BELTWIDE NEMATODE RESEARCH AND EDUCATION COMMITTEE REPORT ON COTTON CULTIVARS AND NEMATICIDES RESPONSES IN NEMATODE SOILS, 2016

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Abstract

The 2016 National Cotton Council Nematode Research and Education Committee evaluated two cultivars and five nematicides applied as a seed treatment or in-seed-furrow spray in either *Meloidogyne incognita* or *Rotylenchulus reniformis* infested soil at eleven site locations across the U.S. Cotton Belt. The five nematicide treatments were nominated by Bayer CropScience and cultivar selected based on their performance across the Cotton Belt. Treatments were arranged in a randomized split-plot design with cultivar as whole plot and nematicides as sub-plots. Data from each nematode species was combined for analysis. None of the nematicides provided a significant suppression of *M. incognita*, but Velum Total at 18 and 14 oz/A contributed to the lowest ranking of nematode infection (root galling or eggs per root system). The cotton cv. ST 4946 GLB2 supported a lower ranking of nematode infection and had a greater yield response compared to ST 4747 GLB2. All nematicide treatments contributed to a numeric protection of yield protection in root-knot nematode infested fields. Cotton cv. ST 4946 GLB2 was tolerant to *R. reniformis* as it supported a greater population density of reniform nematode and had a greater yield compared to ST 4747 GLB2. None of the nematicides had a significant impact at reducing reniform population densities, but all contributed to a numeric benefit in yield protection. Though nematicides provided a positive yield benefit, cultivar selection had a greater impact on cotton yield in nematode infested fields.

Introduction

The southern root-knot nematode (*Meloidogyne incognita*) and reniform nematode (*Rotylenchulus reniformis*) continue to be among the most yield limiting disease of cotton across the United States Cotton Belt. For the past two years, estimates of yield loss by these two nematode species often exceed more than 3% across the Cotton Belt (Lawrence *et al.*, 2015; Lawrence *et al.*, 2016). Currently, there are a few moderately resistant cultivars that can be used to manage *M. incognita* (for example; DP 1454NR B2RF, DP 1558NR BF, PHY 427 WRF, ST 4946 GLB2, just to name a few); however, there are no commercially available cultivars with resistance to *R. reniformis*. Because of this lack of resistance and the continued use of susceptible cultivars in *M. incognita* in some areas there is a need to evaluate commercially available and experimental nematicides to manage these cotton nematodes.

The 2016 National Cotton Council Nematode Research and Education Committee selected five nematicides and two cultivars to include in the 2016 uniform trial. The objective of this study was to evaluate the response of cotton cultivars with and without nematicide treatments in nematode infested soils.

Materials and Methods

Cotton Cultivars

Two cultivars were selected for this study because they are broadly adapted across the U.S. Cotton Belt. Cotton cv. ST 4946 GLB2 is moderately resistant to *M. incognita*, while cv. ST 4747 GLB2 is susceptible. Both cultivars are susceptible to *R. reniformis*.

Nematicide Treatments

All seed were treated with a base fungicide treatment of Allegiance FL (metalaxyl) + EverGol Prime (penflufen) + Spera 240FS (mycolobutanil) + Vortex (ipconazole) at a rate of 0.75 + 0.33 + 1.8 + 0.08 oz/cwt, respectively. Gaucho (imidacloprid) at a rate of 0.375 mg ai/seed was used as the non-nematicide control. Nematicide treatments consisted of Aeris (imidacloprid + thiodicarb) at rate of 0.75 mg ai/seed, Aeris + Velum Total (fluopyram) at rate of 0.75 mg ai/seed + 14 oz/A, Velum Total at 14 oz/A, Velum Total at 18 oz/A, and Gaucho + COPeO Prime (fluopyram) at rate of 0.375 mg ai/seed + 0.25 mg ai/seed, respectively. All seed were treated by Bayer CropScience.

