1677 Crop rotation- an effective tool for managing reniform nematodes in cotton

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Cotton nematodes are one of the most serious consequences of the continuous cropping system in Alabama. The reniform nematode (*Rotylenchulus reniformis)* replaced the root-knot nematode (*Meloidogyne incognita)* as the major nematode cotton pest in Alabama. Cotton farmers have had success with nematicides, but cotton fields often have such high reniform populations that nematicides can not eliminate the economic loss caused by the nematode. To address the growing economic damage of the reniform nematode in Alabama, a series of rotation studies including A) a non-host crop rotation, B) winter cover crop rotation, and C) a non-host rotation with the addition nematicides to cotton following a non-host crop rotation were conducted. The non-host crop rotation for one season increased cotton yields. However, fall reniform populations returned to damaging levels after one season back in cotton. The type of non-host or the number of successive years (i.e. from 1 to 3 years) the non-host crop was grown between a cotton crop did not affect the reniform nematode's ability to rapidly rebound to damaging levels. Winter cover crops did not reduce reniform populations in the spring as compared to leaving the soil fallow in any of the 3 years of the tests. A nematicide application (1, 3-D at 28 l/ha) was most effective when applied to cotton following cotton and it also increased cotton yields following 1 year rotation with peanut and soybean but not corn. 1, 3-D was as effective as a one year rotation with corn in increasing cotton yield.

Keywords: *Arachis hypogaea*, *Glycine max*, *Gossypium hirsutum*, reniform nematode, *Rotylenchulus reniformis*, *Secale cereale Sorghum bicolor, Vicia villosa*, and *Zea mays.*

Most Alabama farmers have routinely produced upland cotton (*Gossypium hirsutum* L.) on their best soils in a monoculture system for the past century. This system, although profitable in short run, has created pest problems and, in many cases, has depleted the soil of critical nutrients. Cotton nematodes have been one of the most serious consequences of the continuous cropping system. Until the early 1990s, cotton root-knot (*Meloidogyne incognita*) (Kofoid and White) Chitwood was the only major nematode attacking cotton in Alabama. By 2000, the reniform nematode, *Rotylenchulus reniformis* (Linford and Oliveira, 1940), had replaced cotton root-knot as the major nematode cotton pest in Alabama (Gazaway and McLean, 2003). First reported in an east Alabama cotton field in 1959 (Minton, 1959), reniform nematodes remained an inconsequential nematode pest until 1985 when it was found causing extensive yield losses in a cotton field in south Alabama (Gazaway, 1997). By 1990, a statewide survey revealed reniform nematodes to be widespread in several south and central Alabama counties and in a couple of fields in one county in north Alabama (Gazaway et al, 1992). Reniform nematode's ability to survive for long periods in dried soil (Birchfield and Martin, 1967, Lawrence et al., 2005b) could allow it to spread easily from infested fields to "clean" fields via contaminated soil on farm equipment and vehicles (Gazaway, 1996). A second survey ten years later indicated that reniform nematode had spread throughout most of the state including the Tennessee Valley in north Alabama, the state's major cotton producing region (Gazaway and McLean, 2003). Only the southeast Alabama counties where peanut is rotated with cotton have remained free of reniform nematodes. Reniform nematode's rapid spread and establishment during

this period was also occurring in the neighboring states of Louisiana (McLean and Lawrence, 2000; Overstreet and McGawley, 2000), and Mississippi (Hankins, et al., 1997; Sciumbato et al., 2002). By 2006, reniform nematodes accounted for $105 million in cotton yield losses in these three states alone (Blasingame and Patel, 2007). Losses to reniform nematodes in Alabama with approximately 565,000 acres exceeded $35 million in 2006.

During the 1990's and early 2000, most cotton farmers chose to keep their best land in continuous cotton and rely on nematicides to control reniform nematode infestations rather than rotating to other crops. Aldicarb (Temik 15G®) and 1,3-dichloroprene (1, 3-D) (Telone II®) have been the two most effective and commonly used nematicides in cotton (Gazaway et al, 2001). 1, 3-D is applied 1- to 3-weeks prior to planting while aldicarb is applied in the seed furrow at planting. The primary goal is to protect the cotton seedlings' roots from reniform nematode for 4- to 6-weeks until the plant can develop a strong root-system. Additional post-plant applications of aldicarb and oxamyl (Vydate CLV®) later in the season at pin head square have had success in some cases but can be inconsistent (Lawrence and McLean, 2000).

