FIELD RESISTANCE TO PYRENOPHORA BROMI IN BROMUS INERMIS AND BROMUS SPP.[1]

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Abstract

A severe epidemic of the leaf spot disease of bromegrass caused by Pyrenophora bromi developed on spaced plants at the Big River field test area in August 1968. The progress of the disease on 20 replicated and unreplicated test entries of Bromus species and strains was followed from July to September. Disease ratings on three dates during the epidemic showed a high positive correlation. Infection was uniform on the test blocks at the height of the epidemic.

Synthetics bred from clones selected from the northern/southern hybrid S-7269 of smooth bromegrass, Bromus inermis, showed higher disease resistance than the resistant standard 'Lincoln'. Synthetics between the clones of S-7269 and field-resistant clones of B. tyttholepis S-1172 also showed high resistance to the pathogen. Parent clones of the synthetics and hybrids, were similar to their progeny in reaction to the pathogen. Selections of B. biebersteinii, B. ornans, B. carinatus, and other introduced Bromus spp. also appeared promising as sources of resistance. Northern-type B. inermis cultivars were either very susceptible or not noteworthy for their resistance. Leaf spots on resistant strains of B. inermis often were sharply necrotic; susceptible strains of the same species senesced more rapidly than resistant lines.

Introduction

The leaf spot causedby Pyrenophora bromi (Died.) Drechs. syn. Pleospora bromi Died. [stat. conid. Drechslera bromi (Died.) Shoem., syn. Helminthosporium bromi (Died.) Died.] is the most important foliar disease of smooth bromegrass, Bromus inermis Leyss., in seed and hay crops on the Black and Gray Soils in Saskatchewan, Alberta, and the Peace River Region of British Columbia (11, 12, 13). Northern-type cultivars of smooth bromegrass that are currently grown in these regions have been found less resistant to the pathogen than southern types (8, 13, 14). Northern/southern hybrids showed intermediate resistance (13). Resistance to P. bromi superior to that in B. inermis has been found in weed bromes (1, 2, 6), in other members of the Bromopsis (Zerna) Section of Bromus to which B. inermis belongs (1, 2, 4, 6), and in hybrids between members of the latter Section (7).

In a test at Big River, Saskatchewan, in 1967 (13), seven clones of S-7269, a northern/southern synthetic of B. inermis, were not infected with P. bromi whereas interplanted 'Carlton 1961' and S-6733 Syn 2 were diseased. Six clones of B. tyttholepis Nevski (10) were also free from infection. These uninfected clones appeared promising as sources of resistance.

This paper reports the field reactions *to* P. bromi of (a) the resistant clones of B. inermis and B. tyttholepis from the 1967 test, (b) synthetics made from these clones, (c) hybrids between the B. inermis and the B. tyttholepis clones, (d) other Bromus spp. in the Bromopsis Section.

Materials and methods

The origins and characters of the plant material are given in Table 1.

Seeds were germinated in moist chambers and seedlings pricked out into a potting mixture in 5-cm peat pots. Clonal material was divided and grown in similar pots. Subsequently, plants in the pots were set out in the field on 15-17 May when seeded and clonal material had attained about the same stage of growth.

The test area was in a cultivated plot within a hay field of common bromegrass on Gray Woodland Soil at Big River, Saskatchewan. This hayfield bromegrass was an infection reservoir, since crops in previous years were severely infected with P. bromi. Infector rows of very susceptible Bromus sp. OT1927/9833 (13) were planted 5.5 m apart, with 1.5 m between plants. There were five rows of these which divided the test into four blocks, and the plants in them were intended to act as secondary infection foci from primary ones in the hay field. Test entries, in groups of 10 plants at 0.5 m spacing, were planted in the 5.5 m wide blocks at right angles to the five infector rows of susceptible Bromus sp. There were 25 cross rows of test entries,

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Table 1. Origins and descriptions of test entries

