VARIETAL AND NEMATICIDAL RESPONSES OF COTTON IN NEMATODE-INFESTED SOILS

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Abstract

The Beltwide Cotton Nematode Research and Education Committee, a cooperative partnership of multiple states across the Beltwide, annually assesses the efficacy of nominated varietal-nematicidal treatment combinations in both root-knot and reniform nematode infested soils. This report exclusively focuses on data collected in Alabama. Five nematicidal treatments, an insecticide control, and a fungicide control designated by Bayer Crop Science were applied to two varieties of cotton. The trial was conducted in two locations, with test sites in both central and northern Alabama. Parameters measured included plant stand, plant vigor, nematode population density, and seed cotton yield. Data analysis revealed no significant variety by nematicide interactions for the 2016 trials, indicating both varieties responded similarly to nematicidal treatments. Overall, plant stand for all treatments fell within an acceptable range for cotton production (2-4 plants/foot of row). Combined data revealed a low rate (14 fl oz/A) and a high rate (18 fl oz/A) in-furrow spray of Velum Total improved vigor over the fungicide control. Furthermore, both Velum Total treatments supported significantly lower nematode population densities when compared to the insecticide control. The high rate of Velum Total (18 fl oz/A) significantly increased seed cotton yield by 675 pounds over the fungicide control.

Introduction

The Beltwide Cotton Nematode Research and Education Committee conducts an annual research project to build awareness of common cotton nematode pathogens present in the U.S. cotton belt. This annual study collects data from cooperative research in multiple states; however, this report focuses solely on data collected in Alabama. Root-knot and reniform nematodes pose significant economic threat to cotton growers of Alabama; in 2016, an estimated 42,600 bales were lost to nematode pathogens (14,200 due to root-knot infection, 28,400 due to reniform pressure) (Lawrence et al., in press). Cotton variety selection and chemical nematicide treatment offer growers two lines of action when facing nematode-infested soils. This study sought to provide growers information regarding the efficacy of available nematicides on two commonly selected cotton varieties. Specifically, data were collected and analyzed to investigate (1) the potential interaction of variety by nematicide treatment, and (2) the effect of treatment and variety on parameters including stand, vigor, nematode population density, and seed cotton yield.

Materials and Methods

Six nematicide treatments nominated by Bayer Crop Science were evaluated on two varieties of cotton. Trials were planted at one location in central Alabama and one location in north Alabama. Parameters measured included plant stand, plant vigor, nematode population density, and seed cotton yield.

Cotton Cultivars

Stoneville 4946 B2RF (ST4946) and Stoneville 4747 GLB2 (ST4747) were selected for use in these trials. Both ST4946 and ST4747 demonstrate moderate height at maturity and medium growth habits; however, ST4946 is considered tolerant to the root-knot and reniform nematodes due to its noteworthy yield history, whereas ST4747 demonstrates less tolerance in the presence of the nematodes. A premium seed treatment fungicide package was applied to all seeds at the same rate in addition to the randomly assigned chemical treatment.

Nematicide Treatments

The treatment list (Table 1) included seven randomly assigned treatments, five of which were categorized as nematicidal and two considered as controls. Aeris (25.6 oz/cwt seed) was applied as a seed treatment (ST) prior to

planting as the standard seed treatment nematicide. Velum Total was applied as an in-furrow spray (IFS) at planting, one treatment administering a low rate (14 fl oz/A) and a separate treatment applying a higher rate of the chemical (18 fl oz/A). Two combination treatments were evaluated; Velum Total (14 fl oz/A) + Aeris ST (25.6 oz/cwt seed) consisted of an in-furrow spray at planting over a seed treatment, and Gaucho ST (12.8 oz/cwt seed) + Fluopyram ST (8.5 oz/cwt seed) combined two seed treatments prior to planting. Both a fungicide package control and an insecticide (Gaucho, 12.8 oz/cwt seed) + fungicide package control were included in the treatment list.

Table 1. Treatment, rate, and application type for Alabama NCC Nematicide Research 2016 Program.

Treatment	Rate	Rate Unit	Application Type
1. Base fungicide (fungicide control)	-	-	Pre-treated seed
2. Gaucho (insecticide control)	12.8 oz	/cwt seed	Seed treatment
3. Velum Total low rate	14 oz	fl oz/A	In-furrow spray
4. Velum Total high rate	18 oz	fl oz/A	In-furrow spray
5. Velum Total low rate + Aeris	14 oz + 25.6 oz	fl oz/A + /cwt seed	In-furrow spray + Seed treatment
6. Aeris	25.6 oz	/cwt seed	Seed treatment
7. Gaucho + Fluopyram	12.8 oz + 8.5 oz	/cwt seed + /cwt seed	Seed treatment + Seed treatment

