BELTWIDE NEMATODE RESEARCH AND EDUCATION COMMITTEE REPORT ON FIELD PERFORMANCE OF SEED-APPLIED AND SOIL-APPLIED NEMATICIDES, 2018

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Abstract

The 2018 National Cotton Council Nematode Research and Education Committee evaluated three seed-applied and two soil-applied nematicides to manage *Meloidogyne incognita* or *Rotylenchulus reniformis* in cotton. The susceptible cotton cultivar Stoneville 4949 GLB2 was used at all eleven site locations across the U. S. Cotton Belt. All locations had a low population density of root-knot and reniform nematodes, except Louisiana, which was severe. None of the nematicides had a significant effect on crop stand or seedling vigor. Based on the assessment of *M. incognita* infection (e.g. root-galling, gall index, and egg production) the treatments that ranked the best for infection suppression were Velum Total at 18 oz/A and COPeO Prime + Velum Total at 14 oz/A. In the *R. reniformis* fields, COPeO Prime and Velum Total at 18 oz/A provided the best suppression of nematode reproduction recovered from soil samples. Of the trails conducted in *M. incognita* infested fields, BioST Nematicide 100 had the greatest impact on yield protection. This is the first year this committee has tested the seed-applied bionematicide. Of the trials conducted in *R. reniformis* infested fields, the greatest numeric yield protection was observed with AgLogic at 5 lb/A. Overall, the three seed-applied nematicides provided a similar degree of root protection and yield protection. Of the soil-applied nematicides, they were generally better than the seed-applied for nematode suppression and yield protection, but higher rates of Velum Total did not always provide an added benefit for nematode suppression or yield protection.

Introduction

The southern root-knot nematode (*Meloidogyne incognita*) and reniform nematode (*Rotylenchulus reniformis*) continue to be among the most yield-limiting factors affecting cotton production across the United States Cotton Belt. For the past three years, estimates of yield loss by these two nematode species exceed more than 3% across the Cotton Belt (Lawrence et al., 2016; Lawrence et al., 2017; Lawrence et al., 2018). Though a few cotton cultivars with resistance to southern root-knot nematode are commercially available, none have resistance to *R. reniformis*. Nematicides are useful in an integrated pest management program and evaluating them across the Cotton Belt provides an understanding of their performance across production systems. Therefore, the objective of this study was to evaluate the relative impact of seed-applied and soil-applied nematicides at several locations across the US Cotton Belt.

Materials and Methods

Cotton Cultivars

The upland cotton cultivar, Stoneville, ST 4949 GLB2 and ST 4946 GLB2, were selected for this study because of their broad adaptation across the U.S. Cotton Belt and that they are susceptible to *M. incognita* and *R. reniformis*. Only ST 4946 was used in root-knot infested fields.

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 a storage rate of Gaucho 600 F (imidacloprid) at 4.6 oz/cwt. Seed-applied nematicides consisted of Aeris (imidacloprid + thiodicarb) at rate of 0.75 mg ai/seed, BioST Nematicide 100 at rate of 7.02 oz/cwt, and COPeO Prime (fluopyram) + Gaucho 600 F at a rate of 0.2 mg ai/seed + 4.6 oz/cwt, respectively. All seed were treated at the University of Tennessee at West Tennessee Research and Education Center in Jackson, TN. The soil applied nematicide, Velum Total (fluopyram + imidacloprid) was applied in-furrow at planting at a rate of 14 and 18 oz/A. Velum Total was applied with 5-6 gal of water/A using a flat fan nozzle oriented perpendicular to the seed furrow. AgLogic 15 GG (aldicarb) was applied in-furrow at planting at 5 lb/A in trials conducted in root-knot nematode infested fields. Various combinations of seed-applied and in-furrow applied nematicides were evaluated in this multi-state trial (Table 1).

Field Experiments

Field efficacy of seed-applied and soil-applied nematicides were assessed in seven *M. incognita* infested fields in Alabama, Arizona, Arkansas, Georgia, Texas, North Carolina, and Virginia, while four experiments were conducted in *R. reniformis* infested fields in Florida, Louisiana, Mississippi, and Texas. The experimental design was a randomized complete block design with four to five replicates per treatment. Individual 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. Plant stand counts were taken on 14 to 30 days after planting (DAP) as number of pants per 10 ft of row. Vigor ratings were based on a six point scale with 0 = poor vigor and 5 = best and sampled at 14 to 30 DAP. Population densities of root-knot and reniform nematodes were sampled at 30 to 60 DAP by collecting a representative soil subsample from each plot. Samples were collected near the existing stand of cotton. Root-knot nematode infection was determined at 30 to 60 DAP from 5 to 10 root systems based on gall counts per root system, rating system (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. These data were ranked from lowest to greatest based on each method at each location. Seed cotton yield was collected at harvest.

Statistics

Data were analyzed by mixed GLM procedure and mean separation by Tukey's HSD test at P = 0.10 using SPSS (version 25.0). The model statement consisted of location, nematicide, and the interaction with a random statement of block. Ranked data was not analyzed.

Results and Discussion

In *M. incognita* infested fields, there was no interaction (P e 0.20) for stand, nematode population density or yield between location and nematicide, thus only the main effects are reported (Table 1). There was no effect of treatment observed for seedling population density (stand), seedling vigor, or nematode population density (soil samples). Ranking of root infection indicated that COPeO Prime was among the best seed-applied nematicide, Velum Total at 18 oz/A among the best in-furrow applied nematicide and COPeO Prime + Velum Total at 14oz/A among the best combination treatment, with the last two treatments being the best overall across locations. Numerically, a greater seed cotton yield was observed with BioST Nematicide followed by Aeris + COPOeO Prime and COPeO Prime + Velum Total at 10 oz/A. This was the first time BioST Nematicide was evaluated by this committee. Overall, all nematicide and insecticide treatments contributed to a greater numeric yield over the base fungicide treatment.

