Annals of Applied Nematology 2:110–114. 1988.

Bahiagrass for the Management of *Meloidogyne arenaria* in Peanut

R. Rodríguez-Kábana,[1] C. F. Weaver,[1]
D. G. Robertson,[1] and H. Ivey[2]

Abstract: Bahiagrass (*Paspalum notatum*) cultivars Argentine, Pensacola, and Tifton-9 were nonhosts for *Meloidogyne arenaria, M. incognita,* and *Heterodera glycines* in a greenhouse experiment using field soil infested with these nematodes. The effect of Pensacola bahiagrass in rotation with peanut (*Arachis hypogaea*) on *M. arenaria* was studied in 1986 and 1987 in a field at the Wiregrass substation near Headland, Alabama. Each year soil densities of second-stage juveniles of *M. arenaria,* determined near peanut harvest, were 96–98% lower under bahiagrass than under peanut. In 1987 peanut yields in plots following bahiagrass were 27% higher than in plots under peanut monoculture. Juvenile population densities in bahiagrass–peanut plots were 41% lower than in plots with continuous peanut. Using bahiagrass for reducing population densities of *M. arenaria* and increasing peanut yield was as effective as using aldicarb at the recommended rates for peanut.
Key words: aldicarb, *Arachis hypogaea,* bahiagrass, control, cropping system, *Heterodera glycines,* management, *Meloidogyne arenaria, Meloidogyne incognita,* peanut, *Pratylenchus brachyurus,* root-knot nematode, rotation.

Peanut (*Arachis hypogaea* L.) is a host for a variety of nematodes (9,10) including the economically important root-knot nematodes *Meloidogyne arenaria* (Neal) Chitwood and *M. hapla* Chitwood (10). In the southeastern United States, *M. arenaria* race 1 is the primary root-knot nematode pathogen in peanut (5,6,9,10,17). *Meloidogyne arenaria* also is found frequently suppressing soybean (*Glycine max* Merr.) yields (23). Traditionally, management of *M. arenaria* in Alabama peanut fields has been based on the use of nematicides (13) and rotation with corn (*Zea mays* L.) or sorghum (*Sorghum bicolor* Moench), which are less suitable hosts than peanut (18,19,21). This management system evolved from the lack of commercial peanut cultivars resistant to the nematode (4,8) and the availability of inexpensive soil fumigant nematicides. The number of effective nematicides available at present for use on peanut is limited, however, and their cost has increased (13).

Rotation of peanut with either corn or sorghum is ineffective in fields with heavy infestations (> 100 second-stage juveniles [J2]/100 cm^3 soil at harvest) of *M. arenaria* (15). Rotation with corn is effective in maintaining low levels of *M. arenaria* only in fields with low population densities (< 100 J2/100 cm^3 soil) of the nematode and only when peanut is followed by 2 years of corn (11,21). Most corn and peanut crops are produced in unirrigated fields where corn yields are typically very low (< 4,000 kg/ha); therefore the peanut–corn–corn rotation is not attractive economically. Cotton (*Gossypium hirsutum* L.) is an effective rotation crop to manage *M. arenaria* in peanut (12), but it requires specialized, costly equipment not always available to peanut producers. Other crops need to be identified for rotating with peanut to suppress root-knot nematodes. Our objective was to evaluate the effects of bahiagrass (*Paspalum notatum* Flugge) in rotation with peanut on *M. arenaria* race 1.

Materials and Methods

A greenhouse study was conducted to determine the relative susceptibility of three bahiagrass cultivars to attack by root-knot nematodes typically found in peanut and soybean fields in the southeastern

Received for publication 27 April 1988.
[1] Professor and Research Associates, Department of Plant Pathology, Auburn University, Alabama Agricultural Experiment Station, Auburn University, AL 36849.
[2] Superintendent, Wiregrass Substation, Alabama Agricultural Experiment Station, Headland, AL 36345.

