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Crops Uncommon to Alabama for the Management of *Meloidogyne arenaria* in Peanut

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Abstract: In a 1987 field study juveniles of *Meloidogyne arenaria* assayed at the time of peanut harvest were almost undetectable in plots planted with American jointvetch (*Aeschynomene americana*), castor bean (*Ricinus communis*), partridge pea (*Cassia fasiculata*), sesame (*Sesamum indicum*), and cotton (*Gossypium hirsutum*), whereas plots with peanut (*Arachis hypogaea*) averaged 120 juveniles/100 cm^3 soil. Application of aldicarb in peanut resulted in an average of 27 juveniles/100 cm^3 soil. In 1988 all plots were planted to peanut and the aldicarb treatment was repeated in plots that had the nematicide in 1987. In 1988 peanut yields from plots that had no peanut in 1987 were 51–69% higher than the yield from those with continuous peanut and no nematicide. Aldicarb resulted in a 57% increase in yield, which is comparable to 1-year rotation to a nonhost crop. In 1988 harvest-time *M. arenaria* juvenile population densities in soil were the lowest in plots that had castor bean in 1987; however, the partridge pea–peanut and the sesame–peanut rotations also reduced numbers of juveniles when compared with continuous peanut with no nematicide. The aldicarb treatment resulted in juvenile population densities equivalent to those found with either the partridge pea or the sesame rotations. Rotations with American joint vetch or cotton did not result in lower juvenile population densities in peanut in 1988.
Key words: Aeschynomene americana, American jointvetch, *Arachis hypogaea, Cassia fasiculata,* castor bean, cotton, cropping system, cultural practice, *Gossypium hirsutum, Meloidogyne arenaria,* peanut, pest management, *Ricinus communis,* root-knot nematode, rotation, sesame, *Sesamum indicum.*

Meloidogyne arenaria race 1 (Neal) Chitwood is one of the principal yield-limiting pathogens of peanut (*Arachis hypogaea* L.) in the southeastern United States (11,15). The nematode is widespread in the region (7,8,15), and yield losses from it can be so severe that continuous peanut production is not possible without appropriate management of the pest (28). Management strategies for the nematode have been based on the use of nematicides and on rotations with less susceptible crops (16,18,31). There are currently no commercially available peanut cultivars resistant or tolerant to *M. arenaria* and there is little likelihood that such cultivars may be available in the near future (5,10). Nematicide treatments have been effective and profitable (18). Recently, however, the number of nematicides available for peanut has been reduced because of environmental or toxicological considerations. It is possible that no nematicides will be available for peanut production in the future. Rotation with corn (*Zea mays* L.) or sorghum (*Sorghum bicolor* Moench) may be used to suppress *M. arenaria* population densities in fields with low infestations of the nematode (16), but they are ineffective in fields with severe root-knot disease problems (25). Furthermore, because corn and sorghum are typically of low economic value, rotation with these crops is unattractive. The nematode can be managed in peanut production systems by rotating cotton (*Gossypium hirsutum* L.) with peanut (17); however, the majority of peanut producers in Alabama, do not have the specialized equipment to produce cotton. Bahiagrass (*Paspalum notatum* Flugge) in rotation with peanut is effective for the management of *M. arenaria* (26). This forage is attractive for producers with cattle operations on their farms. Also, resistant soybean (*Glycine max* Merr.) cultivars can be used in rotation with peanut to manage *M. arenaraia* (23). Although these rotations offer some alternatives to nematicides for the management of *M. arenaria,* choices of rotation crops are limited. There is a need to find crops suited to Alabama that can be used to manage *M. arenaria* in peanut fields and that

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also have the economic and agricultural prerequisites for adoption by producers in the state. We reported earlier (24) on the possibility of using hairy indigo (*Indigofera hirsuta* L.), a forage legume not commonly grown in Alabama, for managing root-knot disease in peanut. This paper presents results of a study to determine the efficacy of several other crops not common to Alabama as rotation crops in the management of *M. arenaria* in peanut. A preliminary report has been published (19).

Materials and Methods

The value of selected forage and row crop species for the management of *M. arenaria* in peanut was assessed with a field experiment at the Wiregrass substation, near Headland, Alabama. The field had been in peanut production with hairy vetch (*Vicia villosa* Roth) as a winter cover crop for the past 12 years and was naturally infested with the nematode. The soil was a sandy loam (58% sand, 27% silt, 15% clay; <1.0% organic matter, pH = 6.2, and cation exchange capacity <10 meq./100 g soil). Plots in the experiment were 10 m long and eight rows wide on 0.9-m spacing. The experiment was initiated in 1987 when the following crops were planted: American jointvetch (*Aeschynomene americana* L.), 'Hale' castor bean (*Ricinus communis* L.), partridge pea (*Cassia fasiculata* Michx.), 'Florunner' peanut, and 'Baco' sesame (*Sesamum indicum*). Each crop was replicated eight times except peanut which was replicated 16 times. Eight peanut replicates received an at-plant application of aldicarb with a Gandy applicator (Gandy Co., Owatonna, MN) at 3.4 kg a.i./ha (12 kg a.i./ha broadcast) in a 25-cm-wide band centered over the seed furrow and incorporated 2–4 cm deep. Plots in the experiment were arranged in a randomized complete block design. Cultural practices, fertilization, and control of insects and weeds for cotton and peanut were as recommended for the area (1,4). Seeding rates for American jointvetch, castor bean, partridge pea, and sesame were 28, 90, 25, and 5 kg/ha, respectively. Castor bean, cotton, and peanut were planted in rows; the other crops were broadcast. All crops were planted on 15 May 1987. Forage yields of American jointvetch and partridge pea were determined on 2 September 1987 by harvesting the center 1-m^2 area in each plot. Yields of castor bean, cotton, and peanut were obtained at maturity from the center two rows of the plots; sesame yields were from the entire plot area. The plots were left fallow through the winter and in 1988 all plots were planted with Florunner peanut. All crop residues remained on the soil surface through the winter and were plowed into the soil the following spring when plots were prepared for planting. Peanut plots that received aldicarb in 1987 were treated again in the same manner in 1988.

