Identification of Sorghum Downy Mildew Resistance in Corn by Leaf Reaction to Conidial Inoculum

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ABSTRACT

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Ten corn inbred lines were compared for symptoms on leaves inoculated with conidia of *Peronosclerospora sorghi* in the greenhouse and for susceptibility to sorghum downy mildew in the field. A classification system for leaf symptoms was devised. The correlation between leaf symptom types in the greenhouse and levels of downy mildew susceptibility in the field was calculated to determine the feasibility of using leaf reactions to predict levels of downy mildew susceptibility. Degree of severity of leaf symptoms was positively and significantly ($P = 0.01$) correlated with degree of downy mildew susceptibility.

Corn (*Zea mays* L.) can be tested for susceptibility to sorghum downy mildew (SDM) by inoculating it with conidia of *Peronosclerospora sorghi* (Weston and Uppal) C. G. Shaw (2). Inoculated plants that do not show systemic symptoms of SDM (the emergence of chlorotic leaves several days after inoculation) are presumed to be resistant. A minimum observation period of 21 days after inoculation with conidia is required to ensure that the absence of symptoms represents resistance to SDM. However, leaves exposed to conidial inoculum exhibit symptoms of pathogen damage within a few days after inoculation. During testing of inbred corn lines, I noted that inoculated leaves of some inbreds differed in symptom expression, indicating that differences in leaf symptoms could be related to differences in susceptibility to systemic infection by *P. sorghi*. If so, resistant genotypes could be identified by the reactions of inoculated leaves rather than by symptoms of systemic infection. This would substantially reduce the time required to screen corn lines for resistance to SDM. The study reported here was conducted to determine the relationship between the reactions of corn leaves to inoculation with conidia of *P. sorghi* and the susceptibility of the corresponding corn lines to SDM.

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MATERIALS AND METHODS

Ten inbred corn lines (Table 1) that had been tested for reaction to *P. sorghi* in field trials in Texas (3) were selected for this study. Germinated corn seeds were planted in 6-cm-diameter peat pots of pasteurized soil at the rate of three seeds per pot. The seedlings were inoculated (1) with conidia of *P. sorghi* when the second leaf of the plant had unrolled enough for the leaf tip to flatten. At this stage of growth, part of the second leaf was still shielded from inoculum by enclosure in the leaf whorl.

The symptoms on the inoculated leaves were observed for 7 days. A classification system was devised for leaf reactions, based on the symptoms exhibited by the second leaf 7 days after inoculation.

TABLE 1. Relationship of reaction of inoculated leaves and susceptibility to systemic infection by *Peronosclerospora sorghi* of 10 corn inbreds

Inbred	Number of plants inoculated	Percentage of plants in reaction class[a]			Leaf reaction score[b]	Field score[c]
		R	I	S		
B68	169	0	3	97	3.0	100
B77	97	2	4	94	2.9	100
H49	45	0	0	100	3.0	100
Mo17	192	19	76	5	1.9	22
N7A	149	1	4	95	2.9	95
N28	85	1	10	89	2.9	100
R177	116	93	7	0	1.1	5
33-16	51	88	12	0	1.1	6
Tx601	58	88	12	0	1.1	0
Va26Ht	110	1	90	9	2.1	24

$r^d = +0.97$ ($P = 0.01$)

[a] R = resistant reaction, I = intermediate reaction, S = susceptible reaction.
[b] Mean of the sum of leaf reactions when reactions R, I, and S are given numerical values of 1, 2, and 3, respectively.
[c] Maximum percentage of plants infected with sorghum downy mildew observed in three field trials.
[d] Coefficient of correlation between maximum infection percentages in field trials and leaf reaction scores.

