

Crop rotation for the control of reniform nematodes.

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Abstract: The reniform nematode (*Rotylenchulus reniformis*) replaced the root-knot nematode (*Meloidogyne incognita*) as the major nematode cotton pest in Alabama. Cotton farmers have been able to manage moderate to heavy reniform populations with nematicides, but have been unsuccessful managing extremely high reniform populations. Only rotation with non-susceptible summer crops has been successful in these extreme cases. To address the growing economic damage of the reniform nematode in fields with extremely high reniform nematode populations, a series of rotation studies including non-host crop rotations with and without nematicides applied 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. In 2006, a nematicide application (Telone at 3 gal/a) 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. Telone was as effective as a one year rotation with corn in increasing cotton yield. In 2007, however, Telone failed to improve cotton yields. Lack of a yield response could have been caused the extreme drought (<16 in.) during the growing season.

Materials and Methods

The rotation/nematicide study : This 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 1). The soil is a Ruston Very Fine 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 for several years. The field trial is a split-plot design with nematicides as the 1^o factor and summer non-host crops as the 2nd factor with 4 reps. All non-host crop plots and continuous cotton plots are 8 rows wide and 40 ft long. Cotton plots are split into (2) 4-row subplots, one subplot is selected at random and treated with the fumigant, Telone II. The entire field was planted in the winter with a rye cover which was cut in the spring, plowed and disked 6 weeks prior to planting the summer crops. Telone II was injected 18 inches deep at a rate of 3 gal/a into raised seedbeds to designated nematicide plots three weeks before planting. Cotton seed (DPL-449BG/RR) was treated with Cruiser® for early season insect control. Corn (Pioneer 33M53RR), peanut (AP3), and soybean (DP5634RR) were planted in the non-host plots on the same day as cotton.

Nematode samples were collected at planting and at harvest. Twenty soil cores, 1 in. diam. and 6 in. deep, were collected using a zig-zag sampling pattern. Plot samples were placed in plastic bags, labeled, and transported in an ice chest to the Auburn University Plant Diagnostic Laboratory. Nematodes were extracted from the soil by combined gravity screening and sucrose 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). Where there was an absence of treatment interactions on nematode population or seed cotton yield, the main effects were compared.

Results and Discussion

In 2006, Telone, 3 gal/a improved cotton yields in all rotations except where cotton followed corn (Table 2). It increased yields most 368 lb/a when applied to cotton following cotton (Table 2). Telone when applied to cotton following soybean or peanut produced a increase in yield of 195 lb/a and 170 lb/a, respectively. Telone treated cotton following a 1 year rotation with corn was only slightly greater numerically (64 lb/a) than the untreated cotton following corn. Cotton treated with Telone following peanut in 2005 produced the highest cotton yield in 2006 (Table 2). In 2007, Telone failed to improve cotton yields significantly (Table 3).

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 in 2006 (Table 2). Two thousand-seven (2007) was the first year that yields from the 1-year and 2-year rotation could be compared directly. Both the 1- and 2-year rotations improved cotton yields significantly over continuous cotton. The 2-year rotation was numerically but not significantly superior to the 1-year rotation (Table 3). The yield increase is reflected in smaller 2006 fall populations of reniform nematode following one season of peanut and corn (Table 2). It is also noteworthy that in the fall of 2006 the lowest reniform populations occurred in the plots following 2 years of peanut and corn but there were no significant differences in reniform populations between the 1- and 2-year rotations in the fall of 2007 (Table 4).

This test has undergone severe drought conditions during both the 2006 and 2007 growing seasons. In 2007, the test received 16 inches of rain the entire growing season. Consequently, both cotton yields and reniform nematode populations have been adversely impacted due to the lack of soil moisture. A real response to crop rotation and nematicide treatment has been undoubtedly compromised both years as a result of these unfavorable growing conditions. We will not have an accurate measure of the real affect of crop rotation and nematicide treatments until more normal growing conditions return.

Table 1. Rotation scheme for crop rotation study.