Field Experiments

Seven experiments were conducted in *M. incognita* infested fields, while four experiments were conducted in *R. reniformis* infested fields. These experiments were conducted by eight cooperators (authors) across the U.S. Cotton Belt, thus a range of plot size and times of data collection are reported. Cotton cultivars were planted at the recommended rates by the local extension service. The experimental design was a split plot design with cotton cultivar as whole plots and nematicides as sub-plots. Whole plots were randomized in four complete blocks. Individual sub-plots consisted of two to four rows, 25 to 60-ft-long, spaced either 36 to 40-in apart separated by a 3-ft fallow alley. Velum Total was applied in the seed furrow through a flat fan nozzle oriented perpendicular to the seed furrow using a pressurized sprayer. The sprayer was calibrated to deliver ~6 gal/A. Plant stand counts were taken on 30 to 60 days after planting (DAP) and converted to plants per 10 ft of row. Population densities of root-knot and reniform nematodes were sampled at 30 to 60 DAP by collecting a representative soil subsample from each plot by arbitrarily sampling near each seedling. Root-knot nematode infection was determined at 30 to 60 DAP from 5 to 10 root systems based on galls per root system, rating the root system for galls (six or ten point scale) or by extracting eggs with 1.0% NaOCl. Eggs were counted using a stereoscope and used to calculate eggs per g of root. Seed cotton yield was collected at harvest.

Statistics

Data were analyzed by mixed GLM procedure and mean separation by Tukey's Honest Significant Difference test at $P = 0.10$ using SPSS (version 19.0). The model statement consisted of location, replication, cultivar, nematicide, and their interaction with a random statement of location nested in rep. Results on cultivar, nematicide and their interaction are reported.

Results and Discussion

There was no interaction for seedling stand or vigor between cultivar and nematicide in *M. incognita* infested soils (Table 1). Of the nematicides, a lower ($P = 0.10$) seedling vigor was observed for seed treated with the base fungicide and Velum Total at 18 oz/A than other treatments. There was an interaction for *M. incognita* population density between cultivar and nematicide (data not shown), thus nematode suppression by nematicide was inconsistent between cultivars. The only significant interaction observed was a lower ($P = 0.10$) population density of *M. incognita* with Velum Total at 14 oz/A on ST 4747 GLB2 than Aeris + Velum Total at 14 oz/A on ST 4946 GLB2. All other cultivar by nematicides treatment combinations supported a statistically similar population of root-knot nematode. There was a greater population density of *M. incognita* on ST 4946 GLB2, which does not reflect the magnitude of resistance in this cultivar compared to ST 4747 GLB2, a susceptible cultivar. Alternately, and more accurately, root-galling and nematode reproduction as eggs was a better indicator of nematode infection and cultivar response as fewer eggs and galls were observed on ST 4946 GLB2 than ST 4747GLB2. Based on nematode infection ranking data, Velum Total at 18 oz/A, Velum Total at 14 oz/A, Aeris, Gaucho, Gaucho + COPeO Prime, fungicide base, and Aeris + Velum Total would rank in nematode infection low to high, respectively. There was no interaction between cultivar and nematicide in regards to cotton yield. A greater (P = 0.01) yield was observed for ST 4946 GLB2 than ST 4747 GLB2; however, there was no effect of nematicide on cotton yield protection. Overall, all nematicide and insecticide treatments contributed to a greater numeric yield over the base fungicide treatment.

Table 1. Effect of cotton cultivar and nematicide in *Meloidogyne incognita* infested soil.

Cultivar	Stand[z] 30-60 DAP	Vigor[y] 30-60 DAP	*Meloidogyne incognita*[x] 30-60 DAP	Seed cotton (lb/A)
ST 4747GLB2	30.6	3.8	110 a	3,248 a
ST 4946 GLB2	29.8	3.9	157 b	3,357 b
Treatment and rate				
Fungicide base	26.8	3.7 a[w]	145	3,240
Gaucho 600 (0.375 mg ai/seed)	28.2	3.9 b	162	3,365
Aeris (0.75 mg ai/seed)	28.5	4.0 b	130	3,246
Aeris (0.75 mg ai/seed) Velum Total (14 oz/A)	38.4	4.0 b	190	3,302
Velum Total (14 oz/A)	28.8	3.9 b	83	3,393
Velum Total (18 oz/A)	28.2	3.7 a	128	3,302
Gaucho 600 (0.375 mg ai/seed) COPeO Prime (0.25 mg ai/seed)	28.9	3.9 b	102	3,271
Statistics: Prob (F)				
Cultivar	0.26	0.91	0.10	0.01
Treatment	0.76	0.0005	0.98	0.29
Cultivar x Treatment	0.43	0.65	0.10	0.87