Field Experiment Design

Field trials were conducted at two locations in Alabama. One test site was located in the central region of the state at the Plant Breeding Unit in Tallasee, Alabama. The soil type of this area is a Kalmia loamy sand (80% sand, 10% silt, 10% clay), and the field in which the test was conducted supports a natural *Meloidogyne incognita* race 3 infestation. The second test site set in the Tennessee Valley Research and Extension Center in Belle Mina, Alabama, is characterized by a Decatur silt loam (23% sand, 49% silt, 28% clay) and hosts an inoculated *Rotylenchulus reniformis* infestation. Plots in both locations consisted of four rows measuring 25 feet long with 40 – 36 inch row spacing and were arranged in a randomized complete block design with five replications. An alley measuring 15 feet wide separated blocks. Cotton cultivars were treated with chemical seed treatments by Bayer Crop Science corresponding to assigned treatments. Velum Total was applied to designated plots as an in-furrow spray with 8002 flat fan nozzles angled diagonally across the seed furrow immediately preceding the seed. Stand counts and vigor ratings were measured at 28 days after planting (DAP) in central Alabama and 33 DAP in north Alabama. Additionally during this initial data collection, four random, representative plants were dug with shovels from each plot, and the nematodes were extracted from the root systems using 6% NaOCl and collected on a 25 µm sieve. Seed cotton was harvested mechanically by plot at harvest to determine yield.

Statistics

Responses of cotton variety and nematicide treatment were analyzed both by location and as a whole in order to assess total nematicidal activity. Data were analyzed used SAS Proc Glimmix version 9.4 (SAS Institute Inc., Cary, NC). The model statement for each analysis listed the Variety, Treatment, and Variety by Treatment interaction, and the random statement included Rep. Significant difference was determined for variety, treatment, and interactions at $P \leq 0.10$. Total stand, plant vigor, nematode population density, and seed cotton yield were analyzed; differences of least-square means were based on adjusted P values using the option adjust = Tukey in the LSmeans statement.

Results and Discussion

Data analysis showed no significant variety by treatment interaction in either location alone or both locations combined (Table 2), indicating a similar response of variety and treatment in singular tests and overall.

Table 2. Probability of significant F-test for combined data analysis of variance across both locations ($P \leq 0.1$).

	Degrees of freedom	Stand	Vigor	Eggs/g root	Yield
Variety	1	0.1934	0.4040	0.0726	0.3473
Treatment	6	0.3529	0.0003	0.0009	0.0298
Variety*Treatment	6	0.7144	0.9974	0.6078	0.6970

Central Alabama

Root-knot nematode disease pressure was intense for cotton in 2016. Varieties responded similarly for all parameters measured. Plant stand at 28 DAP was similar for all nematicide applications, and all stand counts fell within the acceptable range of 2-4 plants per foot of row (Table 3). The Base fungicide control and Velum Total 14 fl oz/A treatments exhibited increased vigor compared to the Velum Total 14 fl oz/A + Aeris and Gaucho + Fluopyram treatments. Both ST4946 and ST4747 vigor ratings were similar across all nematicide treatments. The Velum Total 18 fl oz/A treatment significantly reduced nematode eggs per gram of root compared to the base fungicide control. Seed cotton yields varied by 798 lb/A; however, yields demonstrated statistical similarity across nematicide treatments as well as both varieties.

Table 3. Stand, vigor, root-knot nematode population density, and seed cotton yield data collected for central Alabama.

Treatment and Rate[w]	Stand[x]	Vigor[y]	Root-knot eggs /g root	Seed cotton (lb/A)
1. Base Fungicide	82 a[z]	2.5 c	14,977 a	1939 a
2. Gaucho 12.8 oz/cwt seed	79 a	2.9 bc	12,591 ab	1814 a
3. Velum Total 14 fl oz/A	81 a	2.6 c	3615 ab	2079 a
4. Velum Total 18 fl oz/A	87 a	3.0 bc	2318 b	2612 a
5. Velum Total 14 fl oz/A + Aeris 25.6 oz/cwt seed	81 a	3.8 a	9168 ab	2293 a
6. Aeris 25.6 oz/cwt seed	81 a	3.2 b	10,963 ab	1956 a
7. Gaucho 12.8 oz/cwt seed + Fluopyram 8.5 oz/cwt seed	83 a	4.1 a	7663 ab	2294 a
Varieties				
ST4946 (tolerant)	83 a	3.2 a	7039 a	2178 a
ST4747 (susceptible)	81 a	3.1 a	10,474 a	2104 a

[w]Data is combined since no interaction between variety and nematicides was indicated.

[x]Stand indicates the number of seedlings in 25 ft of row 28 days after planting (DAP).

[y]Vigor ratings ranged from 1-6 with 1 indicating strong proliferation and 6 representing extremely poor vitality.

[z]Column numbers followed by the same letter are not significantly different at P=0.1 as determined by the Tukey-Kramer method.