Each year of the study, soil samples for nematode analysis were collected from all plots 3 weeks before peanut harvest to coincide with the period of maximal development of juvenile population of *M. arenaria* in soil (22,27). Samples from each plot consisted of 16–20 cylindrical cores (2.5 cm d × 20–25 cm deep) taken from the root zones along the center two rows (or 10-m^2 area) in order to have a core for each 0.5–0.7 m of plot length. The cores from each plot were composited and a 100-cm^3 subsample was then used to assess nematode populations with the "salad bowl" incubation technique (21).

Data were subjected to standard procedures for analysis of variance (29). Fisher's least significant differences were calculated when F values were significant. Unless otherwise stated all differences between means referred to in the text were significant ($P \leq 0.05$).

Results

Aldicarb treatment resulted in increased peanut yields both years of the study (Table 1) and reduced *M. arenaria* juvenile population densities in 1987 but not in 1988. All rotations resulted in increased peanut yields in 1988 when compared with continuous peanut without aldicarb. The highest yields, although not significantly higher than other rotations, were obtained

TABLE 1. Yields of selected crops and their effects on *Meloidogyne arenaria* juvenile population densities in soil 3 weeks before peanut harvest in a field study at the Wiregrass Substation near Headland, Alabama.

Crop sequence†		*M. arenaria* juveniles/100 cm^3 soil		Yield (kg/ha)	
1987	1988	1987	1988	1987	1988
Peanut (−)	Peanut (−)	120	243	2,333‡	1,763
Peanut (+)	Peanut (+)	28	154	2,522	2,767
Castor bean	Peanut (−)	1	63	1,719	2,984
Amer. Jointvetch	Peanut (−)	1	263	6,949	2,685
Partridge pea	Peanut (−)	0	123	7,173	2,685
Sesame	Peanut (−)	2	124	263	2,821
Cotton	Peanut (−)	0	267	1,694	2,658
	LSD ($P \leq 0.05$):	78	102	—	414

† (+) = aldicarb (3.4 kg a.i./ha, 25-cm band) at plant; (−) = no treatment.
‡ Differences for peanut yields were significant ($P \leq 0.05$).

in plots that had been in castor bean (69% increase) or in sesame (60% increase). Peanut yields from the castor bean rotation were higher ($P \leq 0.10$) than those from the jointvetch, partridge pea, or cotton rotations ($P \leq 0.10$).

Factorial analysis of the data on *M. arenaria* juvenile densities revealed a significant cropping system × year interaction. In 1987 juvenile population densities were almost undetectable in plots with all crops but peanut. In 1988 the lowest population densities were in plots that had either castor bean, partridge pea, or sesame in 1987; population densities in these plots were lower than those in plots with continuous peanut without aldicarb or in the plots with jointvetch or cotton rotations. There were no differences among population levels in plots with cotton–peanut, jointvetch–peanut, or continuous peanut without aldicarb.

DISCUSSION

Several green manure and row crop plants were found to be as good as cotton, or better, for the management of *M. arenaria* race 1 and to increase peanut yields in fields infested with the nematode. These crops can be used to manage *M. arenaria* with equal or better effectiveness than that obtained with aldicarb at-plant applications. It is significant that American jointvetch, castor bean, partridge pea, sesame, and cotton all reduced *M. arenaria* juvenile population densities in soil to almost undetectable levels. When peanut was planted after these crops, however, only plots that had been in castor bean, partridge pea, or sesame had lower numbers of juveniles in soil at peanut harvest than plots with untreated peanut and no nematicide. There is evidence that sesame (*S. orientale* now *indicum*) root exudates and castor bean crop residues may be repellent or nematotoxic to *Meloidogyne* spp. (2,20).

Dry matter yields obtained for American jointvetch and partridge pea indicate that these legumes would be useful as green manure crops. Partridge pea has been used for green manure in the southeastern United States (6,9). American jointvetch and hairy indigo have been used as summer fallow cover to suppress root-knot (*Meloidogyne* spp.) and sting (*Belonolaimus longicaudatus* Rau) nematodes before planting winter vegetables (12,13,14). We did not incorporate the foliage and other matter produced by American jointvetch or partridge pea into the soil. Incorporation of organic matter of that type into the soil could reduce *M. arenaria* population densities, as has been shown for other leguminous amendments and nematodes (20).

Castor bean and sesame are relatively high value crops and could be grown commercially in Alabama (30). Our sesame seed yields were low, but this resulted from our lack of proper equipment to harvest the crop. The United States imports sesame seed to satisfy internal demand (32). Thus, it is possible that this plant could be a profitable rotation crop to manage nematode problems in peanut.

Castor bean is used in the production of industrial oils (3,9), but the crop is limited in the United States to the Great Plains and irrigated land in the Southwest (9). In the past, diseases of floral parts and seed caused by *Botrytis* sp. limited castor bean production in the humid southeastern states (9); however, diseases caused by these fungi possibly could be controlled with new fungicides. Castor bean yields in our study were comparable to those reported from traditional production areas, and we did not observe any serious disease with the cultivar Hale.

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