HOSTS FOR *MELOIDOGYNE HAPLANARIA*

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ABSTRACT

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Meloidogyne haplanaria is a newly described species from Texas that attacks peanut. Common bean, garden pea, radish and soybean were confirmed as hosts in greenhouse tests. Cowpea and eggplant were poor hosts, supporting <40 eggs/g roots 8 weeks after inoculation. Reproduction of *M. haplanaria* varied among 10 soybean cultivars, ranging from 160 to >7,000 eggs/g roots 14 weeks after inoculation with 10,000 eggs/pot. The *M. arenaria*-resistant peanut cultivar NemaTAM was also resistant to *M. haplanaria*, but resistance in tomato to *Meloidogyne* spp. conferred by the *Mi* gene was not effective against *M. haplanaria*.

Key words: host range, *Meloidogyne haplanaria*, peanut.

RESUMEN

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Meloidogyne haplanaria es una especie recientemente descrita atacando al cacahuete en Tejas. Fríjol común, guisante, rábano y soya fueron confirmados como huéspedes en ensayos de invernadero. Caupi y berenjena eran huéspedes ineficientes, manteniendo menos de 40 huevos por gramo de raíces a 8 semanas después de ser inoculados. La reproducción de *M. haplanaria* variaba entre 10 cultivares de soya de 160 a >7,000 huevos por gramo de raíces a 14 semanas después de inoculación con 10.000 huevos por crisol. El cultivar NemaTAM de cacahuete resistente a *M. arenaria* también era resistente a *M. haplanaria*, pero la resistencia de tomate a *Meloidogyne* spp. conferido por el gen *Mi* no era efectivo contra *M. haplanaria*.

Palabras clave: cacahuete, maní, *Meloidogyne haplanaria*, nemátodo barrenador.

INTRODUCTION

Meloidogyne haplanaria, the Texas peanut root-knot nematode, is a recently described species originally found attacking peanut *(Arachis hypogaea*) in Texas (Eisenback *et al.*, 2003). The current known distribution of the nematode is limited to peanut fields in three widely separated counties in Texas (unpublished data). Two studies have documented that *M. haplanaria* is capable of limiting yield of peanut in nematode-infested soils, but this species was less aggressive than the more widely distributed parasites of peanut *M. arenaria* and *M. javanica* (Abdel-Momen and Starr, 1997; Meador, 2001). In those reports *M. haplanaria* was referred to as an undescribed *Meloidogyne* spp.

The description of *M. haplanaria* lists two other susceptible hosts (tomato, *Lycopersicon esculentum* and pepper, *Capsicum annuum*), but with *M. haplanaria* producing less than 20% of the eggs per g roots on tomato as did *M. incognita* or *M. arenaria* (Eisenback *et al.*, 2003). Pepper was only a moderate host of *M. haplanaria* in that report. The authors also reported

that cotton (*Gossypium hirsutum*), maize (*Zea mays*), tobacco (*Nicotiana tobacum*), watermelon (*Citrullus lanatus*), and wheat (*Triticum aestivum*) were nonhosts. Additionally, Meador (2001) reported that in field tests, peanut cultivars with resistance to *M. arenaria* supported relatively low population densities of *M. haplanaria* compared to peanut cultivars susceptible to *M. arenaria*. The objective of this study was to test additional crop species for their ability to serve as hosts for *M. haplanaria*. A preliminary report has been published (Bendezu and Starr, 2002).

MATERIALS AND METHODS

Isolates of *M. haplanaria* and *M. arenaria* race 1 used in these experiments were obtained from peanut in Texas. *Meloidogyne haplanaria* was cultured on peanut cv. Florunner, whereas *M. arenaria* was cultured on tomato cv. Rutgers. Eggs collected by the NaOCl method (Hussey and Barker, 1973) were used for inoculum for all tests. Species identification was confirmed by esterase and malate dehydrogenase phenotypes (Eisenback *et al.*, 2003; Esbenshade and Triantaphyllou, 1990).

