First report of eyespot [*Pseudocercosporella herpotrichoides]* in spring barley in Alberta

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Pseudocercosporella herpotrichoides [(Fron) Deighton], the causal agent of eyespot was isolated from the stubble of spring barley near Olds, Alberta in January 1987. This is the first report of this disease in barley in Alberta. As far as can be determined there are also no other reports of the causal agent infecting barley in Canada or other cereals in the Prairie Provinces. Eyespot in barley has been noted at several locations in Central Alberta and in the Peace River Region. In one particular field of barley, cv. Johnston, located near Airdrie, Alberta, 87.8 percent of the stems had eyespot lesions.

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On a isolé l'espèce *Pseudocercosporrella herpotrichoides* [(Fron) Deighton], responsable de la tache ocellee, a partir d'échantillons de chaume d'orge de printemps recueillis pres de Olds (Alberta) en janvier 1987. C'est la premiere fois qu'on signale la presence de cette maladie chez le blé en Alberta. Nous n'avons pu trouver d'autres rapports d'infection du ble au Canada ou d'autres céréales dans les provinces des Prairies par cet agent pathogene. On a signalé des cas de tache ocellée chez l'orge à plusieurs endroits du centre de l'Alberta et dans la region de la riviere de la Paix. Dans un champ d'orge Johnston situe pres de Airdrie (Alberta), 87,8 pour cent des tiges presentaient des lesions dues a la tache ocellée.

Pseudocercosporella herpotrichoides [(Fron) Deighton)], the causal agent of eyespot which is also known as foot rot or strawbreaker, was isolated from the stubble of spring barley near Olds, Alberta in January 1987. During the summers of 1987 and 1988 the fungus was observed infecting spring barley in fields near Olds, Airdrie, Innisfail, Rimbey, Wetaskawin and Fairview. As far as it can be determined this is the first report of this disease infecting a cereal crop in Alberta. In Canada, the disease has been reported on wheat in Ontario, Quebec and British Columbia, but never before on any cereal crop in the Prairie Provinces (Conners, 1967; Ginns, 1986). The fungus was positively identified by R.A. Shoemaker of the Biosystematics Research Centre, Agriculture Canada, Ottawa (DAOM 196996). All isolates have produced even-edged colonies characteristic of the wheat-type (W-type) pathotype of *Pseudocercosporella herpotrichoides* (Scott, Hollins & Muir, 1975). Host range studies with the differential hosts, barley, wheat and rye have not been conducted.

Eyespot is a widespread disease of wheat, barley and rye crops in Europe, the USSR, South Africa, parts of North America and Australasia (Anon., 1981). The disease reduces the yield of the crop through direct effects on the movement of water and nutrients in the host and through indirect effects resulting from lodging. Eyespot can cause yield losses of up to 50% in winter wheat (Bruehl *et al.*, 1968), but is rarely of any importance in spring cereals.

Eyespot lesions in barley are usually located on the stem within 5 cm of the crown of the plant (Mathre, 1982). In Alberta, however, it has not been uncommon to find barley stems with eyespot infections higher up on the stem. These

