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RESPONSE OF SELECTED COTTON VARIETIES TO THE RENIFORM NEMATODE IN ALABAMA

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Abstract

Management of the reniform nematode (*Rotylenchulus reniformis)* in cotton production is currently limited to nematicides and crop rotation. However, the discovery of cotton varieties with tolerance levels to the reniform nematode would be a great asset and management tool for producers. Selected transgenic cotton varieties were screened for tolerance and or resistance to the reniform nematode. Selected varieties were evaluated in two producers fields naturally infested with the reniform nematode. The field in Limestone Co., AL was monocultured cotton, conventionally tilled, under irrigation, while the Lawrence Co., AL field was an annual corn cotton rotation, no-tilled, without irrigation. In both field tests, cotton varieties were evaluated on yields and reniform nematode reproduction. Field trials indicated there may be some level of tolerance among certain varieties. Reniform nematode reproduction potential was evaluated in the greenhouse. Greenhouse trials indicated that all of the commercial varieties tested are susceptible to the reniform nematode. Reproduction factors ranged from 13.3 on Sure Grow 747 to 39.5 on Phytogen GA 161.

Introduction

The reniform nematode is currently a pest not only in Alabama, but a large portion of the cotton belt. The reniform nematode has been estimated to cause a 6% loss to the Alabama cotton crop. Currently there are no varieties with resistance to the reniform nematode. There are only a few management practices that can be implemented to overcome the effects of the reniform, which include the use of nematicides such as Temik 15G, Vydate L, and Telone II. Crop rotations with non-host plants also have a positive effect on reducing reniform populations. Nematicides and rotations can reduce reniform populations and increase cotton yields, but they are not always environmentally sound or cost effective. Recently there have been efforts to breed for resistance to the reniform nematode in cotton, but a commercially resistant variety will take many years to develop and release.

The purpose of evaluating different commercially available cultivars in response to the reniform nematode was to try to identify a variety that might be tolerant. The identification of a variety with some tolerance or that out yields other varieties in the presence of the reniform nematode, would be a valuable asset in assisting producers with their reniform management plan.

Materials and Methods

In the spring of 2002, two field trials and greenhouse evaluations were set up to evaluate the tolerance of many currently available cotton varieties to the reniform nematode. The field trials were conducted in producers fields located in Limestone Co. and Lawrence Co., AL that were infected with *R. reniformis.* Both soil types were Decatur silt loams. Greenhouse trials were also set up at Auburn University to test for resistance among different varieties in a controlled environment.

Twelve transgenic cotton varieties were evaluated with and without Temik 15G in Limestone Co. The test was planted April 18 using a MaxEmerge® type plot planter. Temik 15G 5.0 lb/A or Di-Syston 15 G 6.0 lb/A were applied at planting in the seed furrow with chemical granular applicators attached to the planter. Plots consisted of 2 rows, 25ft long with a 40 in. row spacing arranged as paired plots in a randomized complete block design with four replications. Ten Cruiser treated transgenic cotton varieties were examined with and without Temik 15G in Lawrence Co. The test was planted April 22 using a John Deere MaxEmerge® planter. Plots consisted of 1 row, 200 ft long with a 30 in. row spacing and were arranged as a split plot with four replications. Temik 15G 7 lb/a was applied at planting in the seed furrow with chemical granular applicators attached to the planter. Vydate L 16 oz/A was applied as a broadcast spray on June 18 to each of the Temik plots. All plots were maintained with standard production practices recommended by the Alabama Extension Service and commonly used in the area. Population densities in the two field plots of reniform nematode were determined at planting, peak bloom, and at harvest. Soil cores, 1-in diameter and 8-in deep were collected from the rows in each plot in a systematic sampling pattern. Nematodes were extracted using gravity screening and sucrose centrifugation technique. The Limestone Co. field was harvested September 30 with a John Deere plot picker. Seed cotton weights for each plot were recorded. The Lawrence Co.

field was harvested November 11. Seed cotton weights for each plot were determined with a yield monitor attached to a Case IH cotton picker. Mixed models analysis of variance with nearest neighbor adjustment (NNA) was conducted using the average residual of adjacent plots as a covariate. Least squares means are reported with standard errors.

