Susceptibility of Soybean Cultivars and Lines to Pratylenchus hexincisus[1]

M. E. ZIRAKPARVAR[2]

Abstract: Population increase of *Pratylenchus hexincisus* on 41 soybean cultivars (maturity groups I-VI) and lines was tested under greenhouse conditions. After 3 months, *P. hexincisus* was recovered from the roots of all plants tested. Final populations of *P. hexincisus* per pot were larger than the initial population in 13 cultivars. Pathogenicity of *P. hexincisus* on five soybean cultivars representing maturity groups (I-V) was demonstrated under greenhouse conditions. An inoculum of 5,000 *P. hexincisus*/plant significantly decreased the root and shoot biomass of all five soybean cultivars after 3 months. *Key words:* lesion nematode, resistant cultivar, ecology, pathogenicity.

Journal of Nematology 14(2):217-220. 1982.

Pratylenchus hexincisus (Taylor and Jenkins) is associated with corn (*Zea mays* L.) and soybean (*Glycine max* L.) in the North Central states of the USA (3,6,7,9, 10). Resistant cultivars are important for control of plant parasitic nematodes in pest management systems. Large differences in susceptibility of some soybean cultivars to lesion nematode (*Pratylenchus* spp.) occur (1,5,8). The pathogenicity of *P. hexincisus* on Corsoy soybeans has been demonstrated (11); however, little is known about the susceptibility of other cultivars. Field tests usually are confounded by other parasitic organisms, including other nematode species. The objectives of the research were to determine the susceptibility of various soybean cultivars to *P. hexincisus* and to determine its pathogenicity on five soybean cultivars under controlled conditions.

MATERIALS AND METHODS

The *P. hexincisus* used in all tests originally was obtained from field corn in Iowa and was increased on corn and tomato in the greenhouse. Steam-sterilized sandy soil (86% sand, 11% silt, 3% clay, 2.5% organic matter, pH 7.0) was used in all tests. All plants were fertilized with N-P-K (6-10-4) at 6 g/15-cm-d clay pot 1 month after planting.

Host susceptibility tests: Forty-one soybean cultivars and lines representing maturity groups I-VI (Table 1) were tested for susceptibility to *P. hexincisus* under greenhouse conditions. The designs were randomized blocks with five replications, each consisting of one plant growing in a 15-cm-d clay pot. Two tests consisting of 16 and 25 soybean varieties were conducted from 15 October 1979 to 17 January 1980 and from 18 March to 21 June 1980, respectively. Seeds were germinated in petri dishes, and one seedling was planted 2.5 cm deep in the center of each pot. Fifteen milliliters of water containing 3,000 ± 100 nematodes were pipetted into a 3-cm-deep hole near the seedling 3 days after planting.

Nematode recovery: The roots and soil were removed from each pot, and the soil was shaken gently from each root system and mixed thoroughly. *P. hexincisus* was extracted from 100 cm^3 of soil from each pot by using a centrifugal-flotation method (4). Adhering soil was washed from the roots, and 1–2 g of roots from each root system were selected randomly and cut into 1.5-cm segments for nematode extraction by a shaker method (2). The remaining root mass and the roots used for extraction were dried at 90 C for 5 days. Numbers of *P. hexincisus* per gram of dry root and per whole root system were calculated. Numbers of *P. hexincisus* per pot were determined by multiplying the number of nematodes per 100 cm^3 of soil by 15 and adding the result to the number of nematodes per whole root system.

Pathogenicity tests: Pathogenicity tests of *P. hexincisus* on soybean cvs. S1346, S1578, G-3340, Clark 63, and Forrest rep-

Received for publication 7 May 1981.

[1]Journal Paper No. J-10243 of the Iowa Agriculture and Home Economics Experiment Station, Ames, IA 50011. Project 2375. Supported by a grant from the Iowa Soybean Promotion Board.

[2]Department of Plant Pathology, Seed and Weed Sciences, Iowa State University, Ames, IA 50011. Present address: Union Carbide Agricultural Products Company, Inc., P. O. Box 12014, T. W. Alexander Dr., Research Triangle Park, North Carolina 27709. The author thanks D. C. Norton for guidance in preparation of this manuscript.

Table 1. Numbers of *Pratylenchus hexincisus* after 3 months on soybean cultivars and lines inoculated with 3,000 ± 100 nematodes per 15-cm-d pot.

