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Host Suitability of Grain Sorghum Cultivars to *Meloidogyne* spp.[1]

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Abstract: Grain sorghum cultivars (Funk G-499GBR, Funk G-611, Funk G-522A, Funk G-522DR, Coker 7723, Coker 7675, Coker 7623, Pioneer B815, Pioneer 8222, Pioneer 8272) were evaluated in the greenhouse for resistance to populations of *Meloidogyne incognita* race 3, *M. arenaria* race 2, and *M. javanica* from South Carolina, and *M. arenaria* race 1 from Georgia. All the sorghum cultivars were poor hosts or nonhosts of *Meloidogyne* spp. with fewer than 1 or 2 egg masses per root system in all cultivar × nematode combinations. Sorghum (Coker 7723) planted in a field infested with *M. incognita* race 3 and *M. arenaria* race 2 was not galled; however, galling and egg masses were observed on tobacco (Coker 319). Populations of second-stage juveniles at harvest were 2,865 and 72/500 cm^3 soil for the tobacco and sorghum plots, respectively. Sorghum was a poor host of *Meloidogyne* spp. and may be useful as a rotation crop to reduce populations of root-knot nematodes.

Key words: host suitability, *Meloidogyne arenaria, M. incognita, M. javanica,* root-knot nematode, sorghum, *Sorghum bicolor.*

Meloidogyne spp. are commonly associated with field crops in the southeastern United States (9). *Meloidogyne incognita* (Kofoid and White) Chitwood is the predominant species of *Meloidogyne* in South Carolina, although crop losses due to other species have increased in recent years (7). The incidence of *M. arenaria* (Neal) Chitwood and *M. javanica* (Treub) Chitwood in South Carolina has increased dramatically during the past decade; this complicates traditional rotation schemes because *Meloidogyne* host status varies with crop species (7,9).

The suitability of sorghum (*Sorghum bicolor* (L.) Moench) as a host of *Meloidogyne* spp. has been addressed by several authors (3,11,13,14). Grain sorghum suppressed the juvenile populations of *M. arenaria* race 1 in field soil to 8–10% that of peanut (11). In Louisiana 9 of 10 sorghum cultivars were highly susceptible to *M. incognita* and one was moderately resistant (3). Others showed sorghum was a poor host for *M. incognita,* although some reproduction occurred (10). Variation in the host suitability of other graminaceous crops to populations of *Meloidogyne* spp. suggests that the reaction of sorghum to populations of *Meloidogyne* spp. may vary by location (1). We examined the host reaction of grain sorghum to isolates of *Meloidogyne* spp. found in South Carolina and Georgia.

Materials and Methods

Greenhouse study: Ten grain sorghum cultivars were evaluated in the greenhouse for host suitability to *Meloidogyne arenaria* race 2, *M. incognita* race 3, and *M. javanica,* isolated from tobacco in the Pee Dee region of South Carolina, and *M. arenaria* race 1 isolated from peanut in Georgia. *Meloidogyne* spp. were cultured on tomato (*Lycopersicon esculentum* Mill. cv. Rutgers) for 55–60 days in a greenhouse at 25 ± 5 C. Species confirmation and race identification were based on differential host plants, perineal patterns, and second-stage juvenile (J2) morphometrics (12). Inoculum was prepared by extracting eggs from 60-day-old tomato roots (8).

Ten sorghum cultivars (Funk G499GBR, Funk G611, Funk G522A, Funk G522DR, Coker 7723, Coker 7675, Coker 7623, Pioneer B815, Pioneer 8222, Pioneer 8272) were evaluated for host suitability to *Meloidogyne* spp. and compared to the susceptible host, Rutgers tomato. A heat-pasteurized mixture of Norfolk sandy loam soil : peat : sand (2:2:1 v:v), pH 6.0, was added to 15-cm-d plastic pots. Three seeds of each sorghum cultivar were sown in sep-

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TABLE 1. Egg mass index of *Meloidogyne* spp. on grain sorghum cultivars in the greenhouse.

