PERFORMANCE EVALUATION OF LONREN-1 GENOTYPES IN RESPONSE TO NEMATICIDES

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Abstract

The reniform nematode (*Rotylenchulus reniformis*) is one of the most damaging pests to cotton grown in the southeastern region of the United States. Currently, there are no reniform resistant cultivars on the market. Germplasm lines LONREN-1 and LONREN-2 have recently been released for cotton breeders to use in breeding efforts with desirable cultivars to establish resistance. Previous screenings for reniform resistance in breeding lines have demonstrated that some lines are indeed highly resistant. However, when high numbers of reniform nematodes are present, severe stunting in the seedling stage is common within these resistant development lines. The LONREN-1 germplasm, three resistant lines from the LONREN-1xFM966 cross, one susceptible line from the LONREN-1xFM966 cross, and the susceptible cultivar DP393 were treated with nematicides and their performances evaluated in micro-plot and field trial experiments. Plant heights were recorded at 30, 45, and 60 days after planting (DAP). Reniform populations were recorded at 30 and 60 (DAP), and again at harvest. In micro-plot and field trial experiments, an increase in plant height was evident at 30 and 45 DAP in resistant lines that had been treated with nematicides. Reniform populations were significantly lower in several resistant lines that were treated with nematicides.

Introduction

The reniform nematode (*Rotylenchulus reniformis*) is a semi-endoparasitic nematode that is widely distributed in subtropical and tropical regions of the world (Robinson, 2002). In 2010, an estimated 213,627 bales were lost in the United States due to damage caused by the reniform nematode, with Alabama, Louisiana, and Mississippi having the largest yield reduction impacts (Blasingame et. al, 2011). Host plant resistance within cotton could be a very good alternative for control of reniform nematodes. However, suitable sources of resistance have not been found in upland cotton (*Gossypium hirsutum*) cultivars that are available to cotton producers (Robinson and Percival, 1997; Usery *et al.*, 2005; Yik and Birchfield, 1984).

In April of 2007, the United States Department of Agriculture (USDA) released two germplasm lines LONREN-1 and LONREN-2 (Starr *et al.*, 2007). Since released, LONREN lines have shown the potential to decrease reniform populations in greenhouse and field trial experiments (Bell *et al.*, 2009; Weaver *et al.*, 2011). In field trials that were absent of reniform nematodes, no significant yield loss was observed in the LONREN lines when compared to susceptible entries (Weaver et al., 2011). Fiber quality from LONREN lines was also reported to be desirable most notable in fiber strength (Bell *et al.*, 2009; Weaver *et al.*, 2011). Unfortunately, when LONREN resistant lines were planted in field trials where high nematode populations were present as a result severe stunting, delayed development, and significant yield loss were evident when compared to susceptible lines (Bell *et al.*, 2009; Weaver *et al.*, 2011).

The hypothesis of this study is that nematicides would suppress nematode pressure in the cotton seedling stage, reducing the amount of damage to the root system and allow resistant lines to grow to a point to withstand the hypersensitive reaction of the plant. The three objectives of this study were to: 1) Evaluate reniform nematode populations on LONREN derived genotypes with and without nematicides 2) Evaluate the effects that applying nematicides have on early seedling stunting of LONREN genotypes, and 3) Evaluate yield performances influenced by nematicides.

Material and Methods

Six different genotypes were evaluated in a 6 × 2 factorial design. The genotypes entered in this study were the germplasm line LONREN-1, three resistant genotypes A107, A122, and B219 that were derived from the cross LONREN-1 x FM966, the susceptible genotype B211, and the conventional cultivar Deltatpine (DP) 393. The resistant lines that were selected for this study have previously been reported to reduce reniform populations in previous field trial screenings and display high levels of resistance in greenhouse screenings (Sikkens *et al.*, unpublished data). The yield performance of the selected lines from previous field trial screenings was also a factor in the selection process. Two different nematicide formulations, abamectin and thiodicarb, the fungicide Dynasty, and the insecticide Cruiser were applied to stock seed of each of the six entries to establish one level of the second factor. The second level of the second factor will only have the fungicide and insecticide formulations applied to each of the six entries. The same factorial design was used for evaluation purposes in micro plot and field trial experiments.

