BELTWIDE NEMATODE RESEARCH AND EDUCATION COMMITTEE REPORT: FIELD PERFORMANCE OF SEED- AND SOIL-APPLIED NEMATICIDES, 2020

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Abstract

The 2020 National Cotton Council Nematode Research and Education Committee evaluated two seed-applied and two soil-applied nematicides to manage *Meloidogyne incognita* or *Rotylenchulus reniformis* in cotton. There were seven and four field experiments in *M. incognita* and *R. reniformis* infested fields, respectively across ten states in the U.S. Cotton Belt. The cotton cultivar Deltapine DP 1646B2XF was used. None of the nematicides had a significant impact on seedling stand establishment or vigor. Numerically, Copeo® + Velum® Prime (6 fl oz/A) had the lowest percentage of root system galled and the best suppression of *R. reniformis* reproduction across locations. Of the experiments conducted in *M. incognita* infested fields, Copeo® had the greatest numeric impact on yield protection followed by Copeo® + Velum® Prime (6 fl oz/A). Whereas Copeo® + Propulse® 3.34 SC (13.6 fl oz/A) had the greatest impact on yield protection in *R. reniformis* fields followed by Copeo® + Velum® Prime (6 fl oz/A). These data support the combination of seed-applied + soil-applied nematicides to suppress cotton nematode infection and protect yield potential compared to a solo application method of seed- or soil-applied nematicides.

Introduction

The southern root-knot nematode (*Meloidogyne incognita*) and reniform nematode (*Rotylenchulus reniformis*) continue to be among the most yield-limiting plant-parasitic nematodes that affect cotton production across the U. S. 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., 2018; Lawrence et al., 2019; Lawrence et al., 2020). Nematicides continue to be an important part of an integrated pest management program; however, few multistate studies are conducted to assess the benefit of recently registered seed- and soil-applied nematicides across the U.S. Cotton Belt. The objective of this study was to evaluate the relative impact of seed-applied and soil-applied nematicides at several locations across the U.S. Cotton Belt.

Materials and Methods

Cotton Cultivars

The upland cotton cultivar, Deltapine, DP 1646 B2XF was selected for this study because of its broad adaptation across the U.S. Cotton Belt. The cultivar is marketed as susceptible to *R. reniformis* and *M. incognita*.

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 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 used commercially applied to the seed prior to any seed treatment application. All seed were treated at the University of Tennessee at West Tennessee Research and Education Center in Jackson, TN. The soil applied nematicide, Velum® Prime (fluopyram) was applied in-furrow at planting at a rate of 6 fl oz/A. The soil applied fungicide/nematicide, Propulse® 3.34 SC (fluopyram + prothioconazole) was applied in-furrow at planting at a rate of 13.6 fl oz/A. Soil-applied treatments were applied with 5-6 gal of water/A using a flat fan nozzle oriented perpendicular or microtube directed into to the seed furrow. Various combinations of seed-applied and in-furrow applied nematicides are listed in Table 1.

Field Experiments

Field efficacy of seed-applied and soil-applied nematicides were assessed in seven *M. incognita* infested fields in Alabama, Arkansas, Georgia, North Carolina, South Carolina, Texas, and Virginia, while four experiments were conducted in *R. reniformis* infested fields in Alabama, Florida, Louisiana, and Mississippi. 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 to 8-ft fallow alley. Plant stand counts were taken on 14 to 30 days after planting (DAP) and reported as the number of pants 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 at 30 to 60 DAP by collecting soil subsamples from each plot. Samples were collected near the existing stand of cotton at 6-8-in depth per treatment. Root-knot nematode infection was determined at 30 to 60 DAP from 5 to 10 roots based on either gall counts per root system, rating system (six or ten point scale) or estimating percent of root system with galls. All data were converted to percent root system with galls for analysis. Seed cotton yield was collected at harvest.

Statistics

Data were analyzed using a factorial ANOVA in the general linear mixed model procedure with nematicides as fixed variables, and location and block as a random variable using IBM SPSS Statistic version 27 (International Business Machines Crop., Armonk, NY). Additionally, data were analyzed in a general linear mixed model procedure with application method (seed-applied, soil-applied, and combined methods) as fixed variables. Percent root system galled, nematode population densities, and yield data for *M. incognita* trials were transformed using an inverse distribution function; while nematode population densities and yield for *R. reniformis* trials were transformed using Log10 (x +1) transformation to normalize for analysis and non-transformed data are reported (Timpleton, 2001). Means were separated at $\alpha = 0.05$ by Tukey's Honest Significant Difference test

Results and Discussion

In *M. incognita* infested fields, there was no location by nematicide ($P > 0.05$) interaction for percent root system galled, nematode population density or yield (Table 1). There was, however, a significant location by nematicide interaction ($P < 0.05$) for plant stand and vigor, which is understandable given the variation in environmental conditions shortly after planting across the 2020 cropping season (data not shown). Based on the main effects, nematicides did not have a significant impact on stand, vigor, nematode population density, galling, or yield (Table 1). Overall, galling was low with an average percent root system galled of 4.6% across locations. Numerically, Copeo® + Velum® Prime contributed to the lowest percent root system galled, while Copeo® provided the greatest yield protection.

