Severity of, and resistance of barley varieties to, scald and net blotch in central Alberta

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Forty-eight barley fields were examined for severities of scald ***(Rhynchosporium secalis)*** and net blotch ***(Pyrenophora teres)*** in 18 counties in central Alberta in 1993. On a scale of 0 (no disease) to 9 (whole plants were severely affected), average and maximum scald severities were 3.4 and 9.0 (n=48), average and maximum net blotch severities were 3.2 and 8.3 (n=48). Scald was most severe in Stettler, Lacombe, Flagstaff, Leduc, Mountainview and Rockyview counties, and net blotch was most severe in Paintearth Red Deer, Flagstaff and Clearwater counties. Of 48 barley varieties and lines evaluated in four cooperative tests, 11 were resistant (severity score≤2) to scald and 12 were resistant to net blotch. Cultivars Falcon and Tukwa, and line SD402 showed resistant reactions to both scald and net blotch.

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En 1993, dans 18 comtés du centre de l'Alberta, quarante-huit champs d'orge on été examines afin de determiner le degré de virulence de la tache pile ***(Rhynchosporium secalis)*** et de la rayure réticulée ***(Pyrenophora teres).*** Sur une échelle de 0 (abscence de maladie) A 9 (plante en entier sévèrement atteinte), les degrés moyen et maximum de virulence de la tache pâle sont de 3,4 et de 9,0 (n=48), tandis que les degrés moyen et maximum de virulence de la rayure réticulée sont de 3,2 et 8,3 (n=48). Ce sont dans les comtés de Stettler, Lacombe, Flagstaff, Leduc, Mountainview et Rockyview que la tache pâle s'est manifestée avec le plus de vigueur, pendant que dans les comtés de Paintearth Red Deer, Flagstaff et Clearwater la rayure réticulée faisait des ravages. Sur 48 variétés et lignées d'orge qui ont été évaluées dans quatre essais coopératifs, 11 se sont révélées résistantes (degré de virulence ≤2) à la tache pale et 12 à la rayure réticulée. Les cultivars Falcon et Tukwa et la lignée SD402 se sont montrés resistants autant A la tache pale qu'à la rayure réticulée.

Introduction

Barley (***Hordeum vulgare*** L.) is an important feeding and malting crop in Alberta (6). During the past decade, the annual area has been over 5 million acres and the farm value was around 300 million dollars per year (1). Over seventy five percent of this barley production was in central Alberta. Scald [***Rhynchosporium secalis*** (Oudem.) J.J. Davis] and net blotch ***(Pyrenophora*** teres Drechs.) have been the most destructive diseases of barley in central Alberta (2, 7). Yield losses of up to 30%, due to either disease, have been reported in commercial fields (5, 10). Control of these diseases has been primarily through 2-3 year rotations with non-host crops in Alberta (4). However, with the recent widespread use of conservation tillage and expansion of susceptible barley variety cultivation in the province, the severities of these diseases have increased. To maintain yield and grain quality, the fungicide propiconazole (Tilt) was registered for ground and aerial applicaltion in Alberta (4, 9). Propiconazole is effective for the control of both scald and net blotch. However, the relatively high cost of the fungicide (vs. the price of barley) has limited its use to pedigree seed and malting barley. Development of resistant barley cultivars and their use in commercial production would be the most effective methods of controlling scald and net blotch. This paper reports the distributions and severities of scald and net blotch on barley in central Alberta, and reactions of barley cultivars and advanced lines to the two diseases in cooperative tests in 1993.

Materials and methods

Forty-eight commercial barley fields were assessed for severities of scald and net blotch. The fields were distributed in 18 counties which are the centres for barley production in central Alberta (Fig. 1). Up to 40% of the barley fields in Alberta are seeded with the cultivar Harrington (8) and eight fields of this cultivar were selected from the 48 fields as controls for the two disease

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assessments. The cultivars in the other 40 fields were not determined.

Forty-eight cultivars and advanced lines in the cooperative tests were examined at Lacombe (L), Stettler (S), and Drumheller (D), and 29 of these varieties were examined at Oyen (O). Field plots of these cultivars were established using culture practices recommended for central Alberta. The plots were 8 rows, 2.5 m long and arranged in a complete randomized block design with four replicates.

Assessments of the two diseases were conducted in commercial fields between July 27 -August 10 and in cooperative tests between August 12-19 when the barleys were in milk dough stage, development stage 75-80 on Zadoks scale (11). Severity of each disease was determined by rating 10 randomly chosen plants in 2-4 sampling sites in each commercial field or in two replicate plots in each cooperative test. An assessment scale of 0 (no disease) to 9 (all leaves of the plant severely affected) was used (3). Average scores <2.1, between 2.1 to 3.0, or >3.0 were considered resistant, moderately resistant, and susceptible reactions, respectively, relative to the overall infection levels. Fields having scores above 7.0 for either scald or net blotch were considered as having severe epidemics of the diseases.