[z] Cotton seedlings per 10 ft. of row
[y] Seedling vigor based on 0-5 scale where 5 = most vigorous seedling growth
[x] Population density of *Meloidogyne incognita* per 100 cm^3 soil
[w] With each treatment category, numbers within a column followed by the same letter are not significantly different at P = 0.10 according to Turkey's HSD.

There was no interaction for seedling stand, vigor, nematode population density or yield between cultivar and nematicide in reniform infested fields (Table 2). Seedling stand was relatively uniform across treatments, while seedling vigor was the best (P = 0.10) for the fungicide base treatment compared to other nematicide treatments. Fewer reniform nematodes were observed on ST 4747 GLB2; however it produced less seed cotton than ST 4946 GLB2. Of the nematicide treatments, Aeris was ranked among the best at suppressing reniform nematode population density in two of the four trials; however, Aeris +Velum Total at 14 oz/A was ranked the best at yield protection in two of the four trials. All nematicide and insecticide treatment contributed to a numeric yield benefit over the fungicide base treatment (Table 2).

Table 2. Effect of cotton cultivar and nematicide in *Rotylenchulus reniformis* infested soil.

Cultivar	Stand[z] 30-60 DAP	Vigor[y] 30-60 DAP	*Rotylenchulus reniformis*[x] 30-60 DAP	Seed cotton (lb/A)
ST 4747GLB2	34.3	3.8	10,411	2,135
ST 4946 GLB2	34.4	3.9	11,292	2,187
Treatment and rate				
Fungicide base	33.1	4.5 a[w]	9,287	2,236
Gaucho 600 (0.375 mg ai/seed)	33.6	3.6 b	10,129	2,397
Aeris (0.75 mg ai/seed)	32.6	3.2 c	11,395	2,320
Aeris (0.75 mg ai/seed) Velum Total (14 oz/A)	34.6	3.4 bc	11,076	2,495
Velum Total (14 oz/A)	32.9	3.2 c	10,387	2,421
Velum Total (18 oz/A)	33.8	3.3 c	13,559	2,468
Gaucho 600 (0.375 mg ai/seed) COPeO Prime (0.25 mg ai/seed)	34.7	3.4 bc	10,128	2,447
Statistics: Prob (F)				
Cultivar	0.96	0.29	0.68	0.71
Treatment	0.32	0.001	0.83	0.31
Cultivar x Treatment	0.86	0.97	0.73	0.41

[z] Cotton seedlings per 10 ft. of row
[y] Seedling vigor based on 0-5 scale where 5 = most vigorous seedling growth
[x] Population density of *Rotylenchulus reniformis* per 100 cm^3 soil
[w] With each treatment category, numbers within a column followed by the same letter are not significantly different at $P = 0.10$ according to Turkey's HSD.

Summary

Cultivars had a greater impact on M. incognita suppression than nematicides. These nematicides provided varying levels of nematode suppression and yield protection among locations. Cultivars had less of an impact in reniform infested soils, possibly due to the lack of resistance in each cultivar; however ST 4946 GLB2 expressed tolerance to the reniform nematode by contributing to a greater yield though nematode reproduction was higher than that of ST 4747 GLB2. No single nematicide stood out across these four locations in regards to nematode suppression; however, all nematicide treatments contributed to a greater numeric yield protection compared to the base fungicide treatment.

Disclaimer

This paper reports the result of research only. Mention of a pesticide in this paper does not constitute a recommendation by the University of Arkansas, Division of Agriculture or does it imply registration under FIFRA. This work was supported by a grant from Bayer CropScience.

References

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