BAHIAGRASS-COTTON ROTATIONS AND THE MANAGEMENT OF MELOIDOGYNE INCOGNITA AND HOPLOLAIMUS GALEATUS

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ABSTRACT

Rodríguez-Kábana, R., D. G. Robertson, and J. Bannon. 1993. Bahiagrass-cotton rotations and the management of *Meloidogyne incognita* and *Hoplolaimus galeatus*. Nematropica 23:141-147.

A 3-year experiment was conducted to determine the value of 'Pensacola' bahiagrass (Paspalum notatum) as a rotation crop for the management of nematode problems in cotton (Gossypium hirsutum). The experiment was in a field infested with Meloidogyne incognita, Hoplolaimus galeatus, and Paratrichodorus minor, as the principal nematodes, with small populations of Helicotylenchus dihystera, Pratylenchus spp., and Tylenchorhynchus claytoni. Yields of seven cotton cultivars (Deltapine 20, Deltapine 50, Coker 320, Coker 315, Stoneville 453, DES 119, and S 1001) following 2 years of bahiagrass were higher than in cotton monoculture. The magnitude of the yield response to the rotation was cultivar dependent. At-plant application of the nematicide aldicarb (17 g a.i./100 m row) improved cotton yields in both the monoculture and the rotation system. Yield response to the nematicide was more pronounced in the monoculture than in the rotation system; in both systems the response was cultivar dependent.

Key words: aldicarb, bahiagrass, cotton, crop rotation, cropping systems, Gossypium hirsutum, Hoplolaimus galeatus, Iance nematode, management, Meloidogyne incognita, nematode control, Paratrichodorus minor, Paspalum notatum, root-knot nematode, stubby root nematode.

RESUMEN

Rodríguez-Kábana, R., D. G. Robertson y J. Bannon. 1993. Rotaciones de pasto 'bahía' con algodón para controlar los problemas causados por *Meloidogyne incognita* y *Hoplolaimus galeatus*. Nematrópica 23:141–147.

A fin de determinar la eficacia del pasto 'bahía' (Paspalum notatum var. 'Pensacola') como supresor de nematodos en algodón (Gossypium hirsutum) se llevó a cabo un experimento de rotación durante 3 años. Este se realizó en un campo infestado por Meloidogyne incognita, Hoplolaimus galeatus y Paratrichodorus minor, como nematodos principales, y por pequeñas poblaciones de Helicotylenchus dihystera, Pratylenchus spp. y Tylenchorhynchus claytoni. Después de dos años utilizando pasto bahía las producciones de siete cultivares de algodón (Deltapine 20, Deltapine 50, Coker 320, Coker 315, Stoneville 453, DES 119 y S 1001) fueron más altas que en el sistema de monocultivo de algodón. Cada variedad presentó una respuesta diferente a la rotación. La aplicación del nematicida aldicarb al plantar (17 g i.a./100 m surco) mejoró las producciones en ambos sistemas, monocultivo y rotación, aunque este incremento fue más evidente en el monocultivo. De nuevo, la eficacia del nematicida dependió de la variedad.

Palabras clave: aldicarb, algodón, control, Gossypium hirsutum, Hoplolaimus galeatus, Meloidogyne incognita, nematodos de las agallas, Paratrichodorus minor, Paspalum notatum, pasto bahía, rotaciones de cultivos, sistemas de cultivo.

INTRODUCTION

Damage from nematodes is an important yield limiting factor in the production of cotton (Gossypium hirsutum) (12,16). Cotton fields are commonly infested with nematode species that cause damage to the roots directly or in association with

vascular wilt pathogens (12,16). Many cotton fields in Alabama are infested with the root-knot nematode *Meloidogyne incognita* (Kofoid & White) Chitwood, the reniform nematode (*Rotylenchulus reniformis* Linford & Oliveira), and other plantparasitic nematodes (4).

The management of nematode problems in cotton has been based primarily on the use of resistant cultivars and the application of nematicides. Breeding for resistance to nematodes in cotton has focused on M. incognita (races 3 and 4) and the Fusarium wilt/M. incognita disease complex. Unfortunately, most cultivars or breeding lines highly resistant to M. incognita lack other desirable agronomic characteristics (13,15). In addition, the use of root-knot resistant cultivars can result in increased damage from other nematode species to which these cultivars are susceptible. This may account for the increased importance of R. reniformis in Alabama in recent years (4). Also, cultivars that have been developed for resistance to the M. incognita/Fusarium wilt complex in most cases support high levels of reproduction by M. incognita (14,17). The use of nematicides can help solve some of these problems, but the number of nematicides available to producers is limited and the rates needed nematode control are expensive (1).

