Soybean Cultivar Reactions to Soybean Stem Canker Caused by *Diaporthe phaseolorum* var. *caulivora* and Pathogenic Variation Among Isolates

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ABSTRACT

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Twelve isolates of *Diaporthe phaseolorum* var. *caulivora* that cause stem canker disease of soybeans (*Glycine max*) were compared for their relative virulence on field-grown plants of the soybean cultivars Tracy, Bragg, and J77-339. A wide range of virulence was measured among isolates. The most virulent caused lesions with a mean length up to 61.9 cm at 60 days after inoculation; the least virulent caused lesions averaging 20.7 cm at 60 days. Differences in virulence of the pathogen are believed to contribute to observed variation in severity of the disease at different locations. Fifteen soybean cultivars resistant to stem canker disease were identified.

Stem canker disease of soybeans (*Glycine max* (L.) Merr.) caused by *Diaporthe phaseolorum* (Cke. & Ell.) Sacc. var. *caulivora* (Athow & Caldwell) (*Dpc*) (3) was first recognized in Mississippi in 1975 (1). In retrospect, this disease is believed to have been present in the state for several years before 1975, but its prevalence was low and did not attract attention. The disease was first observed in the northeastern and east central portions of the state but has now been observed in most areas of the state where soybeans are grown.

Disease severity has varied greatly at different locations. This variation may be the result of variation in environmental conditions, especially the degree of drought stress, or variation in the virulence of the pathogen at different locations. Isolates of the pathogen recovered from diseased plants growing in different areas were tested for differences in pathogenic virulence. Measured differences in virulence among 12 isolates are presented in this report. Fifteen cultivars with resistance to the stem canker disease are identified.

MATERIALS AND METHODS

Isolates tested. All isolates of the pathogen (Table 1) (except the one from Ohio) were isolated from soybean plants symptomatic of stem canker disease (2). Diseased plants were collected by the author or sent to him by W. Moore or W. Jordan, Mississippi State University, and L. Young, Jackson, TN. The isolate from Ohio was provided by A. F. Schmitthenner, Wooster. All isolates were from plants grown in 1981 and their sources are listed in Table 1. To recover the pathogen from diseased plants, stem sections taken from the margin of a canker were surface-disinfected in 1% sodium hypochlorite for 1 min, rinsed in sterile water, and plated on acidified potato-dextrose agar (PDA). After incubation for 3 days at 21 C, hyphal tips were transferred to PDA slants for maintenance.

Cultivars used. Soybean cultivars Tracy and Bragg and the breeding line J77-339 were inoculated to determine the relative virulence of *Dpc* isolates. J77-339 is very susceptible to stem canker disease and was used as an indicator to demonstrate development of the disease. Tracy is a very resistant cultivar and was used in this study to detect the presence of a very virulent strain of the fungus if one were among those selected. Cultivar Bragg was used as an indicator of the relative virulence of the isolates tested. Bragg was chosen because previous research (1) has shown that this cultivar is moderately susceptible to the disease but that canker development is slow enough to allow measurements of canker enlargement.

Preparation of inoculum. Flat toothpicks were boiled for 30 min in each of three changes of water, dried, and placed in 150-ml vials with 25 ml of potato-dextrose broth. The broth-saturated toothpicks were sterilized in the vials by autoclaving for 15 min at 120 C. After cooling, they were inoculated with mycelium of appropriate *Dpc* isolates and incubated at 21 C for 15 days before use (1).

Inoculation technique. A modification of the toothpick inoculation method was used (1). The cultivars used in this study were seeded in sandy loam soil on 1 June 1982 and inoculated on 1 July by making a hole through the soybean stem about 10 cm above the soil with a dissecting needle and inserting a toothpick infested with the pathogen into the hole. The inserted toothpick was not protected with a sealing compound. Twenty plants of Tracy, Bragg, and J77-339 were inoculated using each *Dpc* isolate in each of three replicates. Uninfested toothpicks were

Table 1. Response of Bragg soybeans 60 days after inoculation with isolates of the stem canker pathogen *Diaporthe phaseolorum* var. *caulivora* from different locations