Four separate tests were conducted in 15-cm-diam. pots containing a coarse sand-peat potting medium (6:1, v/v). In the first test, seeds were germinated in moistened rolls of germination paper at 26°C and seedlings were transplanted individually into the pots when radicals were 4- to 6-cm long. In subsequent tests, four seeds were planted in each pot and then thinned to one seedling per pot just prior to inoculation. Seedlings were inoculated ca 10 days after transplanting or after development of the first true leaves. Each seedling was inoculated with a suspension of 10,000 eggs/pot by pipetting the suspension into three holes placed equidistant from the base of the seedling. Inoculated plants were maintained in a greenhouse with temperatures ranging from 24 to 32°C. Plants were harvested 8 or 14 weeks after inoculation, soil was washed from the roots, and eggs were extracted from the roots using NaOCl (Hussey and Barker, 1973). Host status was determined based on eggs per gram of root for each plant species. In the comparison of host status of tomato cultivars with and without the *Mi* gene for resistance to *M. arenaria*, the severity of root galling was measured using a 0 to 5 scale (Hussey and Janssen, 2002). The tests of tomato cultivars was conducted in the winter months when the temperatures in the greenhouse were less than 28°C.

All tests were established as completely randomized experiments, with either four (tests 1 and 3) or 10 replications (tests 2 and 4) of each treatment. Data were analyzed using the SAS (SAS Institute, Inc., Cary, NC) general linear model procedure with mean separations, when appropriate, using least significant differences (LSD) or Duncan's multiple range test. Nematode count data were transformed by $\log_{10}$ (x + 1) prior to analysis but actual treatment means are reported. Correlation analysis was used to compare reproduction of *M. arenaria* and *M. haplanaria* in two tests.

RESULTS

In the first test, *M. haplanaria* had a high level of reproduction on the *M. arenaria*-susceptible peanut cultivar Florunner, on the garden pea cultivar Sugar Snap, and on the radish cultivar Cherry Belle (Table 1). The reproduction index (initial population density/final population density) for all of these plants was greater than 10. The *M. arenaria*-resistant peanut NemaTAM, bean cultivar Tender-Green and the eggplant cultivar Black Beauty were poor hosts, with the reproduction index for each being less than 1.0.

Table 1. Reproduction of *Meloidogyne haplanaria* on selected crop species.

Species	Cultivar	Eggs/g root
Arachis hypogaea	Florunner	1,342 A
	NemaTAM	46 B
Phaseolus vulgaris	TenderGreen	3 B
Pisum sativum	Sugar Snap	5,711 A
Raphanus sativus	Cherry Belle	1,162 A
Solanum melogena	Black Beauty	3 B

Values are means of four replications measured at 8 weeks after inoculation, values followed by the same letter are not different ($P = 0.05$).

In the second test, reproduction of *M. haplanaria* was evaluated on two tomato cultivars, Rutgers which is susceptible to *M. arenaria*, and Motelle, which is resistant to *M. arenaria* because it carries the *Mi* gene. Both tomato cultivars were good hosts for *M. haplanaria* with similar levels of root galling (Table 2). In contrast, *M. arenaria* produced far fewer eggs ($P < 0.05$) on the resistant Motelle with lower root galling than on Rutgers.

The third test compared reproduction of *M. haplanaria* and *M. arenaria* on different cultivars of legume crops. All three cultivars of garden pea tested were good hosts, but supported a greater level of reproduction ($P < 0.05$) of *M. arenaria* than of *M. haplanaria* (Table 3). Soybean and common bean cultivars supported moderate to low levels of reproduction of both species. All three cowpea cultivars were poor hosts of both species. The level of reproduction of *M. haplanaria* on these plants was not correlated with reproduction by *M. arenaria* ($r = 0.05$).

In the final test, reproduction of the two nematode species was compared on 10 soybean cultivars, with seven of the cultivars carrying the transgenic trait for resistance to the herbicide glyphosate. The reproduction of each nematode species varied among soybean genotypes ($P < 0.05$) (Table 4), and was not related to the transgenic trait. The level of reproduction of *M. haplanaria* was correlated with the level reproduction of *M. arenaria* ($r = 0.787$, $P < 0.05$) on this selection of soybean cultivars.

DISCUSSION

The host range of *M. haplanaria* has been expanded to include several additional legume crops and the crucifer crop radish. Additionally, the data show that not all common legume crops are hosts and that there can be variability in susceptibility within a crop species, as was observed

Table 2. Reproduction of *Meloidogyne haplanaria* and *M. arenaria* on tomato cultivars with and without the *Mi* gene for resistance to *M. arenaria*, and root gall indices of inoculated plants.

		M. haplanaria		*M. arenaria*	
Cultivar	*Mi* gene	Eggs/g root	Gall index	Eggs/g root	Gall index
Rutgers	-	2,415	3.2	3,966	3.6
Motelle	+	2,752	3.5	64	0.6

$LSD_{0.05}$ for eggs per gram root = 1,012; for gall index = 1.5. Values are means of 10 replications measured at 8 weeks after inoculation.