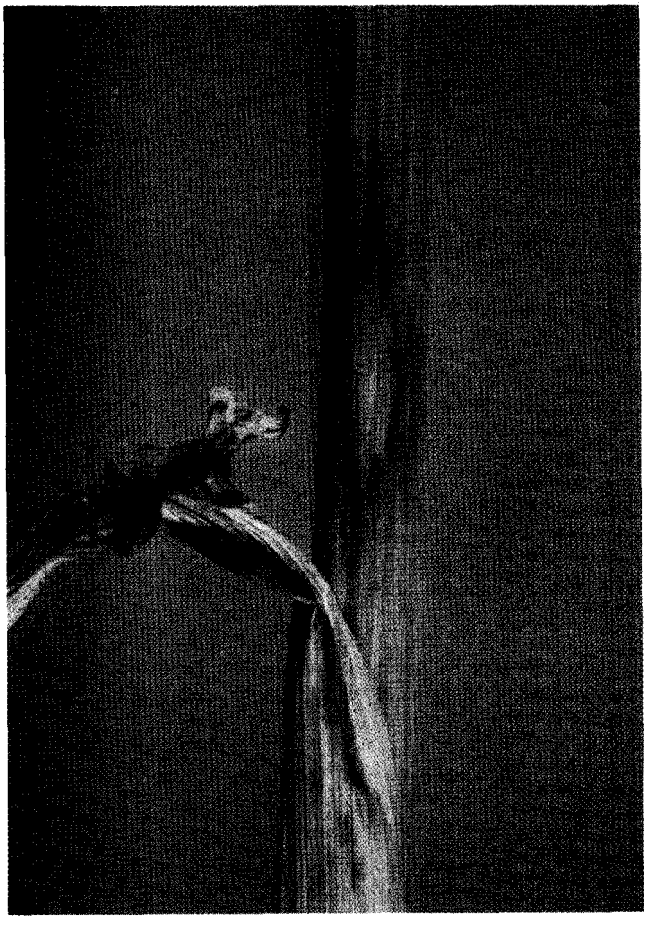

Figure 1. Eyespot lesion located near the leaf collar.

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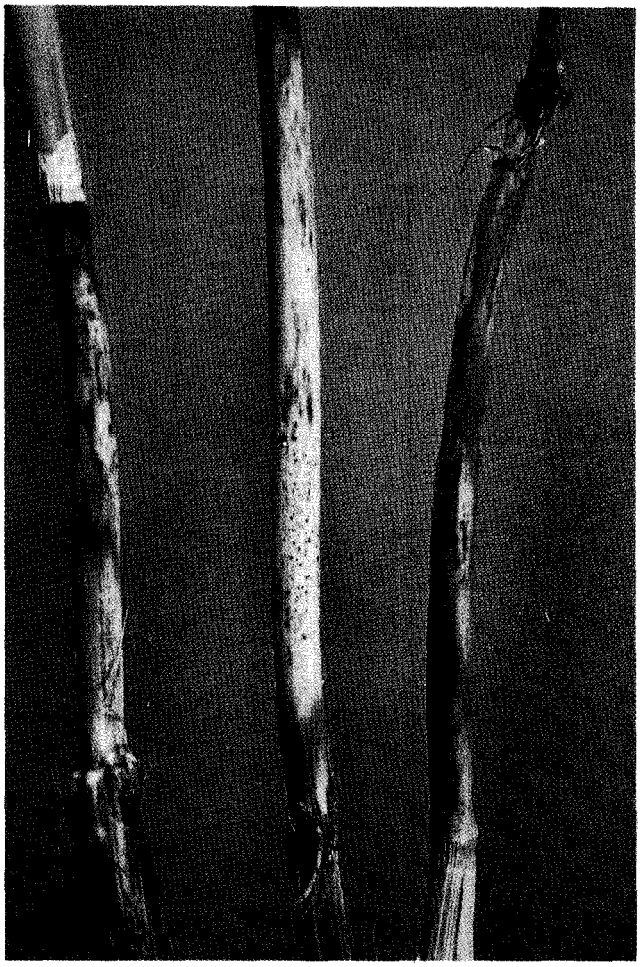

Figure 2. Stems with multiple eyespot lesions with fungus-darkened areas.

infections tend to occur near the leaf collar and auricles (Figure 1). It is very common to have an accumulation of free moisture at this location on the plant which may provide suitable conditions for spore germination and infection. Spores might also be concentrated in this region as a result of runoff from the leaf lamina towards the stem. Eyespot infections with fungus-darkened centers were not found in 1987, but were common in 1988 (Figure 2). Wefts of mycelium were often present within the lumen of infected stems (Figure 3).