Species	Text - fig. ref. no.	Cultivar, strain or accession no.	Origin	Description
B. inermis Leyss	1	Carlton 1961	Saskatoon	Northern type, susceptible standard cultivar.
	2	Lincoln	Neb., U. S. A.	Southern type, resistant standard cultivar.
	3	OT1561/400-404 and /493	U. S. S. R.	Northern type Russian cultivars.
	4	OT1927/9835	Bulgaria	B. inermis var. aristata. Northern type.
	5	Clones B36-42	Saskatoon	Resistant clones from 1967 test (loc. cit.). From northern/southern hybrid S-7269.
	6	S-7304	Saskatoon	Synthetic of clones B36-42.
	7	S-7306	Saskatoon	Duplicate of S-7304.
B. tyttholepis Nevski	8	Clones B30-35 from S-1172	Col., U. S. A.	Resistant clones from 1967 test. Selected from S-1172, a synthetic made at Saskatoon from B. erectus received in 1944. **
	9	OT1927/9493	U. S. S. R.	Glabrous, leafy, extreme bunch type. From Central Siberia.
	10	Korean	Uncertain	Leafy, vigorous selection by E. Buglass, Res. Branch, Can. Agr. Exptl. Farm, Indian Head, Sask.
B. inermis x tyttholepis	11	S-7305 BI	Saskatoon	Seed from B. inermis in synthetic of clones B36-42 and B30-35.
	12	S-7305 BT	Saskatoon	Seed from B. tyttholepis in synthetic of clones B36-42 and B30-35.
B. biebersteinii Roem. & Schult.	13	Regar	Idaho, U. S. A.	A high yielding, disease resistant cultivar, released in the U.S.A. in 1966 (5).
	14	Clones B55-61 from OT1927/8572	Hungary	Leafy, winter hardy and disease resistant at Saskatoon.

* Accession no., Forage Crops Section, Research Station, Canada Department of Agriculture, Ottawa.

** According to Nath & Nielsen (10) most of the B. erectus introduced into N. America is B. tyttholepis Nevski.

Table 1 (Continued)

Species	Text - fig. ref. no,	Cultivar, strain or accession no.	Origin	Description
B. ornans Kom.	15	Polycross	Uncertain	From Res. Branch, Can. Agr. Res. Sta., Lethbridge, Alberta.
	16	A52	Uncertain	From Res. Branch, Can. Agr. Res. Sta., Lethbridge, Alberta.
	17	A54	Uncertain	From Res. Branch, Can. Agr. Res. Sta., Lethbridge, Alberta.
B. angrenicus Drob.	18	Clones B23-29 from OT1927/8569	Hungary	Leafy, winter hardy but very disease susceptible at Saskatoon. Morphologically close to B. inermis.
B. carinatus L.	19	Kew collection	Kew, England	Naturalized, from Pacific N. W. of N. America.
Bromus sp.	20	OT1927/98 33	Grenoble, France	Taxonomic position uncertain, very susceptible to P. bromi in 1967 test. A small, glaucous, hairy perennial.

each row containing 40 plants. Susceptible and resistant standard cultivars of B. inermis, 'Carlton 61' and 'Lincoln', respectively, were planted across the four blocks of the test alternately as cross rows 4, 8, 12, 16, 20, and 24. Since some of the seed of new introductions germinated poorly and the amount of clonal material was limited, full replication was not possible for all test entries.

Severity of Pyrenophora leaf spot was rated on a 0 to 4 scale, where 0 was no disease and 4, very severe disease. Selenophoma leaf spot, caused by S. bromigena (Sacc.) Sprague & Johnson, was absent and scald, caused by Rhynchosporium secalis (Oud.) J.J. Davis, was present in insignificant amounts on the rating dates of 24 July, 14 August, and 10 September, 1968.

