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MYCOSES IN RYE (*SECALE CEREALE* L.) – OCCURRENCE AND THREAT. THREE-YEAR STUDY IN THE REGION OF SOUTHERN POLAND

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Abstract: In the years 1997-1999 the occurrence of rye diseases in the region of south-western Poland was investigated on rye varieties Warko, Dańkowskie Złote and hybrid rye Marder. Eyespot (*Pseudocercosporella herpotrichoides* var. *acuformis*) and brown rust (*Puccinia recondita*) occured most frequently in the experimental period. Fusarium stem base rot and leaf blight (*Fusarium* spp.) and leaf scald (*Rhynchosporium secalis*) were occasionally of considerable importance, but their occurrence was usually less frequent. Variety Marder showed high susceptibility to stem base and leaf diseases, especially to brown rust. When one treatment with fungicides was applied, grain yield increase of cv Marder reached the value of 20,03% in conditions of high infection by pathogens. It was concluded that in the years favourable for the development of diseases on rye, chemical control with broad-spectrum fungicides might be advisable, especially for protecting susceptible varieties.

Key words: rye, eyespot, rusts, leaf scald, fusarium, leaf blotch, south-western Poland

I. INTRODUCTION

Rye (*Secale cereale* L.) is commonly cultivated in Poland on soils, which are less suitable for wheat cultivation, mainly because of inadequate fertility, acid pH and poor soil – water relations. Such soils are however suitable for rye cultivation, which is less sensitive to adverse environmental conditions and more tolerant to infection by pathogens. This enables to obtain economically acceptable grain yield on these soils.

As compared to wheat and barley diseases, rye diseases have not been thoroughly investigated, and thus the respective literature is frequently incomplete. Rusts (*Puccinia recondita, P. striiformis, P. graminis*) and powdery mildew (*Blumeria graminis*), common pathogens of *Graminae* also infect rye. In Poland they were investigated both in relation to varietal resistance of rye and chemical control of diseases (Pokacka and Grala 1978; Ździebkowska 1985). Other leaf diseases of rye also commonly occur on our continent, of which leaf scald (*Rhynchosporium secalis*) seems to be of most importance in some years (Kluge 1993; Kurowski et al. 1988; Pokacka 1973; Werres and Hindorf 1993). Species of *Fusarium* are well known fungi which infect stem base and all aerial organs of rye plants, and they commonly occur wherever rye is cultivated. Eyespot (*Pseudocercosporella herpotrichoides* var. *acuformis* is also a well known rye disease (Dammer 1990; Miedaner et al. 1995); although its harmfulness is not fully documented for field conditions. Eyespot fungus frequently occurs as *Pseudocercosporella-Fusarium* complex and in such circumstances the infection of stems can cause increased damage, especially in the case of *P. herpotrichoides* var. *acuformis* (R-type). Bateman and Munnerey (1995) indicated

that R-type of the fungus occurred more frequently than W-type in mixed infections with *Fusarium* spp. as secondary colonizers. They suggested that this is likely to occur in most eyespot infected crops and most seasons because of ubiquity and abundance of *Fusarium* spp.

The aim of investigation presented in this paper was to determine which pathogens of stem base and leaves are currently the most dangerous to rye cultivated in south-western Poland, at what severity they occur, and what is the range of susceptibility of the two most commonly cultivated in Poland varieties Dańkowskie Złote, Warko, and a hybrid rye Marder (Fossati et al.1991).

II. MATERIAL AND METHODS

Data on the occurrence and severity of rye diseases were collected in the years 1997--1999 on 21 commercial fields. Each field comprised 2 experimental variants: 1-unprotected against diseases and 2-protected with fungicides, spraying was performed at growth stage GS 40-42 in the second experimental variant. However in the year 1998 observations were also performed on a field with cv Warko, where plants were twice sprayed with fungicides at GS 30-31 and GS 42-45.

From the start of vegetation in the spring until harvest the following diseases were scored using standard methods: eyespot (*Pseudocercosporella herpotrichoides*, *Fusarium* leaf blight (*Fusarium* spp.), leaf blotch (*Stagonospora nodorum*, *Septoria* spp.), powdery mildew (*Blumeria graminis*), leaf rust (*Puccinia recondita*) and leaf scald (*Rhynchosporium secalis*). Rarely occurring diseases were not scored. These included head blight (*Fusarium* spp.) and take-all (*Gaeumannomyces graminis*). Three levels of disease estimation were accepted:

- Survey of fields in the early spring which enabled to establish the development of first disease symptoms.
- Phytopathological analysis of collected plant samples. The infection index according to Bojarczuk and Bojarczuk (1974) was calculated for stem base diseases; per cent of infected plants by particular pathogens infecting leaves and ears; per cent of infected leaf area by those pathogens; per cent of loss of assimilating green leaf area (GLA).
- Verification of visual diagnosis using light microscopy and isolations of plant pathogens on artificial media.