In 1988, a field of spring barley, cv. Johnston, west of Airdrie, Alberta had a very high incidence of eyespot. A random sample of 410 stems were collected along a "V" pattern from the field at Zadoks growth stage (ZGS) 85 (Zadoks *et al.*, 1974). The stems were rated using the scale developed by Scott & Hollins (1974):

0 uninfected;
1 slight eyespot (one or more small lesions occupying in total less than half the circumference of the stem);
2 moderate eyespot (one or more lesions occupying at least half the circumference of the stem);
3 severe eyespot (stem completely girdled by lesions; tissue softened so that lodging would readily occur).

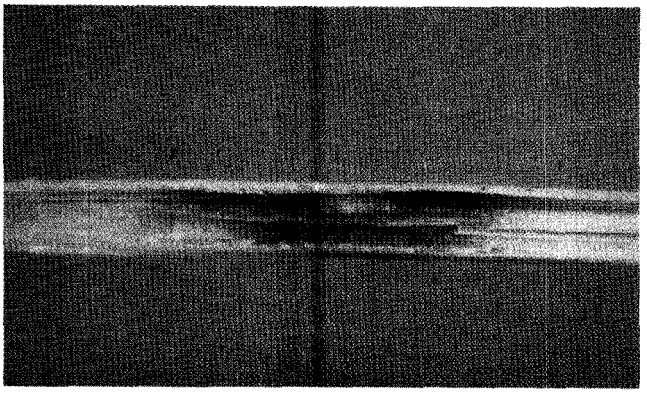

Figure 3. Wefts of mycelium within the lumen of an infected stem.

A total of 87.8% of the stems had eyespot lesions (Table 1). The majority of the stems fell in the moderate eyespot category. Many of the stems were completely girdled which would place them in the severe eyespot category. However, the stem tissue was not softened in any of these stems, and thus should be placed in the moderate category (Hollins, 1989). Although girdling of the stem did not cause softening of the stem tissue leading to lodging, it did appear to be responsible for the production of a significant amount of whiteheads (Figure 4). There was no appreciable amount of common root rot *(Cochliobolus sativus, Fusarium* spp.) or take-all *(Gaeumannomyces graminis)* present which could explain the whitehead symptoms. Whitehead symptoms resulting from eyespot infections which can girdle the stem are a common expression of the disease in Washington State. Whiteheads, however, do not always appear when the stems are girdled. Whitehead symptoms appear to be related to the water status of the plant. Under dry conditions, infected stems die and produce whiteheads whereas under moister conditions the plants survive longer and whiteheads are not produced (Murray, 1989).

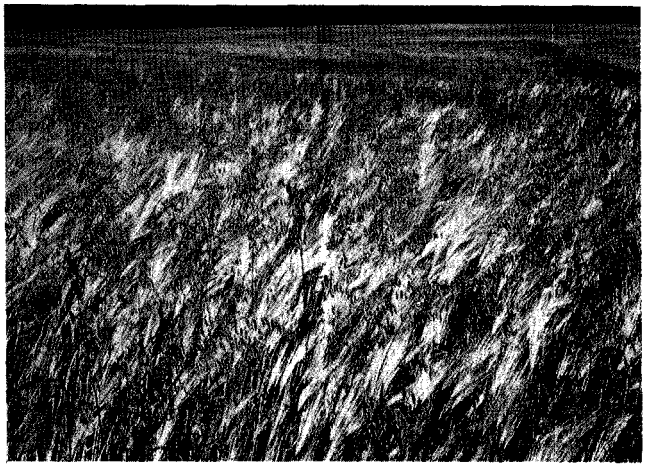

Figure 4. Whitehead symptoms resulting from eyespot infection in a field of barley, cv. Johnston, near Airdrie, Alberta. A high level of tame oat volunteers were present in this field.

Table 1. Severity of eyespot in spring barley, cv. Johnston near Airdrie, Alberta, August 1988.