Isolate	Source of isolate: Cultivar	Source of isolate: Location	Length of lesion (cm)	Plants with lesions ≤10 cm (%)	Plants killed (%)
81-6	Bedford	Carroll County, MS	61.9 a[z]	9.8 a	21.0 b
81-75	Bragg	Grenada County, MS	54.9 ab	19.8 bc	8.7 bc
81-82	J77-339	Lee County, MS	53.2 ab	13.5 ab	48.8 a
81-102	Bedford	Madison County, TN	45.2 abc	35.5 de	0.0 c
81-73	Bedford	Grenada County, MS	40.1 bcd	23.1 cd	0.0 c
D-209	J77-339	Lee County, MS	35.0 bcd	37.5 de	9.2 bc
81-77	Unknown	Yalobusha County, MS	27.0 cd	34.9 de	5.3 bc
81-7	Bedford	Carroll County, MS	26.4 cd	46.2 ef	17.3 bc
81-11	Bedford	Carroll County, MS	22.5 d	58.7 fg	0.0 c
81-70	Ransom	Noxubee County, MS	22.4 d	61.7 g	1.6 c
81-65	Bedford	Madison County, MS	20.7 d	62.3 g	0.0 c
D0048MI	Unknown	Ohio	1.0 e	100.0 h	0.0 c
Control	...	...	0.5 e	100.0 h	0.0 c

[z] Data are the means of three replicates (20 plants per replicate); lesion data are from living plants only. Means not followed by the same letter are significantly different ($P = 0.05$) according to Waller-Duncan's multiple range test.

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inserted into control plants.

Measurement of virulence of isolates. Stems of inoculated plants were split with a very sharp roofing hatchet 60 days after inoculation. The extent of internal lesion development was measured from the point of inoculation toward the top of the plant. The number of dead diseased plants was also recorded.

Test for sources of resistance. A search was made among soybean cultivars maintained in the germ plasm collection at Stoneville, MS, for additional sources of resistance to stem canker in 1983. Twenty-six selected cultivars were inoculated with a virulent isolate of the pathogen recovered from a diseased J77-339 plant growing at Verona, MS, and rated for their response as described before. Twenty plants of each tested cultivar were inoculated.

RESULTS AND DISCUSSION

Cultivar J77-339 was very susceptible to all *Dpc* isolates tested except the one from Ohio. Ninety-two to 100% of all inoculated J77-339 plants were dead 60 days after inoculation. The isolate from Ohio was not virulent to J77-339 and plants inoculated with this isolate did not differ from the controls. None of the isolates caused disease symptoms in Tracy plants. A wide range in virulence was measured among isolates of *Dpc* when disease development in Bragg was measured (Table 1). Lesion length varied significantly from a mean of 61.9 cm caused by isolate 81-6 to 20.7 cm caused by isolate 81-65.

The relative virulence of isolates was also reflected in the percentage of plants with stem lesions 10 cm or shorter and the percentage of plants killed (Table 1). The data indicate that differences in disease severity at different locations may be caused by a variation in virulence of the pathogen. A striking difference was also measured between isolates from the same location. Isolates 81-6, 81-7, and 81-11 were recovered from Bedford soybean plants growing only a few meters apart in a field in Carroll County, MS. Isolate 81-6 was one of the most virulent isolates tested, whereas 81-7 and 81-11 were among the least virulent (Table 1).

Besides differences in virulence of the pathogen at different locations and differences in environmental conditions that may influence disease development, results of this research indicate that the severity of the disease is also affected by the resistance of the cultivar. In a search for additional sources of resistance in 1983, 16 cultivars developed very small lesions when artificially inoculated in field plots (Table 2). The resistance of Tracy-M and CNS has been reported (1) and they were included in this test as resistant controls. These resistant cultivars may be very important in future breeding programs for stem canker resistance. In addition to the resistant cultivars listed in Table 2, cultivars Hollybrook, Bedford, Ogden, Tanner, and Seminole and the breeding lines J77-339 and D55-1492 were also included in this test. These soybean lines were very susceptible, with most inoculated plants dead within 60 days of inoculation.

Table 2. Disease reactions of soybean cultivars to inoculation with isolate D-209 of the stem canker pathogen *Diaporthe phaseolorum* var. *caulivora* in field plots[a]

Cultivar	Maturity group	Lesion length[b] (mm)
Luthy	V	14 (10–20)
Virginia	V	16 (10–20)
Hayseed	VI	3 (2–5)
Laredo	VI	2 (1–3)
Rose Non-pop	VI	2 (1–3)
FC 31745	VI	3 (2–5)
Clemson	VII	9 (8–10)
CNS	VII	3 (1–5)
Pluto	VII	23 (20–30)
Tanner	VII	12 (10–15)
Arisoy	VIII	13 (10–15)
Avoyelles	VIII	2 (1–3)
Mamloxi	VIII	3 (2–5)
Mamotan	VIII	3 (2–5)
Dorman	VIII	3 (1–5)
Tracy-M	VIII	2 (1–5)

[a] Planted on 2 June, inoculated on 7 July, data recorded on 14 September 1983.

[b] Lesion length is mean of 20 plants; figures in parentheses represent the range of lesion lengths for cultivar.

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