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Peanut–Cotton Rotations for the Management of *Meloidogyne arenaria*

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Abstract: The efficacy of 'Deltapine 90' cotton (*Gossypium hirsutum*) in rotation with 'Florunner' peanut (*Arachis hypogaea*) for the management of *Meloidogyne arenaria* was studied for 2 years in a field in southeastern Alabama. In 1985, *M. arenaria* juvenile populations in plots with cotton were 98% lower than in plots with peanut. Peanut and cotton yields were increased by treatment with aldicarb (3.3 kg a.i./ha in a 20-cm-band) in 1985 but not in 1986. In 1986, peanut yields were highest and *M. arenaria* juvenile populations in soil were lowest in plots that had cotton the previous year. In 1986, numbers of *M. arenaria* juveniles in plots with peanut both years were reduced by treatment with aldicarb to levels found in plots with cotton–peanut rotation. The use of aldicarb in peanut following cotton similarly treated reduced the incidence of southern blight (*Sclerotium rolfsii*). Cotton–peanut is a good rotation for the management of *M. arenaria* and to increase peanut yields without the use of nematicides.

Key words: biological control, cropping system, pest management, population dynamics.

Root-knot nematode *Meloidogyne arenaria* (Neal) Chitwood is widespread in peanut (*Arachis hypogaea* L.) growing areas of the southeastern United States (2,6). Damage to peanut by this pathogen can be severe and results in significant yield losses (3,7,9,16). In contrast with other crops, no commercially available peanut cultivars are resistant or tolerant to *M. arenaria* and they probably will not be available in the near future (4). Traditionally, *M. arenaria* in peanut in Alabama and other southeastern states has been managed by the use of nematicides (5,12) and rotation of this legume with corn (*Zea mays* L.), sorghum (*Sorghum bicolor* Moench), or even selected soybean (*Glycine max* Merr.) cultivars (9,11). Corn and sorghum, although hosts for *M. arenaria*, are less suitable than peanut for *M. arenaria* development (17,19). Rotations with corn work well in fields with low infestation levels of *M. arenaria* (11), but they are not successful in fields with high infestation levels of the nematode (14). Cotton (*Gossypium hirsutum* L.) is not a host of *M. arenaria* and has been suggested for use in rotation with peanut to reduce *M. arenaria* populations (17); however, there is no information on the relative efficacy of cotton for control of *M. arenaria* in peanut in the southeastern United States. Our objective was to assess the value of cotton compared with the use of nematicide treatment for control of *M. arenaria* in a peanut field.

Materials and Methods

A rotation experiment was established in an irrigated field at the Wiregrass Substation near Headland, Alabama. The field had been planted with peanut and a winter cover crop of hairy vetch (*Vicia villosa* Roth) for the previous 8 years. The soil was a sandy loam, < 1.0% (w/w) organic matter and pH = 6.2, and was infested with > 200 *M. arenaria* juveniles/100 cm^3 soil at peanut harvest time. Table 2 contains a description of the treatments in the experiment. Each treatment had eight replications (plots) within a randomized complete block design. Plots were eight 10-m-long rows with 0.9-m spacing. Aldicarb (Temik 15G) was applied at-plant in a 20-cm-wide band at a rate of 3.3 kg a.i./ha; this rate was equivalent to 14.85 kg a.i./ha on a broadcast basis. Cultural practices and control of foliar diseases, insects, and weeds were as recommended for the area (1). Peanut and cotton were planted during the first week of May both years. Each year peanuts were harvested during the first week of October and cotton a month later. Yield data for each crop were obtained from the middle two rows of each plot.

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TABLE 1. Effects of crops and aldicarb (Temik 15G) treatment on juvenile populations of *Meloidogyne arenaria* and yields of Florunner peanut and Deltapine 90 cotton in 1985 in a rotation experiment at the Wiregrass Substation, Headland, Alabama.

Crop	Nematicide 3.3 kg a.i./ha	Juveniles per 100 cm^3 soil	Yield (kg/ha)
Peanut	(−)	579	3,173
Peanut	(+)	538	3,689
Cotton	(−)	15	2,830
Cotton	(+)	10	3,391
LSD (P = 0.05):		90	

Differences in yield within each crop for peanut and cotton were significant (P = 0.01).

Composite soil samples for nematode analysis were collected from the root zone in early September to coincide with the period of maximal juvenile population level of *M. arenaria* on peanut (2,15). Samples for each plot consisted of 16–20 soil cores, 2.5 cm d × 20–25 cm deep, taken from the middle two rows at 0.3–0.5 m spacing. A 100-cm^3 subsample was used to determine nematode numbers by the "salad bowl" incubation technique (13).