Rotation	Telone^z	2005	2006	2007	2008	2009
corn 1 year	+/-	cotton	corn	cotton	corn	Cotton
peanut 1 year	+/-	cotton	peanut	cotton	peanut	Cotton
soybean 1 year	+/-	cotton	soybean	cotton	soybean	Cotton
corn 2 year	+/-	corn	corn	cotton	corn	Corn
peanut 2 year	+/-	peanut	peanut	cotton	peanut	Peanut
soybean 2 year	+/-	soybean	soybean	cotton	soybean	Soybean
cont. cotton	+/-	cotton	cotton	cotton	cotton	Cotton
corn 1 year	+/-	corn	cotton	corn	cotton	Corn
peanut 1 year	+/-	peanut	cotton	peanut	cotton	Peanut
soybean 1 year	+/-	soybean	cotton	soybean	cotton	Soybean
corn 2 year	+/-	cotton	corn	corn	cotton	Corn
peanut 2 year	+/-	cotton	peanut	peanut	cotton	peanut
soybean 2 Year	+/-	cotton	soybean	soybean	cotton	soybean
corn 2 year	+/-	cotton	cotton	corn	corn	cotton
peanut 2 year	+/-	cotton	cotton	peanut	peanut	cotton
soybean 2 year	+/-	cotton	cotton	soybean	soybean	cotton

^zTelone, a nematicide, was applied to designated cotton plots.

Table 2. Effect of crop rotation and nematicide treatment on reniform nematodes and cotton yield in 2006.

		2006			
Rotation		Spring nematode population	Fall nematode population	Seed cotton yield lb/a	
2005	2006	no./100 cc		Nematicide	No nematicide
Cotton	Cotton	1140	3450	1734	1366
Cotton	Corn	1087	367	NA	NA
Cotton	Peanut	1081	383	NA	NA
Soybean	Cotton	856	3235	1619	1424
Corn	Cotton	753	2592	1767	1702
Cotton	Soybean	528	315	NA	NA
Peanut	Cotton	257	2321	1838	1668
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		151
C.V. (%)		58	49		13
Nematicide		Seed cotton yield lb/a			
	Nematicide			2006	2007
	No nematicide			1739	1597
	Pr>F			1540	1541
	LSD (0.10)			0.0579	0.5898 NA
	C.V. (%)			123	76
				13	

^zNot included in the statistical analysis. Comparisons included for information only.

Table 3. Effect of crop rotation and nematicide treatment on cotton yield in 2007.

2005	Crops		2007 Seed Cotton Yield lb/acre
	2006	2007	
Cotton	Corn	Cotton	1535
Cotton	Peanut	Cotton	1512
Cotton	Soybean	Cotton	1536
Corn	Corn	Cotton	1726
Peanut	Peanut	Cotton	1705
Soybean	Soybean	Cotton	1651
Cotton	Cotton	Cotton	1319
LSD (0.05)			257
Pr>F	Rotation		0.0001
Pr>F	Nematicide		0.5898 NA
Pr>F	Rotation x Nematicide		0.9848 NA

Table 4. Effect of crop rotation and nematicide treatment on reniform nematode populations in 2007.

2005	Crops		Telone	No Telone
	2006	2007	Reniform/ 100CC Soil	
Corn	Cotton	Corn	322 de	190 e
Peanut	Cotton	Peanut	369 de	242 e
Soybean	Cotton	Soybean	199 e	317 de
Cotton	Corn	Corn	149 e	175 e
Cotton	Peanut	Peanut	225 e	368 de
Cotton	Soybean	Soybean	334 de	297 de
Cotton	Corn	Cotton	953 b-e	1450 ab
Cotton	Peanut	Cotton	836 b-e	1293 abc
Cotton	Soybean	Cotton	918 b-e	1397 abc
Corn	Corn	Cotton	802 b-e	1197 a-d
Peanut	Peanut	Cotton	667 b-e	1371 abc
Soybean	Soybean	Cotton	867 b-e	1830 a
Cotton	Cotton	Cotton	1382 abc	1887 a
LSD (P=0.05)				511