Wheat and Grain Sorghum Varietal Reaction to *Meloidogyne incognita* and *Rotylenchulus reniformis*

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ABSTRACT

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Wheat varieties Arthur 71, Coker 747, Coker 6815, Delta Queen, Double Crop, Florida 301, McNair 1813, McNair 1003, and Southern Belle were resistant to the root-knot nematode, *Meloidogyne incognita*. Sorghum varieties Funk G 421, Funk G 499 BR, Funk G 516 BR, Funk G 522 A, Funk G 522 BR, Funk G 550, Funk G 611, Funk G 623, and DeKalb D 55 were susceptible to *M. incognita*. All wheat and sorghum varieties tested were nonhosts of the reniform nematode, *Rotylenchulus reniformis*.

Wheat (*Triticum aestivum* L.) acreage is increasing in the southeastern and Gulf states, USA, where it is used as a double crop with soybeans and in corn, cotton, and sugarcane rotations. Grain sorghum (*Sorghum vulgare* var. *drummondii* Hitchc.) is planted in harvested wheat stubble and in corn, cotton, and soybean rotations. More information is needed on the population buildup of root-knot and reniform nematodes on wheat and grain sorghum varieties because production of these varieties and successive crops would be affected. The importance of nematode pathogens of wheat and grain sorghum remains largely unknown because wheat is grown mostly in winter and spring in midwestern and plains areas where soil temperatures are cooler and nematodes relatively inactive. However, wheat and grain sorghum are known to host several nematodes in all climates. The root-knot nematodes *Meloidogyne naasi* Franklin and *M. incognita* (Kofoid & White) Chitwood are parasitic on wheat (2,4). Anzalone and Birchfield (1) found eight wheat varieties grown in the southern United States that were resistant to *M. incognita*. Nothing is known about the resistance of wheat and grain sorghum to the reniform nematode, *Rotylenchulus reniformis* Linford & Oliveira, in the southern United States, where it causes losses to soybean and cotton following grain crops. Therefore, we tested nine wheat and eight sorghum cultivars for resistance to *M. incognita* and *R. reniformis,* which influence production of subsequent crops.

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MATERIALS AND METHODS

Wheat tests. Wheat varieties Arthur 71, Coker 747, Coker 6815, Delta Queen, Double Crop, Florida 301, McNair 1813, McNair 1003, and Southern Belle were exposed to *M. incognita* and *R. reniformis* to determine resistance. Wheat varieties were grown in soil infested with root-knot and reniform nematodes in the greenhouse and contained in 250-cm^3 peat moss pots embedded in 25.4-cm clay pots containing steam-sterilized soil. Four replicates of the wheat varieties were planted exposed in 250 cm^3 of soil containing 500 larvae of *M. incognita* and a mixture of 5,000 larvae, males, and females of *R. reniformis*. Plants were arranged in a complete randomized block experimental design on benches in the greenhouse and a second block outside the greenhouse exposed to natural weather. Susceptible tomato Floralou and soybean Davis 68 were exposed to the root-knot larvae and reniform nematode mixture and were grown and assayed the same way as the wheat varieties to test the viability of the nematodes. They were allowed to grow about 90 days in the first test and 150 days in the seond test outside.

The plants were removed and observed for galls and egg masses. Roots were indexed according to a modified Horsfall-Barrett (3) system with five rating groups: 0 = no galls or egg masses, 1 = 1–25% of roots galled, 2 = 26–50% of roots galled, 3 = 51–75% of roots galled, and 4 = 76–100% of roots galled. Soil nematode counts were made from the 250-cm^3 soil sample at the end of the tests. Roots of plants tested with reniform nematode were observed for males and egg masses, and soil counts were made from the 250-cm^3 soil sample. A modified Seinhorst sieving technique (5) was used to separate the nematodes from soil and debris. Three 325-mesh sieves in series were used to separate the nematodes from the soil, and a fourth 325-mesh sieve mounted on a plastic ring with filter paper inside was used to remove the debris and excess water and to concentrate the nematodes. The fourth 325-mesh sieve with the nematodes was deposited in the top of a 90-mm petri dish half-filled with water and allowed to stand 24 hr. The samples were standardized to 100 cm^3 of water. Nematodes were counted in a 10-cm^3 aliquot of water by aid of a stereoscopic microscope, and the nematode population per 250 cm^3 of soil was estimated.

Sorghum tests. Sorghum varieties Funk G 421, Funk G 499 BR, Funk G 516 BR, Funk G 522 A, Funk G 522 BR, Funk G 550, Funk G 611, Funk G 623, and DeKalb D 55 were tested with *M. incognita* and *R. reniformis* isolated from cotton. Test plants were grown in 250-cm^3 plastic cups containing about 500 larvae of *M. incognita* and a mixture of 5,000 larvae, males, and females of *R. reniformis*. Plants were arranged in a complete randomized block design with four replicates on benches in the greenhouse. Susceptible tomato Floralou and soybean Davis 68 exposed to the *M. incognita* and *R. reniformis* mixture were grown and assayed the same as the grain sorghum varieties to test the viability of the nematodes. The first sorghum experiment was allowed to grow 72 days and the second 49 days, with greenhouse temperature controlled by an air conditioner. Temperature was maintained at 28 C (±1 C) and humidity at 65%. Plants were grown under artificial influorescent Gro-lux lights placed 18 in. above the plants on the greenhouse bench. The experiment was repeated once. Roots were observed for gall formation after 72 days in the first and 49 days in the second experiment. The nematode population was determined from the 250-cm^3 soil sample. A root indexing system using five classes was used whereby 1 = 0–20%, 2 = 21–40%, 3 = 41–60%, 4 = 61–80%, and 5 = 81–100% of roots galled. Roots were examined for *R. reniformis* female infection and egg masses. Soil nematode counts were made from the 250-cm^3 soil sample to determine buildup or decline of the nematode population.

