Supplement to Journal of Nematology 22(4S):651–653. 1990.

Reproduction of *Meloidogyne incognita* on Open-pollinated Maize Varieties[1]

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Abstract: Forty-three open-pollinated maize varieties were tested for resistance to the southern root-knot nematode, *Meloidogyne incognita* race 4, in greenhouse tests. An experiment repeated on five different planting dates assessed nematode reproduction 60 days after inoculation with 3,000 eggs per plant. Tebeau and Old Raccoon showed consistently high levels of resistance in all plantings, with the lowest reproduction factor (RF) values (0.2 and 0.4) and low numbers of eggs per gram of fresh root (222 and 955). Bill Dailey Variety and Sheppard Corn had the same level of resistance to *M. incognita* as the resistant hybrid, Mp307 × Mp707, but they were less consistent in different plantings. Levi Mallard, African Bushman, and Field's White Variety were the most susceptible varieties with RF values of 3.1–3.3 and 2,479–3,678 eggs per gram of fresh root.
Key words: corn, maize, *Meloidogyne incognita*, resistance, southern root-knot nematode, *Zea mays*.

Maize (*Zea mays* L.) has been used in crop rotation with tobacco, soybean, cotton, and other crops to reduce root-knot nematode populations which are potentially serious pests for tobacco, soybean, and cotton in some southern states (2,4,5). However, using maize in crop rotation systems to control root-knot nematodes is not always successful in reducing nematode populations (2,4). Many commercial maize hybrids are hosts for *Meloidogyne* spp. (1,6,8,10), which limits the effectiveness of crop rotation in managing root knot.

Maize hybrids and inbred lines have been evaluated for resistance to *Meloidogyne* spp. (6–10). Commercial hybrids and inbred lines with resistance to *M. arenaria* (Neal) Chitwood and *M. javanica* (Treub) Chitwood have been identified (8–10). Few inbred lines and no commercial hybrids with resistance to *M. incognita* (Kofoid & White) Chitwood have been identified (7–9). This investigation was conducted to determine the potential value of open-pollinated maize varieties as sources of resistance to *M. incognita.*

Received for publication 11 September 1989.
[1] Contribution of the Crop Science Research Laboratory, USDA ARS, in cooperation with the Mississippi Agricultural and Forestry Experiment Station. Published with the approval of both agencies as Paper No. J-7257 of the Mississippi Agricultural and Forestry Experiment Station. Use of trade names in this publication does not imply endorsement.
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The authors thank Paul Buckley and Gerald Matthews, Jr., for technical assistance.

MATERIALS AND METHODS

Forty-three open-pollinated varieties of maize collected by R. E. Gettys, Coker's Pedigreed Seed, Hartsville, South Carolina, were evaluated in the greenhouse for levels of resistance to *Meloidogyne incognita* race 4. A resistant hybrid, Mp307 × Mp707, and a susceptible hybrid, Ab24E × T216, were included in the tests as checks (7). A mixture of methyl bromide-treated sandy loam and river sand (80% sand, 14% silt, 6% clay) was added to inverted-pyramid-shaped cells of Todd planter flats (Model 300, Speedling, Sun City, Florida). Seeds of each variety were planted in separate cells and 7-day-old seedlings were thinned to one plant per cell. All plants were fertilized weekly with a 20:20:20 (N:P:K) fertilizer. The experiment was conducted five times with planting dates of 28 October, 4 November, 22 November, 14 December 1988; and 24 January 1989. Maize varieties were arranged in a randomized complete block design with 10 replications in each planting.

The nematode population was cultured on tomato (*Lycopersicon esculentum* Mill. cv. Floradel). Eggs were collected from tomato roots by the NaOCl method (3) and 7-day-old seedlings were inoculated with approximately 3,000 eggs by applying 1 ml water-egg suspension into the soil of each cell. Sixty days after inoculation, maize roots were cut from the plant, washed free from soil, blotted dry, and weighed. Roots were cut into 1-cm segments, and nema-

TABLE 1. Reproduction factor (RF) and number of eggs of *Meloidogyne incognita* race 4 per gram fresh root on open-pollinated maize varieties.