Results and discussion

Net blotch was observed in all of the 48 fields examined and scald was observed in 47 fields; one field in Mountainview County was free of scald (Fig. 1). Although the two diseases were commonly found in almost all of the fields, their severity differed from county to county and from field to field. Severe epidemics of scald (ratings >7.0) were observed in eight fields in Stettler, Lacombe, Flagstaff, Leduc, Mountainview and Rockyview counties. Severe epidemics of net blotch were observed in four fields in Paintearth, Red Deer, Flagstaff and Clearwater counties. The level of both diseases in barley fields in Ponoka, Wetaskiwin and Brazeau was less than 3.0. The average scald severity was 3.4 and the range varied from 0.0 to 9.0, while the net blotch severity averaged 3.2 and ranged from 0.1 to 8.3. Difference in severity between the two diseases was significant ($t=272.2$, $P < 0.001$).

Severe scald and net blotch developed on cv. Harrington in the eight fields selected as control. In these fields the severity of scald averaged 6.2, and that of net blotch averaged 3.6 . The disease levels for Harrington were significantly higher than the averages of 2.9 and 3.1 for scald and net blotch, respectively, recorded for the cultivars in other 40 fields.

Infection with scald and net blotch occurred in each of the four cooperative tests (Table 1). The severity of the two diseases and the differential resistance of the cultivars and lines varied among the four test sites. At each site, scald was more prevalent than net blotch. At Stettler 28 cultivars and lines had scald severity scores of 8 to 9, which almost completely obscured net blotch symptoms. The maximum net blotch severity recorded in the cooperative tests was 6.0 on cv. Harrington seeded at Lacombe.

Relatively lower scald severity was observed on cv. Harrington in the cooperative tests compared to the severity recorded in the commercial fields. Among the 13 malt barleys evaluated, Harrington had an average disease severity score of 4.4 while the values for the other 12 cultivars were above 4.6. Of the 35 feed varieties tested, eleven were resistant and five were moderately resistant to scald. The desending order of resistance for the 16 barley entries was CDC Richard, Falcon, SD507, Duke, SD506, CDC Guardian, HB314, Leduc, SD402, TR129, Seebe, AC Lacombe, Brier, SD903, Tukwa and TR318. Three malt barley and nine feed barley cultivars and lines showed resistance reactions to net blotch.. Among these net blotch resistant entries, Duel, Tankard, Stein, BT374, BT421, CDC Buck, Noble, TR128 and TR232 had severe scald infections. The cultivars Falcon and Tukwa and line SD402 showed resistance to both scald and net blotch (Table 1). Tukwa and Falcon were registered in 1992. They were developed at the Field Crop Development Centre, Alberta Agriculture at Lacombe, Alberta. Line SD402 was bred at the Crop Development Centre, University of Saskachewan, Saskatoon, Saskachewan. The three cultivars have as yet not been used to any extent commercially in Alberta.

The widespread distribution of scald and net blotch on barley in Alberta reported herein and the severe levels of infection on the most popular commercial cultivar Harrington suggest that these continue to be economically important diseases. It appears that the annual yield losses for each disease in Alberta may have increased to more than the 2-4% estimated in 1982 (5). Harrington, although being generally considered susceptible to both scald and net blotch, is still the most resistant genotype to scald among the 13 malt barley varieties. The result suggests that breeding for scald resistance in malting barleys is required to produce cultivars more adapted to central Alberta.

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Table 1. Reactions of barley cultivars and lines to scald and net blotch at Lacome (L), Stettler (S), Drumheller (D), and Oyen (O) in central Alberta in 1993.