There was no significant difference ($P > 0.05$) among application methods for suppression of root galling. Only the combined method provided a lower numeric percent root system galled at 3.4% compared to the non-nematicide control (4.3%). Similarly, there was no significant difference among application methods for yield; however, all application methods contributed to a greater numeric yield benefit with 1.27, 2,95, and 6.6% greater seed cotton yield for seed-applied, soil-applied and combined methods than the non-nematicide treated control (2,107 lb/A).

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

	Stand[z]	Vigor[y]	*Meloidogyne incognita*[x]		Seed cotton (lb/A)
Treatment and rate	14-30 DAP	14-30 DAP	Soil	% Galling	
Non-nematicide control[w]	25.8	4.2	107	4.7	2,107
Copeo® (0.20 mg ai/seed)	25.6	4.3	150	3.4	2,344
BioST® Nematicide 100 (7.0 oz/cwt)	25.6	4.1	171	5.9	2,173
Velum® Prime (6 oz/A)	27.6	4.4	92	4.8	2,269
Propulse® 3.34 SC (13.6 fl oz/A)	26.8	4.3	89	4.0	2,069
Copeo® + Velum® Prime (6 fl oz/A)	24.2	4.6	104	2.9	2,296
Copeo® + Propulse® 3.34 SC (13.6 fl oz/A)	23.7	4.3	92	3.9	2,215
$P > F$	0.35	0.09	0.84	0.18	0.15

[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 and percent of root system galled 30-60 DAP.
[w] All seed were treated with a premium fungicide base and storage rate of Gaucho® 600 F.

In the *R. reniformis* infested fields, there was no nematicide by location ($P > 0.05$) interaction for yield. There was, however, a nematicide by stand, vigor, and nematode population density ($P < 0.05$) interaction. It is not uncommon for such an interaction given the differences in environmental conditions across locations. For these proceedings, only the main effects are reported (Table 2). Based on the main effects, nematicides had no effect on stand, seedling vigor, and nematode population densities. Statistically, BioST® Nematicide 100 had the lowest ($P \leq 0.05$) yield compared to Propulse® 3.34 CE and Copeo® + Velum® Prime or Copeo® + Velum® Prime + Propulse® 3.34 SC.

There was no significant difference ($P > 0.05$) among application methods for suppression of *R. reniformis* population densities. Numerically, the seed- + soil-applied treatments contributed to the lowest reniform counts (1,254 RN/100 cm^3) compared to the non-nematicide control (1,505 RN/100 cm^3 soil). Similarly, there was no significant difference among application methods for yield and unlike the *M. incognita* trial only the soil-applied and seed- and soil-applied treatments provided a greater numeric yield benefit at 1.21 and 4.54% greater, respectively, compared to the non-nematicide treated control (1,980 lb/A).

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

	Stand[z]	Vigor[y]	*Rotylenchulus reniformis*[x]	Seed cotton (lb/A)
Treatment and rate	14-30 DAP	14-30 DAP	30-60 DAP	
Non-nematicide control[w]	28.4	3.5	1,505	1,894 abc[v]
Copeo® (0.20 mg ai/seed)	23.6	3.2	1,655	1,833 ab
BioST® Nematicide 100 (7.0 oz/cwt)	23.3	2.9	1,987	1,775 a
Velum® Prime (6 fl oz/A)	29.0	3.6	1,670	1,879 abc
Propulse® 3.34 SC (13.6 fl oz/A)	29.5	3.5	1,725	1,957 bc
Copeo® + Velum® Prime (6 fl oz/A)	24.5	3.4	1,161	1,984 bc
Copeo® + Propulse® 3.34 SC (13.6 oz/A)	23.0	3.3	1,355	2,013 c
$P > F$	0.30	0.39	0.59	0.01

[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.
[v] Different letters indicate a significant difference at $\alpha = 0.05$ according to Tukey's HSD test.

Summary

Seed- and soil-applied nematicides were variable in their suppression of *M. incognita* and *R. reniformis*. Furthermore, no single treatment provided a consistent protection of cotton yield potential. Overall, the combination of seed-applied + soil-applied nematicide treatments contributed to a greater numeric seed cotton yield than the non-nematicide control or seed-applied nematicides or soil-applied nematicides, which is similar to that reported by this committee (Faske et al., 2020).

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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