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Susceptibility of Soybean Cultivars to *Pratylenchus scribneri*^{1, 2}

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ABSTRACT

Soybean cultivars representing maturity groups I-X were compared for their susceptibility to *Pratylenchus scribneri* under greenhouse conditions. A preliminary screening of 51 cultivars indicated a relatively wide range of susceptibility. Reevaluation of 12 of the cultivars confirmed that Clark 63, Woodworth and Williams are highly susceptible. Amsoy 71, Bonus, Corsoy, Jupiter and Wayne supported only limited reproduction. Custer, Dyer and Forrest, resistant to other nematodes, also appeared to be resistant to *P. scribneri*, while PI 88788 was intermediate in susceptibility. In comparison to other cultivars, Corsoy was the most intolerant of infection because growth was poorest and the density of nematodes in the roots was high.

INTRODUCTION

Resistant cultivars are increasingly important for the control of plant-parasitic nematodes in pest management systems. Resistance is a complex of different types of host responses and nematode adaptations. It involves a series of physiological reactions in both host and nematode, producing numerous by-products that do not necessarily inhibit nematode developmental biology or populations. A number of cultivars of soybean, *Glycine max* (L.) Merr., have been developed with resistance to the highly pathogenic heteroderid nematodes. However, cultivar susceptibility to lesion nematodes, *Pratylenchus* spp., common parasites of soybean in the western hemisphere and considered a potential threat to soybean production, has not been studied extensively. Lindsey and Cairns (4) demonstrated that cultivars Bragg, Custer, Dyer, Hill, and Pickett, resistant to certain other nematodes, showed tolerance to *Pratylenchus*

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brachyurus (Godfrey) Filipv. and Schuurm.-Stekh., whereas Hood was susceptible and intolerant. Endo (3), however, detected no differences in susceptibility to this nematode species between Peking and Lee soybeans. Dickerson and Franz (2) reported that Clark 63 was resistant to *P. alleni* Ferris but susceptible to *P. scribneri* Steiner.

Preliminary investigations confirmed that Clark 63 soybean is highly susceptible to five species of *Pratylenchus* occurring in Illinois and three additional species native to Puerto Rico. This study was conducted to determine and compare the susceptibility and tolerance to various soybean cultivars to *P. scribneri*, a nematode species that is widely distributed throughout the North American soybean belt.

MATERIALS AND METHODS

Comparative development of populations of *P. scribneri* on soybean cultivars and the response of soybeans to nematode infection were studied in two greenhouse tests. In the first, 51 cultivars were selected for preliminary screening on the basis of commercial value, maturity group (I-X) and/or resistance or tolerance to other nematodes and other disease-causing organisms (table 1). One-hundred fifty-three 12.5-cm diam clay pots containing autoclaved Sparta loamy fine sand were inoculated with 2,000 nematodes and planted with one seed/pot. Three replicates/treatment were placed on a greenhouse bench in a randomized complete-block design. Air and soil temperatures ranged from 26 to 30 C (\bar{x} =28 C) and 17 to 28 C (\bar{x} =25 C), respectively. Dry weights of plants were recorded and nematode populations estimated 90 days after inoculation. Nematodes were extracted from soil by a modification of the method of Christie and Perry (1) and from roots by incubation in a mist chamber.

In the second test, 12 cultivars exhibiting contrasting susceptibility in the first experiment were selected for reevaluation. Ninety-six 12.5-cm diam clay pots containing autoclaved Onarga loamy fine sand were inoculated and planted as previously described. Experimental design, incubation period and data collection were the same as in the first test except that there were eight replicates/treatment. Air and soil temperatures ranged from 17 to 37 C (\bar{x} =26 C) and 15 to 31 C (\bar{x} =25 C), respectively.