Scoring of diseases was always performed on 100 plants collected along diagonal line across the field. Leaf diseases were scored on 3 fully developed leaves on which the symptoms could be best seen; dead old leaves were not taken under consideration in later stages of plant development. Respective data on the position of examined leaves are given in Table. To estimate harmfulness of diseases grain yield from non- protected control fields and protected with broad-spectrum fungicides fields was compared. However results of chemical control are not discussed in detail in the present paper.

III. RESULTS AND DISCUSSION

Data on the occurrence and severity of stem base diseases are presented in table1. In early stages of growth the infection by stem base pathogens was low, but was increasing

Table

Infection of three rye varieties by pathogenic fungi in the years 1997-1999

IOR Sośnicowice 1997-1999

Year	Variety	Disease index*				Percentage of affected leaf area%									
		eyespot *Pseudocercosporella herpotrichoides*		foot rot *Fusarium* spp.		leaf scald *Rhynchosporium secalis*			leaf rust *Puccinia recondita*			leaf blight *Fusarium* spp.		leaf blotch *Stagonospora nodorum*	
		I observation – start of vegetation GS 30	II observation – end of vegetation GS 91	I observation - start of vegetation GS 30	II observation – end of vegetation GS 91	I observation - start of vegetation GS 30 $L_5 - L_3$	II observation – full vegetation GS 49 $L_4 - L_2$	III observation – end of vegetation GS 71 $L_3 - L_1$	I observation – start of vegetation GS 30 $L_5 - L_3$	II observation – full vegetation GS 49 $L_4 - L_2$	III observation – end of vegetation GS 71 $L_3 - L_1$	II observation – full vegetation GS 49 $L_4 - L_2$	III observation – end of vegetation GS 71 $L_3 - L_1$	II observation – full vegetation GS 49 $L_4 - L_2$	III observation – end of vegetation GS 71 $L_3 - L_1$
1997	Warko	3a	400a	36a	84a	0	1.63a	0	0	0a	1.76a	1.3a	38.44a	0	0.39a
	Dańkowskie Złote	32a	312a	56a	100a	0	2.5a	0	0	0.09a	0.32a	1.89a	43.12a	0	0.89a
	LSD 0,05	48,57	137,99	78,98	24,92	–	1,77	–	–	0,28	2,78	1,28	40,35	–	0,64
1998	Warko	0a	210a	0a	216b	3.84a	12.62b	4.73c	0.04	3.21a	8.18a	2.37	8.24a	0	3.78a
	Dańkowskie Złote	3a	150a	24b	94a	5.05a	4.84a	1.36b	0	5.56a	14.06b	0	5.42a	0	6.72b
	Marder	5a	150a	5a	142a	41.53b	4.78a	0.5a	0.02	6.76a	18.68c	2.23	6.99a	0	2.54a
	LSD 0,05	5,22	64,23	17,89	67,13	5,73	2,67	0,39	–	3,19	3,47	–	2,12	–	1,32
1999	Warko	28a	98a	4a	35ab	0.36a	1.07a	14.73a	0a	0b	0.57a	0.48a	0	0a	2.46b
	Dańkowskie Złote	8a	75a	2a	8a	2.71b	6b	23.72b	0.02a	0.13a	16.98b	0.01a	0	0.13a	3.58b
	Marder	13a	213b	19b	72b	0.92a	17.07c	22.99b	0.04a	3.74a	73.68c	0a	0	0.02a	0.02a
	LSD 0,05	20,34	53,57	13,10	44,00	1,03	3,35	7,71	0,07	1,92	13,52	0,76	–	0,18	1,77

* disease index – (Bojarczuk – Bojarczuk 1974)

