Resistance of Maize Inbreds to *Meloidogyne incognita* and *M. arenaria*

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ABSTRACT

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Forty-eight maize inbreds were evaluated for resistance to *Meloidogyne incognita* race 4 and *M. arenaria* race 2 in the greenhouse. Resistance was based on host suitability by determining reproduction factors (RF) (final egg numbers/initial egg numbers) and number of eggs per gram of fresh root. Mp307 had the lowest RF value (1.8) and the lowest number of eggs per gram of root (756) for *M. incognita*. The lowest RF value (0.2) for *M. arenaria* was recorded for AR218, Mp313, SC213, and T220. Eighteen inbreds failed to maintain the *M. arenaria* population at the initial population level. Number of *M. arenaria* eggs per gram of root ranged from 182 for Mp313 to 8,069 for Mp84:5173. Although several inbreds were poor hosts for both nematode species, resistance to *M. incognita* was not correlated with resistance to *M. arenaria*.

Additional key words: *Zea mays*

Maize (*Zea mays* L.) is attacked by numerous species of plant-parasitic nematodes (6,10). Although root-knot nematodes (*Meloidogyne* spp.) parasitize maize, they have not been investigated extensively. It is generally accepted that maize is tolerant to root-knot nematodes. Symptoms caused by these nematodes range from barely visible to severe stunting and galling of the roots.

There are conflicting reports on the host suitability of maize for root-knot nematodes (1,7–9). Conclusions on this issue range from *Meloidogyne* spp. reproducing little on maize (4) to their increasing readily even when no visible symptoms were observed (2). A recent study (12) showed many commercial hybrids to be excellent hosts for *M. incognita* (Kofoid & White) Chitwood and *M. arenaria* (Neal) Chitwood; however, several hybrids were identified as poor hosts for *M. arenaria*. The usefulness of many of these hybrids in crop rotations for the management of *M. incognita* and *M. arenaria* may be limited. Resistant maize hybrids are needed to effectively manage root-knot nematode populations.

The objective of our research was to evaluate maize inbreds for resistance to *M. incognita* and *M. arenaria* on the basis of host suitability.

MATERIALS AND METHODS

Populations of *M. incognita* race 4 and *M. arenaria* race 2 were obtained from the Department of Plant Pathology, North Carolina State University, Raleigh. Inoculum was increased on tomato (*Lycopersicon esculentum* Mill. cv. Floradel) in the greenhouse. After 8–10 wk, eggs were collected from tomato roots with NaOCl (5).

Forty-eight maize inbreds were selected for this study. Seeds were planted in Todd Planter Flats (model 300, Speedling, Inc., Sun City, FL) containing a potting mixture of methyl bromide-sterilized sandy loam soil and river sand (1:1). Each flat contained 32 7.6-cm square inverted pyramid-shaped cells 7.6 cm deep. Seven- to 10-day-old seedlings, thinned to one per cell, were inoculated by pipetting a

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water suspension containing about 3,000 nematode eggs of the appropriate species into each cell. Plants evaluated for resistance to *M. incognita* and *M. arenaria* were grown in the greenhouse at an average temperature of 30 ± 5 and 29 ± 3 C, respectively. Inbreds were arranged in a randomized complete block design with eight replicates for each nematode species. The experiments were repeated at an average temperature of 30 ± 5 and 28 ± 3 C for *M. incognita* and *M. arenaria*, respectively, following the same procedure.

After 60 days, roots were carefully washed free of soil, blotted dry, weighed, and cut into 1-cm segments. Eggs were extracted from each root system using NaOCl (5) and counted. Oostenbrink's (11) R factor (RF) (final egg number/initial egg number) and the number of eggs per gram of fresh root were determined for each inbred-nematode treatment. Data from both tests for each nematode species were combined and subjected to analysis of variance. Inbreds were compared by least significant differences (LSD) ($P = 0.05$). Correlation coefficients were calculated to determine if resistance to *M. incognita* was related to resistance to *M. arenaria*.

RESULTS AND DISCUSSION

None of the inbreds were immune to *M. incognita*. Inbreds differed ($P = 0.05$) in ability to support the *M. incognita* population (Table 1); however, this nematode increased on all inbreds. Mp307 had the lowest RF value (1.8) and the lowest number of eggs per gram of fresh root (756). The highest RF value and number of eggs per gram of fresh root were 16.5 for T216 and 5,807 for Mo17.

