Genetic Resistance is a Consistent Management Tool Against Reniform Nematode in Cotton

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Introduction

Figure 1. Reniform nematode

Rotylenchulus reniformis, reniform nematode, is an increasingly detrimental crop pest in cotton. A range of nematicides are used against this pest, and new genetic resistance to reniform nematodes is being integrated into modern cotton varieties. The efficacy of these management tools and their interactions have not been adequately assessed to inform grower decisions. Field research is underway at Damon, College Station, and Wall, Texas to evaluate genetic resistance and nematicides to determine which management options offer the greatest efficacy against reniform nematodes.

Objective

Determine the efficacy of genetic resistance and nematicides to mitigate cotton yield reduction due to reniform nematodes.

Hypothesis

Genetic resistance and nematicides will influence cotton performance in the presence of reniform nematodes.

Methods & Materials

Two studies were conducted over two years in three locations with known reniform nematode infestations: Damon, College Station, and Wall, Texas in 2019 and 2020

Cotton Genetics Study

- Treatments included six to eight varieties per location (Table 1)
- Split-plot applications:
  - Fluopyram + Prothioconazole: 13.6 oz ac^{-1} in-furrow
  - Untreated

Figure 2. Wall 2020 planting

Nematicide Study

- Treatments included six nematicide options (Table 2):
  - Aldicarb 15G: 5 lbs ac^{-1} in-furrow at planting
  - Fluopyram + Prothioconazole: 13.6 oz ac^{-1} in-furrow at planting
  - Oxamyl: 17 oz ac^{-1} foliar broadcast at 30 and 45 days after planting

Statistical Methods

- Randomized Complete Block Design with 4 replications
- Cotton genetics study: 6 or 8 × 2 factorial (location dependent), split-plot design
- Nematacide study: 2 × 6 factorial
- Mixed model analyses
  - Fixed: location, variety, nematicide, and all interactions
  - Random: block nested within location
  - Tukey's HSD (α = 0.05)

Table 1. Varieties tested and their nematode resistance. The susceptible check is represented as SUS, root-knot nematode resistance as RKN, and reniform nematode resistance as REN.

Trait	2019*	2020
SUS	PHY340 W2FE	PHY340 W2FE
RKN	PHY440 W3FE	-
RKN	PHY480 W3FE	PHY480 W3FE
RKN	DG3651 B2XF	DG3651 B2XF
RKN	DP1747 NR B2XF	DP1747 NR B2XF
RKN	DP18R628	DP18R628
REN	PX3D43 W3FE	PX3D43 W3FE
REN	-	PX3D32 W3FE
REN	-	DP19R24 NR B3XF

*PHY340 W2FE, the susceptible check, was left out of the Damon location in 2019.

Table 2. Nematicide treatments and their treatment numbers.

Treatment number	Treatment
1	Aldicarb 15G
2	Aldicarb 15G + Oxamyl
3	Fluopyram + Prothioconazole
4	Fluopyram + Prothioconazole + Oxamyl
5	Oxamyl
6	Untreated Check (UTC)

Table 3. Location and variety effect on cotton yield (lbs ac^{-1}) across locations for 2019. REN variety is outlined in green (α = 0.05).

Variety	PX3D43 W3FE	DP1747 NR B2XF	DP18R 628	PHY480 W3FE	PHY340 W2FE*	DG3651 B2XF	PHY440 W3FE
College Station	1612 a	1531 ab	1474 a-c	1361 b-d	1331 cd	1264 d	1174 d
Wall	354 a	82 b	166 ab	100 b	122 b	74 b	107 b

*susceptible check

Table 4. Location and variety effect on cotton yield (lbs ac^{-1}) across locations for 2020. Area outlined in green shows REN varieties (α = 0.05).