Both 1, 3-D (Telone II®) and aldicarb (Temik 15G®) have advantages and disadvantages. Soil and climatic conditions at the time or shortly after application determine the nematicides' effectiveness. Aldicarb applied to soil when it is too dry will not be activated or if applied just before a heavy rain, it can be washed out of the root zone. 1, 3-D, a fumigant, is ineffective if injected when the soil is cold and too wet. Moreover, 1, 3-D, although an excellent nematicide, is restricted to fields in south and central Alabama because in Alabama it can only be applied in fields that plant on raised seed beds.

Most Alabama cotton farmers preferred aldicarb because they could apply this granule in the seed furrow at planting to any type of cotton tillage system. Since cotton farmers were already using a low rate of aldicarb applied at 504 g a.i./ha to control early season insects, they achieved acceptable or good reniform nematode control at a little additional cost by simply adding another 336 g a.i./ha (i.e.840 g a.i./ha). Except for the occasional use of 1, 3-D, cotton farmers relied almost entirely on aldicarb to manage reniform nematodes from the mid 1980s through 2000. In some fields, the wide spread and constant use of aldicarb led to its rapid decomposition in the soil by microbes, rendering the nematicide ineffective against reniform nematodes (McLean and Lawrence, 2003; Lawrence, et al., 2005a). Although cotton farmers had reasonable success with nematicides in many fields, some cotton fields have such high reniform populations that even nematicides can not eliminate the economic damage caused by the nematode.

Currently, no commercial cotton varieties with resistance or tolerance to reniform nematodes are available (Usery, et al., 2005). Therefore, crop rotation is the only viable alternative for reducing reniform nematode populations to a manageable level. Moreover, crop rotation provides additional benefits by controlling weeds more efficiently, improving soil fertility and soil texture, and increasing organic matter.

Prior to 1990, little research had been conducted on the use of crop rotation to manage reniform nematodes in cotton (Robinson et al, 1997). To address the growing economic damage of the reniform nematode in Alabama , a series of rotation studies were conducted to: 1) to identify summer non-host crops that could be grown economically in Alabama and reduce reniform nematode populations; 2) determine the minimum number of consecutive years that a non-host crop had to grown to reduce reniform populations and increase cotton yields; 3) determine the number of consecutive years cotton could be grown following rotation before reniform populations rebounded and cotton yields were reduced; 4)

determine the effect of winter cover crops with non-host crops on reniform populations and cotton yields; and 5) determine if nematicides applied to cotton following rotation with non-host crops would further increase cotton yields.

METHODS AND MATERIALS

The three fields, located on the Ward Brothers' farm (Escambia county) in south Alabama, were selected for the rotation studies because they have a history of severe economic cotton yield losses due to reniform nematodes. Two fields are adjacent to each other and directly across the road from the third field. The current rotation study (i.e. rotation/nematicide study) is located in the first field where reniform nematodes were found causing economic damage to cotton in Alabama in 1985 (Gazaway, 1997). Soil in this field is a sandy loam (49 – 56 % sand, 15 - 34 % silt, 12 - 17 % clay, 2.2 - 1.9% OM, and pH 6.0- 6.2) that has been cropped continuously with cotton.

Original non-host crop rotation study (Trial A): The original rotation study, conducted from 1994 through 1997, was designed to find suitable and profitable non-host crops that could be rotated with cotton to manage reniform nematodes. The non-host crop rotation study compared the effect of twelve rotations and/or nematicide systems on reniform populations and cotton yield (Table 1). Crops evaluated consisted of upland cotton (*Gossypium hirsutum)*, grain sorghum *(Sorghum bicolor)*, soybean (*Glycine max*) and bahia- grass (*Paspalum notatum*) in 1, 2 and 3 years rotations. Cotton *(c.v. DES 119*), grain sorghum (*c.v DeKalb DK-55* in 1994 and 1995*, c.v. DeKalb DK64BR* in 1996 and 1997), and soybean (*c.v. Centennial*) were rotated with one year of cotton at 1-, 2- and 3- year intervals, respectively. Bahiagrass (*c.v. Pensacola*) was rotated with one year of cotton at 2- and 3-year intervals (Table 1). The 12 treatments were arranged in a randomized complete block design with 8 replicates. Plots were 8 rows 0.965m wide and 15.24 m long on raised seed beds. Aldicarb (Temik 15G®) was placed at 1176 g a.i./ha in the seed furrow at planting to designated nematicide plots. Disulfoton (Di-Syston 15G®) was applied in furrow at 840 g a.i./ha to all other plots for early season insect control. All plots were maintained throughout the season with herbicide, insecticide, fertility, and cultural production practices as recommended by the Alabama Cooperative Extension System. Crops yields and soil analyses for nematode data were collected from the two center rows of each plot.

