

Reactions of Smooth Bromegrass Accessions to Brown Leaf Spot Caused by *Pyrenophora bromi*

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ABSTRACT

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Plants of 93 accessions from 13 foreign countries and the United States and five commercial cultivars of smooth bromegrass (*Bromus inermis*) were screened for resistance to brown leaf spot by inoculations with *Drechslera bromi*, the conidial state of *Pyrenophora bromi*. On a scale of 1-5, mean disease severity ratings for brown leaf spot ranged from 3.2 to 4.1 (overall mean 3.7), or from moderately to highly susceptible. No smooth bromegrass entry was highly resistant to *P. bromi*; however, 174 resistant plants (rating of 2 or lower) were selected from among 70 entries after the first inoculation. No resistant plants were selected from 28 of the entries. After a second inoculation, the overall mean disease rating of selected plants was 2.72 ± 0.92 , whereas the mean of 21 selected susceptible plants was 4.36 ± 0.59 . Mean disease ratings of five commercial cultivars were similar (range 3.5-3.7). The susceptibility of smooth bromegrass germ plasm to infection by *P. bromi* did not differ much in this broad-based population.

Additional key words: disease resistance, *Helminthosporium bromi*

Brown leaf spot, caused by *Pyrenophora bromi* (Died.) Drechs. (conidial state = *Drechslera bromi* (Died.) Shoem. = *Helminthosporium bromi* Died.), is an economically important disease of smooth bromegrass (*Bromus inermis* Leyss.) in the cool, temperate areas of northern United States and southern Canada (1,7,11,12). This disease, described in detail by Chamberlain and Allison (3), is probably the most prevalent and causes more damage in terms of reductions in yield and forage quality than any other disease of this species (4,6,10). Brown leaf spot is not effectively controlled by crop rotation, and control by chemical spraying is not economically feasible. Therefore, development of resistant strains offers the only practical means of control.

The purpose of this study was to evaluate the potential for resistance to brown leaf spot disease in 93 accessions of smooth bromegrass from 13 foreign countries and the United States and to compare their reactions with those of several commercial cultivars. Another

objective was to select resistant genotypes from each entry (if any) for use in a breeding program.

Table 1. Brown leaf spot ratings of introduced strains and commercial cultivars of smooth bromegrass inoculated with conidia of *Pyrenophora bromi*

| PI number or cultivar | Country or state (U.S.) of origin | First inoculation | | Second inoculation | |
|-----------------------|-----------------------------------|-------------------|----------------------------------|---|--|
| | | No. of plants | Mean disease rating ^a | No. of resistant plants selected ^b | Mean disease rating of selected plants |
| 315385 | USSR | 79 | 3.2 | 6 | 3.3 |
| 326258 | USSR | 91 | 3.3 | 4 | 3.0 |
| 279647 | Canada | 70 | 3.3 | 2 | 1.7 |
| 345596 | USSR | 90 | 3.4 | 2 | 2.0 |
| 255871 | Poland | 86 | 3.4 | 9 | 2.4 |
| 206644 | Turkey | 97 | 3.4 | 3 | 3.0 |
| 232217 | Utah | 74 | 3.4 | 3 | 1.5 |
| 232218 | Utah | 98 | 3.4 | 4 | 1.6 |
| 311020 | Rumania | 89 | 3.5 | 0 | ... |
| 262457 | USSR | 86 | 3.5 | 2 | 1.7 |
| 258744 | USSR | 91 | 3.5 | 3 | 2.2 |
| 315378 | USSR | 97 | 3.5 | 4 | 2.7 |
| 274612 | Poland | 88 | 3.5 | 3 | 2.7 |
| 234045 | Spain | 89 | 3.5 | 2 | 2.5 |
| 262455 | USSR | 80 | 3.5 | 2 | 2.5 |
| Lancaster | Nebraska | 84 | 3.5 | 0 | ... |
| 315384 | USSR | 83 | 3.5 | 8 | 3.2 |
| 326261 | USSR | 91 | 3.5 | 4 | 2.2 |
| 315376 | USSR | 95 | 3.5 | 3 | 2.3 |
| 173648 | Turkey | 85 | 3.5 | 3 | 3.3 |
| 340069 | Turkey | 94 | 3.5 | 4 | 2.7 |
| 325227 | USSR | 83 | 3.6 | 2 | 3.5 |
| 325260 | USSR | 92 | 3.6 | 0 | ... |
| 325230 | USSR | 99 | 3.6 | 2 | 3.5 |
| 109812 | Manchuria | 78 | 3.6 | 5 | 2.6 |
| 311022 | Rumania | 88 | 3.6 | 0 | ... |
| 315379 | USSR | 90 | 3.6 | 1 | 4.0 |
| 258743 | USSR | 82 | 3.6 | 1 | 2.0 |
| 173651 | Turkey | 89 | 3.6 | 2 | 3.5 |
| 255870 | Poland | 53 | 3.6 | 0 | ... |
| 340070 | Turkey | 91 | 3.6 | 2 | 2.5 |

