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EFFICACY OF NEMATICIDES WITH THRIPS-MANAGEMENT CONSIDERATIONS ON SOUTHERN ROOT-KNOT AND COLUMBIA LANCE NEMATODES IN GEORGIA

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Abstract

Five trials were conducted in 2003 to compare the efficacy of aldicarb (Temik 15G) to either imidacloprid (Gaucho 480F) or to thiamethoxam (Cruiser 5FS) alone and in combination with 1,3-dichloropropene (Telone II) in fields where nematodes were believed to be a problem on cotton. Temik 15G (5 lb/A at plant + 5 lb/A sidedress) was included in four of the five trials for comparison. Southern root-knot nematode, *Meloidogyne incognita*, was found at three sites; Columbia lance nematode, *Hoplolaimus columbus*, was found in the other two sites. The difference in yield between aldicarb and imidacloprid or thiamethoxam was never statistically significant; however the aldicarb numerically out-yielded one or the other of these compounds in three of four direct comparisons. When combinations of aldicarb + 1,3-dichloropropene were compared to combinations of 1,3-dichloropropene with either imidacloprid or thiamethoxam, differences in yield were not statistically significant; however the combination with aldicarb had the greater numerical yield in four of five trials. Because the interaction between location and treatment was not significant at p=0.05, data were analyzed across four field sites where aldicarb and imidacloprid were compared. Differences between aldicarb and imidacloprid were not significant nor were they different in combination with 1,3-dichloropropene. Yields from treatments that included 1,3-dichloropropene were significantly greater than those which included only aldicarb or imidacloprid, but were not different from the aldicarb applied in-furrow at planting followed by a sidedress application. Two applications of Temik 15G at 5 lb/A was as effective as Telone II treatments when populations of southern root-knot nematodes were moderate.

Introduction

Cotton growers in Georgia are becoming increasingly aware of the damage that parasitic nematodes are causing to their crop and the need to better manage the problem. In a survey of random fields conducted by agricultural agents within the Cooperative Extension Service in 2002, it was found that 68% of 1652 samples were infested with southern root-knot nematodes, 4.8% with reniform nematodes, and 2.9% with Columbia lance nematode. However, these percentages varied widely. For example, in a southern region of the state that included Brooks County, 94% of the samples submitted by those agents were infested with southern root-knot nematode. Reniform and Columbia lance nematodes were not found. However, in the Burke-Jefferson County region of the northeastern edge of the Coastal Plain, the percentage of samples infested with root-knot, reniform and Columbia lance nematodes were 46, 33 and 38, respectively.

Although many cotton growers who would benefit from improved management of nematodes do not use nematicides, most do employ measures to reduce the impact of thrips on seedling cotton. A common strategy used by the growers has been to incorporate aldicarb (Temik 15G) at a “thrips” rate of 3.5 lb/A in the open furrow at planting. Recently, two seed treatments have become available for the management of thrips on cotton, imidacloprid (Gaucho 480F from Gustafson) and thiamethoxam (Cruiser 5FS from Syngenta), that may prove to be attractive alternatives for the grower. Many growers find that seed treatments are easier to use than granular in-furrow insecticides and the seed treatments are in some cases less expensive for the grower. However, aldicarb is not only an insecticide, but also has nematicidal properties as well. Generally nematicidal benefits are observed when the rate of Temik 15G is 5 lb/A or greater. Although 3.5 lb/A of Temik 15G is generally considered inadequate to manage nematodes, there is some evidence that it provides better control of this pest than either imidacloprid or thiamethoxam, neither of which is effective as a nematicide. For example, in a field trial conducted in Colquitt County in 2002 where the populations of southern root-knot nematodes reached levels over three times the “economic threshold” value, it was found that yields from plots treated with Temik 15G at 3.5 lb/A (498.8 lb lint/A) were significantly greater than from plots where the seed treatment Gaucho 480F at 8.0 fl oz cwt (429.3 lb lint/A) was used.

