

Incidence of *Pyrenophora avenae* Ito et Kurib. in Europe between 1994–1998, and the Varietal Reaction of Oats to it

JOSEF ŠEBESTA¹, BRUNO ZWATZ², HYWEL W. RODERICK³, LUCIANA CORAZZA⁴,
MARIA HALINA STARZYK⁵, LARS REITAN⁶ and IGOR LOSKUTOV⁷

¹Research Institute of Crop Production – Division of Plant Medicine, Prague, Czech Republic;

²Federal Office and Research Centrum for Agriculture – Institut für Medizin, Wien, Austria; ³Institute of Grassland and Environmental Research, Aberystwyth, Plas Gogerddan, The United Kingdom; ⁴Plant Pathology Research Institute, Roma, Italy, ⁵Association of Plant Breeders, Wielopole, Poland; ⁶Norwegian State Agricultural Research Stations, Kvithamar, Stjoldal, Norway; ⁷Institute of Plant Industry, St. Petersburg, Russia

Abstract

ŠEBESTA J., ZWATZ B., RODERICK H.W., CORAZZA L., STARZYK M.H., REITAN L., LOSKUTOV I.G. (2001): **Incidence of *Pyrenophora avenae* Ito et Kurib. in Europe between 1994–1998, and the varietal reaction of oats to it.** Plant Protect. Sci., 37: 92–96.

In Europe in the period 1994–1998, *Helminthosporium leaf blotch* disease was recorded in Austria, Belarus, Bulgaria, the Czech Republic, Estonia, Finland, Hungary, Italy, Norway, Poland, Russia and Yugoslavia. There was large variation in the quantitative reaction of oat (*Avena sativa* L.) genotypes to this disease, ranging from a disease resistance index (DRI) of 71 with cv. Kasadra to 16 with cv. Pan. Oat genotypes such as Kasadra, Pc 60, Pc 61, IL 86-6404, IL 86-1158, Rodney M, Pg 15, Cc 4761, Vermiou, Roxton, IL 85-6467, IL 85-2069, Pc 54-2, Orlando, OM 1387, Pc 59, KR 3813/73, IL 86-4189, Pc 68, Melys, OA 503-1, KR 288/73L/569, POB 1429/93, Pg 16, Pc 55 and Pc 56 had a consistently high disease resistance index. On the other hand, some had a low index which confirms the existence of pathogenic specialization of the causal fungus *Pyrenophora avenae* Ito et Kurib.. Despite the absence of detailed analyses of the reaction of oats to the pathogen, it seems feasible to breed for resistance to the disease.

Keywords: *Pyrenophora avenae*; oats; variety resistance; Europe

The fungus *Drechslera avenae* (Eidam) Scharif (*Helminthosporium avenae* Eidam) (perf. state *Pyrenophora avenae* Ito et Kurib.) is a common and destructive pathogen of oats in humid and cold regions of Europe and North America (HARDER & HABER 1992; ŠEBESTA 1970). It has also been reported from Asia and South Africa (WELSH *et al.* 1953). Before the application of organic mercury seed dressing the disease caused damage in the United Kingdom (DILLON 1943). According to MULLER (1963), *Pyrenophora avenae* was the most frequent pathogen inciting the characteristic spot symptoms in the former German Democratic Republic. Later on, KIEWNICK (1974) reported that *Pyrenophora* leaf blotch was the most serious disease in Germany after loose smut and crown rust.

The causal agent of this leaf blotch was noted to be a common fungus in Sweden (OLOFSSON 1976) and Finland (REKOLA *et al.* 1970).

The varietal reaction of oats to *P. avenae* was extensively studied by EARHART and SHANDS (1952). The oat lines B 1-47-67 and Wisconsin hybrid X 279-1 expressed resistance, supposedly applicable in resistance breeding to the disease (EARHART & SHANDS 1952). Problems of varietal reaction were also studied by MULLER (1963). The oat line Bernburg St. 37664 was heavily infected, whereas less than half that level of infection was found on cvs. Omiko and Flaemingsweisse II. In general, North American cultivars were much less infected than German ones. The cvs. Clinton and Bonham and line 2411 were

recommended for resistance breeding. Furthermore, some lines resistant to *P. avenae* were identified by PANDEY and MISRA (1973). GRACHEV (1961) and KUNOWSKI and BRESHKOV (1981) found resistance in Iowa 2052, Aigorduro, selections from cv. Garry and in accessions of *A. byzantina*, *A. strigosa* and *A. brevis*. Recently, rate limiting resistance in several oat-breeding lines was reported by FRANK and CHRIST (1988) (cit. HARDER & HABER 1992).