RESULTS AND DISCUSSION

Although relatively low daytime temperatures appeared to restrict nematode population development, results in the first test indicated that there was a relatively wide range of susceptibility to *P. scribneri* among soybean cultivars. Based on total number of nematodes recovered 90 days after inoculation, cultivars Adams, Nemashirozu, Williams and Woodworth were highly susceptible (table 2). Amsoy 71, Blackhawk,

TABLE 1.—Maturity group and disease resistance of soybean cultivars evaluated for susceptibility to *Pratylenchus scribneri*

Cultivar ¹	Maturity group	Resistance to nematodes ²	Resistance to fungal, bacterial and virus diseases ³
Adams	III		
Amsoy*	II		
Amsoy 71*	II		<i>Phytophthora</i> sp.
Beeson*	II		<i>Phytophthora</i> sp.
Bethel	IV	Mi	
Blackhawk	I	Mi, Mh	
Bonus*	IV		<i>Phytophthora</i> sp.
Bragg	VII	Ma, Mi	CCMV
Calland*	III		<i>Phytophthora</i> sp.
Chippewa 64*	I		
Clark 63*	IV		<i>Phytophthora</i> sp.
Corsoy*	II		
Custer*	IV	H ₍₁₋₃₎ , Rr	
Cutler*	IV		<i>Phytophthora</i> sp.
Cutler 71*	IV		CCMV
Dare*	V	M, Rr	
Delmar	IV	Mi	
Dyer*	V	H ₍₁₋₃₎ , Ma, Mi, Rr	CCMV
Essex	V		
Forrest	V	H ₍₁₋₃₎ , Mi, Rr	CCMV
Hampton	VIII	Mi	
Hardee**	VIII	Mi	
Hark*	I		
Harosoy 63	II		<i>Phytophthora</i> sp.
Hawkeye 63	II		<i>Phytophthora</i> sp.
Hill	V	H, Mi	CCMV
Illini	III		<i>Phytophthora</i> sp.
Ilsoy	III	Mh	
Jackson	VII	Mi	
Jupiter**	X		
Kent*	IV		<i>Phytophthora</i> sp.
Laredo	VI	Mi	
Lee	VI		<i>Cercospora sojina</i>
Lindarin 63	II		
Lincoln	III		
Mack	V	H ₍₁₋₃₎	
Nemashirozu	IV	H ₍₁₋₃₎	CCMV
Peking	IV	H ₍₁₋₃₎	
Pickett 71	IV	H ₍₁₋₃₎	
PI 87631-1	III	H ₍₄₎	
PI 88788	III	H ₍₁₋₄₎ , Mi	
PI 89722	IV	H ₍₄₎	
PI 90763	IV	H ₍₁₋₃₎	
Rampage*	I		
Shelby	III		
Scott	IV		Bacterial pustule
Wayne*	III		
Wells*	II		
Williams*, **	III		
Woodworth	III		
York	V		

¹ * = Cultivars recommended for Illinois, ** = potential tropical cultivars.

² H_i = *Heterodera glycines* and its races, M = *Meloidogyne*, Ma = *M. arenaria*, Mi = *M. incognita*, Mh = *M. hapla*, Rr = *Rotylenchulus reniformis*.

³ CCMV = Cowpea Chlorotic Mottle Virus.

TABLE 2.—Susceptibility of 51 soybean cultivars to *Pratylenchus scribneri* (Expt. 1)

Cultivar	Dry shoot weight <i>gm</i> ²	Number (× 1,000) of nematodes/pot ^{1, 2}
Bonus	6.9	0.5
Dyer	3.7	0.5
Lindarin 63	2.0	0.6
Hampton	5.4	0.6
Amsoy	5.8	0.7
P.I. 90763	5.4	0.8
Jupiter	7.3	0.8
Hill	9.1	0.9
P.I. 88788	3.9	1.0
Calland	4.8	1.0
York	2.5	1.1
Wells	4.4	1.1
Hawkeye 63	5.8	1.1
Forrest	3.1	1.1
Custer	7.0	1.1
Wayne	8.7	1.2
Mack	11.4	1.2
P.I. 87631-1	5.2	1.2
Kent	4.6	1.2
Essex	7.9	1.2
Jackson	6.6	1.3
Delmar	2.4	1.4
Beeson	4.9	1.4
Peking	6.1	1.5
Hardee	7.5	1.5
Laredo	5.9	1.6
Dare	5.9	1.6
Corsoy	2.6	1.6
Bethel	3.2	1.8
Cutler 71	7.2	1.9
Bragg	6.2	1.9
P.I. 88772	4.9	2.0
Scott	4.9	2.1
Rampage	3.6	2.2
Lee	7.5	2.4
Cutler	5.2	2.6
Illini	3.8	2.9
Hark	4.5	2.9
Chippewa 64	3.2	2.9
Harosoy 63	6.6	3.1
Blackhawk	3.0	3.5
Amsoy 71	8.7	3.5
Ilsoy	6.2	3.7
Shelby	9.5	3.8
Pickett 71	9.0	3.8
Lincoln	4.9	4.2
Clark 63	8.3	4.2
Williams	9.9	7.9
Adams	3.7	8.4
Nemashirozu	4.8	9.7
Woodworth	6.6	16.3

¹ Each value is the mean of three replications.² Combined soil and root extracts, 90 days after inoculation with 2000 nematodes/pot.

