EFFECT OF PHYTOGEN SEED TREATMENT PRODUCTS AND CULTIVARS TO MANAGE THE RENIFORM NEMATODE IN MISSISSIPPI

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Abstract

Rotylenchulus reniformis, the reniform nematode, is a continuing problem for Mississippi cotton farmers as well as cotton farmers throughout the southern United States. The reniform nematode remains a major yield-limiting constraint, especially where cotton has been planted continuously. In Mississippi, the reniform nematode can be a severe yield reducer in situations where soil populations exceed the economic thresholds which are greater than or equal to 1,000/pint of soil in the spring and greater than or equal to 5,000/pint of soil post-harvest. Currently, no resistant varieties are commercially available; therefore, additional management options including seed-applied nematicides may be beneficial to manage yield-limiting reniform nematode populations. During 2020, two field trials were conducted to consider the role of integrated management practices at managing the reniform nematode. Several different seed treatments including a base fungicide combination as well as a seed-applied nematicide were used in combination with several different cotton cultivars for a total of 16 treatments in each trial. Soil samples were collected from each plot at pre-plant, mid-season, and harvest to assess the reniform nematode population present. Nematode populations increased throughout the season and were above economic threshold at harvest with nematode populations above threshold in 75% of the treatment combinations. In general, the reniform nematode numbers observed as an average were greater in the cultivars that received the seed-applied nematicide when compared to cultivars without the seed-applied nematicide regardless of field location. Managing the reniform nematode through integrated approaches, such as with cultivar and seed-applied nematicide combinations may prove an effective alternative for cotton farmers.

Introduction

Rotylenchulus reniformis, the reniform nematode, is one of three major nematode pests in the Mississippi cotton production system. In addition to impacting cotton production Mississippi, the reniform nematode is also responsible for yield losses in other southern, cotton growing areas in Alabama, Arkansas, Georgia, Louisiana, Missouri, and Texas. All of the southern states with substantial cotton production have reported have historically reported high reniform nematode infestations in field situations where continuous cotton production has been the predominant cropping system (Lawrence et al., 2017; Lawrence et al., 2018; Lawrence et al., 2019; Lawrence et al., 2020). In field situations where the reniform nematode population is greater than the economic threshold, significant yield reductions can be observed. In severe infestations, the reniform nematode can be responsible for yield losses greater than 30%. Populations of the reniform nematode reported to result in yield losses in Mississippi range from 1,000 reniform nematodes/pint in the spring to 5,000 reniform nematodes/pint shortly after harvest. At present, reniform-resistant cotton cultivars are not widely available. However, management considerations for the reniform nematode with the existing germplasm and integrating seed-applied nematicides may prove to be beneficial for some cotton farmers depending on field history or the overall reniform nematode population structure of specific fields. The specific objective of these trials was to determine the benefits of cultivar and seed treatment combinations in managing the reniform nematode.

Materials and Methods

Two fields (Field 1 and 6) at the Delta Research and Extension Center in Stoneville, MS, with a history of moderate reniform nematode infestation were used in 2020. Trials were planted in a randomized complete block design (RCBD) with a split-plot constraint (cultivar; n=8). Plots consisted of four rows of cotton (40" centers) and were 35 feet long separated by a 7 foot fallow alley. Treatment combinations consisted of several seed-applied nematicide treatments in combination with cultivar tolerance. Seed treatments consisted of either a base treatment (fludioxonil + mefenoxam + myclobutanil + imidacloprid) or the base treatment + Trio which is Phytogen's proprietary seed treatment package (azoxystrobin/fludioxonil/mefenoxam + sedexane + BioST VPH). The BioST VPH serves as the seed-applied nematicide component. Stand counts and vigor were assessed post-planting by evaluating the number of plants emerged in the middle two rows of each plot and observing the appearance of the whole plot (vigor). Soil samples were collected preplant, mid-season and approximately at harvest to assess the reniform nematode population present and determine the effects of treatment combinations on soilborne nematode populations. Nematodes were extracted from 200 cc of soil from each representative plot and numbers are presented by pint of soil. Extractions were completed by elutriation and sucrose centrifugation. The center two rows from each plot were machine-harvested post-defoliation with a two row Case IH cotton picker outfitted with a harvest weigh cell system. All data were analyzed in PROC GLIMMIX ($\propto = 0.5$).