United States. Soil for the experiment was collected from a soybean field in Baldwin County, Alabama, that had been in continuous soybean production for 8 years with rye (*Secale cereale* L.) or ryegrass (*Lolium* sp.) planted each year as a winter cover crop. The sandy loam soil (pH 6.2; organic matter < 1.0% [w/w], cation exchange capacity < 10 meq/100 g soil) was infested with *M. arenaria*, *M. incognita* (Kofoid & White) Chitwood, and *H. glycines* Ichinohe (race 4). The ratio of *M. arenaria* to *M. incognita* was estimated at 1:3 based on J2 measurements and perineal patterns of females extracted from soybean roots. Soil population densities of *Meloidogyne* spp. and *H. glycines* J2, determined as described, were 20 and 12/100 cm^3, respectively. The soil also contained low numbers (8/100 cm^3 soil) of *Pratylenchus brachyurus* (Godfrey) Goodey. Moist (60% field capacity) soil from the field was sieved (1-mm pore) to remove crop debris and large particles and mixed 50:50 v/v with builder's fine (< 0.5 mm) sand. This mixture will be referred to as soil in this paper. The soil was apportioned in 1-kg amounts and placed in 1-liter capacity, 10-cm-d, cylindrical PVC pots. 'Davis' soybean was planted five seed/pot in eight pots to serve as a control (23). Bahiagrass cultivars Argentine, Pensacola, and Tifton-9 were planted 30 seed/pot. The experiment was replicated eight times. The pots were arranged in a randomized complete block design and maintained for 8 weeks. At the end of the experiment, the plant root systems were separated from the soil and examined for females and cysts of *H. glycines* and galls induced by *Meloidogyne* spp. Roots were then incubated in water for 72 hours to determine nematode population densities (14). Root gall indices were determined on a scale of 0 = no galls to 10 = maximal galling (24). Nematode densities in soil were determined for each pot using a 100-cm^3 soil sample (14).

A field experiment was initiated in 1986 to assess the effectiveness of Pensacola bahiagrass for reducing the population density of *M. arenaria* race 1 in a 'Florunner' peanut production system. The field was located at the Wiregrass substation and had been in continuous peanut production for the past 10 years with hairy vetch (*Vicia villosa* Roth) as a winter cover crop. The soil was a sandy loam (pH = 6.0; organic matter < 1.0% [w/w]; cation exchange capacity < 10 meq/100 g soil) infested with *M. arenaria* race 1 (> 100 J2/100 cm^3 soil at harvest). The field was level and equipped with a pivot irrigation system. Plots contained eight rows (0.9 m wide × 10 m long) planted to either peanut or bahiagrass. Rotation systems were 1) continuous peanut, 2) continuous peanut with an at-plant aldicarb application, 3) bahiagrass (1986) followed by peanut (1987), 4) bahiagrass followed by peanut with an at-plant aldicarb application, or 5) continuous bahiagrass. No cover crop was planted following peanut in 1986. Each system was replicated eight times and arranged in a randomized complete block design. Cultural practices and control of foliar diseases, insects, and weeds were as recommended for peanut in the area (1,3). Bahiagrass was planted by drilling 33 kg seed/ha with no fertilization other than what was needed for peanut. Aldicarb (15G) was applied at 3.3 kg a.i./ha in a 20-cm-wide band (broadcast equivalent rate = 14.85 kg a.i./ha) with the seed furrow in the middle of the band. Aldicarb was incorporated 2–4 cm deep with spring-activated tines set just ahead of the planter shoe and behind the bander.

Soil for nematode assay was collected from the plant rhizosphere at spacings of 0.5–0.7 m along the length of the plot 2 weeks before peanut harvest to be within the period of maximal population development of *M. arenaria* (16). Each sample consisted of 16–20 2.5-cm-d soil cores collected 25 cm deep from the center two rows of each plot with the use of a standard cylindrical soil probe. The cores from each plot were composited, and a 100-cm^3 subsample was used to determine nematode numbers (14).

Peanut yields were determined at crop maturity by harvesting the two center rows of each plot. Yield of bahiagrass hay was

TABLE 1. Root galls induced by *Meloidogyne* spp. and nematode population densities in roots of a soybean and three bahiagrass cultivars in a greenhouse experiment with field soil naturally infested with *Meloidogyne arenaria, M. incognita, Heterodera glycines* race 4, and *Pratylenchus brachyurus.*

			Population density (no./g fresh root)		
	Galls/g fresh root	Root-knot index†	*Meloidogyne* spp. J2	*H. glycines* J2	*Pratylenchus brachyurus*
Davis soybean	58	6	78	19	32
Argentine bahiagrass	0	0	1	3	7
Pensacola bahiagrass	0	0	14	2	6
Tifton-9 bahiagrass	0	0	14	2	4
LSD (P = 0.05)	16	0.6	56	10	18

† Scale: 0 = no galling to 10 = maximal galling (24).

not determined. Plots with bahiagrass in 1986 that were planted to peanut the following year were plowed under 6 weeks before planting time (9 May 1987).

All data were subjected to analysis of variance (20). Fisher's least significant differences were calculated for all variables. Unless otherwise stated, all differences between means referred to in the text were significant at $P = 0.05$.

