BELTWIDE NEMATODE RESEARCH AND EDUCATION COMMITTEE: CULTIVAR AND NEMATICIDE RESPONSE IN NEMATODE INFESTED FIELDS, 2021

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Abstract

The 2021 National Cotton Council Nematode Research and Education Committee evaluated two seed-applied and two soil-applied nematicides on two cultivars to manage *Meloidogyne incognita*, *Rotylenchulus reniformis*, or *Hoplolaimus columbus* in upland cotton. These experiments were conducted across the U.S. Cotton Belt from Arizona to Virginia. There were five experiments in *M. incognita* infested fields, seven in *R. reniformis* infested fields, and one in a *H. columbus* infested field. The cotton cultivars Deltapine DP 1646 B2XF and DP 2141NR B3XF were used. DP 1646 B2XF is susceptible to all cotton nematodes, whereas DP 2141 B3XF is resistant to *M. incognita* and *R. reniformis*. In *M. incognita* infested fields, a greater ($P > 0.05$) yield was observed with DP 1646 B2XF, whereas DP 2141NR B3XF had a greater yield trend in *R. reniformis* and *H. columbus* infested fields. A greater ($P > 0.05$) reduction in *R. reniformis* population densities was observed between 45 and 60 days after planting with DP 2141NR B3XF compared to DP 1646 B2XF. No nematicide had a significant impact on the suppression of nematode population densities or root gall development compared to the non-nematicide treated control. Of the nematicides tested, Copeo and BioST Nematicide 100 had a greater yield trend in *M. incognita* infested fields whereas the Velum 4.16 SC (6 fl oz/A) and AgLogic 14GG (5 lb./A) had a greater yield trend in *R. reniformis* infested fields.

Introduction

The southern root-knot nematode (*Meloidogyne incognita*), reniform nematode (*Rotylenchulus reniformis*), and Columbia lance nematode (*Hoplolaimus columbus*) are among the most yield-limiting pest of cotton across the U. S. Cotton Belt. For the past three years, estimates of yield loss by these nematode species exceed 3% across the U. S. Cotton Belt (Lawrence et al. 2019; Lawrence et al. 2020; Lawrence et al. 2021). Nematicides and resistant cultivars are key elements in an integrated pest management program; however, few multistate studies are conducted across the U.S. Cotton Belt. In 2021, four cultivars with resistance to the southern root-knot nematode and reniform nematode were commercially available. These cultivars consisted of Deltapine DP 2141NR B3XF and DP 2143 RN B3XF, and Phytogen PHY 332 W3FE and PHY 443 W3FE. The objective of this study was to evaluate the relative impact of cultivars and nematicides at several locations across the U.S. Cotton Belt.

Materials and Methods

Cotton Cultivars

The upland cotton cultivars, Deltapine, DP 1646 B2XF and DP 2141NR B3XF were used. The cultivar, DP 1646 B2XF is susceptible while DP 2141NR B3XF is resistant to *R. reniformis* and *M. incognita*. Both cultivars are susceptible to *Hoplolaimus columbus*, which was the primary nematode species in South Carolina.

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, and base insecticide treatment of Gaucho 600 F (imidacloprid) at 0.375 mg ai/seed. Seed-applied nematicides consisted of Copeo (fluopyram) at a rate of 0.2 mg ai/seed and BioST Nematicide 100 (*Burkholderia rinojensis*, strain A396) at rate of 7.0 oz/cwt. A storage rate of Gaucho 600 F at 0.8 oz/cwt (0.03 mg ai/seed) was commercially applied to the seed prior to any seed treatment. All seed were treated at the University of Tennessee at West Tennessee Research and Education Center in Jackson, TN. The soil applied nematicide, Velum (fluopyram) was applied in-furrow at planting at a rate of 6 fl oz/A with 5-6 gal of water/A using a flat fan nozzle oriented perpendicular to the seed furrow or a microtube directed into to the seed furrow. AgLogic 15GG (aldicarb) was applied in-furrow at plating at 5 lb./A. To manage thrips, Admire Pro (imidacloprid) was applied at planting, in-furrow with all treatments except AgLogic 15GG at 9 oz/A with 5-6 gal of water/A.