RESULTS AND DISCUSSION

Wheat tests. All wheat varieties tested were resistant to *M. incognita*. Root gall

Table 1. Wheat varietal reaction to *Meloidogyne incognita* and *Rotylenchulus reniformis*[x]

Varieties	*M. incognita* Gall index[y] Test 1	*M. incognita* Gall index[y] Test 2	*M. incognita* Larvae (per 250 cm³ of soil) Test 2	*R. reniformis* soil counts (per 250 cm³)
Tomato Floralou	4.0 a[z]	4.0	1,800	6,550 a[z]
Arthur 71	0.0 b	0.5	0	2,720 b
Coker 747	0.5 b	0.8	35	2,380 bc
Coker 5815	0.0 b	0.3	0	2,880 b
Delta Queen	0.5 b	0.8	0	1,705 bc
Double Crop	···	0.3	0	3,100 b
Florida 301	···	0.3	0	655 bc
McNair 1003	0.5 b	1.0	0	5.0 c
McNair 1813	0.1 b	0.0	4	2,085 bc
Southern Belle	0.5 b	1.0	0	1,065 c

[x]Averages of four replicates.
[y]0 = No galls or egg masses, 1 = 1–25%, 2 = 26–50%, 3 = 51–75%, and 4 = 76–100% of roots galled.
[z]An uncommon letter denotes significance at the 5% level of probability according to Duncan's multiple range test.

Table 2. Sorghum reaction to *Meloidogyne incognita* and *Rotylenchulus reniformis*[w]

Varieties	*M. incognita* Gall index[x] Test 1	*M. incognita* Larvae (per 250 cm³ of soil) Test 1	*M. incognita* Larvae (per 250 cm³ of soil) Test 2	*R. reniformis* Larvae (per 250 cm³ of soil)[z] Test 1	*R. reniformis* Larvae (per 250 cm³ of soil)[z] Test 2
Tomato Floralou	5.0 c[y]	2,835 b	···	2,000 b	···
Soybean Davis 68	···	···	1,440 ab	···	1,380 b
Funk G 421	4.0 b	920 ab	1,210 ab	440 a	1,520 b
Funk G 499 BR	2.0 a	600 ab	1,600 ab	170 a	145 a
Funk G 516 BR	5.0 c	2,000 ab	2,650 b	280 a	880 a
Funk G 522 A	5.0 c	1,200 ab	770 ab	320 a	600 a
Funk G 522 BR	5.0 c	1,415 ab	920 a	200 a	920 a
Funk G 550	5.0 c	1,415 ab	1,700 ab	170 a	800 a
Funk G 611	5.0 c	345 a	···	170 a	···
Funk G 623	5.0 c	1,640 ab	320 a	290 a	1,230 b
DeKalb D 55	5.0 c	250 a	···	920 a	···

[w]Averages of four replicates.
[x]1 = 0–20%, 2 = 21–40%, 3 = 41–60%, 4 = 61–80%, and 5 = 81–100% of roots galled.
[y]An uncommon letter denotes significance at the 1% level of probability according to Duncan's multiple range test.
[z]No egg masses and reduced soil counts indicated a nonhost reaction.

indices ranged from 0.0 to 1.0. Few if any larvae used as inoculum were recovered from soil grown to Coker 747 and McNair 1813 varieties (Table 1). The few galls observed on the wheat varieties were small and free of egg masses. The Floralou tomato and Davis 68 soybean checks had numerous galls and showed an increase in *M. incognita* in the soil where the plants were tested.

Wheat varieties tested were nonhosts to *R. reniformis*; the roots contained no infective females and egg masses. The *R. reniformis* population declined from the original 5,000/250 cm³ of soil to 3,000 or fewer among the wheat varieties tested. The population decline was significantly greater in Florida 301 and McNair 1003 varieties (Table 1). Numerous egg masses were observed in the Floralou tomato and Davis 68 soybean checks. An increase in the soil population from the root area of the check plants was noted (Tables 1 and 2).

Sorghum tests. All sorghum varieties tested were highly susceptible to *M. incognita* except Funk G 499 BR, which was moderately resistant. The larvae increased in the root area of all varieties except Funk G 611 and DeKalb D 55. Although the gall and egg mass index was high in these two varieties, the poor root development in root-knot infested soil may have suppressed nematode reproduction of Funk G 611 and DeKalb D 55 varieties (Table 2).

All sorghum varieties tested were nonhost plants to *R. reniformis*, and no infective females and egg masses were observed on the roots. Numerous reniform nematode females and egg masses were observed on tomato Floralou and soybean Davis 68. The nematode population from the soil around tomato was significantly greater than from around sorghum at the end of the experiment.

Wheat varieties tested should reduce *M. incognita* and *R. reniformis* for other crops that follow in sequence. The reason why nematode populations decreased more under some wheat varieties than under others is not thoroughly understood. Grain sorghum varieties, with the exception of Funk G 499 BR, probably maintain or increase *M. incognita* but reduce *R. reniformis* for subsequent crops.

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