Pathogenic Effects of *Pratylenchus scribneri* in Maize Inbreds and Related Cultivars

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ABSTRACT

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Maize inbreds C123Ht, C103, and Mo17Ht inoculated with 8,500 ± 500 *Pratylenchus scribneri* developed dark brown, discrete lesions on their roots and had reduced root size and weight and extensively pruned root systems 90 days after inoculation in the greenhouse. Inbred B68Ht, similarly treated, had the fewest nematodes and no visible pathological symptoms. In the field, the nematode significantly ($P = 0.05$) reduced either weight, size, volume, or number and/or angle of fibrous roots of some inbreds and hybrids. Inbred C123Ht and its related cultivars C103, Mo17Ht, C123Ht × Mo17Ht, and C123Ht × C103 supported some of the largest numbers of *P. scribneri* both in the greenhouse and the field. In most instances, B37Ht and B68Ht had the fewest *P. scribneri*.

The lesion nematode (*Pratylenchus scribneri* Steiner) is economically important in many crops in the United States (1,4,5,9–13). Although maize (*Zea mays* L.) is a host of the nematode, information about the nematode's pathogenicity in this crop is meager. Colonization by *P. scribneri* of selected inbreds that are or were commonly used in the north central United States varied considerably (14). Although related cultivars possibly can respond similarly to *P. scribneri*, there is no work to verify this. This work studies population changes of *P. scribneri* and assesses their pathogenic effects in maize inbreds and related cultivars.

MATERIALS AND METHODS

Greenhouse experiments. The *P. scribneri* were recovered from a maize field at Iowa State University Hinds Research Farm, Ames, and were increased in maize inbred C123Ht in the greenhouse. Pathogenicity of the nematode was evaluated in seven maize cultivars. Seeds were germinated on damp filter paper in petri dishes. Five-day-old seedlings were transplanted, one per pot, into steam-sterilized soil (60% sand, 24% silt, 16% clay, 2.3% organic matter, and 7.4 pH). Each cultivar was replicated five times in a randomized block design. Ten milliliters of water containing 8,500 ± 500 *P. scribneri* were pipetted into a 2-cm-deep hole around the seedling 1 day after planting. Cultivars without nematodes served as controls. Plants were fertilized with a teaspoonful of Osmocote (14-14-14, NPK) 1 wk after transplanting and watered as required. Light was supplemented with a 15-hr fluorescent light period (1,132 $\mu E\ m^{-2}\ s^{-1}$).

Three months after inoculation, plant roots were removed from the soil, washed, and rated. Plant tops and roots were dried at 90 C for 72 hr before being weighed. A sample (2–3 g) of dislodged fibrous roots was collected randomly, and 100 cm^3 of well-mixed soil was taken for nematode extraction (2,8). Nematodes were counted with a Hawksley slide, and nematodes per gram of dry root were calculated. Soil populations of *P. scribneri* were low and are not reported here.

Field experiments. Eighteen maize inbreds in 1983 and eight in 1984 were tested for nematode increase in loamy sand (81% sand, 12% silt, 7% clay, 2% organic matter, 6.6 pH) naturally infested with *P. scribneri*. Other nematodes present in small numbers were *Xiphinema americanum* Cobb, *Helicotylenchus pseudorobustus* (Steiner) Golden, and *Paratylenchus* sp., for which data are not reported. Cultivars were replicated five times each year in a randomized complete block design. Plots consisted of two adjacent rows 9.2 m long, 0.8 m apart, and planted at 42,000 seeds per hectare on 8 May 1983 and 10 May 1984. Outer rows were bordered with inbred Mo17Ht.

In 1984, one-half of the experimental units of each cultivar were treated with aldicarb 15G. The nematicide was applied in a 17.8-cm band at 2.4 kg a.i./ha with a calibrated, gear-driven, hand-operated applicator and incorporated into the top 4 cm of soil. Soil samples were taken from the top 25 cm of soil with a 2-cm-diameter soil probe at planting and in the inner rhizospheres of 10 randomly chosen plants per plot 40, 76, and 99 days after planting in 1983 and 99 and 101 days after planting in 1984.

Root systems of four randomly chosen plants per plot were removed with a 20-cm-diameter modified turf patcher 76 days after planting in 1983 and 51 days after planting in 1984 for root parameter assessment. Sampling 51 days after planting was selected to minimize root destruction and to ensure removal of nearly whole root systems. Soil was dislodged into a bucket and mixed thoroughly before taking one 500-g sample per plot for nematode extraction. Again, *P. scribneri* in the soil were few and data are not reported. Washed root systems were evaluated with a modification of Eiben's method (6) on a scale of 1–4 from very small to very large root systems. Root angle determination was based on measuring the angle between the crown roots on the first and second upper nodes and crown. Crown roots were counted. Degree of fibrous root production was evaluated on a subjective rating of 1–4 from few to many fibrous roots. Roots were weighed after drying at 90 C for 72 hr. Root volume was determined by water displacement (3).