Table 3. Comparison of the reproduction of *Meloidogyne haplanaria* and *M. arenaria* on selected leguminous crop species.

Species	Cultivar	Eggs/g root	
		M. haplanaria	*M. arenaria*
Glycine max	Lee 74	47 C	272 B
Phaselous vulgaris	Bountiful	284 AB	187 B
	Blue Lake 274	115 AB	3 C
Pisum sativum	Progress	876 A	13,250 A
	Mammoth Melting Sugar	332 AB	11,710 A
	Early Snap	580 A	6,540 A
Vigna unguiculata	California Blackeye 5	30 C	3 C
	California Blackeye 46	0 C	1 C
	Clemson Purple	23 C	0 C

Values are means of four replications measured at 8 weeks after inoculation, values within a column followed by the same letter are not different at the $P = 0.05$ level.

Table 4. Comparison of the reproduction of *Meloidogyne haplanaria* and *M. arenaria* on different cultivars of soybean.

Cultivar	Transgenic	Eggs/g root	
		M. haplanaria	*M. arenaria*
HBK4660	+	259 C	51 B
HBK4855	+	7,170 A	4,680 A
HBK4891	-	200 C	893 A
HBK4920	+	2,200 B	4,090 A
HBK5588	+	1,550 B	1,690 A
HBK5920	+	1,040 B	311 AB
HNK5990	-	820 BC	670 A
HBK5991	-	160 C	420 AB
HBK6020	+	1,460 B	30 B
HBK660	+	2,570 B	841 A

Values are means of 10 replications measured at 14 weeks after inoculation, values within a column followed by the same letter do not differ at the $P = 0.05$ level. Transgenic cultivars carry resistance to the herbicide glyphosate.

with soybean. These data suggest that the breadth of the host range for *M. haplanaria* is similar to several other *Meloidogyne* species in that it is likely to successfully parasitize a large and diverse number of hosts across a large range of plant families.

These data confirmed the previous report (Meador, 2001) that the peanut cultivar NemaTam, which was bred for resistance to *M. arenaria* and subsequently found to be resistant to *M. javanica* (Simpson et al.), is also resistant to *M. haplanaria*. However, the resistance in tomato to *M. arenaria, M. javanica*, and *M. incognita* conferred by the *Mi* gene (Williamson, 1998) is not effective against *M. haplanaria*.

LITERATURE CITED

ABDEL-MOMEN, S. M., and J. L. STARR. 1997. Damage functions for three *Meloidogyne* species on *Arachis hypogaea* in Texas. Journal of Nematology 29:478-483.

BENDEZU, I. F., and J. L. STARR. 2002. Host range of an undescribed *Meloidogyne* sp. isolated from peanut. Nematology 4:261 (Abstr.).

EISENBACK, J. D., E. C. BERNARD, J. L. STARR, T. A. LEE, JR., and E. K. TOMASZEWSKI. 2003. *Meloidogyne haplanaria* n. sp. (Nematoda: Meloidogynidae), a root-knot nematode parasitizing peanut in Texas. Journal of Nematology 35:395-403.

ESBENSHADE, P. R., and A. C. TRIANTAPHYLLOU. 1990. Isozyme phenotypes for the identification of *Meloidogyne* species. Journal of Nematology 22:10-15.

HUSSEY, R. S., and K. R. BARKER. 1973. A comparison of methods of collecting inocula of *Meloidogyne* spp., including a new technique. Plant Disease Reporter 9:1025-1028.

HUSSEY, R. S., and G. J. W. JANSSEN. 2002. Root-knot nematodes: *Meloidogyne* species. Pp. 43-70 *in* J. L. Starr, R. Cook, and J. Bridge, eds. Plant resistance to parasitic nematodes. CAB Publishing, Wallingford, UK.

MEADOR, C. B. 2001. Peanut susceptibility to an undescribed root-knot nematode. M.S. Thesis. Tarleton State University, Stephenville, TX, USA.

SIMPSON, C. E., J. L. STARR, G. T. CHURCH, M. D. BUROW, and A. H. PATERSON. 2003. Registration of 'NemaTAM' peanut. Crop Science 43:1561.

WILLIAMSON, V. M. 1998. Root-knot resistance genes in tomato and their potential for future use. Annual Review of Phytopathology 36:277-293.

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