COTTON VARIETY AND NEMATICIDE COMBINATIONS FOR RENIFORM AND ROOT KNOT MANAGEMENT ACROSS THE COTTON BELT

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Abstract

The 2013 National Cotton Council Nematode Research and Education Committee's nematode research project evaluated cotton variety and nematicide treatment combinations across the cotton belt in diverse production systems. Five nematicide treatments were nominated by Bayer CropScience for evaluation compared to a Gaucho insecticide control on two cotton varieties. The results presented are from the eleven locations where stand, vigor, nematode ratings or population numbers and yield were collected. There was no significant variety x nematicide interactions for the 2013 trials, indicating the nematicide response was similar on the two cotton varieties. Cotton plant stand was similar across varieties and nematicides ranging from 1 to 3 plants per foot of row and averaging 2.3 plants over all tests. The tolerant variety Stoneville 4946GLB2 vigor ratings were greater than the susceptible varieties FiberMax 1740B2F or FiberMax 1944GLB2. Nematicides also affected seedling vigor with the Temik 15G supporting the most vigorous plants compared to the Gaucho seed treatment. ST4946 supported 30 % fewer nematodes and produced 3% higher cotton yields than the susceptible FiberMax 1740B2F or FiberMax 1944GLB2. Temik 15G plus Vydate C-LV foliar spray produced significantly more cotton that the Gaucho seed treatment. The increase was equivalent to a 12% increase or 226 lb/A of seed cotton averaged over all locations across the cotton belt.

Introduction

The Beltwide Cotton Nematode Research and Education Committee was initiated in 1986 and is comprised of Extension and Research Specialists from Land Grant Universities across the cotton belt. The objective of the committee is to build awareness among U.S. cotton producers of the growing economic impact of cotton nematodes

and to provide information on identification of species; distribution and densities of populations; and control measures including cultural and chemical practices. The committee meets on an annual basis to report research findings and identify new priority needs for future cooperative projects. In 2013 National Cotton Council Nematode Research and Education Committee's nematode research project evaluated cotton variety and nematicide treatment combinations over diverse cotton production systems.

Materials and Methods

Five nematicide treatments were nominated by Bayer CropScience for evaluation on two cotton varieties for the 2013 trials.

Cotton varieties

Stoneville 4946B2RF (ST4946) was selected for all trials based on these varieties good performance in local Agronomist trials. This variety could be considered tolerant to root- knot or reniform nematodes due to its good yields history. FiberMax 1740B2RF (FM1740) and FiberMax 1944GLB2 (FM1944) were included as a reference variety because these varieties are susceptible to reniform (*Rotylenchulus reniformis)* and the southern root- knot (*Meloidogyne incognito*) nematodes and are known to response to nematicides. The ST 4946 and either FM1740 or FM1944 were included in test at each location depending on the best variety for the region. The premium seed treatment fungicide package and Gaucho 600 (12.8 oz/cwt) were applied to each seed treatment.

Nematicide treatments

Two standard nematicide treatments, Temik 15 G (aldicarb), applied as an in-furrow granule at 5 lb/A was included as the historical standard, and Aeris (thiodicarb) applied as a seed treatment at 0.75 mg ai per seed was included as the standard seed treatment nematicide. Aeris plus USF0738 (0.75 + 0.175 mg ai per seed) comprised a new premium seed treatment nematicide option. An in-furrow spray at planting with Velum Total applied at 18 oz/A over the seed treatment combination Poncho/Votivo plus Aeris (0.424 mg ai/seed) followed by one or two foliar sprays of Vydate C-LV (16 oz/A at the 2 – 8 leaf stage). This was the "Cadillac" treatment to be compared to Temik 15G (5lb/A) at planting followed by one or two foliar sprays of Vydate CLV (17 oz/A at the 2 – 8 leaf stage). Gaucho 600 (12.8 oz/cwt) represented the non-nematicide control and was included to assess the nematode disease pressure in each field. All nematicides and rates are listed in Table 1.