Winter cover crop/rotation study (Trial B): This study was initiated to evaluate the combined effects of winter cover crops, summer non-host crops, and nematicides on subsequent cotton yield and reniform nematode levels. The winter cover crop treatments consisted of vetch (*Vica villosa c.v. Cahaba White*), rye *(Secale cereal c.v. Wren's Abruzzi*), or fallow. The summer crops were peanut (*c.v. Southern Runner*), corn (*c.v. Garst AP 588-RR*), soybean (*c.v. Centennial)* in 1999, and c.v. *AgroPro 588-RR* from 2000 to 2003) and continuous cotton (*c.v. DPL-458* in 1998, c.v. *DPL-655BG/RR* from 1999 to 2003). One half of the continuous cotton plot (i.e. 4 rows) received the nematicide, aldicarb at 1176 g a.i./ha. Disulfoton was applied in furrow at 840 g a.i./ha to the remaining 4 cotton rows for early season insect control. Winter cover crops were the primary factor in the experimental design with the summer rotation crops and nematicides serving as the secondary and third factors, respectively. The test was a factorial arrangement in a randomized split block design with 5 replications. Plots were 8 rows 7.3 m wide and 7.6 m long. Winter cover crops, vetch and rye, were cut, turned under, and the field disked approximately 4 weeks prior to planting the summer crops. Soil samples for nematode analyses were taken in the spring from the two center rows just prior to planting the summer crops and in the fall after harvest when soil moisture was adequate. Cotton was mechanically picked from the two center rows of each plot. All plots were maintained as previously described.

The rotation/nematicide study (Trial C): A third rotation study began in 2005 to determine if the addition of a nematicide to cotton following the various rotation schemes would further enhance cotton yield. Since cotton damage to reniform nematodes varies greatly from year to year depending upon growing conditions, the test is designed to compare cotton yield and reniform nematode populations following 1- or 2-year rotations with non-host crops the same year every year beginning in 2007 (Table 2). The rotation/nematicide treatments are summarized in Table 3. The field trial is a split-plot design with nematicides as the primary factor and summer non-host crops as the secondary factor with treatments replicated four times. All non-host crop plots and continuous cotton plots are 8 rows wide and 12.19 m long. Cotton plots are split into (2) 4-row subplots, one subplot is selected at random and treated with the nematicide 1, 3-D. The entire field was planted in the winter (2005) with a rye cover crop which was cut the following spring, plowed and disked 6 weeks prior to planting the summer crops. The nematicide, 1, 3-D, was injected 45.7 cm deep at a rate of 28 l/ha into raised seedbeds to designated nematicide plots three weeks before planting. Cotton seed (*cv*. DPL-449BG/RR) was treated with thiamethoxam (Cruiser®) for early season insect control. Corn (*cv*. Pioneer 33M53RR), peanut (*cv*. AP3), and soybean (*cv*. DP5634RR) were planted in the non-host plots on the same day as cotton.

Parameters measured: Nematode samples were collected at planting and at harvest in all rotation systems. Twenty soil cores, 2.5 cm in diameter and 20 cm in depth, were collected using a systematic zig-zag sampling pattern. Upon collection, each plot samples was placed in a sealed plastic bag, labeled, and contained within an insulated ice chest for transport to the Auburn University Plant Diagnostic Laboratory. The soil was mixed thoroughly and a 100 cm^3 sub sample was removed. In 1994 and 1995 nematodes were extracted using the salad bowl technique (Rodriguez and Pope, 1981). From 1996 through 2006, nematodes were extracted from the soil by combined gravity screening and sucrose (specific gravity = 1.13) centrifugal flotation and enumerated with a stereo-microscope. In all years over all studies, cotton yields were harvested with a mechanical plot cotton picker from the two center rows of each cotton 4-row plot.