Thirty-two commercially available varieties were also examined in the greenhouse. Each variety was inoculated with 2000 juvenile and vermiform adult reniform nematodes per 500cc of soil. Varieties were arranged in a randomized complete block design with 5 replications. At 60 days after planting, varieties were harvested. The roots were carefully removed from each pot. The reniform nematodes were then extracted from the soil using gravity screening and sucrose centrifugation technique. Reniform eggs were extracted with 0.5% NaOCl solution. Vermiforms and eggs were enumerated using a stereomicroscope. Wet and dry shoot and root weights were recorded for each variety.

Results and Discussion

Reniform nematode numbers in the Limestone Co., field trial increased from planting to harvest in 83% of the plots as indicated by reproductive factors (Rf) exceeding unity. Rfs varied from a low of 0.83 for Paymaster 1218 BR with Temik compared to a high of 3.17 for FiberMax 989 RR also with Temik. No variety exhibited a Rf below 1 with Temik and Di-Syston. Cotton seed yield varied from 2725 to 3361 lb/A for Deltapine 458 BR with Temik and Sure-Grow 215 BR with Temik, respectively. There was no correlation between yield and Rf for either Temik or Di-Syston treated plots. Of particular interest are the two varieties Paymaster 1218 BR and Sure-Grow 215 BR for which the Di-Syston treatment significantly ($P = 0.10$) out yielded the Temik treatment. These two varieties may have some level of tolerance to *R. reniformis*.

Reniform nematode numbers in the Lawrence Co. field trial increased in all of the plots. Reproductive factors varied from a low of 22.4 in Deltapine 5415 Cruiser treatment to a high of 66.2 in the Stoneville 4892 BR Cruiser treatment. No variety or treatment produced a Rf value of less than 1 indicating the reniform nematode actively reproduced in all plots. Cotton seed yield varied from 2097 to 2726 lb./A for Stoneville 4793 R with Temik and Sure-Grow 521 R without Temik, respectively. Temik 15 G application had no effect on seed cotton yield, except for Deltapine 436 R, Sure-Grow 521R, and Sure-Grow 501 BR, where Temik-treated plots yielded significantly less (192 lbs/A). The phenotypic correlation between Rf and cottonseed yield was non-significant. The absence of a treatment effect is likely the result of the extreme low reniform populations in this field at planting following the previous year in corn production. The results indicate the positive effect of a corn rotation in reducing nematode numbers, but also show how quickly the reniform nematode can reproduce to reach a damaging level after one year of cotton.

Reniform nematode numbers in the greenhouse increased in all of the pots, throughout the experiment. Reproductive factors varied from a low of 13.3 in Sure-Grow 747 to a high of 39.5 for Phytogen GA 161. No variety had a Rf lower than 13.3 indicating that none of the varieties tested possessed any resistance to the reniform nematode. Reniform nematode counts were lowest in Sure-Grow 747 with 26,691 reniform per 500cc of soil. Phytogen GA 161 produced the highest number of reniform with 79,135 reniform per 500cc of soil. Reniform egg counts were also lowest in Sure-Grow 747 with 10,892 compared to Phytogen GA 161, which had a count of 37,719.

No variety was resistant to the reniform nematode. However, the Limestone Co. field trial indicated their may possibly be some tolerance in the Sure-Grow 215 BR and Paymaster 1218 BR varieties. Sure-Grow 215 BR and Paymaster 1218 BR both produced low reproductive factors and comparable yields with or without nematicides. The Lawrence Co. trial did not indicate the presence of a tolerant variety. The previous years corn crop reduced reniform populations to a level too low for a treatment effect to be observed. The Greenhouse test demonstrated that no resistance among varieties is present and that all of the commercial varieties tested are susceptible to high reproduction of reniform nematodes.

Table 1. Reniform nematode numbers, reproductive factors and seed yields from selected Transgenic Varieties in Newby field located in Limestone Co., AL.