RESULTS

Greenhouse experiment. *P. scribneri population increase.* Inbreds B37Ht, B68Ht, and C103 had significantly ($P = 0.05$) fewer *P. scribneri* 90 days after inoculation in the greenhouse than did inbred C123Ht. Numbers of *P. scribneri* in C123Ht × Mo17Ht and C123Ht × C103 were intermediate to those in their inbreds but were not significantly different (Table 1).

Pathogenicity of P. scribneri. Root systems of cultivars inoculated with *P. scribneri* showed discrete, dark brown lesions, extensive pruning, or reduced size (except B68Ht). The nematode caused a 3–32% reduction in root weight within cultivars, but differences were not significant (Table 1). Cultivar B68Ht had a root weight increase resulting from nematode parasitism. Except for C123Ht × C103 and B37Ht, *P. scribneri* also caused a 3–35% reduction in shoot

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Table 1. Numbers of *Pratylenchus scribneri* in roots, root weights, and shoot weights of 7 maize cultivars 90 days after inoculation (greenhouse)

Cultivar[a]	*P. scribneri*/g dry root		Root		Shoot	
	Inoculated	Control	Dry wt (g)	Percent change	Dry wt (g)	Percent change
C123Ht	64,421	0	3.2		19.6	
			2.5	−25.0	17.7	−10.7
C123Ht × Mo17Ht	42,123	0	10.3		39.1	
			9.2	−12.0	38.1	−2.6
C123Ht × C103	41,889	4	10.2		39.3	
			9.9	−5.0	39.8	1.3
Mo17Ht	31,419	28	7.9		34.8	
			5.4	−32.0	21.2	−35.8
C103	8,281	0	5.1		28.9	
			4.3	−16.0	24.9	−15.9
B68Ht	5,487	10	9.8		42.1	
			12.6	29.0	37.0	−13.8
B37Ht	3,433	0	10.3		38.1	
			9.4	−8.9	38.3	0.5
LSD ($P = 0.05$)	33,181	N.S.	4.6		9.2	

[a] Each cultivar was replicated five times and inoculated with 8,500 ± 500 *P. scribneri*.

Table 2. Numbers of *Pratylenchus scribneri* recovered from roots of 18 maize cultivars 40, 76, and 99 days after planting at Hinds Research Farm, Ames, IA, in 1983

Cultivar	Number of *P. scribneri*/g dry root		
	40 Days[a]	76 Days	99 Days
C123Ht	1,179[b]	2,908	58,756
A632Ht	846	2,047	32,950
Oh43	1,049	1,716	27,879
A619Ht	749	2,016	27,744
C123Ht × A619Ht	805	1,454	20,338
C123Ht × C103	1,208	8,742	19,258
C103	1,289	935	16,994
C123Ht × Mo17Ht	469	1,323	15,234
B37Ht	103	303	12,227
Mo17Ht	418	2,245	10,296
B73Ht	995	1,088	9,158
C123Ht × Oh43	1,060	1,251	7,880
$B73Ht_{02/02}$	691	1,151	6,150
$B73Ht_{02/02} \times Mo17Ht_{02/02}$	1,096	683	5,181
$Mo17Ht_{02/02}$	1,029	10,922	5,140
B37Ht × A632Ht	1,092	6,962	4,372
B37Ht × B73Ht	427	847	2,630
B68Ht	565	296	1,560
LSD ($P = 0.05$)	N.S.	N.S.	22,815

[a] Days after planting.
[b] Means of replicates.

weight, but only Mo17Ht was significant (Table 1).

Field experiment 1983. *P. scribneri population increase.* Numbers of *P. scribneri* per gram of dry root were significantly ($P = 0.05$) different only 99 days after planting in 1983 (Table 2). The highest and lowest numbers of *P. scribneri* were obtained from C123Ht and B68Ht, respectively, 99 days after planting. Numbers of nematodes within the roots 40 and 76 days after planting were not significant among cultivars, and rankings were not consistent with numbers at 99 days. Where inbreds and their hybrids could be compared, numbers of *P. scribneri* at 99 days were frequently significantly intermediate or less than the inbred containing the greatest number of nematodes (Table 2).