RESULTS AND DISCUSSION

In the pot test there were no galls induced by *Meloidogyne* spp. in roots of bahiagrass cultivars (Table 1). *P. brachyurus* and J2 of *Meloidogyne* spp. and *H. glycines* were low in bahiagrass roots. There were no cysts or females of *H. glycines* in the roots. In contrast, soybean roots were heavily galled and supported large numbers of *P. brachyurus* and J2 of *H. glycines* and *Meloidogyne* spp. Soybean roots also contained cysts and females of *H. glycines* (12/g fresh weight).

TABLE 2. Nematode population densities (no./100 cm³) in soil from a greenhouse experiment with a soybean and three bahiagrass cultivars.

	Meloidogyne J2	*H. glycines* J2
Davis soybean	43	83
Argentine bahiagrass	14	14
Pensacola bahiagrass	15	18
Tifton-9 bahiagrass	16	23
LSD (P = 0.05)	19	26

Nematode numbers in soil reflected results for roots (Table 2). Numbers of J2 of *H. glycines* and *Meloidogyne* spp. were lowest in soil with bahiagrass and highest with soybean. There were no differences among bahiagrass cultivars in their inability to support reproduction of these nematodes.

Meloidogyne arenaria J2 population densities in soil were lower both years in plots with bahiagrass than in plots in peanut (Table 3). In 1986 aldicarb effectively reduced J2 population densities and increased peanut yield, whereas in 1987 only the peanut yield was increased. In 1987 *M. arenaria* J2 population densities in peanut following bahiagrass were lower than in peanut following peanut. Factorial analysis of the 1987 data on *M. arenaria* J2 indicated no cropping sequence × aldicarb interaction. The analysis also indicated that the effect of aldicarb on J2 population densities was negligible, but the effects of cropping sequences on nematode population densities were evident. Inclusion of bahiagrass in the peanut production system decreased population development on peanut the following year.

Factorial analysis of the 1987 yield data revealed no aldicarb × cropping sequence interaction. Both the use of aldicarb and the inclusion of bahiagrass in the peanut production system resulted in increased peanut yields. The effect of aldicarb on yield considered independently of the effect of cropping sequence on yield resulted in a 32% increase. Conversely, the effect of bahiagrass on peanut yield, considered

TABLE 3. Effect of Pensacola bahiagrass on *Meloidogyne arenaria* J2 population density and on the yield of Florunner peanut in a 2-year field experiment conducted at the Wiregrass substation near Headland, Alabama.

Cropping sequence and treatment†		*M. arenaria* J2‡		Peanut yield (kg/ha)	
1986	1987	1986	1987	1986	1987
Peanut (−)	Peanut (−)	255	277	2,306	1,600
Peanut (+)	Peanut (+)	8	283	3,553	2,333
Bahiagrass	Peanut (−)	15	163		2,034
Bahiagrass	Peanut (+)	2	89		2,495
Bahiagrass	Bahiagrass	5	12		
LSD (P = 0.05)		94	113	727	387

† (−) = no nematicide; (+) = aldicarb applied at-plant at 3.3 kg a.i./ha in a 20-cm-wide band (broadcast equivalent rate = 14.85 kg a.i./ha).
‡ Number per 100 cm^3 soil 2 weeks before harvest.

independently of the effects of aldicarb on yield, resulted in a 15% increase.

Bahiagrass was not a host regardless of the cultivar tested for *M. arenaria, M. incognita,* or *H. glycines.* Bahiagrass, a common pasture crop in southeastern states, provides forage for the beef cattle industry (22). Its root system penetrates soil deeply, even through the hardpans typical of many fields in the southeast, and it is drought tolerant (7). The establishment of bahiagrass in fields with hardpans has resulted in marked improvements in soil physical properties and increased yields of crops following bahiagrass (2). Our test field did not have a troublesome hardpan. Nevertheless, the bahiagrass–peanut rotation system may offer the dual advantage to producers of improving soil properties while reducing root-knot nematode population densities. By including bahiagrass in the peanut production system, it may be possible to maintain *M. arenaria* at low levels without the use of nematicides. One year of bahiagrass before peanut resulted in improved yields and marked reductions in *M. arenaria* J2 population densities in soil. This study will be continued to determine whether additional years in bahiagrass before peanut will offer advantages over the 1-year period.

LITERATURE CITED

1. Alabama Cooperative Extension Service. 1988. Alabama pesticide handbook. Circular ANR 500, Auburn University, Auburn, Alabama.

2. Elkins, C. B. 1985. Plant roots as tillage tools. Pp. 519–523 *in* Tillage machinery systems as related to cropping systems. Proceedings of the International Conference on Soil Dynamics, vol. 3. Auburn University, Auburn, Alabama.