Telone II, 1,3-dichloropropene, is very effective in the management of nematodes; however it is not effective for the management of thrips. As more growers in the state consider the use of Telone II in their program, it is becoming increasingly important to determine if there is any benefit in nematode management to coupling the fumigant with Temik 15G (3.5 lb/A) as opposed to Gaucho 480F or Cruiser 5FS. The primary objective of this study was to answer this question. A secondary objective was to determine if indeed there was any advantage in a field where nematodes were an issue for the use of Temik 15G at 3.5 lb/A as opposed to seed treatments for thrips management. As a final objective, Telone treatments were compared to arguably the most effective Temik treatment, 5 lb/A in-furrow + 5 lb/A side-dress, to determine relative efficacy of such treatments.

Materials and Methods

To evaluate the impact of Temik 15G, Gaucho 480F and Cruiser 5FS when incorporated into a program for the management of nematodes, five trials were conducted in 2003. Three of the trials were conducted using large plots in growers' fields where southern root-knot nematodes were known to occur in the Colquitt-Mitchell County area. The other two trials were conducted in plots on the Southeast Georgia Research and Education Center in Midville where the Columbia lance nematode was known to occur. Temik 15G was compared to Gaucho 480F in three trials and to Cruiser 5FS in one trial. Telone II + Temik 15G was compared to Telone II + Gaucho 480F in four trials, to Telone II + Cruiser in a single trial, and to Temik 15G (5lb/A + 5 lb/A) in four trials. In all trials, Telone II was applied at 3 gal/A. Gaucho 480F was applied to the seed at 8.0 fl oz/cwt. Cruiser 5FS was applied at a rate of 32g/100,000 seed.

Trial 1. Southeast Georgia Research and Education Center, Midville, Burke County (Cruiser 5FS)
A trial was established at the Southeast Georgia Research and Education Center, Midville, GA to evaluate nematicide treatments for management of Columbia lance nematode on cotton. The field in which the test was conducted is planted annually to cotton and has a history of losses to Columbia lance nematode. The soil type in the field is a Dothan loamy sand. Cotton (DP 458 B/R) was planted on 2 Jun on 38 in. rows with a John Deere Max Emerge II planter. In treatments which included Telone II (1,3-dichoropropene), Telone was applied on 13 May. Tillage in the study was conventional and the field was irrigated. The experimental design was a randomized complete block with four replications. Plots were four rows wide by 75 ft in length. Plots were managed throughout the study according to guidelines from the Cooperative Extension Service. Soil samples were collected for nematode analysis on 10 Jun, 18 Jul, and 5 Dec. Plots were harvested on 20 Nov.

Trial 2. Southeast Georgia Research and Education Center, Midville, Burke County (Gaucho 480F)
A trial was established at the Southeast Georgia Research and Education Center, Midville, GA to evaluate nematicide treatments for management of Columbia lance nematode on cotton. The field in which the test was conducted is planted annually to cotton and has a history of losses to Columbia lance nematode. The soil type in the field is a Dothan loamy sand. Cotton (DP 555 B/R) was planted on 2 Jun on 38 in. rows with a John Deere Max Emerge II planter. In treatments which included Telone II (1,3-dichoropropene), Telone was applied on 13 May. Tillage in the study was conventional and the field was non-irrigated. The experimental design was a randomized complete block with five replications. Plots were four rows wide by 75 ft in length. Plots were managed throughout the study according to guidelines from the Cooperative Extension Service. Soil samples were collected for nematode analysis on 13 May, 18 Jul, and 5 Dec. Plots were harvested on 20 Nov.

