2004 BELTWIDE COTTON CONFERENCES, SAN ANTONIO, TX – JANUARY 5-9

GREENHOUSE AND FIELD EVALUATIONS OF SELECTED WINTER COVER CROPS FOR RENIFORM NEMATODE SUPRESSION IN COTTON

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Abstract

The reniform nematode, *Rotylenchulus reniformis,* has become one of the most prevalent cotton (*Gossypium hirsutum* L.) pests in Alabama over the last decade. Cover crops that are non-hosts to *R. reniformis* could potentially decrease the inoculum for next season's cotton crop. Eight cover crops were evaluated for host suitability to the reniform nematode in the greenhouse and field trials. In the greenhouse, each cover crop was planted in autoclaved soil and inoculated with 2000 *R. reniformis*. The pots were harvested sixty days after inoculation. AU Robin crimson clover (*Trifolium incarnatum*), Hairy vetch (*Vicia sativa*), and Subterranean clover (*Trifolium subterraneum*) produced a reproduction factor (Rf = final population / initial population) of greater than one. Other crops evaluated had a reproduction factor of less than one indicating a reduction in the *R. reniformis* populations. The eight winter cover crops were planted in a field naturally infested with *R. reniformis* immediately following the cotton harvest. Nematode samples were collected monthly throughout the winter. Although an increase in *R. reniformis* populations was observed on Crimson clover, Subterranean clover, and Hairy vetch in the greenhouse the nematode populations did not increase over the winter in the field evaluation. These selected winter cover crops could potentially fit into the cotton production scheme providing an aid in reniform management.

Introduction

Nematodes were once considered minor pests, now they cost Alabama cotton producers millions of dollars in lost revenue. The reniform nematode is the most economically damaging nematode pest on cotton in Alabama with an estimated 8% annual yield loss in 2002. From 1998 to 2000, *R. reniformis* was found in 46% of the fields sampled over a 12 county cotton production area.

Several of the most extensively used nematicides are no longer available due to environmental and health concerns associated with them. Few nematicides are being registered as replacements, and as a result, the use of non-chemical management techniques is essential for control of plant-parasitic nematodes and a more sustainable agriculture. Furthermore, winter weeds possibly serve as a host for reniform nematodes during the crop-free season months when most fields are left fallow. In the southeastern United States, winter cover crops are very important in cotton production systems. Non-host cover crops affect nematode population densities potentially preventing economic losses due to damage in subsequent cash crops. Winter cover crops increase soil organic matter, improve soil tilth, decrease soil erosion, increase water penetration and retention, and provide grazing for cattle. Therefore, various cover crops were screened to determine effects on suppression of *R. reniformis* populations.

Materials and Methods

Greenhouse Evaluation

In 2002 and 2003, a greenhouse trial was conducted at the Plant Science Research Center on the campus of Auburn University. In the greenhouse, eight commonly used winter cover crops were evaluated in comparison to cotton (Paymaster 1218 BR) and a fallow soil treatment for host suitability to *R. reniformis*. Selected cover crops and cotton were planted in autoclaved soil. Each test was arranged in a RCBD with five replications and repeated two times. Seeds were allowed to germinate and grow for seven days before inoculation with 2000 *R. reniformis* juveniles and vermiform adults per 500cc of soil. Pots were harvested 60 days after inoculation. Nematodes were extracted using gravity screening and sucrose centrifugation. Eggs were extracted from roots of cover crops using a 10% NaOCl solution. *Rotylenchulus reniformis* populations were enumerated using a stereomicroscope.

Field Evaluation

In the winter of 2002 and 2003, a field trial was conducted in Prattville, AL. Eight commonly used winter cover crops were planted in a field naturally infested with *R. reniformis* immediately following the cotton harvest. Fallow treatments with and without weeds were added as controls. Field plots, 30 ft in length and 10 ft in width, were arranged in a RCBD with five replications. Cover crops were sowed following seeding rates recommended by the Alabama Cooperative Extension System using a field plot grain drill with a row spacing of 7.5 in. Nematode samples were collected at 30 day intervals throughout the winter. Twenty soil cores, 1in. in diameter and 8 in. in depth, were collected monthly using a systematic zig-zag sampling pattern. A 150cc subsample of soil was taken from the twenty soil cores for enumeration. Nematodes were extracted and

enumerated using the methods previously described. All data were statistically analyzed using PROC ANOVA, and means were compared with Fisher's protected least significant difference test ($P \leq 0.05$).

In April 2003, cover crops were burned down with Roundup (glyphosate) at 2 qt/A and planted with DP 451 BR Cruiser treated seed. Plots consisted of four rows, 36 in wide and 30 ft long. Each plot was split and Temik 15G (aldicarb) was applied with a granular applicator attached to the planter at 7lbs/A to two rows. Soil cores, 1 in. in diameter and 8 in. in depth, were collected monthly using a systematic zig-zag sampling pattern. A 150cc sub sample of soil was taken from the original samples for enumeration. Nematodes were extracted and enumerated using the methods previously described.

Results and Discussion

Greenhouse Evaluation

In the greenhouse, all cover crops tested supported significantly lower populations of *R. reniformis* compared to cotton (Table 1). AU Robin crimson clover *(Trifolium incarnatum*), Subterranean clover (*Trifolium subterraneum*), and Hairy vetch (*Vicia sativa*) supported *R. reniformis* reproduction. Each of these crops produced a Rf value greater than one indicating the nematodes were increasing in number with only the specific crop as a food source. The cover crops that produced a Rf value greater than one should be limited in rotation systems for management of *R. reniformis*. All other cover crops tested produced Rf values less than one indicating the nematode was decreasing in numbers.