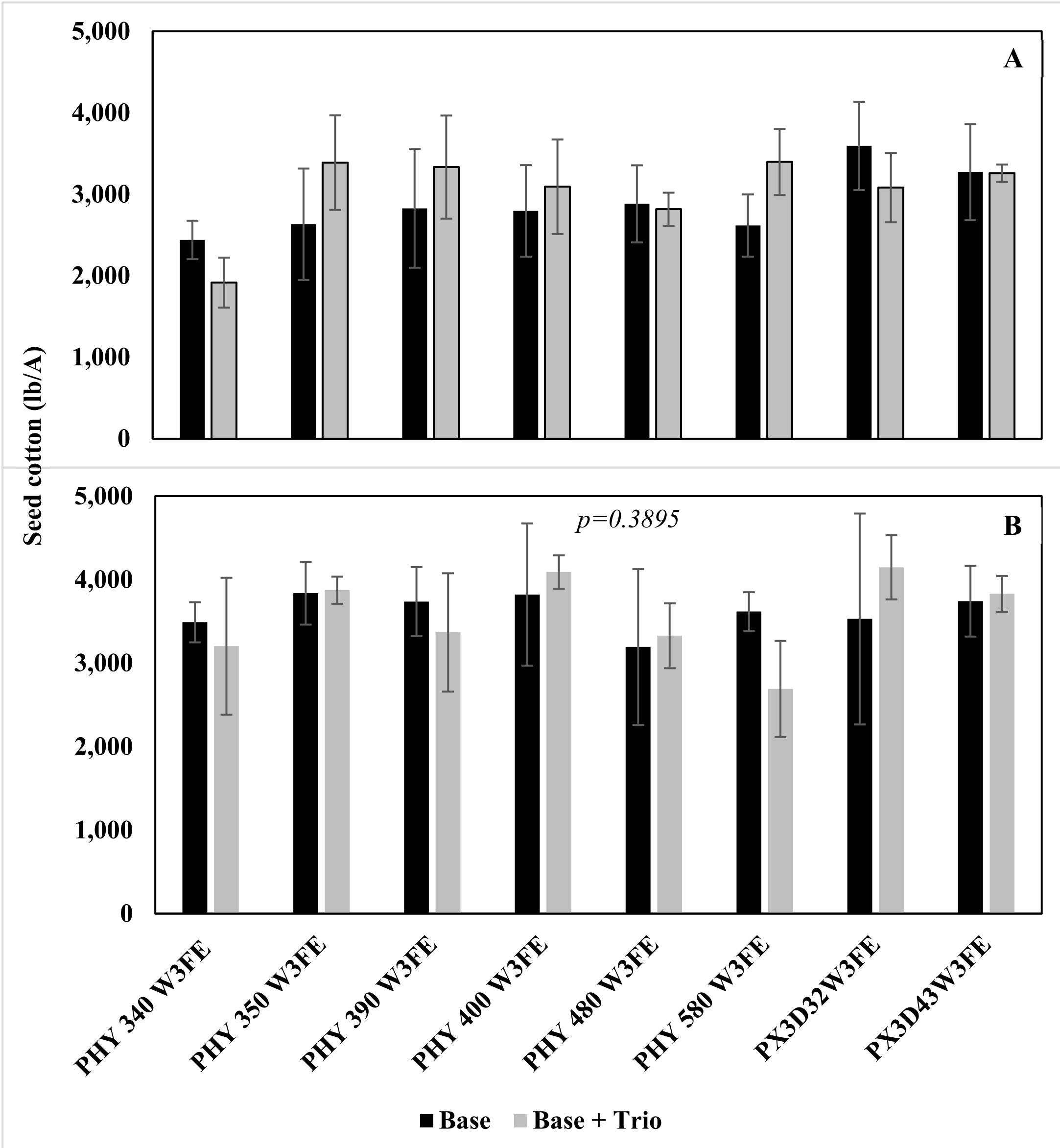
Results

A significant increase in stand, up to 55%, was observed with PHY480 W3FE with the base + Trio combination in the Field 1 location (Table 1). In most cases reniform nematode populations were above the economic threshold (1,000/pint) in the pre-plant sampling regardless of field location. Nematode populations increased during the season and were above the economic threshold (5,000/pint) by the end of the season in all plots regardless of treatment combination. In general, reniform nematode populations at harvest were greater in Field 1 than in Field 6, averaging more than 9,000 per pint versus 5,000 per pint, respectively. In addition, reniform nematode numbers on average were greater in the cultivars that received the seed-applied nematicide product Trio when compared to cultivars without the nematicide by 15% in Field 1 and 7% in Field 6. Out of a possible 16 treatment combinations, reniform nematode populations were greater in 10 of the 16 combinations, or 62%. PX3D32W3FE with the base treatment was significantly different for Field 1 with regards to seed cotton (lb/A) when compared to most other cultivars with the base treatment (Fig. 1A). In Field 1 (Fig. 1A), numerically, the greatest yield was observed with PHY580 W3FE, which was 23% greater than the PHY580 that received the base seed treatment and 43% greater when compared with the cultivar (+Base + Trio seed treatment) that produced the lowest yield plus Trio in Field 1.

Table 1. Percent stand establishment, and pre-plant and harvest reniform nematode (RN) numbers from a cultivar and seed treatment integrated nematode management trial conducted during 2020 at two field locations in Stoneville, MS.

		% Stand		Field 1 RN #s		Field 6 RN #s	
Cultivar	**Seed Treatment[a]**	**Field 1**	**Field 6**	**Pre-plant**	**Harvest**	**Pre-plant**	**Harvest**
PHY 340W3FE	Base	75 de	95	1,007	10,299	2,626	5,390
	Base +Trio	40 g	65	2,543	6,449	587	3,850
PHY 350W3FE	Base	78 b-e	84	1,365	8,855	1,742	3,850
	Base + Trio	77 b-e	83	938	9,914	2,038	5,968