Statistical analysis: For statistical purposes, ANOVA was performed on all data on each trial and treatment effects considered significant where $P \leq 0.10$. Within each trial, treatment effects were examined utilizing LSD and data were combined where no interactions occurred (Statistix 8.0 Analytical Software, P.O. Box 12185, Tallahassee, FL 32317-2185). In Trial A, there was a Year X Rotation interaction detected for the one year rotation regimen; therefore, spring nematode population data were analyzed separately by year. In Trial B, there were Year X Cover X Rotation interactions for spring nematode populations and seed cotton yield; therefore, these data were also analyzed separately by year. Where there was an absence of treatment interactions on nematode population or seed cotton yield, the main effects were compared.

RESULTS AND DISCUSSION

Original non-host crop rotation study (Trial A). The non-host crop rotation for one season increase cotton yields from 269 kg/ha to 544 kg/ha when averaged over 1995 and 1997 (Table 3). The 1 year soybean rotation (+630 kg/ha in 1995, +521kg/ha in 1997) and 1 year grain sorghum rotation (+747 kg/ha in 1995, +336 kg/ha in 1997) produced significantly higher yields than did untreated continuous cotton (Table 1). Aldicarb treated continuous cotton produced only slightly better yields than did untreated continuous cotton in 1995, but out produced untreated continuous cotton by a significant margin (+ 322 kg/ha) in 1997. Reniform spring populations in all treatments were relatively small in both 1995 and 1997 (Table 3). These low populations could result from either sampling the field

when the was too dry or using the salad bowl extraction technique (Rodriguez and Pope, 1981) which does not appear to be as efficient as our current gravity screening-sucrose method for extracting the reniform nematode species. In 1996, cotton was harvested following a 2 year rotation with non-host crops (Table 3). This season had excellent growing conditions for cotton and produced good cotton yields despite high reniform numbers as reflected by high yields in all treatments including in the untreated continuous cotton (Table 3). The aldicarb treated cotton produced the lowest yields. Possible nematicide toxicity early in the season might have accounted for the lower yields. In 1997, cotton was harvested following both 1 year and 3 year non-host rotations (Table 3). Yield following 3 years of bahiagrass, although significantly greater than untreated continuous cotton, was smaller than expected. The 3 year corn rotation produced the highest yields followed by those following grain sorghum (Table 3). Fall reniform populations rebounded to damaging levels after just one season of cotton, even after a rotation of 3 successive years with a non-host (Table 3). These results clearly indicate that cotton should not be grown more than 1 year in any rotation system.

Conclusion for Trial A: Crop rotation is a viable and efficient alternative for managing reniform nematodes according to this four year study. The feasibility of rotation will depend upon the availability of profitable non-host crops. The use of nematicides following a 1 year rotation or even a 2 year rotation with non-host crops would be advisable in cotton fields that support large populations of reniform nematodes. Most cotton producers in Alabama will consider rotating cotton with a non-host crop for 1 year or even 2 years but not for 3 years. Only cotton producers who have livestock and pastureland would consider 3 year rotations. Although the 1 year corn rotation produced mixed results in 1995 and 1997, it still seems to be a viable choice for cotton producers. Soybean (*c.v. Centennial*) also performed well in a 1 year rotation and would be a good choice for cotton producers. However, reniform nematodes feed and produce exceeding well on other soybean cultivars; so, farmers should be cautious in selecting other soybean cultivars to manage reniform. Grain sorghum performed equally well as soybean, but Alabama farmers will not grow it because they do not have a market for it.

Winter cover crop/ rotation study (Trial B). Winter cover crops or fallow did not significantly impact reniform populations in the spring of 1999, 2001, and 2003 when cotton was produced (Table 4). Spring populations were extremely variable from season to season and, therefore, are reported separately. There were no significant reniform population differences in the spring among the winter cover crops in any of the three years. Although not significantly different, vetch which has been reported to be extremely susceptible to reniform nematodes under greenhouse conditions (Jones et al., 2006), had smaller reniform populations than had either rye or fallow in the field. Reniform populations were significantly smaller in the fall following a season of cotton. However, this phenomenon is not unusual since healthier cotton often supports higher reniform populations in the fall because it has a larger root system for reniform to feed and reproduce on. Spring reniform numbers were also variable in 1999, 2001, and 2003 following summer crops produced in 1998, 2000, and 2002 seasons (Table 4). Spring reniform populations following a previous season of cotton were significantly larger than those following corn, peanut, or soybean (Table 4). Following a season of cotton, corn, peanut, and soybean also had significantly smaller fall populations than continuous cotton. However, fall populations in summer non-host crops and continuous cotton were well above the Alabama Cooperative Extension System's recommended threshold level of 1000 vermiform life stages per 100 cm^3 and would require corrective action.