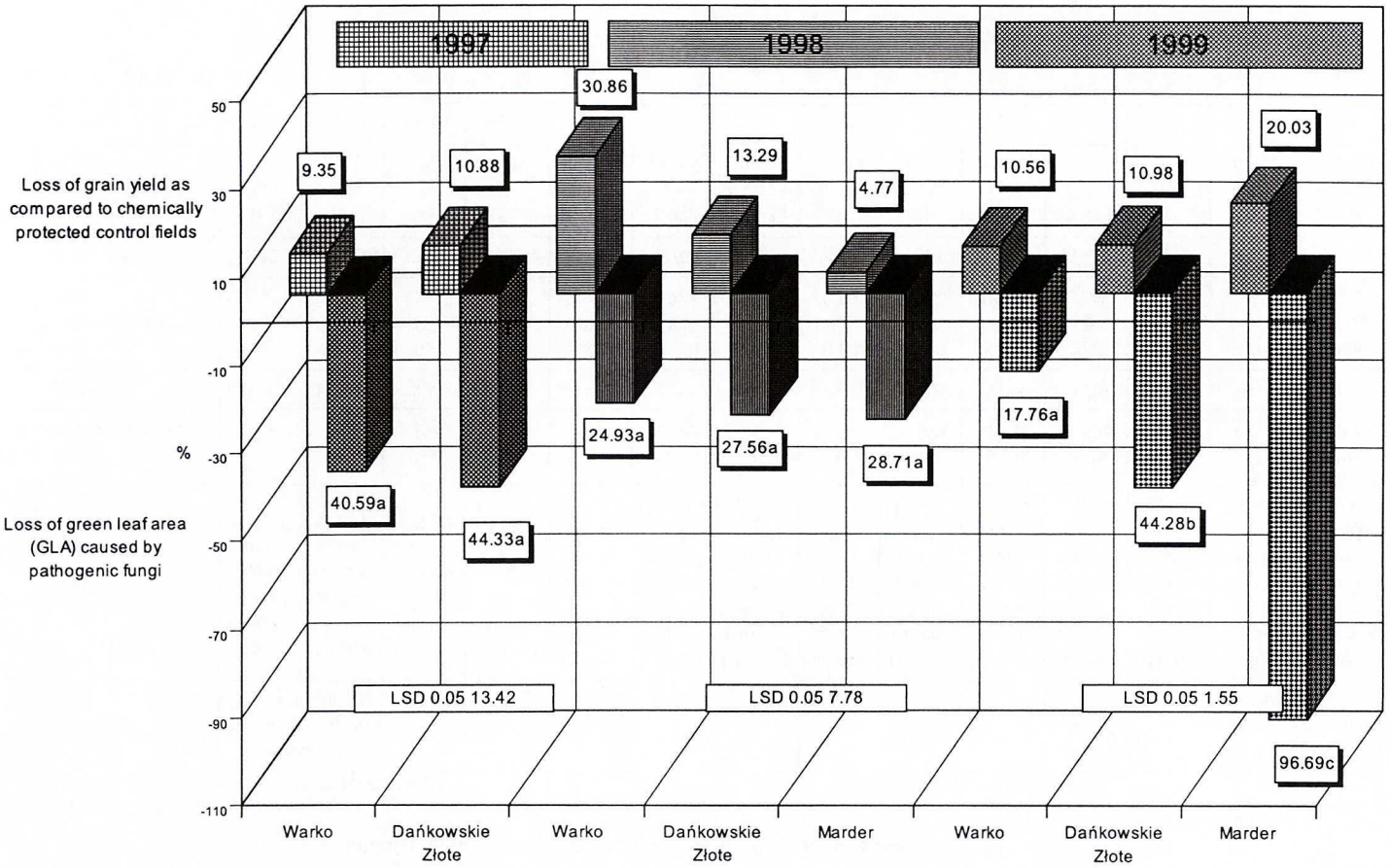

Fig. A comparison of loss of green leaf area (GLA)* on 3 varieties of rye caused by pathogenic fungi and loss of grain yield in relation to chemically protected control
* Average values for growth stages GS 71

in the course of vegetation. This is in agreement with results obtained by Pokacka (1984) on rye, and by Jaczewska (1999) on winter wheat, which is probably related both to low spring rainfall in Poland and relatively low temperatures. In 1997 both Warko and Dańkowskie Złote varieties had relatively high eyespot infection indices at GS–91. The decrease of GLA was also high (40, 59% and 44,33%, respectively), which was probably due to a high level of leaf infection at GS 71 by *Fusarium* spp. (Tab., Fig.). This level of infection of steam bases and leaves may have resulted in the decrease of grain yield by 9,35% and 10, 88% as compared to chemically protected control fields. In 1998 significantly higher infection index was recorded on cv. Warko for *Fusarium* stem base rot at GS-91. Infection index for eyespot was also the highest, although differences between varieties were not significant (Tab.). Grain yield of cv Warko was higher by 30.86% on protected plots (Fig.), which was probably due to the fact, that they were twice sprayed with fungicides. The average GLA loss for all 3 varieties shown in Fig. was about twice lower than in 1997. It is also worth to note that leaves 5-3 of cv Marder showed in 1998 a significantly higher level of infection by *Rhynchosporium secalis* at GS-30 (41.53%) than other varieties, this did not seem to affect grain yield. The infection of leaves of cv Marder by this pathogen was much lower at GS-49 and GS-71.

