IMPACT OF COTTON GENETICS AND NEMATICIDES ON RENIFORM NEMATODE POPULATIONS AND YIELD

Jennifer Dudak
Dr. Tom Isakeit
Texas A&M University
College Station, Texas
Dr. Reagan Noland
Texas A&M AgriLife Extension Service
San Angelo, Texas
Dr. Terry Wheeler
Texas A&M AgriLife Research
Lubbock, Texas
Dr. Gaylon Morgan
Cotton Incorporated
Cary, North Carolina

Abstract

Rotylenchulus reniformis, reniform nematode, is an increasingly important crop pest in cotton. As they have spread throughout the United States cotton belt, economic impact has become more detrimental to the American cotton producer. The percent total yield loss due to this pest has increased significantly in the last decade. Two field research trials were conducted in 2019 at Damon, College Station, and Wall, Texas to evaluate 1) genetic resistance and 2) nematicides for the greatest efficacy against reniform nematodes. The variety trial included cotton varieties with root-knot and reniform resistant genes, and a split-plot factor of in-furrow fluopyram and prothioconazole vs. untreated. The chemical trial included in-furrow Aldicarb 15G, an in-furrow combination of fluopyram and prothioconazole, and foliar-applied oxamyl, applied to both a two-gene root-knot resistant variety and a known susceptible variety. The cost of each nematicide application, plant height, yield, and post-harvest nematode populations were assessed and reported.

Introduction

Cotton growers need to be equipped with the best tools to withstand the damage reniform nematodes cause as they spread across the southern United States. The two methods researched in this study are cotton genetics and nematicides. There are currently zero cotton varieties on the market specifically resistant to reniform nematodes, however companies are actively working to develop such varieties. In the past, certain root-knot nematode resistant varieties have been planted to help alleviate yield loss caused by reniform nematodes. Nematicides have also, historically, been used to control nematode populations; however, availability of some has decreased, and information is lacking regarding other nematicides and this pest. It is crucial to understand the potential of genetic resistance and nematicides to inform the best recommendations.

Materials and Methods

Two studies were conducted at each site. The first compared nematode resistance genetics in six to seven cotton varieties (Table 1). The study was a Randomized Complete Block Design with four replications. Depending on location, either six or seven varieties were planted with a split-plot factor of fluopyram and prothioconazole (994 mL ha^{-1} in-furrow) vs. untreated.

Table 1. Cotton varieties tested at each site and associated nematode resistance.

Damon	College Station & Wall	Trait
-	PHY340 W3FE	Susceptible
PHY440 W3FE	PHY440 W3FE	1 gene root-knot
PHY480 W3FE	PHY480 W3FE	2 gene root-knot
PHYEXP W3FE	PHYEXP W3FE	Reniform
DG3651 B2XF	DG3651 B2XF	2 gene root-knot
DP1747 NR B2XF	DP1747 NR B2XF	2 gene root-knot
DP18R628	DP18R628	2 gene root-knot

The second study compared three different nematicides, alone and in all applicable combinations, and an untreated check (Table 2), applied to two varieties with contrasting nematode resistance. The varieties tested include PHY480W3FE and PHY340W3FE/ PHY440W3FE. Aldicarb 15G was applied in-furrow at planting with insecticide boxes at 5.6 kg ha^{-1}. The fluopyram and prothioconazole combination was also applied in-furrow at planting (994 mL ha^{-1}). Oxamyl was foliar broadcasted (993.9 mL ha^{-1}) at 30 and 45 days after planting (DAP). Plant height was measured at 80 and 100 DAP, lint yield was taken at harvest, and soil samples used to determine nematode populations were taken post-harvest. The pie-pan method was utilized to extract nematodes from 200cc of soil. A mixed model analysis was conducted with the fixed effects including variety, nematicide, and variety by nematicide and the random effects including block and the block by main fixed-effect interaction (study dependent) using Tukey's HSD (α=0.05) to determine differences in plant height, nematode populations, yield, and economic return.

Table 2. Nematicide treatments and costs used for economic analyses.

Treatment	Price ha^{-1}
Aldicarb 15G	$83.40
Aldicarb 15G + Oxamyl	$159.58
Fluopyram and Prothioconazole	$105.02
Fluopyram and Prothioconazole + Oxamyl	$181.20
Oxamyl	$76.18
Untreated Check (UTC)	$0

Results and Discussion

Genetics Study

Variety influenced yield at Damon (p = 0.0016), College Station (p = 0.0001), and Wall (p < 0.0001) (Figure 1) in the genetics study. The application of fluopyram and prothioconazole showed no influence (p > 0.05) on yield at Damon or College Station but increased (p = 0.02) yield (160 kg ha^{-1}) compared to untreated (107 kg ha^{-1}) at Wall. Plant height was influenced by variety at Damon and Wall at both timings (p < 0.0001) (Figure 2), but no influence was found in College Station at either timing (p > 0.05). The application of fluopyram and prothioconazole increased “height a” ($p = 0.02$) by 4.2 cm compared to untreated in Damon but did not affect plant height at the other locations. Variety did not influence nematode populations at Damon or Wall ($p > 0.05$).