Winter cover crops did not appear to affect cotton yield (Table 4). Cotton yield following vetch in 1999 was slightly better than fallow (271 kg/ha) or rye (900 kg/ha) but was not significantly better in 2001 or in 2003 when there were no yield differences among any of the three cover crops. This slight yield increase could have been due to the addition nitrogen provided by this legume cover crop.

All summer non-host crops produced an average of 407 kg/ha more seed cotton than did continuous cotton in 1999 (Table 4). Only cotton following peanut produced significantly larger yields than did continuous cotton in 2001. Although not significantly higher than other treatments, cotton following corn and soybean produced numerically greater yields. The smaller cotton yield following soybean in 2001 was likely due to the change in the soybean cultivar the previous year from the highly resistant '*Centennial*' c.v. to the less resistant '*AgroPro 55*' c.v. In 2003, there were no statistical differences in yield between non-host crops and continuous cotton although cotton yields following corn and soybean were higher by 351 kg/ha and 229 kg/ha, respectively. Cotton yields following soybean were similar to the continuous cotton yields. However, the smaller than expected cotton yield in the cotton plots following peanut is misleading because an extremely high population of volunteer peanuts undoubtedly suppressed cotton yield in those plots.

Trial B Conclusions: The two winter cover crops and fallow appeared to have no effect on reniform numbers. Corn, peanut and possibly soybean in a 1 year rotation with cotton is a viable alternative for managing reniform nematodes.

The rotation/nematicide study (Trial C): 1, 3-D improved cotton yields in all treatments except in the treatment where cotton followed corn (Table 5). It increased yields most (412 kg/ha) when applied to cotton following cotton (Table 5). 1, 3-D when applied to cotton following soybean and to cotton following peanut produced a significant increase in yields of 219 kg/ha and 191 kg/ha, respectively. The 1, 3-D treated cotton following a one year rotation with corn was only slightly greater numerically (72 kg/ha) than the untreated cotton following corn. Cotton treated with 1, 3-D following peanut in 2005 produced the highest cotton yield in 2006 (Table 5).

Looking at the impact of non-host crops alone, a one year peanut or corn rotation produced significantly larger cotton yields than a one year soybean rotation with cotton or continuous cotton (Table 5). The yield increase is reflected in smaller fall populations of reniform nematode following one season of peanut and corn (Table 5). It is also noteworthy to point out that the lowest reniform populations occurred in the plots following two years of peanut and corn. Whether the lower reniform populations in the two year peanut and corn rotation systems will produce an even greater increase in cotton yield will not be known until next year (2007) when cotton yield data will be taken from both the one year and the two year rotation systems.

Rotation/Nematicide Trial C Conclusions: A 1 year rotation with either corn or peanut increased cotton yields substantially. The 1 year soybean rotation failed to increase cotton yields, however. Soybean's failure could be attributed to the loss of '*Centennial* c.v. Since then no reniform resistant, commercial soybean cultivars with Centennial's resistance have been available (Robbins et al, 2001). The fumigant, 1,3-D, was quite effective in the 2006 test. It increased cotton yields in continuous cotton and in cotton following all non-host crops except corn. Although this is just one year's data, it may be possible that the nematicide, 1,3-D, applied to cotton following 1 year rotations with non-host crops could provide profitable returns. More data will be needed in the future before we will know for certain.

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Table 1. Cropping schemes from 1994 through 1997. Trial A.