Variety	No. of row	Disease severity on 0 to 9 scale*									
		Scald					Net blotch				
		L	S	D	O	Mean	L	S	D	O	Mean
Malt barley											
Argyle	6	6.5	8.5	4.5	5.0	5.0	2.5	0.5	2.5	4.0	2.4
BT926	6	4.0	8.5	3.0	4.5	5.3	2.5	1.0	3.5	3.0	2.2
BT930	6	4.0	7.5	3.0	4.0	4.6	2.5	1.5	2.5	2.5	2.3
B1602	6	6.0	8.5	3.5	3.5	5.4	4.0	1.0	2.0	2.5	2.4
Duel	6	6.0	8.5	3.5	5.5	5.1	2.0	0.5	1.0	2.0	1.4
Tankard	6	6.0	9.0	5.0	5.0	6.3	2.0	0.0	1.0	2.0	1.3
AC Oxbow	2	6.0	8.5	4.5	5.0	5.0	2.0	0.5	2.5	4.5	2.4
B1215	2	7.0	8.0	5.0	5.0	6.3	2.5	1.5	2.0	2.5	2.1
Harrington	2	3.0	9.0	1.5	4.0	4.4	6.0	1.0	5.5	5.5	3.3
Manley	2	5.0	8.5	3.0	4.0	5.1	2.0	1.5	2.0	4.5	2.5
Stein	2	5.0	9.0	5.0	6.5	6.4	2.5	0.0	2.0	2.0	1.6
TR118	2	5.0	8.0	3.0	4.0	5.0	3.0	1.5	2.0	3.5	2.5
TR229	2	4.5	8.5	3.0	5.5	5.4	2.0	1.5	3.0	3.5	2.5
Feed barley											
AC Albright	6	4.5	7.0	3.5	3.0	4.5	2.0	1.0	2.5	3.5	2.3
AC Lacombe	6	2.0	4.0	1.5	1.5	2.3	3.0	1.5	2.5	2.0	2.3
Brier	6	3.5	3.0	1.5	1.0	2.3	3.5	2.5	3.0	2.0	2.8
BT374	6	5.5	9.0	4.0	—	6.2	3.0	0.0	2.0	—	1.7
BT419	6	6.0	8.0	2.5	—	5.5	4.0	1.0	3.0	—	2.7
BT421	6	6.5	8.5	3.5	—	6.2	2.0	0.5	3.5	—	2.0
BT672	6	5.0	8.0	3.0	—	5.3	3.0	1.0	2.5	—	2.2
CDC Buck	6	4.0	8.5	4.0	—	5.5	1.5	0.0	2.0	—	1.2
Duke	6	2.0	1.0	1.0	1.0	1.3	4.0	2.5	1.5	2.5	2.6
Falcon	6	1.0	2.5	1.0	2.0	1.2	2.0	1.5	1.0	1.5	1.5
Galt	6	5.5	8.5	2.5	4.0	5.1	3.0	0.5	3.0	2.5	2.3
HB314	6	1.0	2.0	1.5	—	1.5	2.5	3.0	1.0	—	2.2
Heartland	6	5.0	7.5	2.0	5.0	4.9	3.0	1.0	3.0	1.5	2.1
Jackson	6	6.0	8.5	3.5	—	6.0	3.0	0.5	3.5	—	2.3
Leduc	6	1.0	2.0	1.5	1.5	1.5	3.5	3.0	3.5	2.0	3.0
Noble	6	3.5	6.5	3.0	4.5	4.4	1.5	1.0	2.5	1.5	1.6
SD402	6	1.5	2.0	1.0	—	1.5	2.0	1.5	2.5	—	2.0
SD506	6	1.5	1.0	1.5	—	1.3	4.0	2.5	4.0	—	3.5
SD507	6	1.5	1.0	1.0	—	1.2	4.0	3.0	4.0	—	3.7
SD903	6	3.0	3.0	1.0	—	2.3	4.0	2.0	3.5	—	3.2
Tukwa	6	1.5	5.5	1.5	2.0	2.6	2.5	1.5	1.5	1.5	1.8
Abee	2	6.5	9.0	3.0	5.0	5.4	3.5	0.5	3.5	2.0	2.4
Bridge	2	1.0	9.0	2.0	2.0	3.5	4.5	0.5	3.0	2.0	2.8
CDC Guardian	2	1.0	1.5	2.0	1.0	1.4	5.5	2.0	2.5	2.5	3.1
CDC Richard	2	1.0	1.5	1.0	1.0	1.1	5.5	3.5	2.5	2.5	3.5
Condor	2	4.5	8.5	4.0	4.5	5.4	4.5	1.0	3.5	2.5	2.9
HB313	2	6.0	8.0	3.5	—	5.8	3.0	1.5	2.5	—	2.3
Phoenix	2	4.5	7.5	2.5	—	4.8	3.0	1.5	2.5	—	2.0
Seebe	2	1.5	2.5	1.5	—	1.8	4.5	3.0	2.5	—	3.3
TR128	2	5.0	9.0	5.0	—	6.3	3.0	0.5	2.0	—	1.8
TR129	2	1.0	2.0	1.5	—	1.5	4.5	2.0	4.5	—	3.7
TR232	2	4.5	8.0	2.5	—	5.0	2.0	1.5	1.5	—	1.7
TR318	2	1.0	2.5	3.5	—	2.3	3.5	3.5	2.0	—	3.0
TR320	2	4.0	9.0	4.0	—	5.7	3.5	0.5	3.5	—	2.5
Winthrop	2	7.0	9.0	4.0	4.5	6.1	2.0	0.0	4.5	5.0	2.9

* 0 = no disease and 9 = whole plants were severely affected.