Open-pollinated varieties	RF	Eggs/g fresh root
Tebeau	0.2	222
Old Raccoon	0.4	955
Mp307 × Mp707†	0.8	592
Bill Dailey Variety	1.1	685
Sheppard Corn	1.3	976
Opossum Corn	1.3	1,733
Christmas Corn	1.4	969
Ruffin Yellow	1.5	1,077
Limber Cob #1	1.5	1,138
Honey Corn	1.6	1,113
G. H. McElveen	1.6	1,149
O. P. Variety–Rob Stanley	1.6	1,516
Johnny Begman–O. P. Variety	1.7	1,205
Watt's Special Yellow	1.7	1,239
Nesbitt Yellow	1.9	2,536
Indian Flint Graves	1.9	2,810
Long Eared White	2.0	1,404
Armstrong "A"	2.0	1,412
O. P. White Variety–F. W. Brittain	2.1	1,642
Tennessee Little Cob	2.1	1,642
Douthits Prolific	2.1	1,634
Earl Robert's Variety	2.2	1,409
O. P. White Variety–Bill Ansley	2.2	1,444
J. N. Price	2.2	1,568
Hastings White Prolific	2.2	1,600
Job Berry	2.2	1,764
Flint	2.2	2,209
Kyles Long Ear	2.3	1,482
White Variety Brittain	2.3	1,878
Dutch and Talbertson	2.3	2,200
Leco Milling Co.	2.4	1,666
Georgia Cow Corn	2.5	1,959
Mosby Yellow	2.6	1,574
Small Cob–Rex Wilson	2.6	1,584
J. M. Breland	2.6	1,639
Berry's Effingham Co.–GA	2.6	1,641
Hastings Yellow Prolific	2.6	1,839
Burris Corn	2.6	2,103
John Edwards	2.8	1,764
Merrit	2.8	2,176
John A. Griggs	2.9	1,773
Field's White Variety	3.1	2,479
African Bushman	3.2	3,678
Levi Mallard	3.3	2,550
Ab24E × T216‡	3.4	3,017
LSD ($P = 0.05$)	1.2	1,139

Data are means of five plantings.
† *M. incognita* resistant check.
‡ *M. incognita* susceptible check.

tode eggs were extracted in NaOCl (3) and counted.

The reproduction factor (RF) was calculated by dividing the number of eggs per root system by 3,000, and the number of eggs per gram fresh root weight was calculated by dividing the number of eggs by the root weight of each plant. An open-pollinated maize variety is a heterogeneous, heterozygous population, and characteristics of plants within that population may vary. Data from the five planting dates were combined for statistical analysis so that means obtained would best reflect the overall potential of the varieties as sources of breeding material.

RESULTS AND DISCUSSION

Both RF and number of eggs per gram fresh root differed by variety (Table 1), indicating a wide range of reaction to *M. incognita.* The nematode egg production was low in three plantings (4 November, 14 December, and 24 January), possibly because of inadequate temperature control in the greenhouse. However, variation in egg production was high among varieties in these plantings.

Production of eggs by *M. incognita* on roots of different maize varieties varied with the plantings, and the variety × planting date interaction was significant ($P \leq 0.05$) for both RF and eggs per gram root. Therefore, this interaction was used as the error term in making comparisons among means. The genetic heterogeneity of the open-pollinated varieties may have contributed to the variety × planting date interaction.

Tebeau and Old Raccoon exhibited the highest levels of resistance to *M. incognita* by supporting the lowest egg production in all plantings, except for Old Raccoon in the 22 November planting. Tebeau and Old Raccoon had mean RF values of 0.2 and 0.4, respectively, whereas all other open-pollinated varieties had mean RF values above 1.0. Mean numbers of nematode eggs produced per gram fresh root for Tebeau and Old Raccoon were 222 and 955, respectively. Old Raccoon, because of its poorly developed root system, supported a moderately high number of eggs per gram fresh root relative to the resistant hybrid check, Mp307 × Mp707, in the 22 November planting. The RF values and eggs per gram fresh root for Bill Dailey Variety, Sheppard Corn, and Christmas Corn, although higher, did not differ ($P \leq 0.05$) from those of Tebeau.

Most of the open-pollinated varieties tested were hosts to *M. incognita.* The highest RF value and the largest number of eggs per gram fresh root were found in African Bushman with an RF value of 8.8 and 9,629 eggs per gram fresh root in the 22 November planting. Combined analysis indicated that Levi Mallard, African Bushman, and Field's White Variety were the most susceptible varieties, with average RF values of 3.3, 3.2, and 3.1, respectively. Mean number of eggs per gram fresh root ranged from 2,479 to 3,678 on these varieties.

Development of maize genotypes with root-knot nematode resistance would be valuable in managing root-knot nematode populations in intensive cropping systems without the use of nematicides. Use of a root-knot nematode resistant maize hybrid would reduce nematode reproduction, thus limiting damage on the following crop, such as soybean, cotton, or tobacco. However, currently available commercial maize hybrids are not resistant to *M. incognita* (8) and only a few inbreds with resistance to *M. incognita* have been identified (6). The resistant open-pollinated varieties would be useful sources of resistance in the development of inbred lines or populations. Because maize is a host for all *M. incognita* races and for many other *Meloidogyne* species, the resistant open-pollinated varieties selected in this study, such as Tebeau and Old Raccoon should be evaluated further for resistance to other *Meloidogyne* species and races to determine the extent of resistance.

Since this investigation was conducted under greenhouse conditions, the response of the varieties under field conditions is not known. Before initiating a long-term program to select for improved nematode resistance, researchers would be well advised to confirm these findings by field testing those varieties that did not differ ($P \leq 0.05$) from the resistant hybrid check. Also, other attributes of the varieties should be considered in making the final determination as to which should be chosen for further improvement.

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