Field experiment 1984. *P. scribneri population increase.* Numbers of *P. scribneri* in roots differed significantly ($P = 0.05$) among many cultivars 51 and 101 days after planting (Table 3). Significantly fewer *P. scribneri* were recovered from cultivars treated with aldicarb than from untreated ones, especially at 51 days after planting, when the most *P. scribneri* were obtained from C123Ht and the fewest from B37Ht in plots not treated with aldicarb. At 101 days after planting, the most *P. scribneri* were obtained from C123Ht, C123Ht × Mo17Ht, and C103, and the fewest from B68Ht and B37Ht (Table 3).

Pathogenicity of P. scribneri. For most cultivars, treatment with aldicarb, which provided varying degrees of nematode control, resulted in root weight, size, and volume increases 51 days after planting, but most differences were not significant (Table 3). Root weight of aldicarb-treated C123Ht × Mo17Ht was significantly ($P = 0.05$) heavier than that of untreated ones. Aldicarb-treated C123Ht × C103 had a significantly ($P = 0.05$) larger root system than untreated ones. Numbers of crown and fibrous roots and

Table 3. Numbers of *Pratylenchus scribneri*, maize root dry weight, size rating, volume, number of crown roots, and root angle, Hinds Research Farm, Ames, IA, 1984

Cultivar	Treatment	No.[a] of *P. scribneri*/g dry root		51 Days after planting					
		51 Days[b]	101 Days	Dry root weight (g)	Size rating	Volume (ml)	No. of crown roots	Fibrous root production	Root angle
C123Ht	No aldicarb	18,989	52,626	3.2	1.7	6.5	16.8	1.9	32.0
	Aldicarb	3,312	16,758	4.2	1.6	8.3	16.0	1.2	30.7
C123Ht × Mo17Ht	No aldicarb	12,845	13,281	7.4	3.1	14.7	20.0	2.2	34.5
	Aldicarb	1,565	2,203	12.2	3.4	22.1	20.3	2.1	34.5
C103	No aldicarb	11,322	24,573	5.8	1.7	11.8	16.1	2.0	26.3
	Aldicarb	669	9,116	4.8	2.1	10.3	14.1	1.9	30.7
B68Ht	No aldicarb	9,437	4,626	5.1	2.2	10.1	20.9	1.7	38.0
	Aldicarb	1,441	1,932	7.6	2.7	14.1	18.2	1.9	44.3
C123Ht × C103	No aldicarb	7,816	16,159	5.1	2.1	10.8	16.8	2.2	33.3
	Aldicarb	3,046	6,614	7.8	3.0	15.4	18.4	2.0	28.9
$Mo17Ht_{02/02}$	No aldicarb	6,840	14,115	4.4	2.0	9.1	19.2	2.2	28.9
	Aldicarb	1,435	8,209	4.9	2.1	10.5	19.4	2.3	38.8
Mo17Ht	No aldicarb	4,937	9,063	5.8	2.5	13.4	20.5	2.7	38.2
	Aldicarb	4,155	3,232	5.9	2.7	12.2	20.0	2.3	34.9
B37Ht	No aldicarb	3,913	7,848	9.9	2.9	16.8	26.6	2.6	37.4
	Aldicarb	679	2,168	8.8	3.4	15.9	26.3	2.3	36.5
LSD ($P = 0.05$)	···	1,603	12,518	3.4	0.8	5.1	3.8	0.6	10.0

[a] Numbers are means of five replicates.
[b] Days after planting.

root angles of aldicarb-treated cultivars were not significantly different from those of untreated ones. A significantly ($P = 0.05$) negative correlation ($r = 0.3$) existed between numbers of *P. scribneri* and root weight 51 days after planting.

DISCUSSION

The ability of C123Ht and Mo17Ht to support large numbers of *P. scribneri* is consistent with previous results (14). Both C123Ht and Mo17Ht are also excellent hosts for *P. hexincisus* (14). A similar reaction of Mo17Ht to *P. hexincisus* also was found by Georgi et al (7). The inbreds C123Ht and Mo17Ht have C103 in their parentage, which also supported moderate to high numbers of *P. scribneri* (Tables 1–3). Hybrids C123Ht, Mo17Ht, and C123Ht × C103, derivatives of C123Ht, C103, and/or Mo17Ht, also supported high numbers of *P. scribneri* both in the greenhouse and the field (Tables 1 and 3). A common genetic background is a possible explanation for the ability of the related cultivars to support high numbers of the nematodes.

The resistant reactions of B37Ht and B68Ht to *P. scribneri* demonstrated by the inability of the nematodes to induce visible symptoms on B68Ht, the relative superior root performance of B37Ht without aldicarb treatment (Table 3), and their inability to support large numbers of *P. scribneri* confirm previous results (14).

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