

Rotations of Bahiagrass and Castorbean with Peanut for the Management of *Meloidogyne arenaria*

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Abstract: The relative value of 'Hale' castorbean (*Ricinus communis*) and 'Pensacola' bahiagrass (*Paspalum notatum*) as rotational crops for the management of *Meloidogyne arenaria* and southern blight (*Sclerotium rolfsii*) in 'Florunner' peanut (*Arachis hypogaea*) production was studied for 3 years in a field experiment in southeast Alabama. Peanut following 2 years of castorbean (C-C-P) yielded 43% higher than monocultured peanut without nematicide. At-plant application of aldicarb (30.5 g a.i./100 m row in a 20-cm-wide band) to monocultured peanut resulted in an average 38.9% increase in yield over the 3 years of the experiment. Peanut yield following 2 years of bahiagrass (B-B-P) was 36% higher than monocultured peanut without nematicide. Aldicarb application had no effect on southern blight, but both C-C-P and B-B-P rotations reduced the incidence of the disease in peanut. Juvenile populations of *M. arenaria* in soil at peanut harvest time were lower in plots with C-C-P than in those with the B-B-P rotation, and both rotations resulted in lower numbers of juveniles in soil than in the untreated monocultured peanut.

Key words: aldicarb, antagonistic plants, *Arachis hypogaea*, bahiagrass, castorbean, control, crop rotation, cropping systems, management, *Meloidogyne arenaria*, nematode, *Paspalum notatum*, peanut, *Ricinus communis*, root-knot nematode.

The root-knot nematode *Meloidogyne arenaria* (Neal) Chitwood is one of the most important yield-limiting pathogens of peanut (*Arachis hypogaea* L.) in Alabama and other areas of the southeastern United States (5,10,13,25). Traditional management of the pest has been based on the use of nematicides and rotation with crops that are poorer hosts for the nematode than is peanut (13,15,17,27). This strategy resulted from the lack of cultivars resistant to nematodes and the low potential for development of such cultivars (8). The number of nematicides available at present to treat peanut is very limited (1,17), and the cost of these treatments is typically in excess of U.S.\$80.00/ha, which is too high for nonsubsidized peanut production. Rotations with corn (*Zea mays* L.) or sorghum (*Sorghum bicolor* (L.) Moench) can be effective in suppressing *M. arenaria* in fields with low to moderate levels of infestation (50–100 juveniles/100 cm³ soil at peanut harvest), but these rotations do not work well in fields with heavy infestations of the

nematode (> 200 juveniles/100 cm³ soil; 15,22). In addition, profitable production of corn in Alabama is possible only in irrigated fields or in coastal areas where typical rainfall patterns are adequate; such fields are few in Alabama. Cotton (*Gossypium hirsutum* L.), soybean (*Glycine max* (L.) Merr.), and bahiagrass (*Paspalum notatum* Flugge) are crops that can be used successfully in rotation with peanut to suppress *M. arenaria* (16,19,23), but this is feasible only to farmers who have the specialized equipment for cotton production or who can economically justify a pasture crop. The use of soybean as a rotation crop requires correct identification of the reaction of *M. arenaria* isolates present in peanut fields to soybean cultivars. This information is usually not available and cannot be obtained from most extension services. Thus, there is a need to find new crops to rotate with peanut to manage nematode problems and reduce or eliminate nematicide application. Recently, we reported on the potential of a number of crops unusual to Alabama for use in the management of nematode problems in peanut (18,20,21). This paper presents results of a study on the relative value of castorbean (*Ricinus communis* L.) compared

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with bahigrass as rotation crops for the management of *M. arenaria* in peanut.

MATERIALS AND METHODS

The effect of rotations of 'Hale' castorbean and 'Pensacola' bahigrass for managing of *M. arenaria* in 'Florunner' peanut production was studied in a 3-year field experiment at the Wiregrass Substation, near Headland, Alabama. The experiment was initiated in 1988 in an irrigated field that had been in peanut following winter fallow for the preceding 10 years and was heavily infested with the nematode. The soil was a sandy loam (75% sand, 15% silt, 10% clay; pH 6.2; organic matter < 1.0%; cation exchange capacity < 10 meq/100 g soil). Treatments in the experiment consisted of the following cropping schemes: (1) continuous peanut, (2) continuous peanut and nematicide, (3) 2 years of castorbean followed by peanut, and (4) 2 years of bahigrass followed by peanut. The nematicide was aldicarb (Temik 15G) applied at planting in a 20-cm-wide band over the seed furrow at a rate of 30.5 g a.i./100 m row. The row width was 0.91 m, so that this rate was equivalent to 15.3 kg a.i./ha on a broadcast basis. The granules were incorporated lightly (2–3 cm deep) by means of spring-activated tines attached to the planting equipment. Eight replications (plots) of each treatment were arranged in a randomized complete block design. Each plot was eight rows wide and 10 m long.

Castorbean and peanut were planted every year in rows at rates of 80 and 112 kg seed/ha, respectively; bahigrass was drill-planted at the beginning of the study in 1988 using 28 kg seed/ha. Cultural practices and control of foliar diseases, insects, and weeds in peanut were as recommended for the area (1,3,4). Cultural practices followed for castorbean were the same as for peanut, but no fungicides, insecticides, or herbicides were used in this crop because none were needed. Bahigrass was established following recommended practices for the area (3).