Field Experiments

Field efficacy of seed-applied and soil-applied nematicides were assessed in five *M. incognita* infested fields in Alabama, Arizona, Arkansas, Georgia, and Texas, while seven experiments were conducted in *R. reniformis* infested fields in Alabama, Arkansas, Florida, Louisiana (2), Mississippi, and Texas, and one *H. columbus* infested field in South Carolina. The experimental design was a split plot design with cultivars side by side with four to six replicates per treatment. Individual plots consisted of two to four rows, 25 to 60-ft-long, spaced 36- to 40-in apart separated by a 3- to 8-ft fallow alley. Plant stand counts were taken on 14 to 30 days after planting (DAP) and reported as the number of plants per 10 ft of row. Vigor ratings were sampled at 14 to 30 DAP based on a six-point scale with 0 = poor vigor and 5 = best. Population densities of root-knot and reniform nematodes were sampled between 30 and 60 DAP by collecting soil subsamples from each plot. Samples were collected near the existing stand of cotton at 6- to 8-in depth per treatment. Root-knot nematode infection was determined at 30 to 60 DAP from 5 to 10 roots. Galling was on gall counts or percent of root system galled. The galling data were normalized using the min-max scale were new X = (X-Xmin)/(Xmax-Xmin). The min and max values were based on the range of data within each replication per experiment. Seed cotton yield was collected at harvest.

Statistics

Data were pooled from each state by nematode species. Data were analyzed using a factorial ANOVA in the general linear mixed model procedure with nematicides and cultivars as fixed variables, and location and block as a random variable using IBM SPSS Statistic version 27 (International Business Machines Crop., Armonk, NY). When appropriate, data was transformed using Log10 (x + 1) transformation to normalize for analysis and non-transformed data are reported. Means were separated at ± = 0.05 using Fisher's LSD procedure.

Results and Discussion

In *M. incognita* infested fields, there was no location by cultivar by nematicide ($P > 0.05$) interaction for seedling vigor, nematode population density or yield (data not shown). There was, however, a significant three-way interaction ($P < 0.05$) for plant stand, which is understandable given the variation in environmental conditions shortly after planting across the 2021 cropping season (data not shown). There was no significant cultivar by nematicide interaction for any of the dependent variables (Table 1). Based on the main effects, nematicides did not have a significant impact on stand, galling, nematode population density, or yield (Table 1). A greater ($P < 0.05$) vigor rating was observed with AgLogic than other nematicides and the non-nematicide treated control. A lower ($P < 0.05$) vigor rating was observed on DP 1646 B2XF than DP 2141NR B3XF; however, DP 1646 B2XF had greater ($P < 0.05$) yield than DP 2141NR B3XF in *M. incognita* infested fields.

There was no significant difference among application methods for yield; however, seed-applied nematicides contributed to a 11.4% greater yield benefit over the non-nematicide treated control (2,967 lb/A).

Table 1. Effect seed-applied and in-furrow applied nematicides on two cotton cultivars in *Meloidogyne incognita* infested fields.

	Plant stand[z] 14-30 DAP	Vigor[y] 14-30 DAP	*Meloidogyne incognita* Galling[x]	*Meloidogyne incognita* Soil assay	Seed cotton (lb/A)
Cultivar					
DP 1646 B2XF	31.6	3.4 a	0.41	11.6	3,383 b
DP 2141NR B3XF	32.7	3.8 b	0.33	10.1	3,005 a
Treatment and rate					
Non-nematicide control[w]	31.6	3.4 a[v]	0.35	13.9	2,967
Copeo 600 FS (0.20 mg ai/seed)	32.9	3.6 a	0.32	8.5	3,354
BioST Nematicide 100 (7.0 fl oz/cwt)	32.2	3.5 a	0.36	5.8	3,258
Velum 4.16 SC (6 fl oz/A)	32.3	3.5 a	0.42	16.1	3,205
AgLogic 15GG (5 lb/A)	32.0	4.0 b	0.40	18.2	2,132
Statistics: *P* > F					
Cultivar	0.18	<0.05	0.26	0.67	<0.05
Treatment	0.76	<0.05	0.71	0.09	0.34
Cultivar x Treatment	0.09	0.06	0.59	0.34	0.44

[z] Seedlings per 10 ft. row.
[y] Vigor was based on a six-point scale where 0 = worst and 5 = best.
[x] Max-min scale normalized scale [new X = (X-Xmin)/(Xmax-Xmin)]. Raw data was gall counts and percent root system galled. Soil and roots were collected at 30 to 60 DAP (days after planting) from four of the five locations.
[w] All seed were treated with a premium fungicide base and storage rate of Gaucho 600 F. Admire Pro at 9 oz/A was applied in-furrow for all treatments, except AgLogic.
[v] Different letters followed by the same letter are not significantly different at ± = 0.05 according to Fishers LSD procedure

