EVALUATION OF COTTON CULTIVARS WITH AND WITHOUT NEMATICIDES IN THE PRESENCE OF RENIFORM NEMATODE

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Abstract

A greenhouse and field trials were conducted to determine the reductions in plant growth and yield due to the reniform nematode and to determine the potential benefit of seed treatment nematicides on commercially available cotton cultivars. Ten high yielding commercial cultivars were planted with and without seed treatment nematicides in a reniform nematode field and also in an adjacent field without the reniform. Greenhouse tests found the abamectin plus thiodicarb nematicide seed treatments decrease in reniform nematode egg production by 76% over all cotton cultivars. In the field trials, the reniform nematode reduced seed cotton yields by 63% between the field with and without the reniform nematode. The application of the seed treatment nematicides increased the yields of the cotton cultivars in the reniform infested field by 23%. Thus the application of the nematicides did improve yield but not to the level of the yields in the non-infested field

Introduction

The Reniform nematode (*Rotylenchulus reniformis*) is distributed worldwide in tropical and sub-tropical climate zones. In Alabama, this nematode is most damaging on upland cotton. The reniform nematode causes significant yield losses in Alabama and throughout the cotton belt of the United States. It is estimated that reniform nematodes have caused up to 50% loss in cotton yield (Lawrence et al. 2014). Symptoms of a reniform nematode infection include small egg masses on the plant roots, root necrosis, and a decline in yields over time. The purpose of this study is to determine the yield reduction due to the reniform nematode and to determine the yield bust due to nematicide seed treatments. The hypothesis of this study is that the nematicide seed treatments will effectively reduce reniform nematode population densities and subsequent damage to the cotton plants and in turn increase yields. The study was conducted in North Alabama on a research farm that had been previously inoculated with a healthy reniform nematode population, and in a controlled greenhouse environment on the campus of Auburn University.

Materials and Methods

Greenhouse Trial

Ten high yielding cotton cultivars were selected for evaluation with greenhouse trials. Trials were planted at Plant Sciences Research Center at Auburn University in a randomized complete block design replicated 5 times using 150 cc containers. Media used consisted of a 1:1 mixture of pasteurized field soil and sand. Cultivars selected for this trial were Americot NG 1511 B2RF, Deltapine 1321 B2RF, and Deltapine 1133 B2RF, Deltapine 1252 B2RF, Deltapine 1454 NR B2RF, Phytogen 375 WRF, Phytogen 499 WRF, Phytogen 339 WRF, Phytogen 427 WRF, and Stoneville 4747 GLB2. Each seed was treated with a nematicidal seed treatment consisting of Avicta (abamectin) applied at 0.15 mg ai/seed in combination with Aeries (thiodicarb) at 0.375 mg ai/seed. At planting, each conetainer was inoculated with 2000 reniform eggs and vermiform life stages. The trial was allowed to run for 45 days. Data taken at termination of the trial included plant heights, shoot fresh weight, root fresh weight, and reniform population reproduction factors. All data were analyzed in SAS 9.3 using Glimmix procedure. The LSMEANS were separated by Tukey-Kramer (α=0.1).

Field Trial

The same ten cultivars were evaluated for selected variables during the 2014 growing season in field trials. Trials were planted at Tennessee Valley Research and Experiment Center (TVREC) in a completely randomized block design with 5 replications. Soil type at TVREC station is a Decatur silt loam comprised of 23% sand, 49% silt, and 28% clay. Trials were planted in a naturally infested reniform field (field #55) and a non-infested (field #53) reniform field. Each

field was composed of the identical soil types and both fields were irrigated equally according to need. All seeds were treated with Avicta (abamectin) applied at 0.15 mg ai/seed in combination with Aeries (thiodicarb) at 0.375 mg ai/seed. Initial reniform nematode samples were taken at planting. Each plot consisted of two rows, each 25 feet in length with 40-inch spacing between rows. Reniform nematode populations were taken 39 days after planting by extracting reniform eggs from three root systems randomly removed from each plot. Plot yield data was collected 168 days after planting. All data was analyzed in SAS 9.3 using Glimmix procedure. The LSMEANS were separated by Tukey-Kramer (α=0.1).

Results

Greenhouse Trial

Over all cotton cultivars, the plant biomass produced in the greenhouse was 12% larger when grown in soils without the reniform nematode compared to the same cultivars grown with the nematode. The seed treatment nematicide did not increase the plant biomass of the reniform infested cultivars (data not shown). Reniform nematode eggs per gram of root were reduced by the application of the seed treatment nematicides (Table 1). The reduction in the reniform numbers was 76% compared to the cultivars without the nematicide. All cultivars supported similar numbers of reniform nematodes with or without the seed treatment nematicides in the greenhouse tests.

Table 1. Reniform nematode population densities at 45 days after planting on cotton cultivars with and without a seed treatment nematicide and with and without reniform nematodes in the greenhouse, 2014.