Rotation	1994	1995	1996	1997
1	corn	corn	cotton	corn
2	corn	corn	corn	cotton
3	corn	cotton	corn	cotton
4	grain sorghum	grain sorghum	cotton	grain sorghum
5	grain sorghum	grain sorghum	grain sorghum	cotton
6	grain sorghum	cotton	grain sorghum	cotton
7	bahiagrass	bahiagrass	bahiagrass	cotton
8	bahiagrass	bahiagrass	cotton	bahiagrass
9	soybean	soybean	cotton	soybean
10	soybean	cotton	soybean	cotton
11	cotton	cotton	cotton	cotton
12	cotton +N[z]	cotton +N	cotton +N	cotton +N

[z] N- aldicarb applied the seed furrow at 1170 g a.i./ha at planting for nematode **control.**

Table 2. Rotation scheme for the non host rotation/nematicide study (Trial C):

NR	TREATMENT	Treatment[z]	2005	2006	2007	2008	2009	2010
1	corn 1 Year	nematicide	cotton	corn	cotton	corn	cotton	corn
2	corn 1 Year	no nematicide	cotton	corn	cotton	corn	cotton	corn
3	peanut 1 Year	nematicide	cotton	peanut	cotton	peanut	cotton	peanut
4	peanut 1 Year	no nematicide	cotton	peanut	cotton	peanut	cotton	peanut
5	soybean 1 Year	nematicide	cotton	soybean	cotton	soybean	cotton	soybean
6	soybean 1 Year	no nematicide	cotton	soybean	cotton	soybean	cotton	soybean
7	corn 2 Year	nematicide	corn	corn	cotton	corn	corn	cotton
8	corn 2 Year	no nematicide	corn	corn	cotton	corn	corn	cotton
9	peanut 2 Year	nematicide	peanut	peanut	cotton	peanut	peanut	cotton
10	peanut 2 Year	no nematicide	peanut	peanut	cotton	peanut	peanut	cotton
11	soybean 2 Year	nematicide	soybean	soybean	cotton	soybean	soybean	cotton
12	soybean 2 Year	no nematicide	soybean	soybean	cotton	soybean	soybean	cotton
13	cont. cotton	nematicide	cotton	cotton	cotton	cotton	cotton	cotton
14	cont. cotton	no nematicide	cotton	cotton	cotton	cotton	cotton	cotton
15	corn 1 Year	nematicide	corn	cotton	corn	cotton	corn	cotton
16	corn 1 Year	no nematicide	corn	cotton	corn	cotton	corn	cotton
17	peanut 1 Year	nematicide	peanut	cotton	peanut	cotton	peanut	cotton
18	peanut 1 Year	no nematicide	peanut	cotton	peanut	cotton	peanut	cotton
19	soybean 1 Year	nematicide	soybean	cotton	soybean	cotton	soybean	cotton
20	soybean 1 Year	no nematicide	soybean	cotton	soybean	cotton	soybean	cotton
21	corn 2 Year	Nematicide	cotton	corn	corn	cotton	corn	corn
22	corn 2 Year	no nematicide	cotton	corn	corn	cotton	corn	corn
23	peanut 2 Year	Nematicide	cotton	peanut	peanut	cotton	peanut	peanut
24	peanut 2 Year	no nematicide	cotton	peanut	peanut	cotton	peanut	peanut
25	soybean 2 Year	Nematicide	cotton	soybean	soybean	cotton	soybean	soybean
26	soybean 2 Year	no nematicide	cotton	soybean	soybean	cotton	soybean	soybean
27	corn 2 Year	Nematicide	cotton	cotton	corn	corn	cotton	corn
28	corn 2 Year	no nematicide	cotton	cotton	corn	corn	cotton	corn
29	peanut 2 Year	Nematicide	cotton	cotton	peanut	peanut	cotton	peanut
30	peanut 2 Year	no nematicide	cotton	cotton	peanut	peanut	cotton	peanut
31	soybean 2 Year	Nematicide	cotton	cotton	soybean	soybean	cotton	soybean
32	soybean 2 Year	no nematicide	cotton	cotton	soybean	soybean	cotton	soybean

z Nematicide, Telone II, is only applied to cotton plots and is not applied to non-host plots even though indicated in Table.

Table 3. Effect of 1, 2 and 3 year crop rotations on reniform nematodes and cotton yield, Trial A.