Variety	PX3D32 W3FE	PX3D43 W3FE	DP19R24 NR B3XF	PHY480 W3FE	PHY340 W2FE *	DP1747 NR B2XF	DG3651 B2XF	DP18R 628
College Station	953 a	949 a	990 a	708 ab	779 ab	757 ab	460 b	789 ab
Wall	2741 a	2625 a	2207 b	1891 bc	1852 c	1680 c	1127 d	914 d
Damon	962 a	1069 a	879 ab	877 ab	828 ab	741 ab	580 b	800 ab

*susceptible check

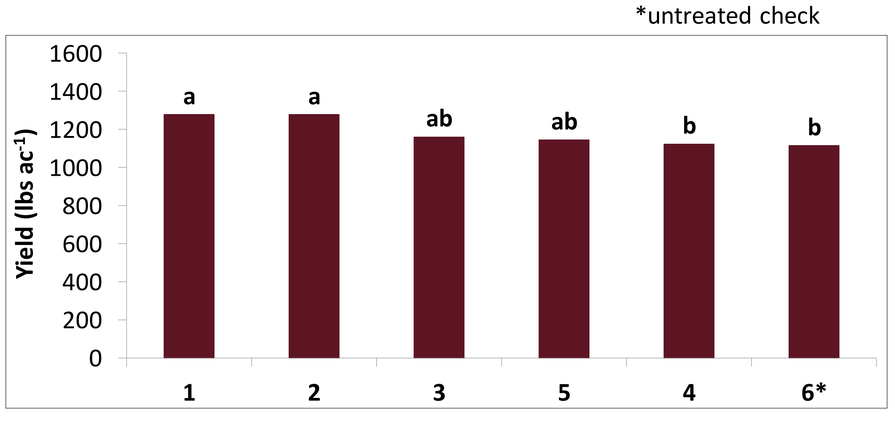

Figure 3. Nematicide effect on yield across location and year (not including Damon 2019) (α = 0.05).

Results

Genetics Study

2019

Figure 4. SUS variety (left) compared to a REN variety (right)

- *PX3D43 W3FE was among the top yielding treatments but was not statistically different from the susceptible check for Damon only (p = 0.002).

**Damon compared separately due to missing susceptible check.*

- Yields at College Station ($\bar{x}$ = 1392.44 lbs ac^{-1}) were higher than yields at Wall ($\bar{x}$ = 143.61 lbs ac^{-1})(p < .0001).
- PX3D43 W3FE out yielded all other varieties by 25.5% in both locations combined (p < .0001).
- PX3D43 W3FE yielded higher than the susceptible check in both College Station and Wall (p = 0.0008)(Table 3).

2020

- Yields at Wall ($\bar{x}$ = 1879.51 lbs ac^{-1}) were higher than yields at Damon or College Station ($\bar{x}$ =819.89 lbs ac^{-1})(p < .0001).
- PX3D43 W3FE and PX3D32 W3FE yielded in the top varieties but were similar to the than SUS and RKN resistant varieties in College Station and Damon (p < .0001).
- DP19R24 NR B3XF was among the top varieties in College Station and Damon but was similar to the susceptible check (p < .0001).
- The top yielding treatments included the three REN resistant varieties in each locations (p < .0001)(Table 4).
- The addition of Fluopyram + Prothioconazole reduced yields by 6.4% across locations (p = 0.006).
- Plots that received Fluopyram + Prothioconazole yielded less in Wall but did not affect other locations (p = 0.005).

Nematicide Study

- Nematicides had no effect on yield in Damon 2019 (p > 0.05).
- The addition of Aldicard 15G and Aldicarb 15G + Oxamyl ($\bar{x}$ = 1277.6 lbs ac^{-1}) increased yields by 163 lbs when compared to the untreated check ($\bar{x}$ = 1114.6 lbs ac^{-1}) across all other locations and years (p = 0.007)(Figure 3).

Conclusions

Genetics Study

- REN varieties consistently mitigated yield loss and outperformed SUS varieties in reniform infested fields.

Nematicide Study

- Nematicide treatments did not consistently improve yield at harvest.

Future Research

Results from Lubbock 2020 will be combined and compared when available. Research will be replicated in 2021.

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