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Table 1. (continued from preceding page)

| PI number or cultivar | Country or state (U.S.) of origin | Second inoculation | | | |
|-----------------------|-----------------------------------|--------------------|----------------------------------|---|--|
| | | First inoculation | | No. of resistant plants selected ^b | Mean disease rating of selected plants |
| | | No. of plants | Mean disease rating ^a | | |
| 325237 | USSR | 89 | 3.6 | 2 | 3.0 |
| Baylor | Iowa | 64 | 3.6 | 5 | 3.0 |
| 262458 | USSR | 91 | 3.6 | 1 | 4.0 |
| 325259 | USSR | 98 | 3.6 | 3 | 2.3 |
| 267054 | Poland | 85 | 3.6 | 0 | ... |
| 326263 | USSR | 99 | 3.6 | 1 | 3.0 |
| 315383 | USSR | 93 | 3.6 | 2 | 2.0 |
| 315398 | USSR | 94 | 3.6 | 0 | ... |
| 315375 | USSR | 92 | 3.6 | 0 | ... |
| 314567 | USSR | 79 | 3.6 | 0 | ... |
| Southland | Oklahoma | 97 | 3.6 | 3 | 2.7 |
| 251681 | USSR | 84 | 3.6 | 1 | 1.5 |
| 315374 | USSR | 95 | 3.6 | 1 | 3.0 |
| 326262 | USSR | 96 | 3.6 | 3 | 2.3 |
| 238249 | Sweden | 84 | 3.7 | 0 | ... |
| 340068 | Turkey | 93 | 3.7 | 0 | ... |
| 172760 | Turkey | 90 | 3.7 | 1 | 2.0 |
| 316172 | Australia | 80 | 3.7 | 0 | ... |
| Lincoln | Nebraska | 94 | 3.7 | 1 | 3.0 |
| 172391 | Turkey | 85 | 3.7 | 3 | 3.3 |
| 316171 | Australia | 89 | 3.7 | 0 | ... |
| 178844 | Turkey | 94 | 3.7 | 3 | 3.0 |
| 324305 | USSR | 82 | 3.7 | 2 | 3.0 |
| 198064 | Sweden | 84 | 3.7 | 0 | ... |
| 258747 | USSR | 91 | 3.7 | 4 | 2.5 |
| 341224 | Canada | 99 | 3.7 | 0 | ... |
| 258745 | USSR | 93 | 3.7 | 3 | 2.0 |
| 326265 | USSR | 91 | 3.7 | 2 | 3.0 |
| 345598 | USSR | 93 | 3.7 | 2 | 2.0 |
| Lyon | Nebraska | 98 | 3.7 | 1 | 2.0 |
| 172395 | Turkey | 88 | 3.7 | 2 | 3.0 |
| 231758 | New Hampshire | 74 | 3.7 | 1 | 2.0 |
| 345597 | USSR | 85 | 3.7 | 2 | 3.0 |
| 173645 | Turkey | 88 | 3.7 | 0 | ... |
| 315377 | USSR | 95 | 3.8 | 1 | 4.0 |
| 314071 | USSR | 76 | 3.8 | 0 | ... |
| 326264 | USSR | 93 | 3.8 | 2 | 2.5 |
| 258746 | USSR | 91 | 3.8 | 3 | 3.0 |
| 341225 | Canada | 96 | 3.8 | 2 | 3.0 |
| 272113 | Poland | 86 | 3.8 | 0 | ... |
| 262454 | USSR | 92 | 3.8 | 2 | 1.7 |
| 172759 | Turkey | 89 | 3.8 | 4 | 3.5 |
| 251527 | Yugoslavia | 94 | 3.8 | 3 | 2.0 |
| 311021 | Rumania | 90 | 3.8 | 0 | ... |
| 315382 | USSR | 90 | 3.8 | 0 | ... |
| 262456 | USSR | 87 | 3.8 | 0 | ... |
| 341226 | Canada | 99 | 3.8 | 1 | 4.0 |
| 341228 | Canada | 94 | 3.8 | 1 | 2.0 |
| 204433 | Turkey | 91 | 3.8 | 0 | ... |
| 292850 | Germany | 97 | 3.8 | 3 | 3.0 |
| 172393 | Turkey | 89 | 3.8 | 2 | 3.5 |
| 173647 | Turkey | 85 | 3.8 | 0 | ... |
| 345594 | USSR | 98 | 3.8 | 1 | 2.0 |
| 315381 | USSR | 90 | 3.8 | 1 | 3.0 |
| 251682 | USSR | 60 | 3.9 | 0 | ... |
| 173646 | Turkey | 88 | 3.9 | 1 | 4.0 |
| 369211 | USSR | 82 | 3.9 | 1 | 3.0 |
| 341227 | Canada | 95 | 3.9 | 0 | ... |
| 369212 | USSR | 81 | 3.9 | 0 | ... |
| 173652 | Turkey | 82 | 3.9 | 0 | ... |
| 345595 | USSR | 97 | 3.9 | 2 | 2.2 |
| 172761 | Turkey | 93 | 4.0 | 0 | ... |
| 206418 | Turkey | 97 | 4.0 | 3 | 3.7 |
| 173650 | Turkey | 92 | 4.0 | 2 | 4.0 |
| 204432 | Turkey | 86 | 4.0 | 2 | 3.5 |
| 178843 | Turkey | 84 | 4.0 | 1 | 2.0 |
| 206678 | Turkey | 86 | 4.1 | 1 | 4.0 |
| Total or mean | | 8,666 | 3.7 | 174 | 2.7 |

^aScale: 1 = none to trace, 2 = slight, 3 = moderate, 4 = severe, 5 = very severe disease. Ratings were made 7-9 days after inoculation. The LSD at k = 100 for comparison of entry means = 0.5.