Cultivar	Maturity group	*Pratylenchus hexincisus*		
		100 cm³ soil*	g dry root*	1,500 cm³ soil + root*
		First test		
Harcor	II	11a	331a	586a
Calland	III	22a	294a	769a
A1564	I	22a	408a	910a
Corsoy	II	13a	456a	1,004a
B216	II	33a	416a	1,220a
Elf	III	16a	366a	1,241a
S1492	II	21a	806a	1,408a
Beeson	II	280b	1,089ad	1,820a
Hodgson	I	15a	945a	1,962a
Wayne	III	34a	806a	1,992a
Wells	II	23a	1,108ad	2,157a
Coles	II	23a	1,030ad	2,162a
Sloan	II	19a	771a	2,460a
Amsoy 71	II	74a	780a	2,686a
Williams	III	264b	5,006bd	12,222b
Woodworth	III	671c	13,442c	34,940c
		Second test		
P61-22	II	7a	371a	627a
S1564	I	9abc	244a	1,024ab
CX155	I	20abc	810a	1,233ab
S2596	II	12abc	207a	1,284ab
A2575	II	8ab	307a	1,409ab
Peking	IV	7a	389a	1,503ab
Forrest	V	6a	395a	1,641ab
J102A	II	14abc	1,766ab	1,732ab
PI88788	III	16abc	478a	1,802ab
A2656	II	9abc	603a	2,317ab
Franklin	IV	9abc	385a	2,332ab
S1474	II	73cd	1,129a	2,544ab
B220	II	12abc	542a	2,750ab
Pickett 71	IV	19abc	694a	2,807ab
S1244	I	19abc	791a	3,107ab
PI90763	IV	13abc	774a	3,213ab
Lee 74	VI	12abc	777a	3,328ab
Bedford	VI	16abc	836a	3,397ab
S1346	I	10abc	1,026a	4,125ab
S4055	III	16abc	829a	4,388ab
Cumberland	III	27abcd	925a	4,911ab
Clark 63	IV	77cde	2,308ab	8,500b
BSR301	III	49bcd	4,450bc	23,601c
S1578	II	199e	8,374c	40,084c
G-3340	III	117cde	9,779d	50,473d

*Means with common letters within a column are not significantly different ($P = 0.05$) according to Duncan's multiple-range test.

resenting maturity groups I-V, respectively, were conducted in the greenhouse. Three treatments for each of five cultivars were arranged in a randomized block design with five replications of each treatment. The treatments were (i) 20 ml of water containing 5000 ± 200 nematodes pipetted on germinated seed and covered with soil, (ii) 20 ml of nematode-free wash water collected during the nematode extraction (herein-

after called "nematode-wash water") was pipetted on germinated seed and covered with soil to monitor effects of microbial contaminants on plant growth, and (iii) soybean plant (check) without nematodes or nematode-wash water. One germinated seed was planted in a 15-cm-d clay pot containing 1,500 cm³ sandy soil.

At the end of 3 months, nematodes were extracted from roots and soil and the same procedures carried out as in the host susceptibility tests. The foliage and roots of each plant were dried at 90 C for 5 days. Weights of the dried roots used in nematode extractions were added to the total root weights.

RESULTS

Host susceptibility tests: P. hexincisus was recovered from the roots of all 41 soybean cultivars and lines tested (Table 1). Final populations (Pf) of *P. hexincisus* per pot were larger than the respective initial population (Pi) with 13 cultivars. Significant differences existed in numbers of *P. hexincisus* per 100 cm³ of soil, per gram dry root, and per pot, among soybean cultivars in both tests. Cultivars G-3340, S1578, Woodworth, BSR301, and Williams (Table 1) supported large numbers ($P = 0.05$) of *P. hexincisus*. Numbers of nematodes per pot varied from 586 in Harcor to 34,940 in Woodworth in the first test and from 627 in P61-22 to 50,473 in G-3340 in the second test (Table 1).

Pathogenicity test: P. hexincisus reduced ($P = 0.01$) shoot and root biomasses of all five cultivars (Table 2). There were no significant differences in shoot and root biomasses of plants inoculated with nematode-wash water compared with the check plants. Numbers of *P. hexincisus* per gram dry root, per 100 cm³ soil, and per pot were different ($P = 0.01$) among the five cultivars tested. Numbers per pot varied from 20,770 in S1346 to 232,388 in G-3340 (Table 2).

Table 2. Shoot and root weight and numbers of *Pratylenchus hexincisus* in five soybean cultivars in the greenhouse 3 months after inoculation with 5,000 ± 200 *P. hexincisus* or wash-water* treated or non-inoculated controls.

Cultivar	Treatment	Shoot† weight (g)	Root† weight (g)	*P. hexincisus*‡		
				g dry root	100 cm³ soil	pot§
S-1346	Inoculated	13.1a	1.6a	12,721a	67a	20,770a
	Wash-water	17.3b	2.4b	0	0	0
	Noninoculated	16.1b	2.6b	0	0	0
S-1578	Inoculated	15.0a	2.2a	62,192b	1,078b	151,568c
	Wash-water	21.3b	4.4b	0	0	0
	Noninoculated	20.7b	3.8b	0	0	0
Clark 63	Inoculated	11.8a	1.9a	44,567ab	399a	92,635b
	Wash-water	21.4b	4.8b	0	0	0
	Noninoculated	21.2b	5.4b	0	0	0
G-3340	Inoculated	14.7a	2.1a	93,812b	1,835c	232,338d
	Wash-water	23.9b	5.7b	0	0	0
	Noninoculated	21.0b	4.5b	0	0	0
Forrest	Inoculated	12.7a	2.1a	10,530a	119a	24,305a
	Wash-water	21.3b	3.6b	0	0	0
	Noninoculated	20.6b	4.4b	0	0	0

*Nematode-free wash water collected during the nematode extraction to monitor effect of microbial contamination on plant growth.