— Was not tested at Oyen.

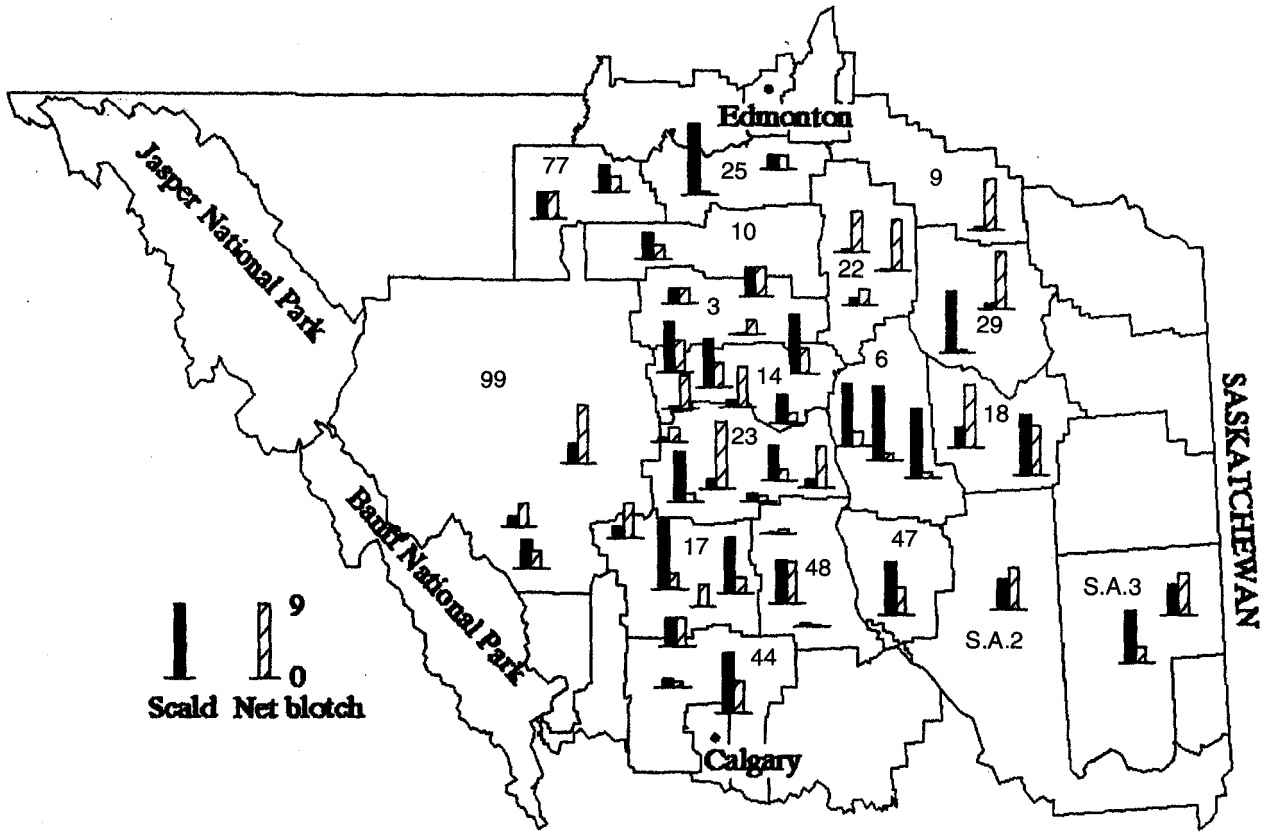

Figure Severity of scald and net blotch on barley in 18 counties in central Alberta in 1993. Disease severity 0 = no disease, 9 = whole plant was severely affected on a 0 - 9 scale.
3 = Ponoka, **6** = Stettler, 9 = Beaver, 10 = Wetaskiwin, 14 = Lacombe, 17 = Mountainview, 18 = Paintearth, 22 = Camrose, 23 = Red Deer, 25 = Leduc, 29 = Flagstaff, 44 = Rockyview, 47 = Starland, 48 = Kneehill, 77 = Brazeau, 99 = Clearwater, S.A.2 = Hanna (Special Area), **S.A.3** = Oyen (Special Area).