^bPlants rated 2 or lower were selected as resistant.

plants each per entry. The number of plants available for screening in a few entries was reduced because of poor seed germination and poor seedling vigor.

Two isolates of *D. bromi* obtained from smooth bromegrass growing at the Rock Springs Agricultural Research Center, Pennsylvania State University, were used in the inoculation tests. Cultures were grown on 20% V-8 juice agar for 9-10 days in an incubator at 22 C with 12 hr of fluorescent light and 12 hr of darkness daily. Plants were inoculated by spraying with an aqueous conidial/mycelial suspension of *D. bromi* until runoff. The inoculum concentration was adjusted to about 1,250 spores per milliliter. Plants were then placed in a dark chamber 3.3 × 3.3 × 2.1 m at 19-21 C as described by Leath and Hill (9). Moist conditions were maintained by periodic misting with distilled water. Plants were returned to the greenhouse about 48 hr later.

The three groups of entries were inoculated at 7-day intervals, and disease ratings were made 7-9 days after inoculation on a scale of 1-5, where 1 = none to trace, 2 = slight, 3 = moderate, 4 = severe, and 5 = very severe. Disease reaction ratings were based on the size and number of lesions. Size was considered more important than number of lesions in evaluating resistance. As an additional test of resistance, all plants rated 2 or lower were repotted and their regrowth was inoculated a second time. A control group of 21 plants from 10 of the most susceptible entries was included for comparison. The plants were inoculated at the four- to six-leaf stage of development, 41-53 days after planting or clipping. The Waller-Duncan multiple range test (13) was used to determine the significance of differences among entry means.

RESULTS AND DISCUSSION

The mean disease severity ratings of the 98 entries ranged from 3.2 to 4.1 (Table 1), i.e., from moderately to highly susceptible. No smooth bromegrass entry was highly resistant to *D. bromi*. The range of disease severity means from the least susceptible (PI 315385, USSR) to the most susceptible entry (PI 206678, Turkey) of 0.9 was disappointingly narrow. However, 174 plants were selected as resistant (rating of 2 or lower) from among 70 entries. The number of plants selected within each entry ranged from nine for PI 255871 from Poland to one from each of 19 other entries (Table 1). No plants were selected from 28 of the entries. In the second inoculation, the overall mean disease rating of selected plants was 2.72 ± 0.92 (mean ± standard deviation), whereas the mean of 21 selected susceptible plants was 4.36 ± 0.59. Selected plants from 64 of the 70 entries had lower mean ratings than the entry mean in the first inoculation. The

mean disease ratings for the five commercial cultivars were similar (range 3.5-3.7); however, of 10 resistant plants selected from among the five cultivars, five were from Lyon and three were from Southland. No plants were selected from Lancaster. The most resistant plants from the second inoculation were used as polycross parents to initiate a program of recurrent phenotypic selection for resistance to brown leaf spot.

We had hoped that the range in disease reaction to *D. bromi* in this broad-based population of smooth brome grass would have been wider. The results suggest that the susceptibility of smooth brome grass germ plasm to *D. bromi* did not differ much in the 14 countries represented. The most resistant plants in this study had low to moderate numbers of small lesions compared with larger, more numerous lesions on more susceptible plants.

Variability in resistance to brown leaf spot within smooth brome grass has been reported by several workers (1,2,5,8,11,12). In Hanson's (7) descriptions of 24 cultivars of smooth brome grass, resistance to brown leaf spot was mentioned for Saratoga and Sac. Saratoga was reported as superior to Manchar and Canadian common in resistance to brown leaf spot and scald. Disease resistance was not mentioned in

the descriptions of 16 cultivars.

Although no entry was highly resistant to *D. bromi*, the reactions of individual plants varied considerably within some entries. Plants that gave low disease ratings for the two inoculations were considered resistant. No smooth brome grass plants showed immunity to *D. bromi*.

This study involved screening a large, diverse collection of smooth brome grass strains. Reliable procedures for inoculating smooth brome grass with conidia of *D. bromi* have been developed at this laboratory. This appears to be the first report of a large-scale screening of smooth brome grass germ plasm with artificial inoculations. We feel that artificial inoculation is more reliable and thorough than natural infection in the field for screening for resistance to brown leaf spot in smooth brome grass. Results of this study indicate that resistance to *D. bromi* in smooth brome grass can be found.

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