Disease Rating*	Percentage of Stems
0 - uninfected	12.2 (12.2)**
1 - slight	19.5 (19.5)
2 - moderate	68.3 (17.1)
3 - severe	0.0 (51.2)

*Scott & Hollins (1974) rating system.
**Percent infected stems assuming that girdled stems that do not have softened stems are considered severely infected.

Slight eyespot infections do not cause any yield reduction; moderate infections only reduce 1000 kernel weight, and severe eyespot infections reduce both grain number per head and 1000 kernel weight (Scott & Hollins, 1974). Yield loss increases when lodging occurs. In England and Wales, the Agricultural Development and Advisory Service (ADAS) in conducting eyespot surveys uses the Scott & Hollins (1974) rating system and the yield loss formula developed by Clarkson (1981) to estimate yield losses. For a given crop:

$$Y = [(0.1n_2 + 0.36n_3)/ n_t]x100\%$$

where Y is percent yield loss and n_2 and n_3 are the numbers of stems in the moderate and severe categories and n_t is the total number of stems in the sample. Stems should be collected at ZGS 75. In the Airdrie field n_2 and n_3 were 68.3% and 0.0%, respectively. Based on the Clarkson (1981) formula, the yield loss in the Airdrie field was 6.8%, although, this may be an overestimation since samples were collected at ZGS 85.

The eyespot rating system used in Washington State considers an infection as severe if the stem is girdled by one or more lesions, regardless of tissue softening (Murray, 1989). Under dry conditions yield losses resulting from girdling of the stem may be severe, irrespective of lodging. Using this rating system, 51.2% of the stems were rated as having severe infections. Based on this method of rating disease severity, it is likely that yield losses were higher than 6.8%.

Despite the difficulties of obtaining an accurate estimate of yield loss, it is apparent that eyespot is widespread and its incidence in a crop may be very high. The disease will hopefully remain a minor problem in spring cereals. The real concern exists with winter cereals. At present, fall rye is the only cereal grown to any extent in the areas where the disease has been found. However, breeders are attempting to develop winter wheat cultivars that are adapted to this area. It may be necessary to incorporate resistance to eyespot in these new cultivars.

Acknowledgements

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Literature cited

1. Anonymous. 1981. Distribution Maps of Plant Diseases. No. 74. Commonwealth Mycological Institute, Kew.
2. Bruehl, G.W., W.L. Nelson, F. Koehler, and O.A. Vogel. 1968. Experiments with Cercosporella foot rot (strawbreaker) disease of winter wheat. Bull. of Wash. Agric. Exp. Sta. 694:1-14.
3. Clarkson, J.D.S. 1981. Relationship between eyespot severity and yield loss in winter wheat. Plant Pathology 30:125-131.
4. Conners, I.L. 1967. Annotated Index of Plant Diseases in Canada. Canadian Dept. Agric. Publ. 1251, Ottawa, Canada. 381 pp.
5. Ginn, J. 1986. Compendium of Plant Diseases and Decay Fungi in Canada, 1960-1980. Canadian Government Publishing Centre, Ottawa, Canada. 416 pp.
6. Hollins, T.W. 1989. Plant Breeding International, Cambridge, England. (personal communication)
7. Mathre, D.E. (ed). 1982. Compendium of Barley Diseases. American Phytopathological Society, St. Paul, Minnesota. 87 pp.
8. Murray, T.D. 1989. Washington State Univ., Dept. of Plant Pathology, Pullman, Wash. (personal communication)
9. Scott, P.R., and T.W. Hollins. 1974. Effects of eyespot on the yield of winter wheat. Ann. Appl. Biol. 78:269-279.
10. Scott, P.R., T.W. Hollins, and P. Muir. 1975. Pathogenicity of *Cercosporella herpotrichoides* to wheat, barley, oats and rye. Trans. Br. Mycol. Soc. 65:529-538.
11. Zadoks, J.C., T.T. Chang, and C.F. Konzak. 1974. A decimal code for the growth stages of cereals. Weed Res. 14:415-421.