The cotton cultivars ST 4946 and ST 4949 were used in six of the seven locations with two treatments: COPeO Prime and COPeO Prime + Velum Total at 14 oz/A (data not shown). There was no interaction between treatments and cultivars for stand, vigor, or yield, but there was a significant interaction for nematode population density. On average, between cultivars, ST 4946 supported 65-75% fewer *M. incognita* than ST 4949 for the NTC and COPeO Prime treatments, while the reverse was true for COPeO Prime + Velum Total treatment. Numerically, ST 4946 supported fewer (60 J2/100 cm^3 soil) compared to ST 4949 (101 J2/100 cm^3 soil) across treatments. The main effects for yield were greater (P = 0.001) with ST 4946 with 2,945 lb/A seed cotton compared to 2,533 for ST 4949. Numerically, COPeO Prime + VT 14 oz had the greatest numeric yield (2,773 lb/A seed cotton) among nematicide treatments.

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

Treatment and rate	Stand[z] 14-30 DAP	Vigor[y] 14-30 DAP	*Meloidogyne incognita*[x] 30-60 DAP	Seed cotton (lb/A)
Non-nematicide control[w]	28.1	4.1	5.1	2,424
Aeris (0.75 mg ai/seed)	26.9	4.0	0.5	2,535
BioST Nematicide 100 (7.02 oz/cwt)	29.7	3.7	2.8	3,047
COPeO Prime (0.20 mg ai/seed)	28.3	4.0	2.1	2,425
Aeris + COPeO Prime	29.3	3.9	0.7	2,713
Velum Total (14 oz/A)	28.8	4.0	1.0	2,559
Velum Total (18 oz/A)	28.7	4.1	7.1	2,590
Aeris + Velum Total (14 oz/A)	27.1	4.0	0.8	2,588
COPeO Prime + Velum Total (10 oz/A)	29.1	4.0	5.9	2,718
COPeO Prime + Velum Total (14 oz/A)	27.9	3.9	1.8	2,542
AgLogic 15 GG (5 lb/A)	27.2	3.9	1.5	2,790
P > F	0.47	0.60	0.35	0.13

[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] All seed were treated with a premium fungicide base and storage rate of Gaucho 600 F

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

Treatment and rate	Stand[z] 14-30 DAP	Vigor[y] 14-30 DAP	*Rotylenchulus reniformis*[x] 30-60 DAP	Seed cotton (lb/A)
Non-nematicide control[w]	29.6	3.3	406	1,958
Aeris (0.75 mg ai/seed)	31.6	3.9	455	2,056
BioST Nematicide 100 (7.02 oz/cwt)	30.6	3.8	369	1,952
COPeO Prime (0.20 mg ai/seed)	32.2	3.3	167	2,163
Aeris + COPeO Prime	31.3	3.4	305	2,015
Velum Total (14 oz/A)	32.4	3.4	415	2,043
Velum Total (18 oz/A)	29.5	2.9	218	2,113
Aeris + Velum Total (14 oz/A)	30.2	3.2	259	2,120
COPeO Prime + Velum Total (10 oz/A)	30.1	3.7	511	2,117
COPeO Prime + Velum Total (14 oz/A)	29.6	3.2	314	2,097
AgLogic 15 GG (5 lb/A)	32.3	2.9	366	2,391
P > F	0.23	0.15	0.11	0.63

[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] All seed were treated with a premium fungicide base and storage rate of Gaucho 600 F

There was no interaction for any dependent variables between location and nematicide in reniform infested fields. Seedling stand and vigor were relatively uniform across treatments (Table 2). Similarly, there was no effect of treatment for suppression of reniform nematodes with the lowest numeric population density with COPeO Prime.

Yield protection by nematicides was similar among treatments all treatments with the greatest numeric yield with AgLogic (Table 2).

Summary

The seed-applied nematicide treatments (COPeO Prime or Aeris) had a positive yield difference compared to the fungicide base 70% of the time with a range of -68 to 350 lb/A seed cotton and average of 140 lb seed cotton/A. Between these treatments, COPeO Prime provided a yield benefit 50% of the time, with an average yield benefit of 95.6 lb seed cotton/A. Aeris provided a yield benefit 100% of the time, which suggest the importance of thrips control in these trial. This contributed to range of 50 to 350 lb/A seed cotton with an economic benefit (above break-even (Aeris at $14.00/A and $0.70 cotton lint/lb and 38% gen out equal to 66 lb seed cotton/A to break even) 77% of the time.

Of the soil-applied nematicides tested, Velum Total at 14 oz/A had a positive yield difference in 2018, 90% of the time compared to the fungicide base with a difference range of -65 to 513 lb/A seed cotton and an average difference of 118 lb seed cotton/A. The economic benefit (above break-even: Velum Total at 25.20/A, $0.70 cotton lint/lb, 38% gen out equal to 95 lb seed cotton/A to break even) occurred 54.5% of the time. Overall, the majority nematicide treatments provide some degree of yield protection over the non-nematicide treatments in both southern root-knot and reniform infested field trials.

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 nor does it imply product registration within each state. This work was supported by a grant from Bayer CropScience.

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