North Alabama

Reniform nematode disease pressure was moderate for irrigated cotton in 2016. Varieties responded similarly for all parameters measured. Plant stand at 33 DAP was similar for all nematicide applications, and all stand counts with the exception of the Base fungicide fell within the acceptable range of 2-4 plants per foot of row (Table 4). All nematicide treatments demonstrated statistically higher vigor compared to the Base fungicide control. Both Velum Total applications (14 fl oz/A and 18 fl oz/A), Velum Total 14 fl oz/A + Aeris combination, and Gaucho + Fluopyram combination reduced reniform eggs per gram of root compared to the Gaucho insecticide control alone. Seed cotton yields were statistically similar across all nematicide treatments.

Table 4. Stand, vigor, reniform nematode population density, and seed cotton yield data collected for north Alabama.

Treatment and Rate[w]	Stand[x]	Vigor[y]	Reniform eggs/g root	Seed cotton (lb/A)
1. Base Fungicide	49 a[z]	4.9 a	3528 abc	2143 a
2. Gaucho 12.8 oz/cwt seed	53 a	3.1 b	8163 a	2797 a
3. Velum Total 14 fl oz/A	52 a	2.5 b	2628 bc	2586 a
4. Velum Total 18 fl oz/A	54 a	2.7 b	1171 c	2821 a
5. Velum Total 14 fl oz/A + Aeris 25.6 oz/cwt seed	59 a	2.5 b	931 c	2840 a
6. Aeris 25.6 oz/cwt seed	56 a	2.6 b	6595 ab	2607 a
7. Gaucho 12.8 oz/cwt seed + Fluopyram 8.5 oz/cwt seed	59 a	2.8 b	1465 c	2901 a
Varieties				
ST4946 (tolerant)	56 a	3.1 b	2956 a	2740 a
ST4747 (susceptible)	53 a	2.9 b	4039 a	2602 a

[w]Data is combined since no interaction between variety and nematicides was indicated.

[x]Stand indicates the number of seedlings in 25 ft. of row 28 days after planting (DAP).

[y]Vigor ratings ranged from 1-6 with 1 indicating strong proliferation and 6 representing extremely poor vitality.

[z]Column numbers followed by the same letter are not significantly different at P=0.1 as determined by the Tukey-Kramer method.

Combined Data

Combining both the Root-knot and Reniform locations revealed plant vigor was higher in both Velum Total treatments (14 fl oz/A and 18 fl oz/A), Aeris alone, and Gaucho alone compared to the Base fungicide control (Table 5). All treatments exhibited similar stand counts, all falling within the acceptable range for cotton production. Nematode population density proved to be lower overall in the more tolerant ST4946 compared to ST4747. The Velum Total 18 fl. oz./A treatment supported a significant lower nematode population density than the Base fungicide control, Gaucho alone, and Aeris alone. The Velum Total 14 fl oz/A treatment reduced nematode population density significantly lower than the Gaucho insecticide control. Seed cotton yield demonstrated similarity by variety. In regards to yield by nematicide treatment, the Velum Total 18 fl oz/A significantly increased yields 675 pounds compared to the Base fungicide control. All other nematicides supported statistically similar yields.

Table 5. Stand, vigor, nematode population density, and yield data collected over both locations.

Treatment and Rate[y]	Stand	Vigor	Nematode eggs/g root	Seed Cotton (lb./A)
1. Base Fungicide	66 a[z]	3.7 a	9252 ab	2041 b
2. Gaucho 12.8 oz/cwt seed	66 a	3.0 bc	10377 a	2305 ab
3. Velum Total 14 fl oz/A	66 a	2.6 c	3121 bc	2332 ab
4. Velum Total 18 fl oz/A	70 a	2.9 bc	1745 c	2716 a
5. Velum Total 14 fl oz/A + Aeris 25.6 oz/cwt seed	70 a	3.1 abc	5049 abc	2566 ab
6. Aeris 25.6 oz/cwt seed	68 a	2.9 bc	8779 ab	2281 ab
7. Gaucho 12.8 oz/cwt seed + Fluopyram 8.5 oz/cwt seed	71 a	3.5 ab	4564 abc	2598 ab
Varieties				
ST4946 (tolerant)	69 a	3.0 a	4997 a	2459 a
ST4747 (susceptible)	67 a	3.1 a	7256 b	2353 a

[y]Data is combined since no interaction between variety and nematicides was indicted.

[x]Stand indicates the number of seedlings in 25 ft. of row 28 days after planting (DAP).

Summary

No interaction was observed between variety and treatment in 2016 trials; the level of susceptibility of the variety did not influence overall nematicidal activity in either location or in the combined data. Overall, the less-susceptible ST4946 supported a statistically lower nematode population density compared to ST4747, but all other measured parameters demonstrated similarity in terms of variety. The high rate of Velum Total (18 fl oz/A) significantly reduced nematode population densities compared to controls at both locations and in the combined data set; the low rate of Velum Total (14 fl oz/A) also effectively reduced overall population density compared to the Gaucho insecticide control. Though yield demonstrated statistical similarity at isolated locations, the high rate of Velum Total (18 fl oz/A) in the combined data set increased seed cotton yield 675 pounds over the fungicide control.

References

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