Micro-plots

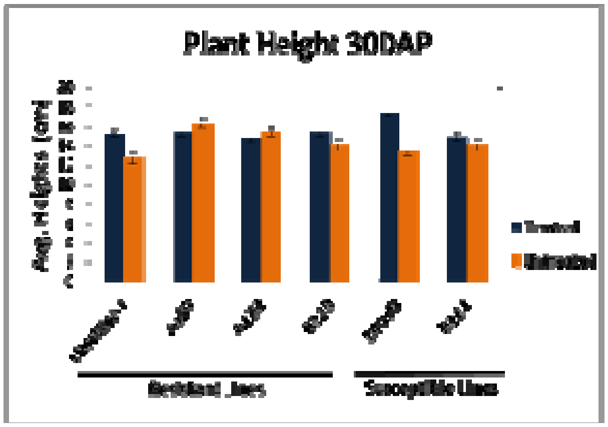
The micro-plot trials were planted in 4500 cm^3 growth pots located at the Plant Science Research Center at Auburn University. Each pot was filled with soil obtained from the Tennessee Valley Research and Experiment Center (TVREC) located in Belle Mina, AL. Each pot was inoculated with reniform nematodes in a concentration of 5000 vermiform per pot. The experiment was planted on 11 May. Plant heights were recorded at 30, 45, and 60 days after planting (DAP). Nematode counts per 150 cm^3 of soil were recorded at 30, 60, and 163 DAP. Each plot was hand-picked and seed cotton weights in grams per plot were recorded. All data were analyzed using SAS 9.2 by comparing the LSmeans using the GLIMMIX procedure.

Field Trials

The field trials were planted in the reniform research area at TVREC in Belle Mina, AL. The field had been artificially infested with reniform in 2007. Each genotype was planted at a population density of 4 seed/foot in single row plots, 25 feet in length with five replications per genotype. This experiment was planted on 17 May. Plant heights were recorded at 30, 45, and 60 DAP. Nematode counts per 150cm^3 of soil were recorded at 30, 60, and 90 DAP and again at harvest. All data were analyzed using SAS 9.2 by comparing the LSmeans using the GLIMMIX procedure.

Results and Discussion

Applying nematicides to LONREN genotypes had some effects on seedling stunting, reniform populations, and yield in the micro-plot trials. An increase in plant heights was evident at 30 DAP in the resistant genotypes LONREN-1 and B219 when comparing entries treated with and without nematicides (Figure 1). At 45 DAP an increase in plant heights was evident in the resistant genotypes A107, A122, and B219 (Figure 2). A significant reduction in reniform populations per 150 cm^3 at 60 DAP was evident in the resistant line A122 (Figure 3). At harvest a significant reduction was evident in the resistant line A107 when comparing entries treated with and without nematicides (Figure 4). When comparing final reniform populations of resistant genotypes to susceptible genotypes, all resistant genotype entries were significantly lower except for the untreated entry A107 (Figure 4). An increase in yield was evident in the resistant genotypes A107 and B219, and a significant increase in LONREN-1.



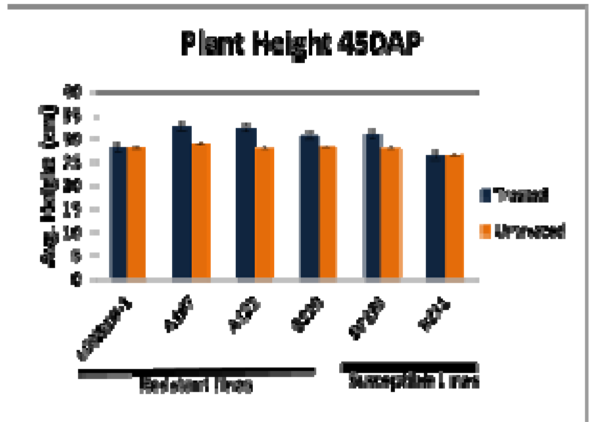
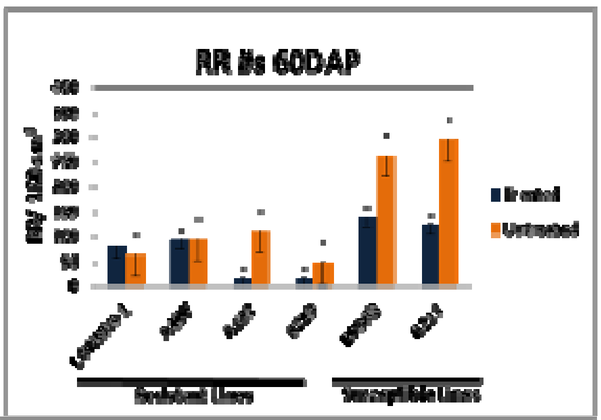