†Means with common letters within a column for a given variety are not significantly different ($P = 0.05$) according to Duncan's multiple-range test.

‡Means with common letters within a column are not significantly different ($P = 0.01$) according to Duncan's multiple-range test.

§1,500 cm³ soil + whole root system.

DISCUSSION

Various soybean cultivars are commonly used as a rotation crop with corn in the North Central states of the USA. Up to 52,000 *P. hexincisus*/g dry root have been associated with poor soybean growth under field conditions in Iowa. Population increase of *P. scribneri* occurred on cultivars such as Clark 63, Williams, Woodworth, Calland, Corsoy, and Beeson (1). Large differences in numbers of *Pratylenchus* spp. among soybean cultivars probably partly explains the wide range in numbers of this nematode occurring among fields.

Although *P. hexincisus* reduced shoot and root biomass of the five soybean cultivars tested, its final population (P_f) differed ($P = 0.01$) in these cultivars (Table 2). For example, at a P_f of 20,770 *P. hexincisus*, shoot and root biomass of cv. S1346 was reduced by 18.6% and 39.5%, respectively. However, at a P_f of 232,338 *P. hexincisus*, shoot and root biomass of cv. G-3340 was reduced by 30.2% and 53.9%, respectively. These results and results reported by others (1,5) indicate that different soybean cultivars have varying reactions to a given species of *Pratylenchus* and that the relationship between nematode numbers and biomass reduction is not always linear.

Knowledge of the reaction of soybean cultivars to *P. hexincisus* will facilitate a management program to control this nematode. Although it is difficult to extrapolate greenhouse data to field conditions, large numbers of *P. hexincisus* per gram dry root have been associated with poor corn and soybean growth in Iowa. Other stresses, such as moisture, low fertility, and other organisms, including nematodes, will allow for fewer nematodes necessary to cause measurable injury in the field. The ability of *P. hexincisus* to reduce plant growth in the greenhouse in the absence of other parasitic organisms adds credibility to the concept that this species is a major contributing factor to reduced yields in fields where large nematode populations occur.

LITERATURE CITED

1. Acosta, N., R. B. Malek, and D. I. Edwards. 1979. Susceptibility of soybean cultivars to Pratylenchus scribneri. J. Agric. Univ. P. R. 62:103-110.

2. Bird, G. W. 1971. Influence of incubation solution on the rate of recovery of Pratylenchus brachyurus from cotton roots. J. Nematol. 3:378-385.

3. Ferris, V. R., and R. L. Bernard. 1958. Plant parasitic nematodes associated with soybeans in Illinois. Plant Dis. Rep. 42:798-801.

4. Jenkins, W. R. 1964. A rapid centrifugal-flotation technique for separating nematodes from soil. Plant Dis. Rep. 48:692.

5. Lindsey, D. W., and R. J. Cairns. 1971. Pathogenicity of lesion nematode, Pratylenchus brachyurus on six soybean cultivars. J. Nematol. 3:220-226.

6. McCallum, D. R., and O. J. Dickerson. 1971. Bean (pinto) root-lesion nematodes (Pratylenchus spp.), soybean (Wayne) root-lesion nematode (Pratylenchus hexincisus). Pp. 159, 172 *in* Fungicide and nematicide test results for 1971. Vol. 27.

7. Norton, D. C., and P. Hinz. 1976. Relationship of Hoplolaimus galeatus and Pratylenchus hexincisus to reduction of corn yields in sandy soils in Iowa. Plant Dis. Rep. 60:197-200.

8. Schmitt, D. P. 1976. Relative suitability of soybean cultivars to Pratylenchus brachyurus. J. Nematol. 8:302 (Abstr.).

9. Taylor, D. P., R. V. Anderson, and W. A. Haglund. 1958. Nematodes associated with Minnesota crops. I. Preliminary survey of nematodes associated with alfalfa, flax, peas, and soybeans. Plant Dis. Rep. 42:195-198.

10. Thomas, S. H. 1978. Population densities of nematodes under seven tillage regimes. J. Nematol. 10:24-27.

11. Zirakparvar, M. E. 1980. Host range of Pratylenchus hexincisus and its pathogenicity on corn, soybean, and tomato. Phytopathology 70:749-753.