Field experiments

Field experiments were conducted in fourteen locations by ten cooperators across the U.S. Cotton Belt. Complete data sets were collected from 11 locations and are presented. Each location utilized a randomized complete block experimental design, with the number of replications ranging from 4 to 5. Cotton was planted in 2 or 4 rows plots with plot lengths of 25 to 50 feet long and row spacing ranged from 36 to 40 inches. Cotton seeds were treated with nematicide seed treatments by Bayer CropScience. Temik 15G was applied at-planting with granular chemical hopper boxes attached to the planter. The foliar Vydate C-LV spray applications were applied with CO_2 charged backpack sprayer or with small plot tractor sprayer systems. The nematode populations were determined at-planting, 30-60 days after planting (DAP) and at-harvest. Cotton stand counts and vigor ratings used in the analyses were taken near 30 DAP. Seed cotton yields were mechanically collected at-harvest.

Statistics

Data were analyzed by the GLM procedure using SAS (SAS Institute Inc., Cary NC). Percent stand, vigor, nematode ratings or densities, and yield were analyzed over locations and by location. Treatment means were separated by using a Protected LSD at $P \leq 0.10$. The Pearson-product correlation method was used to examine the relationship among percent stand, vigor, nematode population densities, and yields over locations.

Table 1. Nematicides formulations, application rates and cotton varieties included in research trials.

Trt#	Variety	Nematicide	Rate	Rate unit	Application Type
1	ST4946B2RF or BX 1346GLB2	Gaucho 600	0.500	mg ai/seed	Seed treatment
2	ST4946B2RF or BX 1346GLB2	Temik 15G	5.0	lbs/A	In-furrow granule
3	ST4946B2RF or BX 1346GLB2	Velum Total IFS + P/V + Aeris + Vydate CLV (x2)	18 oz + 0.424+ 0.75 fb 17 oz (x2)	fl oz/A (IFS) + mg ai/seed (ST) fb fl oz/A (FS)	In-furrow spray + Seed treatment followed by foliar applications (2 leaf & pin head square)
4	ST4946B2RF or BX 1346GLB2	Aeris	0.75	mg ai/seed	Seed Treatment
5	ST4946B2RF or BX 1346GLB2	Aeris + USF0738	0.75 + 0.175	mg ai/seed	Seed Treatment
6	ST4946B2RF or BX 1346GLB2	Telone II or Temik 15G + Vydate CLV	3 gal or 5.0 lb/A + 17oz (x2)	5.0 lb/A + 176oz (x2)	In-furrow treatment fb foliar applications
7	FM1740B2F or FM 1944	Gaucho 600	0.500	mg ai/seed	Seed treatment
8	FM1740B2F or FM 1944	Temik 15G	5.0	lbs/A	In-furrow granule
9	FM1740B2F or FM 1944	Velum Total IFS + P/V + Aeris + Vydate CLV (x2)	18 oz + 0.424+ 0.75 fb 17 oz (x2)	fl oz/A (IFS) + mg ai/seed (ST) + fl oz/A(FS)	In-furrow spray + Seed Treatment followed by foliar applications (2 leaf & pin head square)
10	FM1740B2F or FM 1944	Aeris	0.424+ 0.75	mg ai/seed	Seed treatment
11	FM1740B2F or FM 1944	Aeris + USF0738	0.75 + 0.175	mg ai/seed	Seed treatment
12	FM1740B2F or FM 1944	Telone II or Temik 15G+ Vydate CLV	3 gal or 5.0 lb/A + 17oz (x2)	5.0 lb/A + 17oz (x2)	In-furrow treatment fb foliar applications

Results and Discussion

Nematicides and cotton variety influenced cotton stand, vigor, nematode populations, and yield across all locations. For the 11, there were no significant location x variety x nematicide or variety x nematicide interactions (Table 2), indicating that the variety and nematicide response were similar across locations. Significance was found for location, variety, and nematicide as well as location x variety and location x nematicide indicating the environment at each location did influence variety and nematicide effects. All data are presented on Table 3.