Clark 63, Harosoy 63, Ilsoy, Lincoln, Pickett 71 and Shelby were intermediate; and Chippewa 64, Cutler, Hark, Illini, Lee, Rampage and Scott were resistant. All other cultivars supported no detectable nematode reproduction. Cultivars Bragg, Custer, Forrest, Hill, Mack, Peking, PI 87631-1 and PI 90763, are resistant to other nematodes and appeared to be poor hosts for *P. scribneri* as well. Numbers of nematodes per pot varied from 463 in Bonus to 16,300 in Woodworth. No significant differences in dry weight of shoots were detected because of wide inter and intracultivar variation in plant growth.

TABLE 3.—*Susceptibility and tolerance of 12 soybean cultivars to Pratylenchus scribneri (Expt. 2)*

Cultivar	Dry wt (gm) ¹		Number (× 1,000) of nematodes ¹	
	Shoot	Root	Pot	Gm dry roots
Amsory	30.6a	4.3a	2.1	0.4a
Forrest	34.7a	5.2a	2.2	0.4a
Corsoy	9.4b	1.2c	2.9	2.5b
Dyer	33.9a	5.1ab	3.1	0.5a
Jupiter	32.3a	5.3ab	3.4	0.3a
Wayne	33.2a	4.7ab	3.7	0.7d
Bonus	34.4a	6.3b	3.9	0.6ab
Custer	29.3a	4.3a	4.4	1.0b
P.I. 88788	34.6a	5.9ab	7.0	0.6d
Williams	36.0a	5.0ab	18.5	3.4b
Woodworth	35.3a	5.9ab	33.3	6.0c
Clark 63	34.3a	6.2b	39.1	6.1c

¹ Each value is the mean of eight replications, 90 days after inoculation with 2,000 nematodes/pot; column means followed by the same letters do not differ ($P = 0.05$) according to Duncan's Multiple Range Test.

Results of the second test generally confirmed those of the first, although there was some degree of nematode reproduction in all 12 cultivars. Amsory 71, Bonus, Corsoy, Jupiter and Wayne supported limited reproduction, as did Custer, Dyer, and Forrest, which are resistant to other nematodes (table 3 and fig. 1). PI 88788, a cultivar commonly used in breeding for resistance to the soybean cyst nematode *Heterodera glycines*, was intermediate in susceptibility. Nematode population increase was greatest in Clark 63, but increases were also extensive in Woodworth and Williams. Numbers of nematodes per pot varied from 2,115 in Amsory 71 to 39,000 in Clark 63. Greatest root growth occurred in Clark 63 despite its high susceptibility, and in Bonus, which was relatively resistant. Both root and shoot weights of Corsoy were significantly lower than those of all other cultivars. Even though the total number of nematodes recovered from this cultivar was low, the density of nematodes in roots was rather high, suggesting that this cultivar may be very