3. Everest, J. W., A. K. Hagan, and J. C. French. 1986. Peanut pest management. Circular ANR 360, Alabama Cooperative Extension Service, Auburn University, Auburn, Alabama.

4. Holbrook, C. C., D. A. Knauft, and D. W. Dickson. 1983. A technique for screening peanut for resistance to *Meloidogyne arenaria.* Plant Disease 67:957–958.

5. Ingram, E. G. 1978. Nematological survey of the peanut production area of Alabama. M.S. thesis, Auburn University, Auburn.

6. Ingram, E. G., and R. Rodríguez-Kábana. 1980. Nematodes parasitic of peanuts in Alabama and evaluation of methods for detection and study of population dynamics. Nematrópica 10:21–30.

7. Long, F. L., and C. B. Elkins. 1983. Influence of roots on nutrient leaching and uptake. Pp. 335–352 *in* R. Lawrence, R. Todd, L. Asmussen, and R. Leonard, eds. Nutrient cycling in agricultural ecosystems. Special Publication 23, College of Agriculture Experiment Station, University of Georgia, Athens.

8. Minton, N. A., and R. O. Hammons. 1975. Evaluation of peanut for resistance to the peanut root-knot nematode, *Meloidogyne arenaria.* Plant Disease Reporter 59:944–945.

9. Porter, D. M., D. H. Smith, and R. Rodríguez-Kábana, editors. 1984. Compendium of peanut diseases. The disease series of the American Phytopathological Society. St. Paul, MN: American Phytopathological Society Press.

10. Rodríguez-Kábana, R. 1982. Diseases caused by nematodes. Pp. 378–410 *in* H. E. Pattee and C. T. Young, eds. Peanut diseases. Yoakum, TX: American Peanut Research and Education Society.

11. Rodríguez-Kábana, R., and H. Ivey. 1986. Crop rotation systems for the management of *Meloidogyne arenaria* in peanut. Nematrópica 16:53–63.

12. Rodríguez-Kábana, R., H. Ivey, and P. A. Backman. 1987. Peanut–cotton rotations for the management of *Meloidogyne arenaria.* Journal of Nematology 19:484–486.

13. Rodríguez-Kábana, R., and P. S. King. 1985. Evaluations of selected nematicides for control of *Meloidogyne arenaria* in peanut: A multi-year study. Nematrópica 15:155–164.

14. Rodríguez-Kábana, R., and M. H. Pope. 1981. A simple incubation method for the extraction of nematodes from soil. Nematrópica 11:175–186.

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

16. Rodríguez-Kábana, R., C. F. Weaver, D. G. Robertson, and E. L. Snoddy. 1986. Population dynamics of *Meloidogyne arenaria* juveniles in a field with Florunner peanut. Nematrópica 16:185–196.

17. Rodríguez-Kábana, R., J. C. Williams, and R. A. Shelby. 1982. Assessment of peanut yield losses caused by *Meloidogyne arenaria*. Nematrópica 12:278–287.

18. Sasser, J. N. 1979. Pathogenicity, host ranges and variability of *Meloidogyne*. Pp. 256–269 *in* F. Lamberti and C. E. Taylor, eds. Root-knot nematodes (*Meloidogyne* species) systematics, biology and control. New York: Academic Press.

19. Sasser, J. N., and C. Cameron Carter. 1982. Root-knot nematodes (*Meloidogyne* spp.): Identification, morphological and physiological variation, host range, ecology, and control. Pp. 21–32 *in* R. D. Riggs, ed. Nematology in the southern region of the United States. Southern Cooperative Series Bulletin 276, Arkansas Agricultural Experiment Station, Fayetteville.

20. Steel, R. G. D., and J. H. Torrie. 1960. Principles and procedures of statistics. New York: McGraw-Hill.

21. Trivedi, P. C., and K. R. Barker. 1986. Management of nematodes by cultural practices. Nematrópica 16:213–236.

22. Ward, C. Y., and V. H. Watson. 1973. Bahiagrass and carpetgrass. Pp. 314–320 *in* M. E. Heath, D. S. Metcalfe, and R. F. Barnes, eds. Forages. Ames: Iowa State University Press.

23. Weaver, D. B., R. Rodríguez-Kábana, and D. G. Robertson. 1985. Performance of selected soybean cultivars in a field infested with mixtures of root-knot, soybean cyst, and other phytonematodes. Agronomy Journal 77:249–253.

24. Zeck, W. M. 1971. A rating scheme for field evaluation of root-knot nematode infestations. Pflanzenschutz-Nachrichten 24:141–144.