Cultivar	*M. incognita* Race 3	*M. arenaria* Race 2	*M. arenaria* Race 1	*M. javanica*
Funk G499GBR	0.3	0.1	0.0	0.1
Funk G611	0.3	0.3	0.3	0.1
Funk G522A	0.1	0.3	0.0	0.1
Funk G522DR	0.0	0.4	0.0	0.1
Coker 7723	0.4	0.4	0.0	0.0
Coker 7675	0.3	0.1	0.0	0.0
Coker 7623	0.0	0.1	0.0	0.0
Pioneer B815	0.0	0.0	0.0	0.0
Pioneer 8222	0.3	0.3	0.1	0.0
Pioneer 8272	0.3	0.4	0.1	0.0
Tomato (Rutgers)	4.9	4.9	5.0	4.9

Egg mass index: 0 = no egg masses, 1 = 1–2, 2 = 3–10, 3 = 11–30, 4 = 31–100, and 5 = > 100 egg masses.
All data are the mean of two trials of four replicates each.

arate pots for each treatment. Upon emergence, sorghum seedlings were thinned to two plants per pot. One Rutgers tomato seedling, pregerminated in vermiculite, was added in separate pots to each treatment. All plants were fertilized with a 20:20:20 (N:P:K) fertilizer every 14 days to assure good plant growth.

When the average height of the sorghum and tomato seedlings was 12 cm, each pot received a water suspension containing 5,000 nematode eggs of the appropriate species. Two 2.5-ml aliquots of egg suspension were placed in separate 5-cm-deep holes in the soil and the holes were covered with soil. Control plants received a similar volume of water without eggs using a leachate from uninfected tomato roots. The pots were arranged in a split-plot design with nematodes as main blocks and cultivars as subplots. Treatments were replicated four times and the experiment was repeated once.

Inoculated plants were maintained at 25 ± 5 C for 60 days and evaluated for nematode development. Each root system, washed free of soil, was stained in Phloxine B (150 mg/liter) for 15 minutes and rinsed in tap water to enhance egg mass visibility (5). Roots were rated for galling on a 0–10 scale where 0 = no galling and 10 = 100% of the root tissue galled (2). Egg mass production was rated according to the following scale: 0 = no egg masses, 1 = 1–2, 2 = 3–10, 3 = 11–30, 4 = 31–100, and 5 = > 100 egg masses (12).

Field study: The host suitability of grain sorghum to *M. arenaria* race 2 and *M. incognita* race 3 was evaluated under field conditions in a Norfolk sandy loam soil (pH 5.9, 75% sand, 17% silt, 8% clay, 0.8% organic matter). In 1983, field plots were fumigated with ethylene dibromide (EDB, 90% EC) applied with a gravity flow-meter and injected 15 cm deep with a single chisel per row at 14 liters/ha (222 g a.i./100 m). The fumigant was placed in the center of a 60-cm-wide bed. Bedding discs were used to seal the chisel opening and form a 36-cm-high bed with fumigant placement 40 cm from the top of the bed. Three weeks after fumigation, tobacco (Coker 319) seedling roots were infested with a 50/50 mixture of *M. arenaria* race 2 and *M. incognita* race 3 (500 eggs/nematode species) and transplanted into the test plots (6). At the end of the growing season the tobacco roots were infected with both nematode species as confirmed by perineal patterns and J2 morphometrics (12). Sorghum (Coker 7723) was planted in the infested plots on 17 May 1984 and 15 May 1986 and tobacco (Coker 319) on 7 May 1984 and 2 May 1986. Tobacco was grown in 1985 to increase nematode populations in all plots. Plots consisted of four rows (each 1.2 m wide × 10.6 m long). Plots were arranged in a randomized complete block design. Treatments were replicated four times.

Roots were stained in Phloxine B and rated for root galling and egg masses on 20 September 1984 and 22 September 1986. A 10-g composite sample of roots, collected from 10 plants/plot, was incubated in a $ZnSO_4$ solution (10 mg/liter) for 4 days, and J2 were collected on a 25-μm-pore sieve (4). A soil sample composite of 20 cores (2 cm × 20 cm deep) was removed from the center two rows of each plot at planting and on 15 August both years. A 500-g soil aliquant from each sample was processed by semiautomatic elutriation and centrifugal-flotation (2). Nematode data

TABLE 2. Population density of *Meloidogyne incognita* race 3 and *M. arenaria* race 2 on grain sorghum (Coker 7723) and tobacco (Coker 319) grown in field plots in 1984 and 1986.

	J2/g dry root	Pi	Pf
	1984		
Tobacco	1,635	210	3,670
Sorghum	2**	200	50**
	1986		
Tobacco	468	405	2,065
Sorghum	16**	60*	95*

All data are the means of four replicates.

J2 = second stage juveniles. Pi and Pf = initial and final population densities of *Meloidogyne* spp. extracted from 500 cm^3 of rhizosphere soil.

Mean significantly different from susceptible tobacco control; * $P = 0.05$, ** $P = 0.01$. Analysis performed on $\log_{10}$ (X + 1) transformed data where X = the nematode count.

Tobacco was planted in all plots during 1985 to increase nematode population density.

were transformed to $\log_{10}$ (X + 1), where X is the nematode count.