In the *R. reniformis* infested fields, there was no location by cultivar by nematicide ($P > 0.05$) interaction for seedling vigor, nematode population density or yield (data not shown). There was, however, a significant three-way interaction ($P < 0.05$) for plant stand, which is understandable given the variation in environmental conditions shortly after planting across the 2021 cropping season (data not shown). There was no cultivar by nematicide interaction for any dependent variable (Table 2). Nematicide did have a significant impact on plant stand with fewer ($P < 0.05$) seedlings per 10 row ft with AgLogic than all other nematicides and the non-nematicide control. However, seedling vigor was greater ($P < 0.05$) with AgLogic than all other nematicides and the non-nematicide control. Seedling vigor and yield was greater ($P < 0.05$) on DP 2141NR B3XF than DP 1646 B2XF in *R. reniformis* infested fields.

There was no significant difference ($P > 0.05$) among application methods for suppression of *R. reniformis* population densities or yield protection. A greater numeric yield benefit of 5.9% and 8.3% were observed with seed- and soil-applied nematicides, respectively, compared to the non-nematicide treated control (2,729 lb/A).

In a Columbia lance nematode (CLN) infested field, nematicides had no impact on plant stand with an average of 14.7 plants per 10 row ft. However, a greater ($P < 0.05$) plant stand of 18.4 plants per row feet was observed on DP

2141NR B3XF compared to 11.0 with DP 1646 B3XF. There was no effect of treatment or cultivar on seedling vigor, nematode densities, or yield. Numerically, fewer CLN were observed on DP 1646 B2XF (32 CLN/100 cm^3 soil) and Copeo (20 CLN/100cm^3 soil); however, a numerically, a greater yield was observed on DP 2141NR B3XF (1,490 lb/A) and AgLogic 15GG (1,600 lb./A).

Table 2. Effect of seed-applied and in-furrow applied nematicides on two cotton cultivars in *Rotylenchulus reniformis* infested fields.

	Plant stand[z] 14-30 DAP	Vigor[y] 14-30 DAP	*Rotylenchulus reniformis* 30-60 DAP[x]	Seed cotton (lb/A)
Cultivar				
DP 1646 B2XF	34.4 b	3.3 a	1,582 b	2,857
DP 2141NR B3XF	32.0 a	3.8 b	1,014 a	2,924
Treatment and rate				
Non-nematicide control[w]	33.1 b[v]	3.4 a[v]	1,487	2,729
Copeo 600 FS (0.20 mg ai/seed)	33.4 b	3.4 a	1,274	2,865
BioST Nematicide 100 (7.0 fl oz/cwt)	34.0 b	3.5 a	1,151	2,918
Velum 4.16 SC (6 fl oz/A)	34.2 b	3.6 a	1,320	3,006
AgLogic 15GG (5 lb/A)	31.3 a	3.7 b	1,259	2,934
Statistics: *P* > F				
Cultivar	<0.05	<0.05	<0.05	0.07
Treatment	<0.05	<0.05	0.62	0.26
Cultivar x Treatment	0.12	0.06	0.66	0.63

[z] Seedlings per 10 ft. row.
[y] Vigor was based on a six-point scale where 0 = worst and 5 = best.
[x] Soil and roots were collected at 30 to 60 DAP (days after planting).
[w] All seed were treated with a premium fungicide base and storage rate of Gaucho 600 F. Admire Pro at 9 oz/A was applied in-furrow for all treatments, except AgLogic.
[v] Different letters followed by the same letter are not significantly different at ± = 0.05 according to Fishers LSD procedure

Summary

In *M. incognita* infested fields, a greater seed cotton yield was observed with DP 1646 B2XF, whereas DP 2141NR B3XF had a greater yield trend in *R. reniformis* and *H. columbus* infested fields. A reduction in nematode reproduction was observed with DP 2141NR B3XF. Of these nematicides, the seed-applied had a greater yield trend in *M. incognita* infested fields whereas the soil-applied had a greater yield trend in *R. reniformis* infested fields.

Disclaimer

This paper reports the result of research only and pesticides reported here does not constitute a recommendation by the authors or respective institutions nor does it imply product registration within each state.

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