This is the second study on the incidence of *Helminthosporium leaf blotch* (caused by *Pyrenophora avenae* Ito et Kurib.) on oats as determined in the FAO European project European Oat Disease Nursery within the European System of Cooperative Research Networks in Agriculture programme (SCORENA) (ŠEBESTA 1994, 1995, 1996, 1997, 1998; ŠEBESTA *et al.* 1995a, b, 1996a, b).

The objective of this study was to improve our knowledge about the incidence of *Helminthosporium leaf blotch* on oats in Europe and the varietal reaction of the oat genotypes included in the European Oat Disease Nursery (EODN), later re-named the European and Mediterranean Oat Disease Nursery (EMODN) in the period 1994–1998.

MATERIALS AND METHODS

Sixty-eight genotypes of oat with resistance to crown rust, stem rust, powdery mildew, and tolerance to *Barley yellow dwarf virus* (BYDV) were evaluated for the severity of *Helminthosporium leaf blotch* within the European (and Mediterranean) Oat Disease Nursery trials in 1994–1998 (ŠEBESTA *et al.* 1995a, b). The disease was evaluated on leaves and also, if it occurred, on panicles (ŠEBESTA *et al.* 1994). The amount of infection at individual localities and years was evaluated on the basis of average incidence as being low (+), moderate (++) or high (+++) (ŠEBESTA *et al.* 1995a, b).

Several assessment scales were used to record severity of the pathogen, namely:

1. James's scale (J) (% leaf area infected) (JAMES 1971a, b).
2. 0–8 'western' scale (w) (where 0 = no symptoms).
3. 9–1 'eastern' scale (e) (where 9 = no or very little symptoms).

The following transformations of the scales were used:

1. Resistant = (0, 1) (w), (9, 8) (e), (0–5%) (J)
2. Moderately resistant = (2, 3) (w), (7, 6) (e), (5–25%) (J)
3. Moderately susceptible = (4, 5) (w), (5, 4) (e), (25–50%) (J)
4. Susceptible = (6, 7, 8) (w), (3, 2, 1) (e), (> 50%) (J).

As in a previous study (ŠEBESTA *et al.* 1995a, b), the disease resistance index (DRI) for each genotype was calculated as the sum of all resistant (R) and moderately resistant (MR) evaluations, which are given values of 4 and 3 respectively. The genotypes were then ranked according to value of the DRI.

RESULTS AND DISCUSSION

Incidence of *Helminthosporium leaf blotch* in Europe from 1994–1998

In Europe during 1994–1998, the disease was recorded on oats in Austria, Belarus, Bulgaria, Czech Republic, Estonia, Finland, Hungary, Italy, Norway, Poland, Russia and Yugoslavia (Table 1). A moderate or high incidence of the disease was recorded in Austria at the Petzenkirchen site in 1997, and at St. Donat in 1994–1998. In both Belarus and Bulgaria only low incidences were recorded in 1998 and 1995 respectively.

In the Czech Republic the disease was recorded at all four sites. A low incidence at Kroměříž from 1994–1996 and a moderate level in 1997. At the Krukanice Plant Breeding Station a low incidence was recorded in 1996 and 1998, and a high incidence in 1997. In the east and west districts of Prague a low incidence of the disease was recorded in 1996 and 1997 and from 1995–1998, respectively.

In Estonia a moderate incidence of the disease was recorded in 1995 and a low level in 1997. In Finland a high incidence in 1994 and a low one in 1995 and 1996. In Hungary a low incidence of the disease was recorded in 1998, also in Italy in 1994 and 1998. There was a low incidence in Yugoslavia in 1997, but a moderate one in 1998. In Norway, at the locality Stjordal a high incidence of the disease was recorded in 1996 and a low one in 1998.