Field Evaluation

The field trial was planted December 1, 2002 immediately following the cotton harvest. Populations of *R. reniformis* in the field ranged from a high of 3635 to a low of 1962 with an average of 2974 juveniles and vermiform adults per 150cc of soil (Table 2). Thirty days after planting the *R. reniformis* populations decreased to an average of 498 juveniles and vermiform adults per 150cc of soil with no differences ($P \leq 0.05$) between cover crops. Populations increased to an average of 654, 682, and 869 juveniles and vermiform adults per 150cc of soil at 60, 90, and 120 DAP, with no differences ($P \leq 0.05$) between cover crop treatments. Although AU Robin crimson clover, Subterranean clover, and Hairy vetch increase *R. reniformis* populations in the greenhouse, no increase was observed in the field over the winter months.

Cotton was planted into the cover crop residue on April 28, 2003. Thirty days after planting, *R. reniformis* populations averaged 647 for the untreated and 341 for Temik treated per 150cc of soil (Table 3). In plots that were not treated with Temik, *R. reniformis* populations increased to an average of 908, 1334, and 1376 juveniles and vermiform adults per 150cc of soil at 60, 90, and 120 DAP, respectively. Populations in the Temik treated plots increased to an average of 588, 1275, and 1599 juveniles and vermiform adults per 150cc of soil at 60, 90, and 120 DAP. *Rotylenchulus reniformis* populations were significantly higher ($P \leq 0.05$) in the Temik treated plots than the untreated plots at harvest. Seed cotton yields varied from 2502 to 1229 pounds per acre. All plots treated with Temik produced a greater ($P \leq 0.05$) seed cotton yield compared to the untreated plots. However, cotton following rye produced the lowest seed cotton yields with and without a nematicide.

Table 1. Evaluation of host suitability to *R. reniformis* in the greenhouse

Cultivar	Scientific Name	Common Name	Eggs/500cc soil	RR/500cc soil	Rf value *
AU Robin	*Trifolium incarnatum*	Crimson clover	131897 b	14523 b	7.2
Mt. Barker	*Trifolium subterraneum*	Subterranean clover	11363 c	4532 c	2.2
Gulf	*Lolium multiflorum*	Ryegrass	373 c	445 d	0.22
Wren's Abruzzi	*Secale cereale*	Rye	152 c	183 d	0.09
Hairy	*Vicia sativa*	Vetch	97412 b	7416 c	3.7
Soil Saver	*Avena strigosa*	Oat	306 c	201 d	0.10
Homer	*Lupinus albus*	Lupin	373 c	219 d	0.10
Coker 9663	*Triticum aestivum*	Wheat	255 c	296 d	0.14
PM 1218	*Gossypium hirsutum*	Cotton	241200 a	31698 a	15.8
		Fallow soil	---	147 d	0.07
LSD ($P \leq 0.05$)			51490	3634	---

*Rf = final population / initial population

Nematode populations reported as means from five replications

Means within columns followed by different letters are significantly different according to Fisher's LSD ($P \leq 0.05$)

Table 2. Evaluation of cover crops for host suitability to *R. reniformis* in a field trial

Treatment	December	January	February	March	April
Fallow w/weeds	2961 ab	597 a	479 b	329 b	540 cd
Fallow wo/weeds	3635 a	396 a	736 ab	597 ab	854 abc
Oat	2750 ab	643 a	762 ab	381 ab	695 bcd
Ryegrass	2925 ab	473 a	793 a	427 ab	741 abcd
Wheat	3502 a	376 a	638 ab	499 ab	901 ab
Rye	2966 ab	350 a	736 ab	685 ab	1060 a
Crimson clover	2502 ab	468 a	525 ab	479 ab	412 d
Subterranean clover	3352 a	659 a	659 ab	762 a	499 d
Lupin	1962 b	458 a	638 ab	762 a	592 bcd
Vetch	3182 ab	556 a	576 ab	556 ab	530 cd
LSD ($P \leq 0.05$)	1308	338	289	416	337

Nematode populations reported as means from five replications

Means within columns followed by different letters are significantly different according to Fisher's LSD ($P \leq 0.05$)

Table 3. *Rotylenchulus reniformis* populations and seed cotton yields

Treatment	June	July	August	September	Seed cotton/A
Fallow w/weeds	533 ab	1027 a	1426 ab	1369 b	2073 b
Fallow wo/weeds	473 ab	891 ab	1351 a-d	1555 b	2064 b
Oat	561 a	497 c	1434 ab	1349 b	2073 b
Ryegrass	522 ab	751 abc	1200 bcd	1429 b	2071 b
Wheat	584 a	744 abc	1194 bcd	1485 b	1824 c
Rye	538 ab	723 bc	1210 bcd	1411 b	1582 d
Crimson clover	357 b	754 abc	1135 cd	1287 b	2311 a
Subterranean clover	406 ab	836 ab	1109 d	1563 b	2175 ab
Lupin	432 ab	710 bc	1588 a	1921 a	2081 b
Vetch	533 ab	545 c	1398 abc	1503 b	2044 bc
LSD ($P \leq 0.05$)	185	286	281	339	229
Nematicide				Final populations	Seed cotton/A
Temik				1599 a	2263 a
No Temik				1376 b	1797 b
LSD ($P \leq 0.05$)				152	103

Nematode populations reported as means from five replications

Means within columns followed by different letters are significantly different according to Fisher's LSD ($P \leq 0.05$)