Crop rotation can be useful for the management of nematode problems in cotton and other crops (16,19). Because many cotton producers in Alabama and other southeastern states raise cattle, the possibility of using forage crops in rotation with cotton for the management of nematodes may be attractive. Bahiagrass (Paspalum notatum Flugge) has shown promise for the management of nematode problems in rotation with peanut (Arachis hypogaea) (8,10) and soybean (Glycine max) (9,11). This forage grass is well adapted to most of Alabama and to the southern portions of the southeastern United States. Rotations with bahiagrass are known to improve soil physical conditions and increase cotton yields (3,6). The relative value of the grass for suppression of problems caused by nematodes in cotton

is not known. For this reason a field study was initiated to assess the potential of bahiagrass as a rotation crop for the management of *M. incognita* and other plantparasitic nematodes in cotton.

MATERIALS AND METHODS

The experiment was established in 1990 at Auburn University's Plant Breeding Unit near Tallassee, Alabama, in a cotton field infested with Meloidogyne incognita (Kofoid & White) Chitwood, Hoplolaimus galeatus (Cobb) Thorne, Paratrichodorus minor Siddiqui as well as low numbers of Pratylenchus brachyurus (Godfrey) Filipjev & Schuurmans Stekhoven, P. zeae Graham, and Tylenchorhynchus claytoni Steiner. The field had been in cotton production for the preceeding 5 years. The soil was a sandy loam with pH = 6.1, cation exchange capacity < 10 meq/100 gsoil, and organic matter content < 1.0% (w/w).

The field was divided into 16, 9×28 m sections. One-half of the sections were randomly selected to be drill-planted with bahiagrass in 1990 (25 kg seed/ha) and the other half was row planted with 'Deltapine 50' cotton at 20 kg seed/ha on 1-m rows. Sections with cotton were planted again with Deltapine 50 in 1991 and those with bahiagrass were kept undisturbed. On 7 March 1992, bahiagrass was plowed under and each section was divided into 14 two-row plots (1-m row width). On 16 April 1992, plots were planted to seven cotton cultivars based on response to M. incognita. The cultivars were Coker 315, Coker 320, Deltapine 20, Deltapine 50, DES 119, Stoneville 453, and Suregrow 1001. Each cultivar was planted in two plots within each section, with one plot treated at-plant with aldicarb and the other receiving no nematicide. The 14 treatments within each section were arranged randomly. The nematicide was applied in a 20-cm-wide band at a rate of 17 g a.i./100 m row using an electric granule applicator (Gandy Co., Owatonna, Minnesota).

Each year, soil samples for nematode analysis were collected 1 month before cotton harvest. In 1990 and 1991, samples from sections with bahiagrass consisted of 30-40 soil cores per section taken with a standard 2.5-cm-diam soil probe to a depth of 20-25 cm; the cores were collected at equally spaced intervals along the diagonals of each section. The same procedure was followed for the sections with cotton with the cores taken from the root zones of the plants. Cores from a section were composited and a 100-cm³ subsample was taken for nematode analysis by the salad bowl incubation technique (7). In 1992, soil samples were obtained from each plot by taking 15-20 cores from both rows of the plot. Cores were taken 20-25 cm deep in the root zone at 0.75-m intervals. The cores from each plot were composited and processed as in previous years.

In 1990 and 1991, cotton was harvested from two rows in the center of each section. No data on bahiagrass yield were collected. In 1992, the height of cotton plants was assessed in mid September

1992 by measuring five plants in every plot from the ground level to the top foliar bud. Cotton yields were obtained in 1992 by harvesting the entire plot area.

Cultural practices and control of insects and weeds in cotton were according to recommended practices for the area (1). Bahiagrass was fertilized according to standard recommendations (2).

All data were analyzed following standard procedures for analysis of variance (5,18) and Fisher's least significant differences were calculated when F values were significant (18). Data collected in 1992 were analyzed by a factorial analysis of variance appropriate for a split plot design with cropping history as the main plots. Unless otherwise stated all differences referred to in the text were significant to the 5% or lower level of probability.