		Reniform at harvest*		Reniform reproduction factor		Yield lb seed cotton/A**	
Treatment	**Reniform at planting**	**Temik**	**Di-Syston**	**Temik**	**Di-Syston**	**Temik**	**Di-Syston**
DP 5415 RR	5112	5613	4241	1.10	0.85	2830	2833
ST 4892 BR	4414	6481	4741	1.47	1.07	2894	2678
DP 451 BR	3960	6151	5005	1.55	1.26	2976	3071
DP 436 RR	5064	4460	6143	0.88	1.21	2974	3060
DPL 458 BR	3580	8586	8014	2.40	2.24	2725	2532
FM 989 RR	2441	7744	5375	3.17	2.20	3022	3011
PM 1218 BR	3675	3116	3917	0.83	1.07	3169	3308
SG 215 BR	4667	5884	4412	1.26	0.95	3129	3361
PM 1199 RR	3675	6205	6546	1.69	1.78	3010	2838
ST 4793 RR	4010	4906	5411	1.22	1.35	2874	2832
DP 555 BR	4301	4378	5785	1.02	1.35	2619	2644
FM 989 BR	3462	6294	6412	1.82	1.85	3030	2771
Standard Error	465	790				55	

* Variety x treatment interaction was non-significant ($P = 0.24$). The variety effect was significant with $P = 0.001$.
** Variety x treatment interaction was significant with a calculated $P = 0.0002$.

Table 2. Reniform nematode numbers, reproductive factors and seed yields from selected transgenic Varieties in Clark Field located in Lawrence Co., AL.

		Reniform at harvest*		Reniform reproduction factor*		Yield lb seed cotton/A**	
Treatment	**Reniform at planting**	**Temik**	**Cruiser**	**Temik**	**Cruiser**	**Temik**	**Cruiser**
DP 5415 R	33.4	924	747	27.7	22.4	2241	2369
ST 4793 R	33.4	1008	2285	30.2	68.4	2097	2107
DP 436 R	33.4	1226	916	36.7	27.4	2215	2474
SG 521 R	33.4	1100	1021	32.9	30.6	2572	2726
PM 1199 R	33.4	1091	1959	32.7	58.6	2433	2561
ST 4892 BR	33.4	1766	2210	52.9	66.2	2494	2465
SG 501 BR	33.4	1940	1650	58.1	49.4	2555	2717
SG 215 BR	33.4	782	1650	23.4	49.4	2415	2482
PM 1218 BR	33.4	1206	2036	36.1	61.0	2206	2326
DP 451 BR	33.4	1110	1804	33.2	54.0	2136	2247
Standard Error		278		9.4		55.4	

*Variety x treatment interaction was significant with a calculated $P < 0.01$.
** Variety x treatment interaction was non-significant ($P = 0.18$). The variety effect was significant with $P = 0.001$.

Table 3. Greenhouse Mean Reniform and Egg counts per 500cc of soil.

Variety	Mean Reniform	Eggs
Sure Grow 747	26691	10892
Deltapine 458 BG/RR	29885	15671
Stoneville 4793 RR	31358	14585
Deltapine 5690 RR	36481	16959
Deltapine 565	37030	14755
Deltapine 555 BG/RR	37169	16518
Deltapine 5415	38022	22959
Stoneville 271	38689	20075
Deltapearl	40244	12873
Sure Grow 501 BG/RR	41562	19620
Deltapine 655 BG/RR	41571	20574
Stoneville 5599 BG/RR	42510	29880
Stoneville 580	42757	26430
Paymaster 1218 BG/RR	46721	23702
Texas 28 R	48384	27460
Deltapine 33B	49311	20300
Phytogen 355	52204	29185
Deltapine 491	52880	20188
Fiber Max 989 BG/RR	53187	27760
Sure Grow 521 RR	54781	26311
Deltapine 436 RR	54841	23335
Stoneville 4892 BG/RR	55321	21388
Fiber Max 989	55416	25817
Paymaster 1199 RR	55814	20123
Sure Grow 215 BG/RR	55852	28660
Deltapine 35B	55955	29231
Deltapine 451 BG/RR	60294	29020
Fiber Max 966	61704	30751
Fiber Max 991 RR	66092	29106
Phytogen 78 ACALA	67063	26342
Phytogen HS-12	75437	30241
Phytogen GA 161	79135	37719
LSD P≤(0.05)	25463	13903
CV	71.62	82.7