PHY 390W3FE	Base	70 ef	81	1,022	8,085	1,225	4,524
	Base + Trio	82 a-d	83	784	12,224	1,998	3,946
PHY 400W3FE	Base	77 b-e	82	908	8,855	1,312	5,486
	Base + Trio	74 de	82	630	10,588	985	5,390
PHY 480W3FE	Base	65 f	77	954	10,299	1,801	4,524
	Base + Trio	88 a	84	1,123	12,031	2,250	7,700
PHY 580W3FE	Base	80 a-d	93	1,070	12,031	1,793	7,411
	Base + Trio	81 a-d	62	1,381	16,074	977	4,331
PX3D32W3FE	Base	85 ab	81	1,547	7,026	1,915	4,235
	Base + Trio	85 ab	71	1,220	7,315	660	7,796
PX3D43W3FE	Base	76 cde	75	753	4,620	1,517	5,294
	Base + Trio	84 abc	77	1,688	5,968	816	4,909
	p-value	<0.0001	0.8110	0.6235	0.0891	0.7233	0.6062

[a] Base seed treatment = (fludioxonil + mefenoxam + myclobutanil + imidacloprid)
Base treatment + Trio = base treatment chemicals + Trio (azoxystrobin/fludioxonil/mefenoxam + sedexane + BioST VPH)



p=0.0018

Fig 1. Yield (lbs seed cotton/A ± st. dev.) from two study sites: **A)** Field 1 and **B)** Field 6, conducted in Stoneville, MS during 2020 to compare genetics and seed-applied treatments at managing the reniform nematode.

Discussion

Seed treatment alone did not provide significant increases in seed cotton; however, mathematical differences observed between treatments suggest that specific seed treatment and cultivar combinations may be beneficial depending on the reniform nematode population present in a commercial field situation. Managing the reniform nematode remains an important issue for cotton farmers throughout Mississippi. With the general loss of aldicarb, and reduction in overall uses of in-furrow nematicides as a result of a reduced nematicide availability, farmers are in need of management alternatives to combat high reniform nematode populations. Seed-applied nematicides offer one of those alternatives, but these may not be attractive in situations where extremely high nematode populations are the norm. Adding management options such as with reniform nematode-resistant cultivars should greatly aid cotton farmers.

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