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Field Evaluation of Selected Soybean Cultivars for Resistance to Two Races of *Meloidogyne arenaria*[1]

S. R. KOENNING AND K. R. BARKER[2]

Abstract: The soybean cultivars 'Braxton' and 'Kirby' were less susceptible to both races 1 and 2 of *Meloidogyne arenaria* than 'Centennial' and 'Young', which were highly susceptible. Soybean seed yields of resistant cultivars were greater ($P = 0.05$) than susceptible cultivars. Reproduction of *M. arenaria* races 1 and 2 was significantly lower on less susceptible cultivars compared to highly susceptible cultivars. Root galling, caused by *M. arenaria*, was 5–10 times greater on Centennial and Young than on less susceptible cultivars Kirby and Braxton. Resistance was independent of the host race of *M. arenaria* used in this study. Populations of *M. arenaria* that are highly pathogenic to soybean should be used in screening for soybean resistance rather than specific host races.

Key words: Glycine max, Meloidogyne arenaria, nematode, resistance, root-knot nematode, soybean.

Soybean (*Glycine max* L. Merr.) cultivars with partial resistance to *Meloidogyne arenaria* (Neal) Chitwood have been developed and evaluated against a number of populations of this pathogen, as well as against other nematode species (4,5,8,10, 11). Most information about soybean resistance to *M. arenaria* pertains to either race 1 or race 2, but rarely to both races. Similarly, much of the literature on *M. arenaria* is related to reproduction and galling indices, but not crop yield. Research in Florida has shown that although virtually all cultivars are susceptible to *M. arenaria,* some such as 'Kirby' and 'Braxton' are significantly less susceptible, with lower gall indices and higher yields in the presence of this pest than more susceptible cultivars (10,11).

The increasing incidence of *M. arenaria* in North Carolina (13) is probably the result of increased reliance on *M. incognita*-resistant tobacco cultivars and the recent increase of *M. arenaria* race 1 in North Carolina on peanut (12). The reaction of soybean cultivars to North Carolina populations of *M. arenaria* warrants evaluation, as soybean is often grown in rotation with other *M. arenaria*-susceptible crops. The objectives of this research were to evaluate the reproductive potential of races 1 and 2 of *M. arenaria* on selected soybean cultivars and their effects on yield in field plots.

MATERIALS AND METHODS

The experiment was conducted at the Central Crops Research Station near Clayton, North Carolina in 1991. The soil was a Fuquay sand (93% sand, 4% silt, 3% clay; pH 5.8). Individual plots were inoculated in 1989 with either race 1 or race 2 of *M. arenaria. Meloidogyne arenaria* race 1 was isolated from a peanut field in Martin County, North Carolina, and reared in the greenhouse on tomato (*Lycopersicon esculentum* Mill.) cv. Tropic. Race 1 *M. arenaria* usually reproduces very little on *Meloidogyne incognita*-resistant tobacco (1). Race 2 of *M. arenaria* was isolated from *Meloidogyne incognita*-resistant tobacco (*Nicotiana tabacum* L.) grown in Cumberland County, North Carolina, and maintained on *M. incognita*-resistant tobacco cv. Speight G-70. Eggs of the two species were extracted from tomato or tobacco roots by the NaOCl method (7). Tobacco transplants were dipped in a suspension of Terrasorb (6) containing eggs of the desired *M. arenaria* race. Tobacco plants resistant (McNair 373) to the population of race 1 *M. arenaria* were used for race 2, whereas susceptible tobacco (Coker 371) plants were

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[2] Research Analyst/Extension Specialist and Professor, respectively, Plant Pathology Department, North Carolina State University, Raleigh, NC 27695-7616.

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used for race 1. Plants with the selected nematode races were transplanted into plots arranged in four randomized complete blocks. Plots were 4 rows wide, 9.14 m long, with 3-m alleys in 1989. The susceptible and resistant cultivars of tobacco also were grown in 1990 to maintain and increase populations of the respective races of *M. arenaria.*

Soybeans were planted in mid-May 1991 into appropriate plots at the rate of 30 seeds/m of row. Additional border rows were incorporated into the design to accommodate the change from tobacco row spacing (1.1 m) to soybean row spacing (0.97 m). The experiment was a 4 × 2 factorial with four cultivars (Kirby, Braxton, Centennial, and Young) and two populations of *M. arenaria* (races 1 and 2) arranged in a randomized complete block.

Preplant nematode samples were collected from the center two rows of each four-row plot. Midseason and harvest nematode samples as well as soybean yield were taken from each row within the plot. Soil samples for nematode assay consisted of 8 to 10 2.5-cm-d cores taken to a depth of 15–20 cm. Nematode samples were processed by elutriation (3) and centrifugation (9), and eggs were extracted from soybean roots (2). Gall ratings (0 to 100% of root systems galled) were averaged for three plants from each row. Statistical analysis consisted of analysis of variance (ANOVA) with four observations per plot with four replications. Fisher's LSD was used for mean separation. Nematode data were transformed ($\log_{10}[X + 1]$) prior to ANOVA, but arithmetic means are presented for clarity.