Trial 3. Perryman Farm, Colquitt County (Gaucho 480F)
A trial was established at the Craig Perryman farm in Colquitt County, GA to evaluate nematicide treatments for management of southern root-knot nematode on cotton. The field had been planted annually to cotton and had a history of severe losses to nematodes. The field site contained a mix of Irvington and Tifton loamy sands. Telone II (3 gal/A) was applied to appropriate plots on 29 Apr. Cotton (DP 555B/R) was planted on 5 May on 38-in. wide rows. Tillage in the study was conventional and the field was non-irrigated. The experimental design was a randomized complete block with four replications. Plots were four rows wide by the length of the field (approximately 2000 ft). Side-dress over the plant canopy applications of Temik 15G (5 lb/A) were made on 28 May. Plots were managed throughout the study according to guidelines from the University of Georgia Cooperative Extension Service. Soil was sampled for nematodes on 29 Apr, 17 Jul, and 2 Oct. Plots were harvested 20 Oct.

Trial 4. Winhausen Farm, Mitchell County (Gaucho 480F)
A trial was established at the Tom Winhausen farm in Mitchell Co., GA to evaluate nematicide treatments for management of southern root-knot nematode on cotton. The field had a history of severe losses to nematodes. The field site contained Tifton loamy sand. Telone II (3 gal/A) was applied to appropriate plots on 28 Apr. Cotton (DP 555 B/R) was planted on 7 May. Tillage in the study was strip-till and the field was irrigated. The experimental design was a randomized complete block with three replications. Plots were four rows wide by the length of the field. Side-dress over the plant canopy applications of Temik 15G (5 lb/A) were made on 11 Jun. Plots were managed throughout the study according to guidelines from the University of Georgia Cooperative Extension Service. Soil was sampled for nematodes on 28 Apr, 9 Jul, and 4 Nov. Plots were harvested on 17-18 Oct.

Trial 5. Collins Farm, Mitchell County (Gaucho 480F)

A trial was established at the Bryant Collins farm in Mitchell County, GA to evaluate nematicide treatments for management of southern root-knot nematode on cotton. The field had a history of some losses to nematodes. The field site contained a mix of Wagram and Orangeburg loamy sands. Telone II (3 gal/A) was applied to appropriate plots on the same date as the cotton was planted. Cotton (DP 458 B/R) was planted on 10 May. Tillage in the study was conventional and the field was irrigated. The experimental design was a randomized complete block with four replications. Plots were four rows wide by the length of the field. Side-dress over the plant canopy applications of Temik 15G (5 lb/A) were made on 25 Jun. Plots were managed throughout the study according to guidelines from the University of Georgia Cooperative Extension Service. Soil was sampled for nematodes on 12 May and 10 Jul. Plots were harvested on 28 Oct.

Results

The 2003 season was noteworthy primarily because of near-record cotton yields and the abundant rainfall throughout much of the growing season. For example, record levels of rain fell in Midville, which unfortunately lead to flooding in some of the plot areas. Still, growing and harvest conditions were outstanding in 2003 which may have compensated for some of the damage that could have resulted from elevated populations of nematodes. Damage from thrips was not evaluated in this study. Results of the individual trials are presented below and in tables.

Conditions at the Southeast Georgia Research and Education Center in Midville were exceptionally wet during most of the season and the non-irrigated field (Trial 2) where Gaucho 480F was evaluated was often partly flooded The site of the Cruiser/Temik study (Trial 1) was better drained and had little flooding. The research station received 8.33, 6.01, 12.69, 2.91, 1.71, 3.55 and 1.17 in. of rain in May, June, July, August, September, October, and November (prior to harvest), respectively. Because flooding in one area of Trial 2 severely affected yield, data from some plots were omitted from final analysis. The parasitic nematodes recovered in these Trials 1 and 2 were almost exclusively the Columbia lance nematode. Populations were not statistically different between treatments midway through the season. By the end of the season, populations of the lance nematode in both trials approached or exceeded the economic threshold level determined by the Cooperative Extension Service to be 80 per 100 cc soil. There were some differences in nematode populations in Trial 2 at harvest. In both trials, there was no significant difference in yield between 3.5 lb/A Temik 15G and seed treated with either Gaucho 480F or Cruiser 5FS. in Trial 1, yield from Telone + Temik was not statistically different from Telone + Cruiser-treated seed. However, in Trial 2, Telone + Gaucho-treated seed statistically out yielded Telone + Temik. This unexpected difference might be a result of field conditions during the season rather than from the effect of the specific treatment. Yield from the treatment with two applications of Temik was also significantly lower than from the Telone + Gaucho treatment. Results from the trials in Midville are presented in Table 1 and Table 2.