Figure 1: Plant heights for micro- plot trial at 30 DAP.

Figure 2: Plant heights for micro-plot trial at 45 DAP.



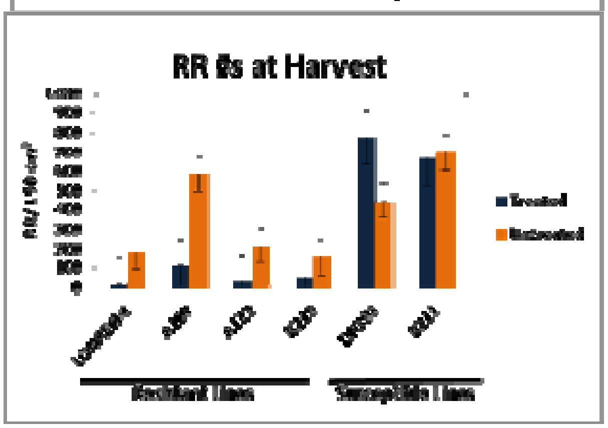


Figure 3: Reniform populations in micro-plot trial at 60 DAP.

Figure 4: Reniform populations in micro-plot trial at harvest.

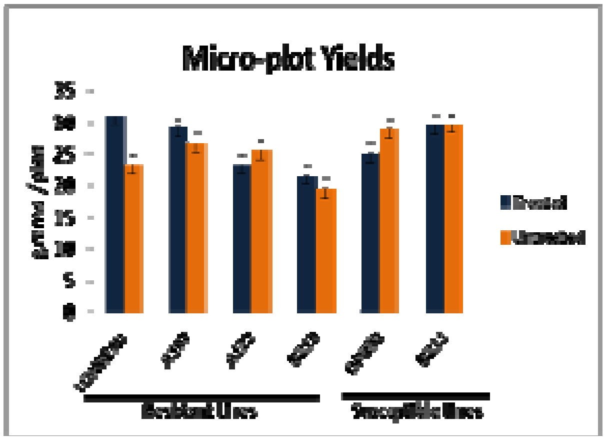


Figure 5: Seed cotton in grams/plot for micro-plots trial.

In the field trial experiment, nematicides applied to LONREN genotypes had effects on both plant heights and reniform populations in the early season stages. However, minimal effects were observed on yields in the field trial experiment. At 30 DAP an increase in plant heights was observed in all the resistant genotype entries treated with nematicides (Figure 6). A significant increase was evident in the resistant genotype B219. At 45 DAP an increase in plant heights was evident in the resistant genotypes LONREN-1, A122, and significantly for B219 (Figure 7). Reductions in reniform populations per 150 cm^3 were evident in all the resistant genotypes at 30 DAP, significantly in the entries LONREN-1, A122, and B219 (Figure 8). At 60 DAP reniform populations were reduced in the resistant genotypes LONREN-1 and A107 (Figure 9). Both of these were significant. When comparing genotypes treated with and without nematicides at harvest, only a small reduction in reniform populations was observed in the resistant genotype B219 (Figure 10). When comparing the resistant and susceptible genotypes across the whole trial at harvest, populations for all the resistant entries were significantly lower than that of the susceptible entries (Figure 10). Yield increases were minimal with no significant increases in seed cotton yields in lbs/acre when comparing resistant genotypes with and without nematicides. However, a 165.5 pound increase was evident in the resistant line B219 (Figure 11).