		1 year rotation			
		1995	1997	1995 +1997 combined	
		Spring	Spring	Fall	Seed
Rotation	Years	nematode	nematode	nematode	Cotton
crop	conducted	population	population	population	Yield

		no./100cc			kg/ha
corn	1995-1997	12	22	2257	1898
grain sorghum	1995-1997	9	15	2189	2172
soybean	1995-1997	13	30	1654	2169
continuous cotton	1995-1997	6	174	1329	1629
cotton + Temik	1995-1997	2	197	1268	1872
Pr>F (year * rotation)		0.0044		0.1703	0.0176
Pr>F		0.0001	0.0001	0.1184	0.0001
LSD (0.10)		149	55	NS	177
C.V. (%)		70	74	78	15
		2 year rotation			
		1996			
		Spring	**Fall**	**Seed**	
Rotation	**Years**	**nematode**	**nematode**	**cotton**	
Crop	**conducted**	**population**	**population**	**yield**	
		no./100 cc		**kg/ha**	
bahiagrass	1994-1996	11	776	2814	
corn	1994-1996	29	545	2751	
grain sorghum	1994-1996	23	611	2768	
soybean	1994-1996	19	712	2649	
continuous cotton	1994-1996	81	850	2685	
cotton + Temik	1994-1996	89	678	2394	
Pr>F		0.0014	0.5065	0.0784	
LSD (0.10)		50	NS	235	
C.V. (%)		101	48	11	
		3 year rotation			
		1997			
		Spring	**Fall**	**Seed**	
Rotation	**Years**	**nematode**	**nematode**	**cotton**	
crop	**conducted**	**population**	**population**	**yield**	

		no./100 cc		kg/ha	
bahiagrass	1994-1997	14	2384	2148	
corn	1994-1997	10	2397	2428	
grain sorghum	1994-1997	10	2439	2132	
continuous cotton	1994-1997	174	2089	1606	
cotton + Temik	1994-1997	197	2133	1928	
Pr>F		0.0001	0.9138	0.002	
LSD (0.10)		55	NS	311	
C.V. (%)		81	41	18	

Table 4. Effect of cover crop and crop rotation on reniform nematode population and cotton yield, Trial B.								
					Fall			
		Spring nematode population			nematode	Seed cotton yield		
		1999	2001	2003	population	1999	2001	2003
		no./100 cc					kg/ha	
Cover crop								
rye		121	407	1190	2904	2417	3113	2939
fallow		121	225	1183	2774	3046	3376	2962
vetch		159	225	984	2515	3317	3149	3138
Pr>F	cover crop	0.3852	0.1201	0.4047	0.0449	0.0002	0.5449	0.548
Pr>F	rotation	0.0035	0.0001	0.0002	0.0199	0.0009	0.058	0.1758
Pr>F	cover X rotation	0.0003	0.7823	0.1306	0.9736	0.9211	0.635	0.3649
Pr>F	year X cover X rotation		0.0001		0.7132		0.0633	
LSD (0.10)		NS	NS	NS	241	224	NS	NS
C.V. (%)		71	98	47	26	13	25	18
Rotation								
corn		90	74	540	2411	3148	3186	3309
peanut		43	247	838	2542	3070	3653	2823
soybean		178	159	900	2643	3049	3059	3075

cotton		224	663	2198	3329	2438	2953	2846
cotton + Aldicarb	[z](Comparison only)				3290			
LSD (0.10)		74	103	483	470	249	428	NS
C.V. (%)		35	55	66	46	13	21	17
[z]Not included in the statistical analysis. Comparisons included for information only.								

Table 5. Effect of crop rotation and nematicide treatment on reniform nematodes and cotton yield, Trial C.

		2006			
		Spring	**Fall**	**Seed cotton yield**	
Rotation		**nematode**	**nematode**	**kg/ha**	
		population	**population**	**Nematicide**	**No nematicide**
2005	**2006**	**no./100 cc**			
cotton	cotton	1140	3450	1943	1531
cotton	corn	1087	367	NA	NA
cotton	peanut	1081	383	NA	NA
soybean	cotton	856	3235	1815	1596
corn	cotton	753	2592	1980	1908
cotton	soybean	528	315	NA	NA
peanut	cotton	257	2321	2060	1870
Comparison only[z]					
corn	corn	219	61		
peanut	peanut	335	106		
soybean	soybean	798	256		
Pr>F	rotation	0.011	0.0001	0.0001	
Pr>F	nematicide	0.4438	0.1072	0.0073	
Pr>F	rotation x nematicide	0.5202	0.1809	0.0649	
LSD (0.10)		407	766	169	
C.V. (%)		58	49	13	
	Nematicide			**Seed cotton yield**	
				kg/ha	
	nematicide			1949	
	no nematicide			1726	
	Pr>F			0.0579	
	LSD (0.10)			138	
	C.V. (%)			13	

[z]Not included in the statistical analysis. Comparisons included for information only.