Rainfall was abundant during the growing season at the Perryman Farm. Rainfall amounts recorded at a weather station in nearby Camilla were 2.43 in., 4.46 in., 6.63 in., 7.15 in., 2.37 in., and 2.68 in. in May, June, July, August, September, and October, respectively. Damage from nematodes in this field was evident from visible differences in growth and vigor among plants from different chemical treatments and from galls that formed in abundance on root systems. However, significant differences were not noted in nematode populations from soil samples collected during the study. Significant differences in yield were observed in this study. Telone II significantly increased yield above all other treatments. Plots treated with Temik 15 G, 5 lb/A at plant followed by an additional 5 lb/A, produced yields that were numerically greater than those of seed treated with Gaucho 480F and plots treated with Temik 15G at 3.5 lb/A. Differences in yield were not significant between Telone treatments nor were differences significant between Temik 15G (3.5 lb/A) and Gaucho 480F. Results from the Perryman trial are found in Table 3.

Rainfall was abundant during the growing season at the Winhausen farm in Mitchell County. Rainfall amounts recorded at a weather station in nearby Camilla were 2.43 in., 4.46 in., 6.63 in., 7.15 in., 2.37 in., and 2.68 in. in May, June, July, August, September, and October, respectively. Populations of southern root-knot nematodes reached elevated levels in the field, though no significant differences were noted between treatments. There were numerical differences in yield between treatments; however only the Telone + Temik combination statistically out yielded the control (seed treated with Gaucho 480). Results from the Winhausen farm are presented in Table 4.

Populations of southern root-knot nematodes were unexpectedly low in the Bryant Collins field in Mitchell County and damage was light. Though there were numerical increases in yields among treatments, none was significant. Unfortunately, because of the grower's decision, the standard treatment of 8.0 fl oz cwt Gaucho 480F was not included in this trial. The greatest economic value in this study was the application of Temik at 3.5 lb/A. Results from the Collins study are presented in Table 5.

It was possible to combine the results from trials where Gaucho 480F was compared to Temik 15G because the interaction between treatment and location was not significant at alpha = 0.05 (though it was close, p=0.0597). These results from the pooled data are presented in Table 6. It was thought that numerical trends observed in individual trials might be significant if

these trials could be combined. There was a numerical, yet not statistically significant difference between yields from Gaucho 480F treatments or Temik 15G (3.5 lb/A) and Telone + Gaucho or Telone + Temik.

Discussion

In five field trials conducted as part of a study of nematode management in Georgia, it was determined that there was no significant yield advantage in comparisons of Temik 15G at 3.5 lb/a versus treating seed with Gaucho 480F or Cruiser 5FS. None of these treatments is adequate in fields where parasitic nematodes have reached populations that are damaging to cotton. It is interesting that in three of four trials where Temik 15G was compared to either Gaucho or Cruiser, the numeric advantage went to Temik, similar to that which was observed in trials in 2002. Evidence from soil sampling alone does not allow one to conclude that this benefit, if indeed it is real, is the result of effect on nematodes, although this may play some role. Other possibilities that were not addressed in this study include treatment effect on thrips and the possibility of a "plant growth response" from Temik.