Table 2. Significant probability for the combined analysis of variance across locations, 2013 NCC Nematode Research Program.

		Probability of a significant F-test			
	Degrees of freedom	Stand/ ft row	Vigor	Nematodes 45-60 DAP	Yield lb/A
Location	9	<0.0001	<0.0001	<0.0001	<0.0001
Variety	1	<0.7669	0.0197	0.0850	0.1819
Location * Variety	9	0.0024	0.4051	0.0161	0.0001
Nematicide	5	0.9391	<0.0001	0.0142	0.0027
Location * Nematicide	45	0.7193	<0.0001	0.0052	0.1455
Variety * Nematicide	5	0.6831	0.2072	0.9254	0.4841
Location * Variety * Nematicide	45	0.9705	0.9609	0.8017	0.9332

Overall, cotton plant stand was similar across varieties and nematicides (Table 3) ranging from 1 to 3 plants per foot of row and averaging 2.3 plants over all tests. Plant vigor was significant between varieties and nematicides at 30 DAP. Vigor ratings were greater from the tolerant variety ST4946 than the susceptible varieties FM1740 or FM1944. Nematicides also had a significant effect on plant vigor. Plants growing in the in the Temik 15 G treatments had higher ratings compared to the Gaucho seed treatment. The Aeris seed treatment plus the experimental USF0738 and the Velum Total in furrow spray added to Poncho/Votivo plus Aeris increased vigor of the cotton seedlings over the Gaucho seed treatment standard. These vigor increases suggest that the nematicides are important for early season plant health and had similar effects on both the tolerant and susceptible varieties.

Root-knot and reniform nematode population densities were measured differently in some locations but overall, the tolerant variety ST4946 supported 30 % fewer nematodes than the susceptible varieties FM1740 or FM1944 (Table 3 and 4). The lowest nematode population densities were recovered in the treatments, which received Temik 15G and the Aeris seed treatment plus USF0738 compared to the Gaucho seed treatment across all locations (Table 5).

Table 3. Cotton variety and nematicide combinations effects on stand, vigor, nematode densities, and yield over 11 locations in 2013.

Cotton variety	Seed treatment and rate	Stand[w] 30 DAP	Vigor[x] 30 DAP	Nematode[y] 30-60 DAP	Seedcotton (lb/A)
ST 4946GLB2	1. Gaucho 600 (0.5 mg ai/seed)	2.33	3.5	3012	2045
ST 4946GLB2	2. Temik 15G 5lb/A	2.34	4.1	1534	2291
ST 4946GLB2	3. Aeris (0.75 mg ai/seed)	2.42	3.8	2227	2149
ST 4946GLB2	4. Aeris (0.75 mg ai/seed) + USF0738 exp	2.38	3.8	902	2154
ST 4946GLB2	5. Poncho (0.424 mg ai/seed)/Votivo + Aeris (0.75 mg ai/seed) + Velum Total	2.32	3.7	2156	2189
ST 4946GLB2	6. Temik 15G 5lb/A + Vydate 17oz/A	2.38	4.0	1099	2383
FM 1740 B2F	1. Gaucho 600 (0.5 mg ai/seed)	2.40	3.5	4655	2127
FM 1740 B2F	2. Temik 15G 5lb/A	2.39	3.8	1727	2257
FM 1740 B2F	3. Aeris (0.75 mg ai/seed)	2.44	3.5	2905	2006
FM 1740 B2F	4. Aeris (0.75 mg ai/seed) + USF0738 exp	2.37	3.7	2234	2053
FM 1740 B2F	5. Poncho (0.424 mg ai/seed)/Votivo + Aeris (0.75 mg ai/seed) + VelumTotal	2.46	3.8	2299	2172
FM 1740 B2F	6. Temik 15 G 5lb/A + Vydate 17oz/A	2.43	3.9	1858	2229
	Nematicides				
	1. Gaucho 600 (0.5 mg ai/seed)	2.36	3.5 c[z]	4174 a	2086 c
	2. Temik 15G 5lb/A	2.37	3.9 a	1776 b	2274 ab
	3. Aeris (0.75 mg ai/seed)	2.43	3.6 bc	2794 ab	2078 c
	4. Aeris (0.75 mg ai/seed) + USF0738 exp	2.38	3.7 ab	1707 b	2104 bc
	5. Poncho (0.424 mg ai/seed)/Votivo + Aeris (0.75 mg ai/seed) + Velum Total	2.39	3.8 ab	2425 ab	2180 abc
	6. Temik 15 G 5lb/A + Vydate 17oz/A	2.40	4.0 a	1610 b	2306 a
	LSD ($P \leq 0.10$)	0.236	0.24	1914.8	184.9
Varieties					
ST 4946GLB2	(Tolerant)	2.36	3.8 a	1822 b	2202 a
FM 1740 B2F	(Susceptible)	2.42	3.7 b	2613 a	2145 a
LSD ($P \leq 0.10$)		0.061	0.09	647.62	68.02