RESULTS AND DISCUSSION

In 1990 and 1991, the numbers of *M. incognita* juveniles in soil in bahiagrass sections 1 month before cotton harvest were only 1–10% of those in sections with cotton (Table 1). There were no differences in numbers of *P. minor* between sections with cotton and those with bahiagrass. Numbers of *H. galeatus* were significantly higher in sections with cotton than in

Table 1. Effects of 'Pensacola' bahiagrass (*Paspalum notatum*) and 'Deltapine 50' cotton (*Gossypium hirsutum*) on numbers of plant-parasitic nematodes extracted from 100 cm³ soil 1 month before cotton harvest in a crop rotation experiment near Tallassee, Alabama, during 1990 and 1991.

	Meloidogyne incognita (J2)		Paratrichodorus minor		Hoplolaimus galeatus	
Crop	1990	1991	1990	1991	1990	1991
Bahiagrass	17	1	15	9	2	0
Cotton	152	143	25	12	11	25
LSD $(P = 0.05)$	52 ^z	49	NS	NS	NS	12

^zLSD values are for comparisons of means within the column above each value; NS = not significant.

those with bahiagrass in 1991 but not in 1990. Seed cotton yields for 1990 and 1991 were 1 148 and 1 973 kg/ha, respectively.

In 1992, at-plant nematicide application failed to suppress M. incognita juvenile populations 1 month before cotton harvest in either cropping system (Table 2). There was no interaction between cotton cultivar and cropping system for this variable. All cultivars were associated with high densities of M. incognita juveniles in soil (101-243 juveniles/100 cm3 soil) and there were no differences among cultivars in the number of juveniles. The bahiagrass-cotton rotation resulted in higher numbers of juveniles in soil than the monoculture. This likely resulted from larger cotton root systems in plots with bahiagrass-cotton than in plots with continuous cotton. In late 1991, cotton sections had much greater population densities of M. incognita than did bahiagrass sections, and early season nematode damage in monoculture plots in 1992 probably reduced the number of available feeding sites. This would result in larger end-of-season juvenile populations in soil with the rotation than in soil with the monoculture.

Numbers of *P. minor* were higher in the continuous cotton system than in plots with the rotation (Table 3). Aldicarb had little or no effect on populations of the nematode. There was no clear relationship between cultivars and numbers of *P. minor* for either the monoculture or the rotation system.

There were no *H. galeatus* detected in samples from plots in sections with bahiagrass-cotton. Numbers of *H. galeatus* in plots with monoculture (Table 4) were not affected by aldicarb application and there was no pattern of response in numbers of *H. galeatus* to cotton cultivars.

In 1992, plants of all cultivars in the rotation system were higher than those in the monoculture system (Table 5). This response to the bahiagrass rotation was true for all cultivars. Aldicarb significantly increased plant height for all cultivars in the monoculture, but only for some cultivars in the rotation plots.

The yield of all cotton cultivars was improved greatly (Table 6) by the rotation. However, a significant interaction between cropping system and cotton cultivars was detected; while the bahiagrass-

Table 2. Effect of cotton (Gossypium hirsutum) cultivars and rotation with 'Pensacola' bahiagrass (Paspalum
notatum) on numbers of juveniles of Meloidogyne incognita in 100 cm³ soil extracted 1 month before harvest.

	Continu	ous cotton	Bahiagrass-cotton	
Cultivar	Untreated	Nematicide ^y	Untreated	Nematicide
Deltapine 20	185	162	233	164
Deltapine 50	159	206	217	166
Coker 320	243	193	261	325
Coker 315	125	129	303	297
Stoneville 453	122	171	298	140
DES 119	101	209	244	191
S-1001	159	146	222	214
LSD (P = 0.05)	63^z	63	95	95

^yAt-plant application of aldicarb (Temik 15G) at 17 g a.i./100 m row in a 20-cm-wide band with light incorporation (3–5 cm) into the soil.

^zLSD values are for comparisons of means within the column above each value.

Table 3. Effect of cotton (Gossypium hirsutum) cultivars and rotation with 'Pensacola' bahiagrass (Paspalum notatum) on populations of the stubby root nematode, Paratrichodorus minor, in 100 cm³ soil extracted 1-month before harvest.