Results and discussion

Pyrenophora leaf spot was noted on common brome in the surrounding hayfield when the test was planted on 17 May 1968. The disease progressed slowly under the dry conditions prevailing in May and June, then rapidly during wet weather in late July. August, and September.

Replicated test entries with the exception of B. ornans 'Polycross' had significantly lower ratings for the disease at all recording dates than the susceptible standard 'Carlton' (Table 1, Fig. 1). On 10 September, when ratings were highest, all replicated test entries had significantly less disease than the resistant standard 'Lincoln'. There were no significant differences in ratings between the duplicate B. inermis synthetics S-7304 and S-7306 on the three dates. In the B. inermis × tyttholepis synthetics, S-7305 BT (B. tyttholepis?) showed significantly less severe spotting than S-7305 BI (B. inermis?) on 24 July and 10 September. In the replicated test entries, the correlations between disease ratings on the three dates were highly significant. The correlations were probably influenced by the severity and uniformity of infection, being lowest ($r = +0.821$) in the earlier period of infection build-up from 24 July to 14 August and highest ($r = +0.882$) in the later period from 14 August to 10 September when disease became very severe on susceptible strains.

Major differences in disease reaction were apparent even in the unreplicated entries, some of which were represented by six to seven related clones. Clones 36-42, parents of S-7304 and S-7306, B. inermis were highly resistant as were clones B30-35, parents of S-7305 BI and S-7305 BT, B. inermis × tyttholepis. Clones B55-61 of B. biebersteinii OT1927/8572 were all highly resistant to P. bromi. On the other hand, none of the clones of

