RESEARCH NOTES

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Soybean Response to Two Isolates of *Meloidogyne arenaria*[1]

E. E. Hiatt III, E. R. Shipe, and S. A. Lewis[2]

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Meloidogyne arenaria (Neal) Chitwood and *M. incognita* (Kofoid and White) Chitwood, prevalent in the sandy soils of the southeastern United States, can severely limit soybean, *Glycine max* (L.) Merr., yield (10,12). *Meloidogyne arenaria* populations have increased in some southeastern states in recent years, apparently due to increased plantings of the soybean cultivar 'Centennial', which is resistant to *M. incognita* but susceptible to *M. arenaria* (5). The planting of *M. incognita*-resistant tobacco cultivars has also caused an increase in *M. arenaria* populations in South Carolina (2). Also, removal of the fumigant nematicides DBCP and EDB, which were more effective than other nematicides against *M. arenaria* (1), may have resulted in increasing *M. arenaria* populations.

Meloidogyne arenaria is more damaging to soybeans than *M. incognita* because of the reproductive capabilities of the nematodes (7,10). Physiological races within a *Meloidogyne* sp. may complicate breeding of resistant cultivars. Because some evidence exists for differences in nematode virulence and soybean resistance at different locations (Lewis, unpubl.), greenhouse experiments were designed to determine differences between two *M. arenaria* isolates and five cultivars for nematode reproduction and galling response.

The number of galls produced by a host race 1 (11) and a host race 2 isolate of *M. arenaria* were compared on three resistant (4) ('Gordon', 'Kirby', and 'Braxton') and two susceptible (3) (Centennial and 'Gasoy 17') soybean cultivars. The Govan, South Carolina (race 2) and Florida (race 1) isolates were collected from soybean and peanut, respectively, and maintained on tomato (*Lycopersicon esculentum* Mill. cv. Rutgers).

Riverview sandy loam soil (75% sand, 18% silt, 7% clay) was mixed equally with river bottom sand, pasteurized, and aerated for 8 days. Six seeds were planted in soil in each 15-cm-d pot, and seedlings were thinned to one plant per pot 13 days later. At day 14 (first trifoliolate leaf stage), plants were inoculated with initial population densities (Pi) of 0, 2,500, 5,000, 10,000, and 15,000 *M. arenaria* eggs per plant (6). Photoperiod was maintained at 14 hours with an average temperature of 27 ± 7 C.

Thirty-nine days after inoculation, plants were harvested and roots were washed, weighed, and incubated for 15 minutes in aqueous 0.005% phloxine B (6) to stain egg masses. Gall indices were determined (0–10 index) by comparing root systems to a series of root drawings with various percentages of galled root tissue (13). Egg counts were made for each root system, and eggs per gram of root tissue (EPG) were calculated (6).

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[2] Graduate student and Associate Professor, Department of Agronomy and Soils, and Professor, Department of Plant Pathology and Physiology, Clemson University, Clemson, SC 29634-0359.

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The experimental design was a randomized complete block, split-plot, with four replications. Isolates were main plots, cultivars were the subplot, and treatments were the four Pi levels. Analyses of variance were calculated on gall indices and EPG to compare isolates and cultivars within isolates. Differences were determined by LSD at an alpha level of 0.05. A regression curve was plotted on Pi for each isolate (averaged across the five cultivars). Orthogonal polynomial contrasts were made to determine if the response of gall index to Pi was significant.

Kirby, Gordon, and Braxton had fewer galls than Centennial and Gasoy 17, with greater differences occurring at the two highest Pi (Table 1). Gall indices were higher for the Govan isolate than for the Florida isolate (Fig. 1). Generally, the gall indices increased as Pi increased for the Florida isolate but less so for the Govan isolate. The cultivar × isolate interaction component of the analysis of variance for gall indices was not significant.

The Govan isolate reproduced better than the Florida isolate on all cultivars (Table 1). Eggs per gram of root tissue did not consistently increase cross Pi, and few differences occurred among cultivars.

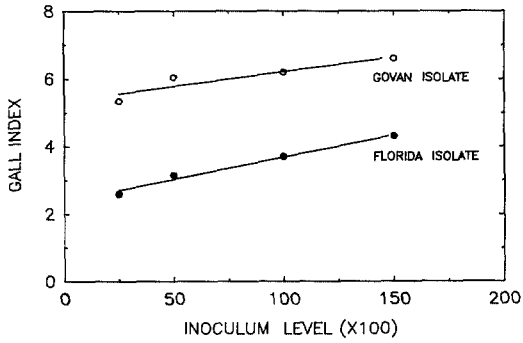

FIG. 1. Orthogonal polynomial fit for isolate × inoculum level relationship for mean gall indices of two *Meloidogyne arenaria* isolates on five soybean cultivars.

Relative host status among cultivars did not change due to Pi. Such a response illustrates the characteristic of tolerance to *M. arenaria*; that is, tolerant cultivars of soybean and *M. arenaria* are compatible and reproduction is not appreciably limited. Kirby, Gordon, Braxton, and Centennial would limit reproduction of *M. incognita*; however, Pi may have an influence on reproduction, depending on the level of resistance in a particular cultivar (9).