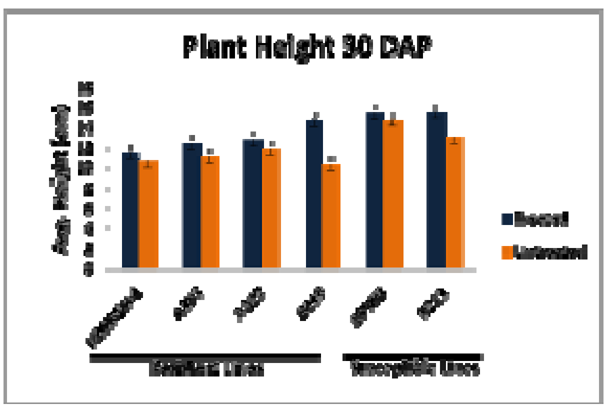


Figure 6: Plant heights for field trial at 30 DAP.

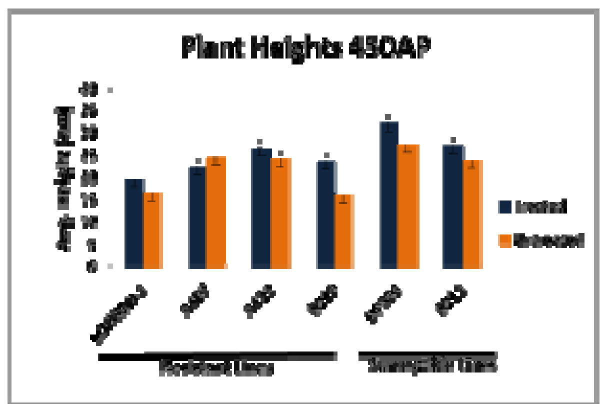


Figure 7: Plant heights for field trial at 45 DAP.

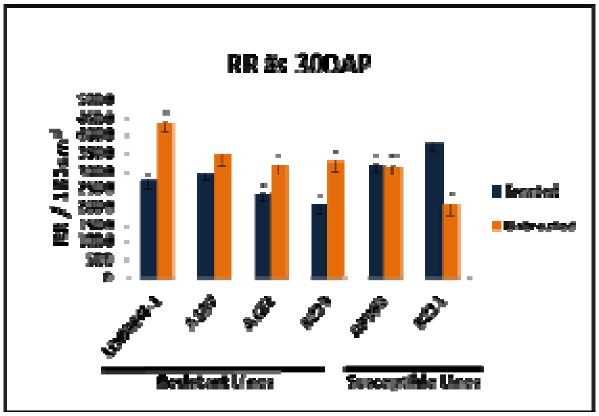


Figure 8: Reniform populations in field trial at 30 DAP.

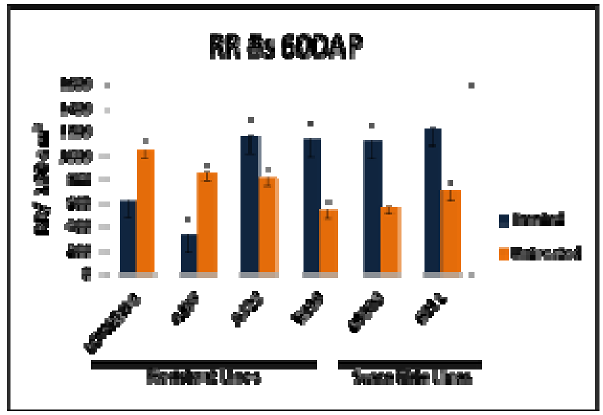


Figure 9: Reniform populations in field trial at 60 DAP

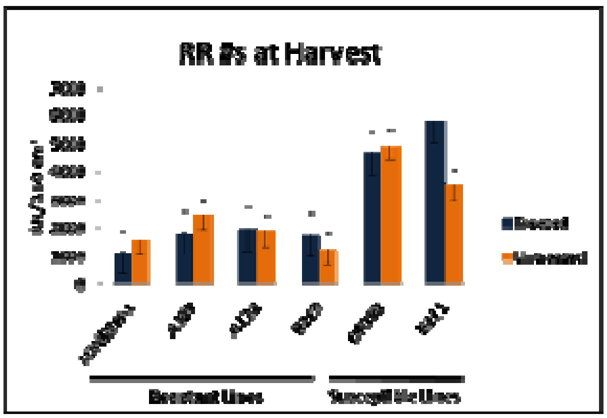


Figure 10: Reniform populations in field trial at harvest.