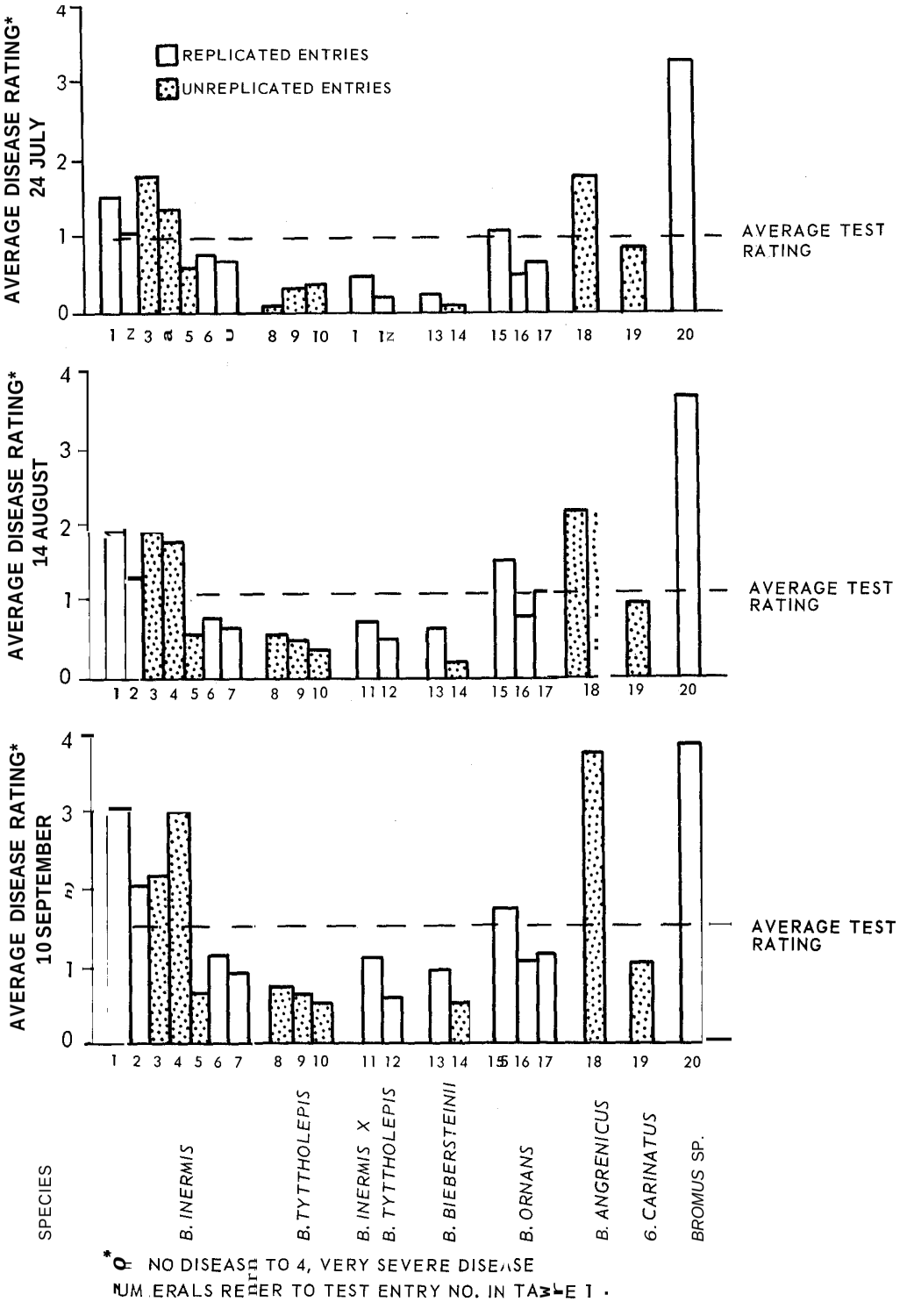

Figure 1. Average disease ratings for *Pyrenophora* leaf spot in *Bromus* species at three dates in 1968.

B. angrenicus OT1927/8569 appeared to have much resistance, as ratings were similar to those for Bromus sp. OT1927/9833. None of the other B. inermis introductions showed noteworthy resistance but B. tytthole**pis** 'Korean' and OT1927/9493 and B. carinatus had low disease ratings. In the unreplicated test entries the correlations between disease ratings on the three dates were highly significant: between 24 July and 14 August, r = +0.931 and between 14 August and 10 September, r = **t0.** 946.

Infectionwas highly uniform over the four blocks of the test in August and September, This was indicated by coefficients of variability of 11%and 7% in disease ratings on the 125 plants of the infector Bromus sp. OT1927/9833, which served as block markers.

Symptoms of the disease on the resistant B. inermis strains S-7304 and S-7306 and their parent clones B36-42 were very different from those on the susceptible 'Carlton', OT1927/9835 (B. inermis), and B. angrenicus. Foliar lesions on resistant lines were fewer in number, usually smaller in size and with less noticeable halos of yellowed tissues than those on the susceptible sorts. In the resistant lines the leaf lesions frequently were sharply necrotic with charred centres to the spots (Fig. *2).* P. bromi was isolated with difficulty from this type of lesion. Occasional plants of 'Lincoln' showed sharp necrotic lesions. Those species and strains which showed rapid vegetative growth, heading, and senescence, e. g. B. angrenicus and B. inermis OT1927/9835 and 'Carlton', had a much higher incidence of Pyrenophora leaf spot than those which developed more slowly **e.** g. B. inermis S-7304, S-7306, and clones B36-42. Whether the disease contributed to a more rapid senescence or whether senescent tissues were more susceptible and more readily colonized by the pathogen is not known.