The incidence of southern blight (*Sclerotium rolfsii* Sacc.) of peanut was assessed at digging time in 1986 by counting the total number of infection loci per plot (10). An infection locus is defined as a length of row ≤ 30 cm with plants killed or dying from *S. rolfsii* infections.

All data were analyzed by analysis of variance (18), and Fisher's least significant differences (LSD) were calculated. Unless otherwise stated, all differences mentioned in the text were significant at the 5% or lower level of probability.

RESULTS AND DISCUSSION

In 1985, treatment with aldicarb at planting had no effect on juvenile populations of *M. arenaria* in soil in September; however, the treatment resulted in increased yields of peanut and cotton (Table 1). Numbers of juveniles in plots with cotton were reduced approximately 98% compared with the numbers observed in peanut plots. These results corroborate that cotton is not a host for *M. arenaria* (17). The lack of reduction in nematode population level in peanut plots treated with aldicarb was not surprising. Nematicides often temporarily suppress nematode development to a degree and result in increased yields but do not affect final *M. arenaria* juvenile population levels in the soil (12).

In 1986 highest numbers of *M. arenaria* juveniles were found in plots with continuous peanut and no nematicide treatment (Table 2). Thus, while aldicarb treatment reduced populations of the juveniles in plots with continuous peanut, differences in populations between nematicide-treated and untreated plots that had cotton in 1985 were not significant. Also, in plots with continuous cotton, aldicarb made no difference in numbers of juveniles. Juvenile populations of *M. arenaria* in 1986 were considerably smaller than in the preceding year. In contrast with 1985, a year with normal rainfall, 1986 was a very hot and dry year with no rain on the experimental field from June to August. The field was irrigated, but we were unable to maintain optimal levels of moisture for peanut

TABLE 2. Effect of crop rotation and aldicarb (Temik 15G) treatment on *M. arenaria* juvenile populations, the incidence of southern blight (*Sclerotium rolfsii*) in peanut, and yields of Deltapine 90 cotton and Florunner peanut in a field experiment at the Wiregrass Substation, Headland, Alabama.

Crop and treatment†		Juveniles per 100 cm^3 soil	Yield (kg/ha)	So. blight (loci/plot)‡
1985	1986			
Peanut (−)	Peanut (−)	72	2,929	10.0
Peanut (+)	Peanut (+)	15	3,200	9.4
Cotton (−)	Peanut (−)	41	3,499	8.3
Cotton (+)	Peanut (−)	23	3,499	8.6
Cotton (−)	Peanut (+)	15	3,363	6.9
Cotton (+)	Peanut (+)	10	3,689	6.1
Cotton (−)	Cotton (−)	16	1,844	
Cotton (+)	Cotton (+)	12	1,898	
LSD (P = 0.05):		22	409§	3.3

† (−) = no nematicide; (+) = treated at-plant with aldicarb at 3.3 kg a.i./ha in a 20-cm-wide band.

‡ One locus represents a length of row ≤ 30 cm with plants killed by *S. rolfsii.*

§ LSD for peanut yields only; differences in cotton yields were not significant.

growth and normal population development of the nematode (15).

Application of aldicarb did not result in increased peanut or cotton yields in monoculture plots. Factorial analysis of the peanut yield data revealed no crop × nematicide interaction. The effects of the 1985 crop on 1986 peanut yields were significant. All plots with peanut following cotton had higher yields than those with continuous peanut and no aldicarb treatment. The use of aldicarb did not result in yield increases when peanut was planted after cotton.

The application of aldicarb to peanut in 1986 in plots that had cotton the previous year resulted in lower incidence of southern blight than was observed for continuous peanut with no nematicide. This finding is significant, since it suggests that the effects of rotation are broad and encompass not only changes in nematode populations but also in the microbial interactions of the soil. The effects of rotations and cropping systems can be properly assessed only when the interactions between nematodes (or other pathogens), crop species, and micro-organisms are considered in toto (8,19).

Our results indicate the following: cotton can be used in rotation with peanut in fields heavily infested with *M. arenaria* to control the nematode and increase peanut yield; a rotation with 1 year of cotton followed by peanut was effective for suppressing *M. arenaria* populations development in the peanut crop. Cotton–peanut rotation may result in reductions in the incidence of southern blight of peanut caused by *S. rolfsii.*

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