Soil samples for nematode analysis were collected each year 2 to 3 weeks before

peanut harvest to be within the period of maximal numbers of juveniles of *M. arenaria* in soil (24). Samples were collected from the center 2 rows of plots with peanut or castorbean, or the equivalent area in the center of those with bahigrass. Soil cores were collected from the root zone to a depth of 20–25 cm from each plot using a standard 2.5-cm probe, to have 16–20 cores per plot spaced at 0.5-m intervals through the length of the plot. The cores from a plot were composited, and a 100-cm³ subsample was used to determine nematode densities with the "salad bowl" incubation technique (12).

The incidence of southern blight caused by *Sclerotium rolfsii* Sacc. on peanut was assessed by counting the number of disease loci ("hits") along the center two rows of each plot with peanut immediately after digging and inversion of the crop; a "hit" represents a length of row \leq 30 cm with plants killed by the fungus (14).

Yields of peanut and castorbean were determined at crop maturity by harvesting the center two rows of each plot. Castorbean yields consisted of all racemes with fruits produced by each of the plants in the two rows. The racemes were dried and the weight of the dry seeds and husks was determined. Castorbean yields were determined only in 1989; bahigrass forage yields were not determined.

All data were analyzed following standard procedures for analysis of variance (9); treatment means were compared by Fisher's least significant difference test (FLSD). Unless otherwise indicated, all differences referred to in the text were significant at $P \leq 0.05$.

RESULTS

In 1988 and 1989, juvenile densities of *M. arenaria* were lowest in plots with either bahigrass or castorbean (Table 1); plots with untreated peanut had numbers approximately 20 times higher than did those with the other two crops. Aldicarb applications reduced juvenile numbers in 1990 but not in the preceding two years. In 1990, the lowest numbers were in plots treated

TABLE 1. Effect of rotation with peanut, castorbean, and bahiagrass on juvenile densities of *Meloidogyne arenaria*, incidence of southern blight, and crop yield in a 3-year field study at the Wiregrass Substation near Headland, Alabama.

Crop and year†			Juveniles/100 cm ³ soil‡			Hits/100 m row§			Yield in kg/ha		
1988	1989	1990	1988	1989	1990	1988	1989	1990	1988	1989	1990
Peanut (-)	Peanut (-)	Peanut (-)	322	304	300	28	118	91	1,953	1,465	1,373
Peanut (+)	Peanut (+)	Peanut (+)	296	188	54	30	91	96	2,527	2,278	1,821
Castorbean	Castorbean	Peanut (-)	14	10	52	—	—	67	—	(2,017)	1,980
Bahiagrass	Bahiagrass	Peanut (-)	16	17	148	—	—	65	—	—	1,883
FLSD ($P = 0.05$):			172	156	79	23	22	23	517	645	450

† (-) = no nematicide; (+) = with at-plant application of aldicarb at 30.5 g a.i./100 m row in a 20-cm-wide band.

‡ Determined 2-3 weeks before peanut harvest using the "salad bowl" incubation technique (12).

§ A "hit" is a disease locus < 30 cm row length (14).

|| FLSD values apply only for peanut yields; castorbean yield (husks + seed) in parentheses.

with aldicarb or in those that had castorbean in 1988 and 1989; densities in the bahiagrass-peanut rotations were lower than were those in plots with continuous peanut with no nematicide.

Aldicarb application had no effect on the incidence of southern blight in any of the 3 years of the study (Table 1). In 1990, the average number of hits in plots with either the castorbean or the bahiagrass rotations was lower than in plots with peanut monoculture.

Peanut yields were improved by aldicarb applications in the first 2 years of the study but not in 1990 (Table 1). Both the bahiagrass and the castorbean rotations resulted in improved peanut yields in 1990, but the difference in peanut yield response between these rotations was not significant. Castorbean yield in 1989 amounted to 2,017 kg/ha, 70% of which was seed.

DISCUSSION

Results show clearly that the two rotations of the study can be used to manage problems caused by *M. arenaria* in peanut. The field used for the study represents a "worst case scenario" because peanut had been grown in it continuously for a decade with consequent accumulation of pathogens. It was possible only to assess populations of *M. arenaria* and the damage caused by *S. rolfisii*; however, we observed that the rotations had other beneficial effects, such as lowering the incidence of pod

rot. This effect of the rotations on disease caused by soilborne fungi contrasts with the failure of aldicarb applications to reduce the incidence of southern blight. This is important because a "hit" per 100 m of row represents a yield loss of as much as 30 to 50 kg peanut/ha (14).

The data on *M. arenaria* juveniles show a major difference in the mode of action between bahiagrass and castorbean on the nematode. Castorbean contains compounds in the roots and other plant tissues that are nematicidal or nematostatic (2,6,7,11,26). This may not be the case for bahiagrass. It is possible that the differences in numbers of *M. arenaria* juveniles between the two rotations observed in this study could be attributable to the production of nematicidal compounds by castorbean. We plan to continue this study to determine if, in succeeding years, this difference between the two rotations persists or increases, as may be expected if castorbean nematotoxins are important under field conditions.

Castorbean is utilized for the extraction of fine-grade industrial oil. The United States is a net importer of the oil, which at present is produced mostly in Brazil and India. Thus, castorbean may become an economic rotation crop useful for managing *M. arenaria* and other peanut pathogens in the southeastern United States if adequate markets for the crop can be developed.

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