The incidence of *Helminthosporium leaf blotch* in Poland suggests that it is one of the more important diseases of oat since it occurred at a moderate level in 1994, 1996, 1997 and 1998, and at a low level in 1995. In the Russian Federation the disease occurred at a moderate level at Nemchinovka in 1994 and at high or moderate levels at St. Petersburg in 1994, 1996 and 1998 (Table 1).

Disease resistance index (DRI) in 68 oat genotypes to *Helminthosporium leaf blotch* as recorded in the EODN (EMODN) trials in the period 1994–1998

The variation of the quantitative reaction of oat genotypes to *Helminthosporium leaf blotch* in Europe in 1994–1998 is very large, ranging from a DRI 71 of cv. Kasadra to 16 of cv. Pan (Table 2).

Oats such as Kasadra, Pc 60, Pc 61, IL 86-6404, IL 86-1158, Rodney M, Pg 15,

Cc 4761, Vermiou, Roxton, IL 85-6467, IL 85-2069, Pc 54-2, Orlando,

OM 1387, Pc 59, KR 3813/73, IL 86-4189, Pc 68, Melys, OA 503-1, KR 288/73L/569, POB 1429/93, Pg 16, Pc 55 and Pc 56 had a consistently high DRI. There is a high degree of similarity of the results from this study with those from a previous analysis of data from 1990–1993 (ŠEBESTA *et al.* 1995a, b), which confirms that calculating a DRI appears to be a suitable method to identify resistant germplasm.

Table 1. Incidence of *Helminthosporium* leaf blotch (*Pyrenophora avenae* Ito et Kurib.) in Europe in 1994–1998 as recorded in the European (and Mediterranean) Oat Disease Nursery (+ = low, ++ = moderate, +++ = high)

Country	Locality	1994	1995	1996	1997	1998
Austria	Drauhofen					
	Edelhof					
	Fuchsenbigl					
	Petzenkirchen				++	
	St. Donat	+++	++	++	++	+++
Belarus	Zhodino					+
Bulgaria	Sadovo		+			
Czech Republic	Kroměříž	+	+	+	++	
	Krukanice			+	+++	+
	Prague East			+	+	
	Prague West		+	+	+	+
Estonia	Jõgeva		++		+	
Finland	Jokioinen	+++	+	+		
Germany	G. Lüsewitz					
	Schwäbisch Hall					
Hungary	Martonvásár					+
Italy	Rome	+				+
Norway	Stjordal			+++		+
Poland	Wielopole	++	+	++	++	++
Russia	Nemchinovka	++				
	St. Petersburg	+++		++		++
Sweden	Svalof					
Yugoslavia	Novi Sad				+	++

Cv. Kasadra and lines Cc 4761, Pc 54-2 and OM 1387 were the most resistant entries, whereas IL 86-1158, Pg 15, Roxton, IL-2069, Orlando, IL 86-4189, Pc 68, Melys, KR 288/73L/569, Pg 16 and line Pc 56 were moderately resistant.

The following had approximately the same number of resistant and moderately resistant readings: Pc 61, Rodney M, Vermiou, IL 85-6467, Pc 59, KR 3813/73 and the line OA 503-1. The genotypes Rodney A, APR 122, SG-K 95708, Cc 3678, Pirol, Zlatak, Adam, Garland, POB 14391/93, Pc 54-1, Rodney H, Manod, IL 86-4467, KR 8122, SG-K 961010, Maldwyn, Pc 62, Rodney B, SG-K 93682, OA 504-6, Pc 58, KR 9046, IL 86-5698, Pc 67 and Pc 50-2 appear to be less resistant.

With the exception of Cc 3678, Pirol, Adam, POB 14391/93, SG-K 961010 and line OA 504-6, the DRI in this second group is mainly formed by genotypes which were moder-

ately resistant. Whereas oats such as cv. Mostyn, Pc 64, Pen2 × CAV 1376, Cc 6490, Pc 63, Pc 38 and cv. Pan were consistently moderately resistant.