The difference in virulence of the two isolates may be related to their history. The Florida (race 1) isolate was originally col-

TABLE 1. Mean gall indices (GI)† and eggs per gram of root tissue (EPG) for five soybean cultivars at four inoculum levels of two *Meloidogyne arenaria* isolates.

	2,500 eggs/plant		5,000 eggs/plant		10,000 eggs/plant		15,000 eggs/plant	
Cultivar	GI	EPG	GI	EPG	GI	EPG	GI	EPG
				Florida isolate				
Kirby	2.0	306	2.5	203	3.5	269	4.0	545
Gordon	2.2	786	3.0	1,340	3.0	1,175	3.8	1,663
Braxton	2.8	263	2.8	349	3.2	470	3.8	782
Centennial	3.0	558	3.5	638	4.5	1,887	5.0	803
Gasoy 17	3.0	526	3.2	545	4.2	832	5.0	1,407
LSD (0.05)	N.S.	N.S.	N.S.	N.S.	0.9	1,061	0.7	N.S.
				Govan isolate				
Kirby	5.0	12,441	5.2	11,193	6.0	24,857	5.8	16,052
Gordon	4.8	18,665	5.8	15,700	5.2	24,313	6.0	33,023
Braxton	4.8	6,916	5.5	23,806	5.2	25,237	6.0	36,990
Centennial	5.8	9,130	6.5	18,325	7.0	19,620	8.0	23,779
Gasoy 17	6.5	8,016	7.2	12,706	7.5	29,239	7.2	49,774
LSD (0.05)	N.S.	6,547	0.9	N.S.	1.2	N.S.	1.4	N.S.

Florida and Govan isolates were significantly different for each parameter at each inoculum level (LSD), alpha = 0.05.
† Gall index is based upon a 0–10 scale in which 0 = no galls and 10 = 100% of the root system galled.

lected from peanut, whereas the Govan isolate (race 2) was collected from soybeans. Also, all *M. arenaria* race 1 isolates apparently do not reproduce on soybeans (D. W. Dickson and R. Rodríguez-Kábana, unpubl.).

The higher Pi of 10,000 and 15,000 eggs resulted in differences in gall indices between susceptible and resistant cultivars; however, differences were small and therefore may not be appropriate for assessing *M. arenaria* resistance. In contrast, Kinloch et al. (8) reported a high correlation between gall indices and seed yield in *M. incognita* infested soil over 3 consecutive years. In our study EPG was not sensitive enough to determine differences between the field-tested resistant and susceptible soybean cultivars. These results indicate that some cultivars previously described as resistant to *M. arenaria* may limit *M. arenaria* reproduction only slightly. Futhermore, *M. arenaria* isolates differ in their ability to cause galling and in their fecundity. Thus higher Pi of eggs may be required to illustrate differences among cultivars (9).

Literature Cited

1. Barker, K. R., F. A. Todd, W. W. Shane, and L. A. Nelson. 1981. Interrelationships of *Meloidogyne* species with flue-cured tobacco. Journal of Nematology 13:67–78.

2. 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.

3. Hartwig, E. E., and H. Lappas, compilers. 1979. The uniform soybean tests, southern states. USDA, Stoneville, MS.

4. Hartwig, E. E., and H. Lappas, compilers. 1984. The uniform soybean tests, southern states. USDA, Stoneville, MS.

5. Hinson, K. 1985. Breeding for resistance to root-knot nematodes. Pp. 387–393 *in* R. Shibles, ed. World soybean research conference III: Proceedings. Boulder: Westview Press.

6. Hussey, R. S., and H. R. Boerma. 1981. A greenhouse screening procedure for root-knot nematode resistance in soybeans. Crop Science 21:794–796.

7. Ibrahim, I. K. A., and S. A. Lewis. 1985. Host–parasite relationships of *Meloidogyne arenaria* and *M. incognita* on susceptible soybean. Journal of Nematology 17:381–385.

8. Kinloch, R. A., C. K. Hiebsch, and H. A. Peacock. 1985. Comparative root-knot galling and yield responses of soybean cultivars to *Meloidogyne incognita*. Plant Disease 69:334–336.

9. Luzzi, B. M., H. R. Boerma, and R. S. Hussey. 1987. Resistance to three species of root-knot nematode in soybean. Crop Science 27:258–262.

10. Rodríguez-Kábana, R., and S. C. Williams. 1981. Assessment of soybean yield losses caused by *Meloidogyne arenaria*. Nematropica 11:105–113.

11. Taylor, A. L., and J. N. Sasser. 1978. Biology, identification, and control of root-knot nematodes. Raleigh: North Carolina State University Graphics.

12. Tisselli, O., J. B. Sinclair, and T. Hymowitz. 1980. Sources of resistance to selected fungal, bacterial, viral and nematode diseases of soybeans. INTSOY Series No. 18. Urbana: International Agricultural Publications.

13. Zeck, W. M. 1971. A rating scheme for field evaluation of root-knot nematode infestations. Pp. 141–144 *in* Pflanzenschutz nachrichten, vol. 24. #1. Leverkusen: Farbenfabriken Bayer Ag-Leverkusen.