Table 1. Reproduction factor (RF) and number of eggs per gram of fresh root for *Meloidogyne incognita* and *M. arenaria* as influenced by maize inbreds

	M. incognita		***M. arenaria***	
Maize inbreds	**RF**[a]	**Eggs/g fresh root**	**RF**	**Eggs/g fresh root**
Mp307	1.8	756	0.4	472
Mp412	3.0	1,076	0.8	562
Mp704	3.6	3,425	0.8	1,632
Mp84:5163	3.7	1,031	2.3	1,948
Va35	4.1	1,630	2.6	2,410
Mp339	4.4	2,173	0.6	775
NC246	4.5	1,690	0.3	424
KY21	4.6	1,451	4.7	3,657
GA215	4.7	1,646	3.0	2,297
GA209	5.0	2,200	4.0	4,679
NC236	5.3	1,640	0.4	637
F6	5.8	1,267	0.3	361
Mo18W	5.8	2,472	4.4	4,208
F44	5.9	1,670	0.3	339
Ab24E	5.9	2,935	1.2	2,133
Tx601	6.2	3,723	5.1	5,512
SC229	6.3	2,710	1.5	1,459
T220	6.4	2,301	0.2	386
Mp83:5011	6.4	2,296	3.4	3,848
AR218	6.5	2,691	0.2	332
Mp83:5003	6.6	1,896	4.7	4,242
Mp83:5015	6.8	1,987	4.8	3,948
Mp702	6.8	2,704	0.7	1,136
T202	6.8	2,856	0.4	731
T212	6.8	4,153	2.3	5,424
Ky225	6.9	3,523	2.1	3,544
GT106	7.0	2,316	1.6	1,763
Mp305	7.1	2,368	4.1	3,908
Va31	7.2	2,491	1.8	2,288
Mp83:5025	7.3	2,520	7.5	5,807
SC213	7.5	3,032	0.2	412
AR234	7.6	3,103	2.3	3,478
Mp701	7.9	2,752	0.6	617
SC246	8.0	2,604	4.7	4,195
Ab28A	8.1	2,171	1.3	1,131
Mp313	8.2	2,064	0.2	182
GA203	8.2	2,264	2.7	2,644
Mp84:5173	8.3	4,432	7.5	8,069
Mp707	8.4	2,766	4.9	4,154
SC060	8.5	3,463	1.3	1,046
Mp705	8.6	2,740	4.5	5,086
Mp706	8.8	2,090	4.7	4,342
Mp84:5169	9.0	3,336	0.5	574
Mo17	9.6	5,807	3.8	4,859
Mp84:5183	11.1	3,044	2.9	2,342
Mp703	12.4	4,649	0.6	1,119
Mp496	13.6	4,569	1.2	1,248
T216	16.5	5,273	0.5	881
LSD ($P = 0.05$)	3.8	1,599	2.0	2,003

[a]RF (reproduction factor) = final egg number/initial egg number.

Inbreds also differed ($P = 0.05$) in their ability to support reproduction of the *M. arenaria* population (Table 1). Eighteen inbreds failed to maintain the nematode population at the initial population level. The lowest RF value was 0.2 for T220, AR218, SC213, and Mp313, and the highest RF value was 7.5 for Mp83:5025 and Mp84:5173. Number of eggs per gram of root ranged from 182 for Mp313 to 8,069 for Mp84:5173.

The two inbreds with the lowest reproduction by *M. incognita* were also poor hosts for *M. arenaria*. Mp307 and Mp412 had RF values of 0.4 and 0.8 for *M. arenaria*, respectively. However, inbreds with lowest RF values for *M. arenaria* showed no resistance to *M. incognita*. T220, AR218, SC213, and Mp313 had RF values of 6.4, 6.5, 7.5, and 8.2 for *M. incognita*, respectively. There was no relationship for resistance to the two species of nematodes. Resistance to *M. incognita* was not significantly correlated ($P = 0.05$) with resistance to *M. arenaria*.

Egg production is a more quantitative measure of resistance of maize for *Meloidogyne* spp. than root-gall ratings. Root-knot galls on maize inbreds are small, and some plants with low gall ratings may actually be good hosts (1). Conversely, plants with numerous galls caused by *Meloidogyne* spp. may support little or no reproduction (3). Egg production is also a more quantitative measure than egg-mass indexes. Although an egg-mass index indicates nematode reproduction, it does not quantify the number of eggs produced.

Oostenbrink's (11) RF provides a basic measurement of nematode reproductive capabilities and gives a good indication of the amount of resistance present in a plant. However, inbreds have less vigorous root systems than hybrids, which may lead to low RF values indicating resistance. Resistance can be verified by measuring number of eggs per gram of root.

Because of the pathogenic variability of *Meloidogyne* spp. on maize (1), the inbreds used in this study may react differently to other host races or geographical isolates. Resistant inbreds identified in this study should be evaluated for host suitability for additional root-knot nematode populations and other nematode species to determine the extent of the resistance.

Commercial maize hybrids currently available are not resistant to *M. incognita*, and only a few are resistant to

M. arenaria (12). The development of resistant maize genotypes would be useful in the management of these nematodes under various cropping systems. Mp307 and Mp313 were the most resistant entries based on host suitability (RF and eggs per gram of root) for *M. incognita* and *M. arenaria*, respectively. These inbreds may serve as resistant germ plasm for further breeding and selection for resistance to root-knot nematodes.

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