All test entries with ratings less than 1.50 on 10 September merit further study. Since the present-day cultivars of B. inermis suitable for use in

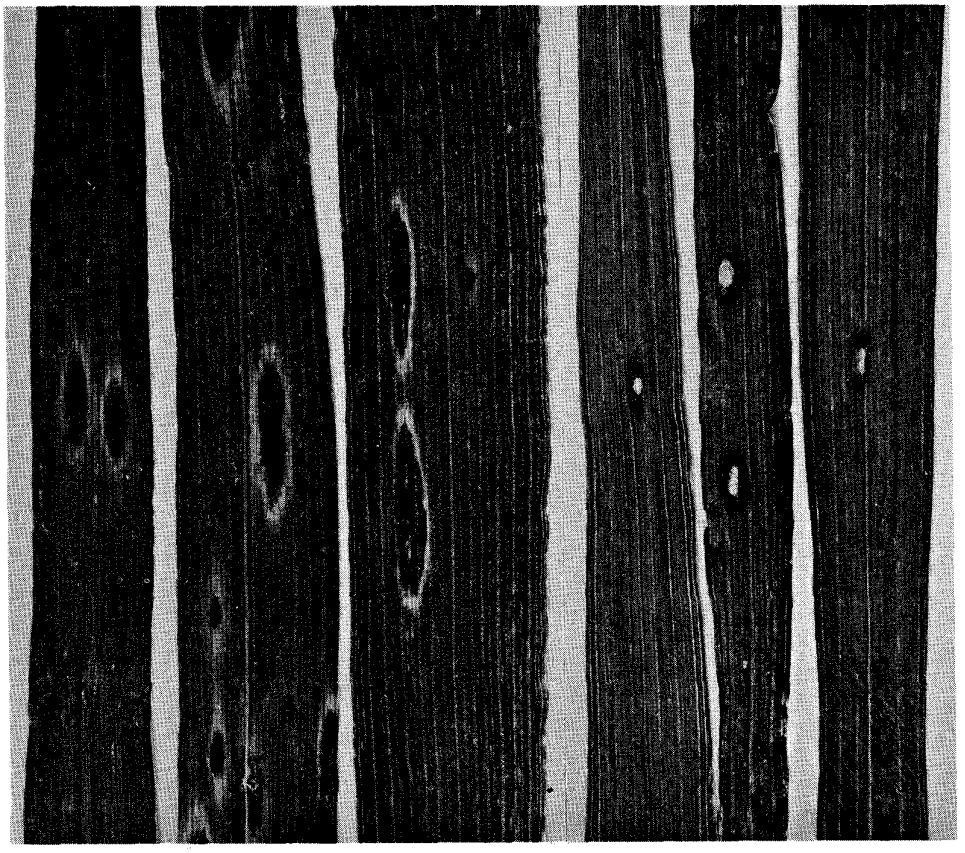

Figure 2. Leaves of a bromegrass susceptible to *Pyrenophora bromi* (left); lessions are large with a pronounced halo. Leaves of resistant bromegrass (right), with small, sharply necrotic lesions.

Western Canada are at best only moderately resistant to P. bromi, the S-7304 and S-7306 synthetics are of the most immediate agronomic interest. Their parent clones, B36-42, were derived by two rounds of mass selection for disease resistance from the high-yielding S-6733 (9), a northern/southern strain bred by R. P. Knowles at Saskatoon. The intermediate line S-7269 in this selection was highly resistant to S. bromigena in tests at Saskatoon in 1968 (unpublished). Since physiolpgic races of P. bromi may occur, it will be necessary to field test these lines for disease resistance in different localities of North America.

The genetic stability of B. inermis × tyttholepis hybrids is in doubt [(3) and E. L. Nielsen, personal communication] and there may be some difficulties in taking advantage of the resistance to P. bromi derived from B. tyttholepis, as in S-7305 BT. Plants in S-7305 BI and BT were morphologically very variable and some had undesirable agronomic characters.

Clones B55-61 of B. biebersteinii OT1927/8572 that appeared more resistant to P. bromi than those of the 'Regar' cultivar of the same species (5) were also leafier and more vigorous than the latter. Some of the other Bromus spp. which showed high resistance to the pathogen may be of agronomic value in special situations in Western Canada where a bunch bromegrass is desired. B. angrenicus OT1927/8569, which was very susceptible to S. bromigena in test plots at other places in Saskatchewan (unpublished), may be useful in epidemiological studies as in infector plant.

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