very clearly limited the occurrence of leaf spot on leaves, which must have been mainly due to the right selection of the preparations. In the literature there can be found many different ways for applying fungicides, especially to limit the spot. The date of the first treatment depends on the dominant fungal species causing these symptoms as well as the harmfulness threshold (Rodemann and Bartels 2000). An early occurrence of necrotic spot symptoms means two or even three treatments are necessary (Kreye *et al*. 1999).

During the years with higher temperatures, brown rust occurred in high intensity. In 2001 at Szestno, in 'Roma' wheat the symptoms covered 39.5% of the plant leaf area on the control plots. A high variation in the susceptibility of the cultivars was reported by Frahm *et al*. (1998), Schollenberger *et al*. (1999), Klingenhagen (2000). The treatments applied were totally effective, however after a single treatment no disease was observed. The high effectiveness coincides with the opinions reported by Jones *et al*. (2000), Bertelsen *et al*. (2001) that preparations including epoxyconasol are one of the best active substances against *P. tritici*.

The applied fungicides clearly prolonged the so-called green effect (GLA) which was determined for 3 upper leaves at the BBCH 85 phase. The positive effects reported coincide with the results reported by Gerhard and Habermeyer (1998), Gerhard *et al*. (1998), Tiedmann and Yuexuan Wu (2001) who showed that after the application of preparations representing the strobilurin group, the aging process of the green organs of wheat is prolonged by a dozen or so days. Grain-filling is then enhanced, and as a result, a higher and better quality yield is produced.

CONCLUSIONS

1. The chemical treatment applied during all the years of the research effectively inhibited the diseases and increased the GLA. Better effects were reported after two applications, however even one treatment definitely improved the plant healthiness.
2. The healthiness of plants grown after oilseed rape was better than after wheat but that favourable effect decreased with plant development. While keeping in mind the forecrop, fungicides must be applied to obtain high yield.
3. High intensity of necrotic leaf spots, mainly caused by *P. tritici-repentis* was observed.
4. *S. nodorum, M. graminicola* and *Fusarium* spp. were not as important as *P. tritici-repentis.*

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POLISH SUMMARY

PORÓWNANIE WYSTĘPOWANIA CHORÓB I ZIELONOŚCI LIŚCI (GREEN LEAF AREA - GLA) PSZENICY OZIMEJ W ZALEŻNOŚCI OD PRZEDPLONU I ZRÓŻNICOWANEJ OCHRONY FUNGICYDAMI

W latach 1999–2008 badano wpływ przedplonu oraz zróżnicowanej ochrony chemicznej na nasilenie występowania chorób grzybowych liści pszenicy ozimej. Wykonano pięć (I–V) oddzielnych doświadczeń: w Szestnie na Mazurach (I), w Lisewie na Żuławach Wiślanych (II) oraz w Wielgłowach i Radostowie na Powiślu (III, IV, V). Nasilenie chorób było zróżnicowane. Mącznik prawdziwy (*Blumeria graminis*) występował w stosunkowo niewielkim lub śladowym nasileniu. W dużym nasileniu wystąpił kompleks nekrotycznych plamistości na liściach wywoływanych przez *Mycosphaerella graminicola*, *Stagonospora nodorum* i *Pyrenophora tritici-repentis*, a także grzyby rodzaju *Fusarium*. W latach 2000, 2001, 2003 w dużym nasileniu występowała rdza brunatna (*P. recondita*). Zastosowane zabiegi okazały się bardzo skuteczne w ograniczeniu chorób grzybowych na liściach. Powierzchnia górnych liści bez objawów porażenia (Greek Lear Area – GLA), w kombinacjach z fungicydami była istotnie większa, przy czym istotny efekt uzyskiwano już po jednym zabiegu. Stwierdzono również, że GLA roślin uprawianych po rzepaku była większa aniżeli po pszenicy.