Resistance of Wheat to Leaf Spot Caused by *Bipolaris sorokiniana*

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ABSTRACT

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Leaf lesions caused by *Bipolaris sorokiniana* on resistant cultivars of wheat (*Triticum aestivum*) were fewer and smaller and sporulated less than lesions on susceptible cultivars. In crosses involving four resistant and four susceptible wheats, resistance was dominant in the F_1 progenies. Disease reactions of the F_2 indicated that resistance was conditioned by two genes in the cultivar Motia and in lines E 5895 and HD 1927 and by one gene in line DT 188.

Leaf spot of wheat (*Triticum aestivum* L.) caused by *Bipolaris sorokiniana* (Sacc. in Sorok.) Shoem. occurs throughout the wheat-growing regions of India and probably ranks close to leaf rust in destructiveness. The disease has been managed by use of cultivars with moderate resistance, but greater resistance is needed. The purpose of this work was to identify sources of resistance, to study its inheritance, and to provide information on how the resistance influenced the pathogen's development.

MATERIALS AND METHODS

Inoculum was prepared from an isolate of *B. sorokiniana* that had produced severe leaf spot in nine of 10 cultivars and lines tested. The one line that it did not severely infect was HD 1927, which was resistant to all isolates of the pathogens to which it was tested. This isolate was grown at about 25 C on a mixture of autoclaved barley, oats, wheat, and rice. About equal volumes of the different grains were used in the mixture. Conidia were washed from the seeds and strained through cheesecloth. Plants were sprayed with inoculum containing about 12,000 conidia per milliliter of water and two drops of Tween 20 (polyoxyethylene sorbitan monolaurate) per 100 ml until dripping wet. After inoculation, plants were kept in a moist chamber for about 48 hr, then removed to greenhouses where temperatures were 18–27 C.

Disease severity was estimated on inoculated leaves 7 days after inoculation, when lesions appeared to have reached maximum size, using a scale of 0–5: 0 = free of spots; 1 = necrotic spots without chlorosis, up to 5% of the leaf area involved; 2 = necrotic spots with light chlorosis, 6–20% of the leaf area involved; 3 = necrotic spots with pronounced chlorosis, 21–40% of the leaf area involved; 4 = 41–60% of the leaf area involved; and 5 = spots merging, more than 60% of the leaf area involved.

A total of 625 spring wheat lines obtained from breeding programs in northwestern India were examined as potential sources of resistance. They were grown in pots 15 cm in diameter, with five plants per pot. The trial was repeated. Plants were inoculated at the three- to five-leaf growth stage.

Inheritance of resistance was studied in eight crosses. Kalyansona and Sharbati Sonora (susceptible commercially grown cultivars) were crossed with resistant lines HD 1927 and E 5895 and susceptible lines HD 4500 and HD 4501 were crossed with resistant Motia and DT 188. Progenies from F_1 and F_2 populations and the parents were evaluated for leaf spot resistance using 25 plants of each parent and F_1 of each cross and at least 151 plants of the F_2 of each cross. The plants, grown in pots 15 cm in diameter, were inoculated at the three- to five-leaf growth stage.

The effect of host genotype on lesion development and on sporulation of the pathogen was studied on resistant or susceptible cultivars and lines inoculated when in the boot growth stage and kept in a moist chamber for 48 hr. Seven days after inoculation, disease severity was estimated in flag leaves and the lesions on leaves were counted. Five lesions were cut from each leaf and measured for size, then placed in 5 ml of distilled water and shaken vigorously for 1 min. Spores of *B. sorokiniana* in the water were counted with a hemacytometer and the number of spores per 100 mm^2 of spot surface was calculated. The experiment was repeated.

RESULTS

Six hundred twenty-five wheat lines were tested for resistance to *B. sorokiniana*. Kalyansona, Sharbati Sonora, Sonalika, and P.V.18 (commercially grown cultivars) had disease ratings of 4–5 and were considered fully susceptible. These cultivars were typical of 591 of the cultivars and lines tested. There were 18 moderately resistant wheats (disease ratings between 1 and 2): PKD 66, PKD 74, PKD 75, HD 1623, HD 1670, HD 1706, HD 1801, HD 1827, HD 1902, HD 1917, E 4900, E 5070, E 5533-1, MACS 5, CA 528, HS 40, DT 192, and CPAN 980. There were 16 resistant wheats (disease ratings not greater than 1): PDK 42, PDK 57, PDK 65, HD 1470, HD 1620, HD 1927, HD 1956, E 5895, DT 188, D 144, DA 491-5, N 3199, W 3, NP 876, NP 891,