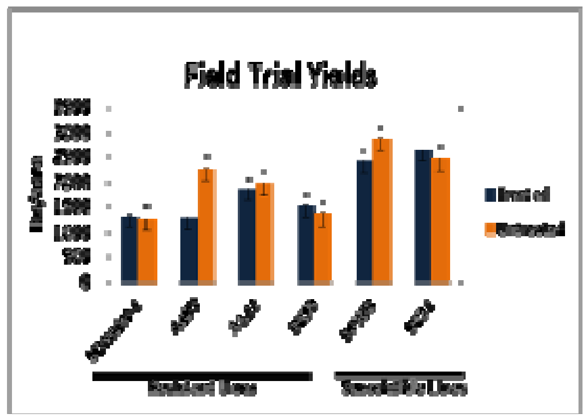


Figure 11: Seed cotton in lbs. /acre for field trial.

Conclusions

The overall goal was to protect LONREN derived resistant genotypes from damage that occurs when the genotypes are introduced to a high reniform population. When introduced to a high reniform population, as was the case in our field trial, early season stunting was reduced in several of the resistant entries. Nematode populations were also reduced in early season observations with a significant reduction in one of the resistant entries. Although a reduction in stunting and reniform population was evident in our study, the resistant LONREN genotypes had a minimal increase in yields where high a reniform population was present.

References

Bell, A.A., J.L. Star, J.E. Jones, R. Lemon, R.L. Nichols, C. Overstreet, and D.M. Stelly. 2009. Nematode resistant and agronomic performance of LONREN and NEMSTACK lines. Proceedings of the Beltwide Cotton Conferences 1:178.

Blasingme, D., M. V. Patel, K. Lawrence, M. Olsen, T. Kirkpatrick, M. Davis, J. Marios, B. Kemerait, P. Colyer, G. Scuimbato, A. Wrather, N. Goldberg, S. Koenning, J.T. Pitts, J. Mueller, M. Newman, J. Woodward, P. Phipps. 2011. 2010 Cotton disease loss estimate committee report. Proceedings of the Beltwide Cotton Conferences 1:306-308.

Roberts, P.A. 2002. Concepts and Consequences of Resistance. Pages 23-41 in: Plant Resistance to Parasitic Nematodes. J.L. Star, R. Cook, and J. Bridge, eds. CABI Publishings, Wallingford, UK.

Robinson, A.F. 2002. Reniform Nematodes: Rotylenchulus Species. Pages 153-174 in: Plant Resistance to Plant-parasitic Nematodes. J.L. Star, R. Cook, and J. Bridge, eds. CABI Publishings, Wallingford, UK.

Robinson, A.F., and A.E. Percival. 1997. Resistance to *Meloidogyne incognita* race 3 and *Rotylenchulus reniformis* in wild accessions of *Gossypium hirsutum* and *G. barbadense* from Mexico. Journal of Nematology 29(4S):746-755.

Starr, J.L., S.R. Koenning, T.L. Kirkpatrick, A.F. Robinson, P.A. Roberts, and R.L. Nichols. 2007. The future of nematode management in cotton. Journal of Nematology 39:283-294.

Usery, S. R., K. S. Lawrence, G. W. Lawrence, and C. H. Burmester. 2005. Evaluation of cotton cultivars for resistance and tolerance to *Rotylenchulus reniformis*. Nematropica 35:121-133.

Weaver, D.B., R.B. Sikkens, R.R. Sahrpe, S.R. Moore, and K.S. Lawrence. 2011. LONREN X FM966 progeny evaluation in a field infested with reniform nematodes. Proceedings of the Beltwide Cotton Conferences 1:737-741.

Yik, C. P., and W. Birchfield. 1984. Resistant germplasm in Gossypium species and related plants to *Rotylenchulus renformis*. Journal of Nematology 16:146-153.