	Reniform infested soil		Non-infested soil
	No seed treatment nematicide	With seed treatment nematicide	No seed treatment nematicide
	Reniform eggs/ gm root	Reniform eggs/ gm root	Reniform eggs/ gm root
ST 4747 GLB2	579 a	138 a	0.0 a
DP 1321 B2RF	976 a	99 a	0.0 a
Americot NG 1511 B2RF	261 a	137 a	0.0 a
PHY 499 WRF	369 a	93 a	0.0 a
PHY 427 WRF	374 a	177 a	0.0 a
PHY 339 WRF	321 a	58 a	0.0 a
DP 1454 NR B2RF	467 a	34 a	0.0 a
PHY 375 WRF	461 a	107 a	0.0 a
DP 1133 B2RF	539 a	250 a	0.0 a
DP 1252 B2RF	867 a	147 a	0.0 a

[z] Means followed by the same letter in a column are not significantly differ (α=0.1, Tukey-Kramer's LS-means)

Field Trial

Reniform nematode population levels were relatively high by the 30 days after planting sampling period. No reniform were found in the non-infested field as expected. In the reniform field, the seed treatment nematicides reduced reniform populations 30% compared to the cultivars not treated with the nematicides (Table 2). DP 1454 NR B2RF with the seed treatment nematicides supported fewer reniform nematodes than all the other cultivars. This cultivar was developed with resistance to the root-knot nematode but did not support as many reniform nematodes in this test. The application of the nematicide reduced reniform numbers on all cultivars except DP 1454 NR B2RF.

Seed cotton yields were reduced 62% by the reniform nematode (Table 3). The application of the seed treatment nematicides improved yield by 23 % compared to the same cultivars without a nematicide application. The average yield over all 10 cultivars in the non-infested field and the reniform infested field were 3930 lb/A and 1464 lb/A, respectively. The application of the seed treatment nematicides in the reniform infested field improved the average yield from the 1464 lb/A to 1905 lb/A. Every cultivar tested produced an increase in yield with the application of the seed treatment nematicides. The cultivars ST 4747 GLB2, DP 1321 B2RF, Americot NG 1511 B2RF, PHY 499 WRF,

PHY 427 WRF, and PHY 339 WRF produced similar yield in the reniform free field. However yield potential was reduced with the reniform nematode. PHY 427 WRF produced the greatest yield with reniform and no nematicide while PHY 499 WRF was very sensitive to the nematode and produced the lowest yields. The application of the nematicide evened the yield differences produce similar yields over all cultivars.

Table 2. Reniform nematode population densities at 30 days after planting on cotton cultivars with and without a seed treatment nematicide and a non-infested field without reniform nematodes, 2014.

	Reniform nematode		
	Infested field		Non-infested field
	No seed treatment nematicide	With seed treatment nematicide	No seed treatment nematicide
	Reniform eggs/ gm root	Reniform eggs/ gm root	Reniform eggs/ gm root
ST 4747 GLB2	5592 a	2706 a	0.0 a
DP 1321 B2RF	3346 a	1684 a	0.0 a
Americot NG 1511 B2RF	1550 a	2237 a	0.0 a
PHY 499 WRF	7051 a	3776 a	0.0 a
PHY 427 WRF	3439 a	1319 a	0.0 a
PHY 339 WRF	4304 a	3758 a	0.0 a
DP 1454 NR B2RF	944 b	3525 a	0.0 a
PHY 375 WRF	2525 a	1062 a	0.0 a
DP 1133 B2RF	2928 a	2380 a	0.0 a
DP 1252 B2RF	3677 a	2175 a	0.0 a

[z] Means followed by the same letter in a column are not significantly differ (α=0.1, Tukey-Kramer's LS-means)

Table 3. Seed cotton yield for cultivars in a reniform infested field with and without a seed treatment nematicide and a non-infested field without reniform nematodes, 2014.

	Reniform nematode		
	Infested field		Non-infested field
	No seed treatment nematicide	With seed treatment nematicide	No seed treatment nematicide
	Lbs./a	Lbs./a	Lbs./a
ST 4747 GLB2	1654.5 ab	2032.4 a	4622.5 a
DP 1321 B2RF	1671.6 ab	2155.7 a	4497.1 ab
Americot NG 1511 B2RF	1104.5 ab	2073.1 a	4374.3 ab
PHY 499 WRF	960.5 b	1350.0 a	4289.4 ab
PHY 427 WRF	2296.7 a	2428.4 a	4262.0 ab
PHY 339 WRF	1462.9 ab	2324.9 a	4201.9 ab
DP 1454 NR B2RF	1124.5 ab	1583.1 a	3594.5 bc
PHY 375 WRF	1788.1 ab	1981.2 a	3580.1 bc
DP 1133 B2RF	1500.2 ab	1738.7 a	3218.3 cd
DP 1252 B2RF	1079.4 ab	1382.4 a	2661.9 d

[z] Means followed by the same letter in a column are not significantly differ (α=0.1, Tukey-Kramer's LS-means)

Summary

The primary goal of these studies was to determine the damage potential of the reniform nematode on cotton cultivars and to determine the potential benefit of the seed treatment nematicides. In the greenhouse trials, nematicides reduced reniform numbers by 76%. In the field trials, nematicides reduced reniform numbers by 30% and increased yields by 23%. However, the reniform nematode did reduce yields between the infested and non-infested field by 63%. It is very important to keep non-infested fields clean and not introduce this pathogen.

References

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