Results and Discussion

Nine sorghum cultivars tested in the greenhouse were poor hosts and Pioneer B815 was a nonhost of *Meloidogyne* spp. (Table 1). Roots of Rutgers tomato plants were heavily galled by all *Meloidogyne* spp. and contained large numbers of egg masses. *Meloidogyne incognita* and *M. arenaria,* the two most common *Meloidogyne* spp. in South Carolina, produced at least one egg mass on 8 of the 10 cultivars tested. Birchfield (3) found 8 of 9 sorghum cultivars, several common to our test, to be good hosts of a Louisiana isolate of *M. incognita.* The different reaction of sorghum to *M. incognita* in our trial and the variability in parasitism of *Meloidogyne* spp. populations to other graminaceous crops suggest the reaction of sorghum to *Meloidogyne* spp. may vary by geographical population (1) or host race of the nematode. Consequently the usefulness of sorghum as a rotation crop will depend on location.

Sorghum (Coker 7723) contained fewer J2 per gram of dry root than did tobacco (Coker 319) ($P = 0.01$) (Table 2). Final populations of *Meloidogyne* spp. in rhizosphere soil following sorghum were suppressed to 1.4% (1984) and 4.6% (1986) of tobacco. Despite a susceptible host being planted during 1985, the initial population densities in plots previously planted to sorghum were still depressed in 1986 (Table 2). This residual effect of nonhost or poor-host sorghum could be utilized in root-knot nematode management programs.

Planting sorghum in an infested field plot resulted in minimal reproduction with a substantial reduction in the final population density at harvest and no galling or egg masses were observed on the roots of field-grown sorghum. Sorghum suppressed *M. arenaria* race 2 and *M. incognita* race 3 under field conditions in our trials. Sorghum could be an important crop for rotation on soils in South Carolina where root-knot nematode is a problem.

Literature Cited

1. Baldwin, J. G., and K. R. Barker. 1970. Host suitability of selected hybrids, varieties and inbreds of corn to populations of *Meloidogyne* spp. Journal of Nematology 2:345–350.

2. Barker, K. R., J. L. Townshend, G. W. Bird, I. J. Thomason, and D. W. Dickson. 1986. Determining nematode population responses to control agents. Pp. 283–296 *in* K. D. Hickey, ed. Methods for evaluating pesticides for control of plant pathogens. St. Paul, MN: American Phytopathological Society Press.

3. Birchfield, W. 1983. Wheat and grain sorghum varietal reaction to *Meloidogyne incognita* and *Rotylenchulus reniformis.* Plant Disease 67:41–42.

4. Bird, G. W. 1971. Influence of incubation solution on the rate of recovery of *Pratylenchus brachyurus* from cotton roots. Journal of Nematology 3: 378–385.

5. Dickson, D. W., and F. B. Struble. 1965. A sieving-staining technique for extraction of egg masses of *Meloidogyne incognita* from soil. Phytopathology 55: 497 (Abstr.).

6. Fortnum, B. A., R. E. Currin III, and J. P. Krausz. 1987. Water absorbent polymer aids in the infestation of field sites with *Meloidogyne* eggs. Journal of Nematology 19:135–137.

7. Fortnum, B. A., and J. P. Krausz. 1984. Increasing incidence of *Meloidogyne arenaria* on flue-cured tobacco in South Carolina. Plant Disease 68:244–245.

8. 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 57:1025–1028.

9. Johnson, A. W. 1982. Managing nematode populations in crop production. Pp. 193–203 *in* R. D. Riggs, ed. Nematology in the southern region of the United States. Southern Cooperative Series Bulletin 276, Arkansas Agricultural Experiment Station, Fayetteville.

10. Orr, C. C., and E. D. Morey. 1978. Anatomical response of grain sorghum roots to *Meloidogyne incognita acrita*. Journal of Nematology 10:48–53.

11. Rodríguez-Kábana, R., and J. T. Touchton. 1984. Corn and sorghum as rotational crops for management of *Meloidogyne arenaria* in peanut. Nematropica 14:26–36.

12. Taylor, A. L., and J. N. Sasser. 1978. Biology, identification and control of root-knot nematodes (*Meloidogyne* species). North Carolina State University and the U.S. Agency for International Development, Raleigh, North Carolina.

13. Thames, W. H., and B. C. Langley. 1967. Effects of sorghum rotations on yields of Spanish peanuts from plots infested with *Meloidogyne arenaria*. Phytopathology 57:464 (Abstr.).

14. Thomas, S. H., and L. Murray. 1987. Yield reductions in grain sorghum associated with injury by *Meloidogyne incognita* race 3. Journal of Nematology 19:559.