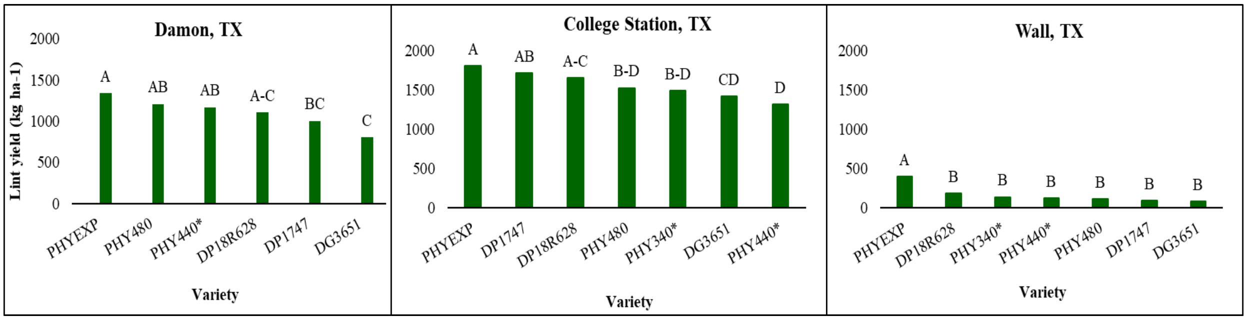

Figure 1. Lint yield from Damon (left), College Station (middle), and Wall (right), Texas. Within locations, means with the same letter are not significantly different ($\alpha = 0.5$). *Non-resistant check.

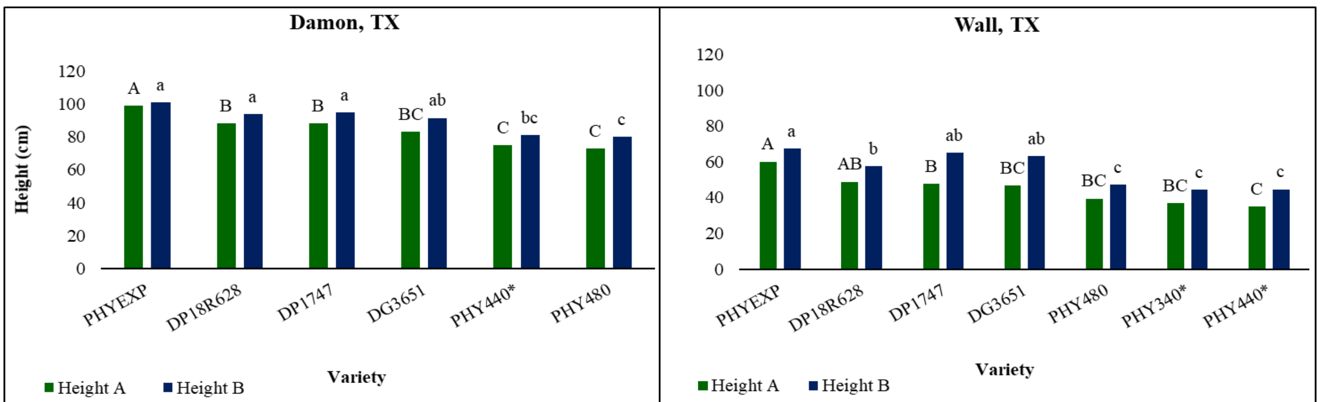

Figure 2. Plant height measurements from two timings at Damon (left) and Wall (right), Texas. *Non-resistant check.

Nematicide Study

Nematicide treatments did not influence cotton yield ($p > 0.05$) at all locations. The application of aldicarb 15G + oxamyl increased plant height ($p = 0.03$) 79 days after planting (DAP) (81.5 cm) compared to no nematicide treatment (72.4 cm) in Damon, Texas. Plant heights at all other timings and locations were not influenced by nematicide treatments ($p > 0.05$). PHY480 resulted in greater plant height (50.1 cm) than PHY340 (44.2 cm) at 99 DAP in Wall, Texas ($p = 0.014$). The utilization of nematicides (prices listed in Table 2.) showed no partial economic gain at Damon, Wall, and College Station ($p > 0.05$) based on a lint price of \$1.43 kg^{-1} (\$0.65 lb^{-1}) and seed price of \$165.35 $tonne^{-1}$ (\$150 ton^{-1}). Lastly, the application of nematicides did not influence nematode populations at Damon and Wall ($p > 0.05$).

Summary

In the genetics study, PHYEXPW3FE was consistently among the top performing at all locations and DP18R628 among the top at Damon and College Station. In the nematicide study, application of a nematicides did not affect yield nor nematode populations and resulted in no economic gains at all locations. These findings indicate that genetic resistance is likely a more effective tool than nematicide applications to manage reniform nematodes in cotton.

Acknowledgements

Thank you to the Texas A&M Cotton Extension Program for the assistance in research. The cooperators who allowed us to conduct this research in their fields. Also, Bayer Crop Science, Corteva Agriscience, and Nutrien Ag Solutions for the donation of seed and nematicides.