In cases of relatively low DRI, the existence of pathogenic specialization of the fungus *P. avenae* is suggested; this has been demonstrated previously by TVEIT (1956), PANDEY and MISRA (1973) and ŠEBESTA *et al.* (1995a, b). Despite the absence of detailed analyses of the reaction of oat genotypes to *P. avenae*, breeding for resistance to the pathogen appears to be feasible. The different varietal responses of oats to the disease was demonstrated by EARHART and SHANDS (1952). More recently, rate-limiting resistance to *P. avenae* in spring oats was described by Frank and CHRIST (1988). Other studies on the resistance of oats to this pathogen includes those by GRACHEV (1962) and KUNOWSKI and BRESHKOV (1981).

Table 2. Disease resistance index (DRI) of oat cultivars and lines to *Helminthosporium* leaf blotch (*Pyrenophora avenae* Ito et Kurib.) in Europe in 1994–1998 (after adjusting to 21 evaluations per line)

Cv./Line	DRI	R	MR	MS	S	Total	Cv./Line	DRI	R	MR	MS	S	Total
Kasadra	71	28	6	2	0	10	POB 14391/93	37	16	12	12	2	16
Pc 60	65	32	33	4	0	21	Pc 54-1	36	0	36	18	0	21
Pc 61	59	32	27	4	2	21	Rodney H	36	12	24	12	4	21
IL 86-6404	55	28	27	8	1	21	Manod	36	12	24	16	2	21
IL 86-1158	53	20	33	6	2	21	IL 86-4467	36	4	30	14	2	20
Rodney M	51	24	27	8	2	21	KR 8122	35	12	21	16	2	20
Pg 15	49	16	33	10	1	21	Maldwyn	34	16	18	16	3	21
Cc4761	49	28	21	8	3	21	Pc 62	34	8	24	14	3	20
Vermiou	49	20	24	10	1	19	Rodney B	33	12	21	18	2	21
Roxton	48	12	36	6	3	21	SG-K 93682	33	8	6	6	2	9
IL 85-6467	48	24	24	10	2	21	OA 504-6	32	20	12	14	5	21
IL 85-2069	47	20	27	8	3	21	Pc 58	32	0	30	18	1	20
Pc 54-2	46	28	18	12	2	21	KR 9046	31	16	15	18	3	21
Orlando	46	16	30	14	0	21	IL 86-5698	31	4	27	16	3	21
OM 1387	46	28	18	12	1	20	Pc 67	31	16	15	22	1	21
Pc 59	44	20	24	8	4	21	Pc 50-2	30	12	18	22	1	21
KR 3813/73	44	20	24	10	3	21	Pg a	29	8	21	18	3	21
IL 86-4189	44	8	36	12	1	21	Pc 39	28	4	24	20	2	21
Pc 68	43	4	39	12	1	21	Pc 50-4	28	16	12	18	4	21
Melys	43	16	27	16	0	21	Rodney ABDH	28	16	12	22	2	21
OA 503-1	43	20	21	10	3	20	Pc 50	27	12	15	20	3	21
KR288/73L	42	12	30	10	3	21	Mostyn	27	0	27	20	2	21
POB 1429/93	42	8	24	8	2	16	Cc 4146	27	8	18	16	4	20
Pg 16	41	8	33	20	3	21	OA 504-5	26	8	18	16	5	21
Pc 55	40	16	24	12	3	21	Pc 64	24	0	24	22	2	21
Pc 56	40	4	36	10	3	21	Pen2 × CAV 1376	24	0	24	14	6	21
Rodney A	39	12	27	12	3	21	Cc 6490	24	0	24	18	4	21
APR 122	39	12	27	14	2	21	APR 166	24	12	12	22	2	21
SG-K 95708	39	8	18	12	0	14	OM 1621	21	12	9	26	1	20
Cc 3678	39	12	6	2	0	6	Maelor	20	8	12	20	5	21
Pirol	38	20	18	14	3	21	Pc 48	20	4	15	24	2	20
Zlatak	38	20	18	14	3	21	Pc 63	18	0	18	18	6	21
Adam	38	24	12	18	1	20	Pc 38	15	0	15	22	5	21
Garland	37	16	21	12	4	21	Pan	16	0	3	0	3	4