[w] Stand is present as number of plants per 1 foot of row.

[x] Vigor is presented on a 1 to 5 scale with 3 being average and 5 being much better than average and 1 being much worse than average.

[y] Nematodes are either *Meloidogyne incognita* or *Rotylenchulus reniformis* and were numbers collected from soil samples, or eggs extracted from roots dug from each plot or in one case the number of galls per root system.

[z] Means followed by same letter do not significantly differ according to Fishers LSD test ($P < 0.10$).

Nematode numbers were significantly different by variety in 5 of the 11 locations (Table 4). FM1740 or FM1944 supported more root-knot or reniform nematodes compared to the ST4946 variety in four of the five locations. Nematicides significantly reduced nematode numbers compared to the Gaucho control in 3 of the 11 locations (Table 5). Reniform nematodes were significantly reduced in three of the four locations. Nematicides significantly reduced the root-knot nematode population densities in only one location. Nematode numbers were significantly reduced in the Temik 15G alone (AL1), Temik 15G plus Vydate C-LV (AR) and Aeris plus the USF0738 experimental (AL2), and Poncho/Votivo with Aeris plus the Velum Total in-furrow spray and Vydate C-LV foliar spray (MS) treatments compared to the Gaucho control.

Table 4. Nematode populations and seed cotton yield by cotton variety over all sites in the 2013 National Cotton Council Nematicide trial.

	Nematodes[x]		Seed Cotton[y] lb/A	
	FM1740B2RF[z]	ST4946B2RF	FM1740B2RF	ST4946B2RF
AL1	9899*	4277	1715	2091
AL2	8961*	6424	1051	1374
AR	779	760	1272	1085
GA	23	22	2749	2818
LA	406*	1167	3758	4074
MS	4359*	3861	3337	3389
NC	25	31	442	297
SC	726	659	495	461
TN	637	760	2791	2741
TX	157*	39	3588	3134
VA	---	---	3265	3609

[x] Nematode numbers between 30-60 DAP determine by 100 to 500 cm^3 samples; eggs extracted from root systems; or counting numbers of galls on roots.

[y] Seed cotton yield.

[z] Fiber Max 1740 B2RF, Fiber Max 1944GLB2, or Stoneville 4946 B2RF.

*Indicates ($P \leq 0.05$) significant differences between in nematode population densities between the two varieties.

Table 5. Nematode populations at 30 - 60 DAP as affected by nematicides over all sites in the 2013 National Cotton Council Nematicide trial.