As in the Temik/Gaucho/Cruiser comparisons, there was typically no statistical difference in yield when Telone + Temik was compared to Telone + Gaucho or Telone + Cruiser. In a single trial (Trial 2) where Telone + Gaucho significantly out yielded Telone + Temik, it is possible that this was the result of environmental conditions in the field. However, in a result similar to that discussed above, yields from the Telone + Temik treatment was numerically greater than Telone + Gaucho or Telone + Cruiser in 4 of 5 direct comparisons. Again, the reason for this difference, if indeed it is real, is unclear.

Performance of Temik 15G, 5 lb/A in-furrow + 5 lb/A side-dress, was comparable to Telone at the Winhausen farm, but not at the Perryman farm or at the Midville trial 2. From our studies in Georgia, this Temik treatments is very effective at moderate-to-high pressure from southern root-knot nematodes, but not as consistent at very high levels of this organism or at high levels of Columbia lance nematode. Interestingly, where two applications of Temik 15G performed as well (Winhausen farm) or better (Nugent farm, data not shown) than Telone in 2003, the farmer had practiced conservation tillage. This fact would be interesting to study in the future.

Conclusions

From the results of five field trials conducted in 2003, growers can be confident of similar results in nematode management and yield when using Telone II (3 gal/A) with either Temik 15G (3.5 lb/A), Cruiser 5FS treated seed, or Gaucho 480F treated seed for thrips control. Slight numerical increases in yield associated with the use of Temik 15G at 3.5 lb/A cannot be explained through nematode management alone. Use of Temik 15G at 5 lb/A twice during the season (in-furrow and side-dress) can lead to yields similar to either Telone + Temik or Telone + Gaucho when nematode populations are moderate to high. However Telone produced better yields when populations of southern root-knot nematodes were very high and when populations of Columbia lance nematode exceeded the economic threshold value of 80 nematodes per 100cc of soil

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Table 1. Columbia lance nematode population levels and yield results for the irrigated Cruiser/Temik study at the Southeast Georgia Research and Education Center, Midville.

Treatment and rate/A	Nematode Counts (per 100 cc soil) 10 Jun	18 Jul	5 Dec	Seed cotton Yield lb/A
1. Treated seed, Cruiser 5FS (8.0 fl oz/cwt)	37.0 a	70.0 a	294.5 ab	1832.6 bc
2. Temik 15 G (3.5 lb/A @ planting)	58.2 a	24.0 a	313.0 ab	1869.3 bc
3. Temik 15 G (5.0 lb/A @ planting + 5.0 lb/A @ side-dress)	N/A	N/A	N/A	N/A
4. Telone II (3 gal/A 20-d before planting) + Temik 15 G (3.5 lb/A @ planting)	9.0 a	22.5 a	171.5 ab	2472.5 a
5. Telone II (3 gal/A 20-d before planting) + Cruiser-treated seed (8.0 fl oz/cwt)	19.5 a	8.0 a	149.0 b	2080.3 abc

*Means followed by the same letter do not differ significantly as determined by Fisher's protected least significant difference test (P≤0.05).

Table 2. Columbia lance nematode population levels and yield results for the dryland Gaucho/Temik study at the Southeast Georgia Research and Education Center, Midville.

Treatment and rate/A	Nematode Counts (per 100 cc soil) 15 May	18 Jul	5 Dec	Seed cotton Yield lb/A
1. Treated seed, Gaucho 480 (8.0 fl oz/cwt)	35.2 a	20.0 a	48.0 bcd	1933.5 c
2. Temik 15 G (3.5 lb/A @ planting)	22.0 a	27.0 a	96.8 abc	2268.3 bc
3. Temik 15 G (5.0 lb/A @ planting + 5.0 lb/A @ side-dress)	6.0 a	20.0 a	111.2 ab	2105.5 bc
4. Telone II (3 gal/A 20-d before planting) + Temik 15 G (3.5 lb/A @ planting)	24.8 a	6.0 a	94.4 abc	2399.1 b
5. Telone II (3 gal/A 20-d before planting) + Gaucho-treated seed (8.0 fl oz/cwt)	20.4 a	21.0 a	21.5 d	2792.0 a

*Means followed by the same letter do not differ significantly as determined by Fisher's protected least significant difference test (P≤0.05) except for the final nematode rating (P≤0.057).