R (resistant) = 4; MR (moderately resistant) = 3; MS (moderately susceptible) = 2; S (susceptible) = 1; Total = whole number of evaluations

References

- DILLON WESTON W.A.R. (1943): Seed disinfectant V. The stripe disease of barley and oats. *J. Agric. Sci.*, **33**: 23–27.
- EARHART R.W., SHANDS H.L. (1952): Oat varietal response to infection by *Helminthosporium avenae* Eidam. *Agric. J.*, **44**: 234–238.
- FRANK J.A., CHRIST B.J. (1988): Rate-limiting resistance to *Pyrenophora* leaf blotch in spring oats. *Phytopathology*, **78**: 957–960.
- GRACHEV A.F. (1961): The resistance of oats to crown rust and helminthosporiosis under the conditions of Primorski Krai. *Ref. Zhur. Biol. No. 141G236* (Abstract).
- HARDER D.E., HABER S. (1992): Oat diseases and pathologic techniques. 1992 Am. Soc. Agron. and Crop Sci. Soc. Am. 677 S. Segoe Rd.: Oat Sci. Technol.-Agron. Monograph, **33**, 307–425.
- JAMES W.C. (1971a): An illustrated series of assessment keys for plant diseases, their preparation and usage. *Can. Dis. Surv.*, **51**: 39–65.

- JAMES W.C. (1971b): A Manual of Assessment Keys for Plant Diseases. Can. Dep. Agric. Publ. 1458.
- KIEWNICK L. (1974): Streifenkrankheit des Hafers (*Drechslera avenae* Curtis ex Cooke: Shoem). Mögliche Ursachen ihres starken Auftretens in den Jahren 1972 und 1973. Meded. Fakult. Landbow. Gent, **39**: 917–978.
- KUNOWSKI Z., BRESHKOV T. (1981): Field resistance of oat varieties from the world collection to *Puccinia graminis* Pers. f.sp. *avenae* Erikss. et Henn. and *Pyrenophora avenae* Ito. Rasten. Nauki, **18**: 118–123.
- MULLER H.J. (1963): Untersuchungen über Blattfleckenkrankheiten des Hafers. II. Pilzliche Blattfleckenenerger des Hafers. Phytopathol. Z., **49**: 266–290.
- OLOFSSON B. (1976): Undersökningar rörande Drechslera-arterna som korn och havre. Meddel. Stat. Vaxtskyd, **16**: 32–425.
- PANDEY S.C., MISRA A.P. (1973): Varietal reaction of oats to *Helminthosporium avenae*. Indian J. Mycol. Pl. Pathol., **3**: 214–216.
- REKOLA O.A., RUOKOLA L., KURTTO J. (1970): Damage caused by *Helminthosporium avenae* Eidam on the crop yield of oats in Finland. Acta Agric. Scand., **20**, 225–229.
- ŠEBESTA J. (1970): Control of oat diseases. SI Ochr. Rostl., No. 4, ÚVTI, Praha.
- ŠEBESTA J. (1994): European Oat Disease Nursery Annual Report 1994. FAO European System of Cooperative Research Networks in Agriculture, Prague.
- ŠEBESTA J. (1995): European Oat Disease Nursery Annual Report 1995. FAO European System of Cooperative Research Networks in Agriculture, Prague.
- ŠEBESTA J. (1996): European Oat Disease Nursery Annual Report 1996. FAO European System of Cooperative Research Networks in Agriculture, Prague.
- ŠEBESTA J. (1997): European Oat Disease Nursery Annual Report 1997. FAO European System of Cooperative Research Networks in Agriculture, Prague.
- ŠEBESTA J. (1998): European and Mediterranean Oat Disease Nursery Annual Report. FAO Eur. System of Cooperative Research Networks in Agriculture, Prague.
- ŠEBESTA J., FORMANOVÁ M., ŠÍP V., VACKE J., ŠKORPÍK M. (1994): Occurrence of *Pyrenophora avenae* Ito et Kurib. in the Czech Republic in 1992 and the varietal reaction of oat to it. Genet. a Šlecht., **30**: 1–8.
- ŠEBESTA J., ZWATZ B., CORAZZA L., RODERICK H.W. (1995a): Disease resistance index – a multi-site indicator of the effectiveness of plant genotypes against diseases. Ochr. Rostl., **31**: 167–176.
- ŠEBESTA J., ZWATZ B., CORAZZA L. (1995b): Incidence of *Pyrenophora avenae* Ito et Kurib. in Europe and the varietal reaction of oat to it. Arch. Phytopath. Pflanz., **29**: 485–490.
- ŠEBESTA J., ZWATZ B., HARDER D.E., CORAZZA L., RODERICK H.W., STOJANOVIĆ S. (1996a): Incidence and resistance of oats to fungus diseases in Europe in 1988–1994. Ochr. Rostl., **32**: 103–113.
- ŠEBESTA J., ZWATZ B., HARDER D.E., CORAZZA L., RODERICK H.W., STOJANOVIĆ S. (1996b): Resistance of oat to fungal diseases in Europe. In: Vth Int. Oat Conf. and VIIth Int. Barley Genetics Symp., Canada, Saskatoon, Proc., 2: 771–773.
- TVEIT M. (1956): Pathogenicity of species of *Helminthosporium* from Brazilian oats. Phytopathology, **46**: 45–48.
- WELSH J.N., CARSON R.B., CHEREWICK W.J. et al. (1953): Oat varieties – past and present. Canada Dept. Agric. Ottawa, Publ. 891.