	Aeris	Aeris+USF	Gaucho	PVAV	T+V	Temik
AL1*	8328	5346	19742	9085	1955	1074
AL2*	9495	3003	8430	9147	7788	8293
AR	946	1083	708	801	469	610
GA	34	18	23	22	23	16
LA	451	265	3847	460	343	852
MS*	5083	4670	7740	1496	2425	3354
NC	27	13	33	32	31	32
SC	454	665	446	553	812	1223
TN	741	686	493	580	811	879
TX	26	31	151	31	201	151

[x] Nematode numbers between 30-60 DAP determine by 100 to 500 cm^3 samples; eggs extracted from root systems; or counting numbers of galls on roots.
*Indicates ($P \leq 0.05$) significant differences between in nematode population densities between the two varieties.

Seed cotton yield varied across locations with the highest yields in Louisiana, Mississippi and Texas with the lowest in North and South Carolinas where flooding occurred (Table 4). The tolerant variety ST4946 produced similar yield to the susceptible varieties FM1740 or FM1944 ($P \geq 0.1819$) over all locations (Table 3). In Alabama, Louisiana,

and Texas, ST4946 produced significantly more cotton by an average of 227 lb/A (Table 4). The Fiber Max varieties produced significantly more yield in Arkansas and North Carolina the yield increase average 174 lb/A. Nematicides that increased plant vigor and reduced nematode populations were also the ones with the greatest yields. Temik 15G plus Vydate C-LV foliar spray produced significantly more cotton that the Gaucho seed treatment (Table 6). This was a 12% increase in seed cotton averaged over all locations across the cotton belt. Temik 15G alone and the Velum Total in-furrow spray in combination with Poncho/Votivo plus Aeris plus Vydate C-LV followed in the ranking for the highest yield, but were statistically similar to Gaucho. The Temik 15G plus Vydate C-LV treatment increase yield 38 % over the Gaucho control in the Alabama root-knot field (AL1) and Temik 15G alone increase yields by 36% in the reniform field (AL2). In the Mississippi reniform field, the Velum Total in-furrow spray applied over the Poncho/Votivo plus Aeris seed treatment with the additional Vydate CL-V foliar spray increased yields 26% compared with the Gaucho control. All three of these locations have very high numbers of nematodes present at planting.

Table 6. Cotton yield as affected by nematicide over all sites in the 2013 National Cotton Council Nematicide trial.

	Seed Cotton Yield lb/A					
	Aeris	Aeris+USF0738	Gaucho	PVAV	T+V	Temik
AL1	1615	1644	1594	1922	2181	2463
AL2	1167	1336	889	1136	1433	1315
AR	1305	1262	1079	1105	1187	1132
GA	2740	2688	2963	2798	2874	2637
LA	3629	3924	4025	3986	3820	4110
MS	3219	3200	3135	3708	3568	3349
NC	397	408	348	332	413	317
SC	528	451	567	448	614	259
TN	2689	2288	2751	2917	2949	2999
TX	3174	3430	3348	3072	3607	3533
VA	3256	3379	3217	3397	3553	3819

Summary

The results from the 11 locations where nematode and yield data were collected for the 2013 National Cotton Council Nematicide Program indicated that nematicides affected cotton varieties similarly. In 5 of the 11 locations where nematicides significantly reduced nematode population densities at 30-60 DAP, 4 of these locations also produced significantly higher seed cotton yields. These locations also had the highest nematode populations at planting indicating that heavy disease pressure was evident. In addition, when combining all 11 locations the initial, at- plant numbers of both the root-knot or reniform nematodes were negatively correlated (P=0.0001) with stand (-0.049), plant vigor (0.084), nematode numbers at 30-60 DAP (0.095), and yield (0.039). These at-plant correlations indicate that the use of a nematicide treatment is an important practice for supporting early season plant growth and final cotton yields.

Disclaimer

This paper reports the results of research obtained only from a one-year study. Mention of a pesticide or variety in this paper does not constitute a recommendation by any of the Universities represented or by the authors.