Table 3. Southern root-knot nematode populations and yield data from Craig Perryman Farm in Colquitt County.

Treatment	Nematodes (per 100 cm^3 soil) 29 Apr	17 Jul	2 Oct	Seed cotton lb/A
1. Treated seed, Gaucho 480F (8 fl oz/cwt)	29.0 a	82.0 a	999.0 a	1563 b
2. Temik 15 G (3.5 lb/A @ planting)	8.0 a	19.0 a	259.0 a	1539 b
3. Temik 15 G (5.0 lb/A @ planting + 5.0 lb/A @ side-dress)	7.0 a	61.5 a	504.0 a	1742 b
4. Telone II (3 gal/A) + Gaucho 480F	5.5 a	15.5 a	328.0 a	2023 a
5. Telone II (3 gal/A) + Temik (3.5 lb/A)	7.0 a	62.0 a	263.5 a	2148 a

*Means followed by the same letter do not differ (P≤0.05) as determined by Fisher's protected least significant difference test.

Table 4. Southern root-knot nematode populations and yield data from Tom Winhausen Farm in Mitchell County.

Treatment	Nematodes (per 100 cm^3 soil) 28 Apr	9 Jul	4 Nov	Seed cotton lb/A
1. Treated seed, Gaucho 480 (8 fl oz/cwt)	74.0 a	157.3 a	642.0 a	2426 bc
2. Temik 15 G (3.5 lb/A @ planting)	67.0 a	111.3 a	533.3 a	2461 abc
3. Temik 15 G (5.0 lb/A @ planting + 5.0 lb/A @ side-dress)	15.0 a	250.7 a	472.0 a	2582 ab
4. Telone II (3 gal/A) + Gaucho 480F	57.3 a	144.0 a	752.0 a	2564 ab
5. Telone II (3 gal/A) + Temik (3.5 lb/A)	46.0 a	178.7 a	459.3 a	2596 a

*Means followed by the same letter do not differ (P≤0.05) as determined by Fisher's protected least significant difference test.

Table 5. Southern root-knot nematode populations and yield data from the Bryant Collins Farm in Mitchell County.

Treatment	Nematodes (per 100 cm^3 soil) 12 May	10 Jul	Nov	Seed cotton lb/A
1. Treated seed, Gaucho 480F (8 fl oz/cwt)	N/A	N/A	N/A	N/A
2. Temik 15 G (3.5 lb/A @ planting)	0.0 a	1.5 a		1806 ab
3. Temik 15 G (5.0 lb/A @ planting + 5.0 lb/A @ side-dress)	0.0 a	0.0 a		1820 ab
4. Telone II (3 gal/A) + Gaucho 480F	0.0 a	0.0 a		1810 ab
5. Telone II (3 gal/A) + Temik (3.5 lb/A).	0.0 a	0.0 a		1840 a

*Means followed by the same letter do not differ (P≤0.05) as determined by Fisher's protected LSD.

Table 6. Yield data combined for Gaucho/Temik studies in Midville, and Perryman, Winhausen, and Collins Farms. Interaction between location and treatment not significant at alpha=0.05.

Treatment	Seed cotton lb/A
1. Treated seed, Gaucho 480F (8 fl oz/cwt)	1933.1 cd
2. Temik 15 G (3.5 lb/A @ planting)	1989.2 bcd
3. Temik 15 G (5.0 lb/A @ planting + 5.0 lb/A @ side-dress)	2126.5 ab
4. Telone II (3 gal/A) + Gaucho 480F	2195.4 a
5. Telone II (3 gal/A) + Temik (3.5 lb/A)	2243.1 a

*Means followed by the same letter do not differ (P≤0.05) as determined by Fisher's protected least significant difference test.