In 1999 eyespot infection index for cv Marder was significantly higher than for 2 other rye varieties. A high, significant decrease of GLA by 96,69% for this variety was also observed. Both these scoring values seem to be related to the highest grain yield decrease (20.03%) (Tab., Fig.). A considerable loss of GLA of cv Marder was mainly due to a high infection level (73,68%) of leaves at GS-71 by *P. recondita*, although the infection of leaves by *R. secalis* was also higher than in 1998. Infection of leaves of rye varieties by species of *Fusarium* was variable in the years 1997-1999. The higher level of infection was recorded in 1997 (38.4% and 43.2% of infected leaf area) at GS-71 for varieties Warko and Dańkowskie Złote. In 1998 and 1999 only low percentage of leaf area showed symptoms of fusarial infection. Species *Stagonospora nodorum* and *Septoria* spp. were only occasionally found on leaves, and only traces of infection by *Blumeria graminis* were recorded in experimental period, fusarium ear blight was rarely found, although it may be common in some years (Głazek et al.1998).

Hybrid rye cv Marder can be regarded as a variety susceptible to diseases. In the cases of increased infection of rye varieties by pathogens chemical protection with fungicides caused a considerable yield increase (usually by about 10%). It was the most effective on cv Marder in 1999 when yield increase on protected fields increased by 20.03%. This shows that the reaction of cv Marder to chemical protection is the best.

IV. CONCLUSIONS

1. In conditions of south- western Poland rye diseases may present a considerable threat to winter rye. The most damaging diseases of stem base and leaves in 1997-1999 were: eyespot (*Pseudocercosporella herpotrihoides*) and brown rust (*Puccinia recondita*). In some years fusarium stem base rot, fusarium leaf blight (*Fusarium* spp.) and leaf scald (*Rhynchosporium secalis*) may be important.

2. Leaf blotch (*Stagonospora nodorum, Septoria spp.*), powdery mildew (*Blumeria graminis*) and take- all (*Gaeumannomyces graminis*) are at the present of less importance.
3. Hybrid rye cv Marder was the most susceptible to leaf diseases, especially brown rust and scald, but also to powdery mildew (data not shown in the paper). It is also characterised by high susceptibility to stem base diseases.
4. Variety Dańkowskie Złote seems to be less susceptible to eyespot than 2 other varieties, Warko and Marder, however the occurrence of this disease was mainly dependent on the experimental period (the year of study).
5. Hybrid rye cv Marder exhibited the strongest reaction to chemical control of diseases with fungicides. This was particularly evident in the year 1998 when infection of stem bases was high, and in the year 1999 when also the level of infection by leaf pathogens was significantly higher than for other varieties.
6. Chemical protection of rye with broad-spectrum fungicides may be advisable in southern Poland in conditions favourable for the development of disease complex. Expected yield increase may amount to at least 10%.

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MIKOZY W ŻYCIE – WYSTĘPOWANIE I ZAGROŻENIE. TRZYLETNIE BADANIA W REJONIE POLSKI POŁUDNIOWEJ

STRESZCZENIE

W latach 1997-1999 oceniano występowanie chorób grzybowych na roślinach trzech odmian żyta: Warko, Dankowskie Złote i Marder.

Celem przeprowadzonych obserwacji w warunkach polowych i badań laboratoryjnych było określenie, jakie patogeny są obecnie największym zagrożeniem dla upraw żyta, jakie jest nasilenie ich występowania oraz jaka jest podatność na czynniki chorobotwórcze najczęściej uprawianych odmian żyta w Polsce południowej.

W latach 1997-1999 chorobami najsilniej porażającymi podstawę źdźbła i liście żyta były łamliwość źdźbła (*Pseudocercosporella herpotrichoides*) oraz rdza brunatna (*Puccinia recondita*). Fuzarioza podstawy źdźbła, fuzarioza liści (*Fusarium* spp.) i rynchosporioza (*Rhynchosporium secalis*), septorioza liści (*Stagonospora nodorum, Septoria* spp.) mączniak prawdziwy (*Blumeria graminis*) oraz zgorzel podstawy źdźbła (*Gaeumannomyces graminis*) miały mniejsze znaczenie.

Rośliny odmiany Dańkowskie Złote wykazały mniejszą wrażliwość na łamliwość źdźbła niż pozostałych dwóch odmian Warko i Marder. Heterozyjna odmiana Marder wykazała najsilniejszą reakcję na zastosowanie ochrony chemicznej przed chorobami. Uzyskana zwyżka plonu ziarna żyta wynosiła 10-20%.

Badania te pozwalają na szczegółową ocenę przebiegu porażenia i wrażliwości na choroby grzybowe opisanych trzech odmian żyta, a także na wskazanie czy konieczna jest ochrona tej rośliny uprawowej przy użyciu zabiegów chemicznych.