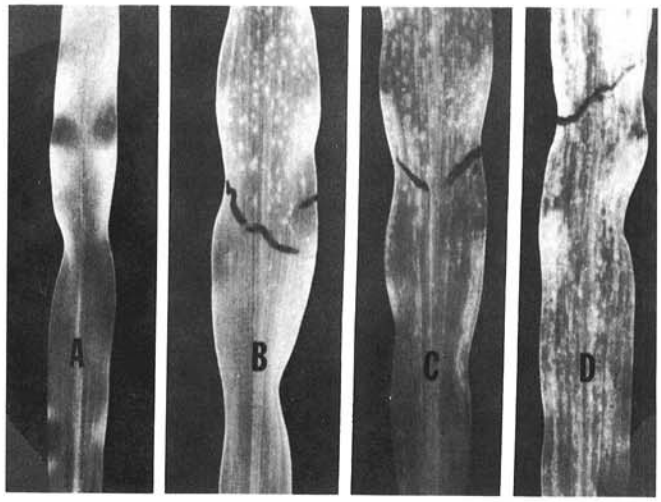

Fig. 1. Uninoculated corn leaf **(A)**, and reactions of inoculated leaves—resistant **(B)**, intermediate **(C)**, and susceptible **(D)**—7 days after inoculation with conidia of *Peronosclerospora sorghi*. Black lines demarcate lowest point of conidial deposition.

The symptoms consisted of changes in color, from green to other hues, in the infected areas of the leaf. The hues of discoloration included white, yellow, gray, and tan. The corn lines differed in color of the infected areas of leaves, but differences in pattern and size of leaf discoloration were more closely related to SDM susceptibility than were differences in lesion color.

The leaf reaction classes were resistant, intermediate, and susceptible. The symptoms of the resistant reaction were small, distinct, discolored spots on the leaf surface that had been exposed to inoculum and little if any spread of leaf discoloration downward into the uninoculated part of the leaf (Fig. 1). In the intermediate reaction, symptoms consisted of blotches of discoloration on the inoculated portions of the leaf and narrow interveinal streaks of discoloration on the uninoculated part of the leaf (Fig. 1). The susceptible reaction consisted of complete discoloration of the inoculated area of the leaf. Leaf discoloration extended downward in a wide band across the uninoculated portion of the leaf (Fig. 1).

The inoculated plants were examined for leaf reaction 7 days after inoculation (Table 1). Numerical values of 1, 2, and 3 were assigned to resistant, intermediate, and susceptible reactions, respectively. A mean score was calculated for the leaf reactions of each inbred population (Table 1). The means of leaf reactions and the maximum incidences of SDM observed in field trials of these inbreds were used to calculate the coefficient of linear correlation between leaf reaction and susceptibility to systemic infection (Table 1).

RESULTS AND DISCUSSION

The first symptoms observed on inoculated leaves were the small, chlorotic spots that marked sites of stomata invaded by conidial germ tubes. These spots appeared on the leaf surfaces exposed to inoculum 48–72 hr after inoculation. In resistant corn genotypes, the initial spots changed very little during the 7 days of observation (Fig. 1). The initially restricted areas of discoloration of both the intermediate and susceptible reaction types increased in size, more so in the latter (Fig. 1).

The heterogeneity for leaf reaction type exhibited by most of the corn lines (Table 1) could have been due to residual genetic heterogeneity in these inbreds or to seed contamination. However, the corn lines were sufficiently different in frequencies of reaction types to permit each line to be classified as a resistant, intermediate, or susceptible reaction type. Assuming that leaf discoloration was caused by colonization of leaf tissues by the pathogen, the differences in leaf reactions among corn inbreds were caused by differences in the rate of pathogen progress through host tissue. Previously reported work (2) suggests that resistance to SDM in corn is caused by inhibition of the pathogen's progress from entry point toward meristematic foliage. This hypothesis is supported by the positive relationship between rate of spread of the pathogen in leaf tissue and susceptibility to systemic SDM found in this experiment.

The positive correlation between the severity of the symptoms of inoculated leaves and degree of susceptibility to systemic infection in the field (Table 1) indicated that the reactions of leaves to inoculation with conidia of *P. sorghi* can be used to identify corn genotypes resistant to SDM. Leaf-lesion tests for resistance can be completed in one third the time (7 days compared with 21 days) required for tests using systemic symptoms; this represents substantial savings in time, personnel, and greenhouse space.

LITERATURE CITED

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