Received for publication April 2, 2001

Accepted for publication July 28, 2001

Souhrn

ŠEBESTA J., ZWATZ B., RODERICK H.W., CORAZZA L., STARZYK M.H., REITAN L., LOSKUTOV I.G. (2001): Výskyt *Pyrenophora avenae* Ito et Kurib. v Evropě v letech 1994–1998 a odrůdová reakce ovsů k této chorobě. Plant Protect. Sci., **37**: 91–95.

V Evropě byla v letech 1994–1998 prokázána hnědá skvrnitost ovsu (*Pyrenophora avenae* Ito et Kurib.) v Rakousku, Bělorusku, Bulharsku, České republice, Estonsku, Finsku, Maďarsku, Itálii, Norsku, Polsku, Rusku a Jugoslávii. Byly zjištěny velké rozdíly v kolísání kvantitativní reakce genotypů ovsu (*Avena sativa* L.) ke hnědé skvrnitosti. Index rezistence k chorobě (DRI) kolísal od hodnoty 71 u odrůdy Kasadra po hodnotu 16 u odrůdy Pan. Genotypy ovsu jako Kasadra, Pc 60, Pc 61, IL 86-6404, IL 86-1158, Rodney M, Pg 15, Cc 4761, Vermiou, Roxton, IL 85-6467, IL85-2069, Pc 54-2, Orlando, OM 1387, Pc 59, KR 3813/73, IL 86-4189, Pc 68, Melys, OA 503-1, KR 288/73L/569, POB 1429/93, Pg 16, Pc 55 a PC 56 měly relativně stále vysoký index rezistence k chorobě. Naproti tomu jiné genotypy vykazovaly opakovaně nízký index rezistence k chorobě, což potvrzuje existenci patogenní specializace houby *Pyrenophora avenae* Ito et Kurib. Přes nepřítomnost podrobné analýzy reakce ovsů k hnědé skvrnitosti, se šlechtění ovsu na rezistenci k této chorobě zdá být proveditelné.

Klíčová slova: *Pyrenophora avenae*; oves; odrůdová rezistence; Evropa

Corresponding author:

Doc. Ing. JOSEF ŠEBESTA, DrSc., Výzkumný ústav rostlinné výroby, odbor rostlinolékařství, 161 06 Praha 6-Ruzyně, Česká republika
tel.: + 420 2 33 02 21 11, fax: + 420 2 33 31 06 36, e-mail: sebesta@vurv.cz