Results and Discussion

Midseason (Pm) and final (harvest) population densities (Pf) of *M. arenaria* eggs and juveniles were much greater ($P = 0.05$) on cultivars Young and Centennial than on Kirby and Braxton (Table 1). The race by cultivar interaction was significant ($P = 0.05$) at midseason, but not at the end of the season (Table 1). Midseason levels of *M. arenaria* race 2 were higher on Young than Centennial. The latter cultivar is resistant to *M. incognita.* Gall ratings for Centennial and Young were approximately 8-fold greater than those for Braxton and Kirby (Table 2). Race of *M. arenaria* had little influence on level of root galling (Table 2). Yields of Braxton and Kirby were 10 to 20% higher than Centennial and Young (Table 2).

Our data concur with other work on levels of susceptibility in these soybean cultivars to *M. arenaria* (8,10,11). In the current research, galling on Braxton and Kirby was less severe than that observed in field research in Florida (10,11). This difference may be the result of the populations used, infestation levels, or a result of differences in environment between North Carolina and Florida. Because tobacco was the previous crop in our work, lower initial population densities might result as residual root systems are generally destroyed in late September, inhibiting further population buildup. Apparently, the race of *M.*

TABLE 1. Midseason (Pm) and final (Pf) population densities of *Meloidogyne arenaria* eggs and second-stage juveniles/500 cm³ soil on four soybean cultivars, Clayton, North Carolina, 1991.

Cultivar	Pm† Race 1	Pm† Race 2	Pf‡ Race 1	Pf‡ Race 2
Braxton	680 ± 600	640 ± 640	400 ± 400	290 ± 410
Kirby	660 ± 610	700 ± 440	340 ± 650	340 ± 580
Young	3,480 ± 3,230	3,680 ± 3,240	1,440 ± 1,260	1,790 ± 760
Centennial	4,780 ± 4,230	2,010 ± 1,570	1,880 ± 1,210	1,240 ± 860

Data are means ± standard deviation of four replications, with four observations per replication.

† Cultivars differ ($P = 0.0001$), and the race by cultivar interaction is significant ($P = 0.015$); LSD ($P = 0.05$) for cultivar within race = 1,290.

‡ Cultivars are significantly different ($P = 0.0001$); LSD ($P = 0.05$) for cultivar within race = 1,090.

TABLE 2. Influence of soybean cultivar and race of *Meloidogyne arenaria* on soybean yield (kg/ha), and percentage galling of root systems of four soybean cultivars, Clayton, North Carolina, 1991.

	Yield†			Root galling (1–100%)‡		
Cultivar	Race 1	Race 2	Mean of races 1 & 2	Race 1	Race 2	Mean of races 1 & 2
Braxton	2,420 ± 659	2,803 ± 565	2,590 ± 645	5 ± 8	4 ± 4	4 ± 7
Kirby	2,426 ± 635	2,816 ± 520	2,590 ± 610	3 ± 3	1 ± 1	2 ± 3
Young	2,185 ± 838	1,949 ± 975	2,070 ± 903	51 ± 28	56 ± 22	54 ± 25
Centennial	2,118 ± 1,126	2,312 ± 887	2,220 ± 1,004	63 ± 25	50 ± 22	56 ± 24

Data are means ± standard deviation of four replications, with four observations per replication.

† Cultivars differ significantly (P = 0.0095), race by cultivar interaction is not significant; LSD (P = 0.05) for cultivar mean = 250.

‡ Cultivars differ significantly (P = 0.0001), race by cultivar interaction is not significant; LSD (P = 0.05) for cultivar mean = 7.4.

arenaria need not be considered when choosing soybean cultivars, because the race × cultivar interaction was not significant with regard to galling or soybean yield. The aggressiveness of populations is more important because research has shown that *M. arenaria* populations differ in their ability to damage soybean (4,5). Variation in aggressiveness among populations of *M. arenaria* (4,5) makes control recommendations difficult. Nevertheless, the lower reproductive rates of *M. arenaria* on some cultivars provides a valuable tactic for managing this pest. Yields of Kirby and Braxton in an *M. arenaria*-infested field were acceptable under North Carolina conditions. Therefore, cultivars Kirby and Braxton could be used in North Carolina in rotation with other susceptible crops as an adjunct to other nematode management tactics. Because these cultivars allow some, though limited, reproduction of *M. arenaria,* other tactics such as nematicides and (or) resistant cultivars might be used in addition to rotation with these cultivars in order to obtain acceptable yields of high-value susceptible crops. Very susceptible crops might still require a nematicide treatment, whereas crops more tolerant to *M. arenaria* may require no treatment following soybean cultivars Kirby or Braxton.

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