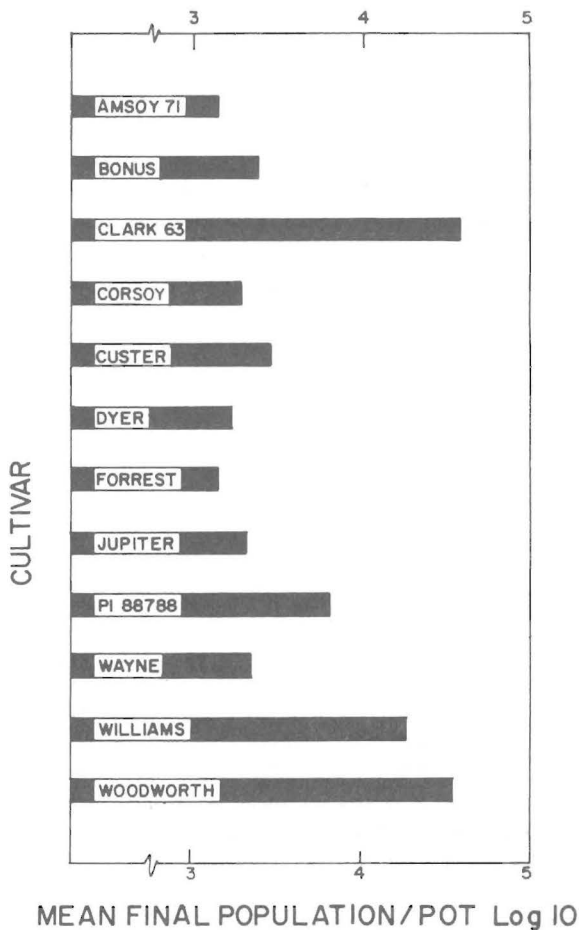


FIG. 1.—Numbers of *Pratylenchus scribneri* recovered from pots of 12 soybean cultivars 90 days after inoculation with 2,000 nematodes.

intolerant of *P. scribneri* infection. There were no differences in dry weight of shoots among other cultivars, indicating that even highly susceptible cultivars may be relatively tolerant of infection under conditions otherwise favorable for plant growth.

Previous studies of development of populations of lesion nematodes on soybean also showed a relatively wide range of susceptibility among cultivars. Schmitt (5) screened 25 southern cultivars against *P. brachyurus* under greenhouse conditions and found different degrees of susceptibility and tolerance based on nematode densities within roots. Among those also tested, Bragg was highly susceptible but tolerant; Essex,

Forrest and Pickett 71 were highly susceptible but intolerant; and Dare and York were relatively resistant to *P. brachyurus*. Lindsey and Cairns (4) also found that Bragg was tolerant to this species based on yields under southern field conditions, as were Custer, Hill and Pickett. Endo (3), however, could not detect any differences in population development of *P. brachyurus* and *P. zae* Graham between Peking and Lee soybeans. Comparing degree of reproduction in Clark 63 and five other cultivars, Dickerson (unpublished data) concluded that soybean is not a good host for either *P. alleni* or *P. neglectus* (Rensh.) Filipv. and Schuurm.-Stekh. Dickerson and Franz (2), noting that Clark 63 was also susceptible to a Kansas population of *P. scribneri*, initially found that cultivars Calland, Cutler, Wayne and Williams were resistant. Later work by Dickerson (unpublished data), however, showed that Cutler 71 was resistant at soil temperatures below 25 C, the temperature at which the other cultivars were tested, but became increasingly susceptible as temperature increased.

Based on results presented herein and elsewhere, it can be concluded that soybean cultivars vary considerably in their susceptibility to species of *Pratylenchus*. Moreover certain cultivars, particularly those with resistance to other nematodes, exhibited a relatively high degree of resistance to *P. scribneri*. These cultivars can be recommended for incorporation into nematode management programs when *P. scribneri* is present, whereas the use of cultivars such as Clark 63, Williams and Woodworth should be discouraged. The resistant cultivar, Jupiter, can be recommended tentatively for tropical areas such as Puerto Rico, but should be screened against *P. coffeae*, *P. brachyurus* and *P. zae* for proof of retained resistance to *P. scribneri* in the tropics.

RESUMEN

Los grados de susceptibilidad al nematodo *Pratylenchus scribneri* fueron determinados entre cultivares de soja (grupos de maduración I-X) en condiciones de invernadero. Un experimento preliminar indicó que existe gran variabilidad en la susceptibilidad relativa de los 51 cultivares estudiados. Un estudio subsiguiente de 12 de los cultivares confirmó que Clark 63, Woodworth y Williams son altamente susceptibles. Los cultivares Amsoy 71, Bonus, Corsoy, Jupiter y Wayne permitieron una reproducción limitada del nematodo. Aparentemente, los cultivares Custer, Dyer y Forrest, que son resistentes a otras especies de nematodos, también son resistentes a *P. scribneri*, mientras que P.I. 88788 mostró un grado intermedio de susceptibilidad. De entre los cultivares estudiados Corsoy fué el único cuyo crecimiento disminuyó cuando las densidades de nematodos dentro de las raíces fueron altas.

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