Table 1. Inheritance of resistance to *Bipolaris sorokiniana* in plants of the F_2 generation of crosses of wheats that were susceptible or resistant

Cross	No. of plants		Total plants	χ^2	*P* value	Mode of segregation
	Resistant	Susceptible				
Kalyansona/HD 1927	81	71	152	0.54	0.25–0.50	9:7
Kalyansona/E 5895	92	64	156	0.48	0.25–0.50	9:7
Sharbati Sonora/ HD 1927	91	67	158	0.12	0.50–0.75	9:7
Sharbati Sonora/ E 5895	80	71	151	0.64	0.25–0.50	9:7
HD 4500/Motia	90	65	155	0.22	0.50–0.75	9:7
HD 4501/Motia	91	61	152	0.80	0.25–0.50	9:7
HD 4500/DT-188	121	35	156	0.54	0.25–0.50	3:1
HD 4501/DT-188	120	36	156	0.30	0.50–0.75	3:1

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Table 2. Leaf spot reaction and development of the disease and of *Bipolaris sorokiniana* in wheats that were resistant (R) or susceptible (S)[a]

Cultivar or line	Disease reaction	Lesions per leaf (no.)	Avg. lesion size (mm^2)	Spores per 100 mm^2 (no.)
Kalyansona	S	45	18.5	110
Sharbati Sonora	S	48	22.5	170
HD 1941	S	38	15.0	80
EA 222-1	S	42	14.0	75
HD 1927	R	15	4.5	22
E 5895	R	18	3.5	15
E 5070	R	22	5.0	25
PKD 65	R	15	5.5	31

[a] Average of three replicates. Coefficient of determination at 5% level was 7.20 for average number of lesions, 2.41 for average lesion size, and 14.55 for number of spores.

and the cultivar Motia.

The parents Kalyansona, Sharbati Sonora, HD 4500, and HD 4501 were susceptible (disease ratings of 4 or 5) and HD 1927, E 5895, DT 188, and Motia were resistant (disease ratings of 1 or less). All plants of the F_1 generation of each cross were resistant, indicating resistance was dominant. Segregation in the F_2 generation (Table 1) of nine resistant plants to seven susceptible in crosses involving resistant lines HD 1927, E 5895, and Motia indicated that resistance was conditioned by two dominant genes. Segregation was three resistant plants to one susceptible in crosses involving DT 188, indicating that the resistance was conditioned by a single dominant gene.

Lines resistant to leaf spot suppressed development of the pathogen more than susceptible cultivars and lines. There were one-third to one-half as many lesions on resistant as on susceptible lines, and the lesions were one-third to one-half as large and produced only one-third to one-tenth as many spores as those on susceptible lines (Table 2).

DISCUSSION

In this study, resistance in wheat to *B. sorokiniana* was conditioned by one or two dominant factors. This is an agreement with the conclusion of Srivastava et al (3), who also studied wheat, and is similar to that of Hayes et al (2) and Arny (1), who studied barley infected with *B. sorokiniana*. If our conclusions had differed from those reported by others (2,3) or if the results had not been clear, we would have confirmed them by observing F_3 families of each cross. Even though F_3 data were not obtained, we concluded that the resistance was simply inherited and that it should be possible to develop resistant cultivars.

Our data indicate that sources of resistance are readily available. In another test not included in this report, line HD 1927 was resistant to 13 isolates of *B. sorokiniana* collected from various locations in India. We concluded that this line should be a valuable source of resistance because it appeared to possess many desirable agronomic traits in addition to its resistance to *B. sorokiniana* and because it readily crossed with Kalyansona and Sharbati Sonora, cultivars that are widely grown in India.

Reduced numbers and size of lesions and reduced sporulation by the pathogen appear to function in resistance to leaf spot in wheat. Widespread use of resistance should help reduce the chance of an epidemic and enhance the efficacy of fungicides that might be employed in a disease management program.

LITERATURE CITED

1. Arny, D. C. 1951. Inheritance of resistance to spot blotch in barley seedlings. Phytopathology 41:691-698.
2. Hayes, H. K., Griffee, F., and Christensen, J. J. 1923. Reaction of barley varieties to *Helminthosporium sativum*. Part I. Varietal resistance. Part II. Inheritance studies in a cross between Lion and Manchuria. Minn. Agric. Exp. Stn. Tech. Bull. 21.
3. Srivastava, O. P., Luthra, J. K., and Narula, P. N. 1971. Inheritance of seedling resistance to leaf blight of wheat. Indian J. Genet. Plant Breeding 31:209-211.