	Continu	ous cotton	Bahiagrass-cotton	
Cultivar	Untreated	Nematicide ^y	Untreated	Nematicide
Deltapine 20	20	16	8	3
Deltapine 50	9	20	13	2
Coker 320	26	34	2	2
Coker 315	16	18	2	1
Stoneville 453	17	24	3	1
DES 119	37	10	14	0
S-1001	25	37	8	0
LSD (P = 0.05)	13^z	13	8	NS

^yAt-plant application of aldicarb (Temik 15G) at 17 g a.i./100 m row in a 20-cm-wide band with light incorporation (3–5 cm) into the soil.

cotton system resulted in an overall 55.7% increase in yield, this increase varied from 36.4% for the S-1001 cultivar to 78.3% for Coker 315 and Stoneville 453.

Yield response to nematicide application was also affected by cropping system and cultivar. In the monoculture system aldicarb resulted in an overall increase in yield of 106.1% ranging from 204.4% for

Stoneville 453 to 69.3% for S-1001. The corresponding overall yield response to the nematicide in the bahiagrass-cotton rotation was 16.9% and varied from 5.0% for Deltapine 50 to 27.4% for S-1001.

Results from this study confirm that bahiagrass rotation can substantially increase cotton yields. By comparison, none of the cotton cultivars tested performed satisfactorily in the monoculture system

Table 4. Effect of cotton (Gosspium hirsutum) cultivars and rotation with 'Pensacola' bahiagrass (Paspalum notatum) on populations of the lance nematode, Hoplolaimus galeatus, in 100 cm³ soil extracted 1-month before harvest.

	Continu	ous cotton	Bahiagrass-cotton	
Cultivar	Untreated	Nematicide ^y	Untreated	Nematicide
Deltapine 20	15	4	0	0
Deltapine 50	14	18	0	0
Coker 320	16	6	0	0
Coker 315	6	18	0	0
Stoneville 453	5	15	0	0
DES 119	14	13	0	0
S-1001	3	19	0	0
$\mathrm{LSD}(P=0.05)$	8 ^z	8	NS	NS

⁹At-plant application of aldicarb (Temik 15G) at 17 g a.i./100 m row in a 20-cm-wide band with light incorporation (3–5 cm) into the soil.

^zLSD values are for comparisons of means within the column above each value; NS = not significant.

^zLSD values are for comparisons of means within the column above each value; NS = not significant.

Table 5. Effect of nematicide application on plant height of seven cotton (Gossypium hirsutum) cultivars planted following 2 years of 'Deltapine 50' cotton or after 2 years of 'Pensacola' bahiagrass (Paspalum notatum) in a field infested with Meloidogyne incognita and other cotton nematodes.

Cultivar	Plant height (cm)					
	Continu	ous cotton	Bahiagrass-cotton			
	Untreated	Nematicide ^y	Untreated	Nematicide		
Deltapine 20	65	85	94	99		
Deltapine 50	64	84	93	93		
Coker 320	65	86	97	96		
Coker 315	69	84	95	102		
Stoneville 453	60	83	88	90		
DES 119	67	90	96	102		
S-1001	73	87	94	100		
$\mathrm{LSD}(P=0.05)$	6^z	6	6	6		

⁹At-plant application of aldicarb (Temik 15G) at 17 g a.i./100 m row in a 20-cm-wide band with light incorporation (3–5 cm) into the soil.

Table 6. Yield response of seven cotton (*Gossypium hirsutum*) cultivars to a rotation with 'Pensacola' bahiagrass (*Paspalum notatum*) where cultivars were planted following 2 years of bahiagrass or after 2 years of 'Deltapine 50' cotton.

Cultivar	Seed cotton yield (kg/ha)					
	Continu	ous cotton	Bahiagrass-cotton			
	Untreated	Nematicide ^y	Untreated	Nematicide		
Deltapine 20	977	2 126	2 028	2 321		
Deltapine 50	1 051	2 223	2 395	2 516		
Coker 320	953	1 735	1 808	2 321		
Coker 315	757	1 515	1 833	2 175		
Stoneville 453	586	1 784	1 930	2 297		
DES 119	904	1 857	2 223	2 443		
S-1001	1 270	2 150	2 052	2 614		
LSD (P = 0.05)	327^z	327	339	339		

⁹At-plant application of aldicarb (Temik 15G) at 17 g a.i./100 m row in a 20-cm-wide band with light incorporation (3–5 cm) into the soil.

with regard to yield or resistance to M. incognita.

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^zLSD values are for comparisons of means within the column above each value.

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