GROWTH AND DEVELOPMENT OF FIVE UPLAND COTTON (*GOSSYPIUM HIRSUTUM*) VARIETIES IN RENIFORM *(ROTYLENCHULUS RENIFORMIS)* INFESTED SOILS

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Abstract

The reniform nematode (*Rotylenchulus reniformis*) is a serious pest affecting cotton production in the southeastern United States. Currently resistance to the reniform nematode is lacking in currently marketed cotton germplasms. An understanding of the growth and development of cotton varieties in the presence of the reniform nematode can assist in management decisions. This understanding will assist growers in selecting and positioning varieties based on the presence of the reniform nematode.

Introduction

Cotton is an important cash crop in 16 states in the US including Mississippi. An annual turnover of 18.3 million bales was recorded in the year 2010, of which 4% was from Mississippi. With present global economic conditions severe economic pressures are placed on cotton producers to decrease costs and increase yields. The productivity of the cotton crop is often affected by many factors including plant-parasitic nematodes. The reniform nematode, *Rotylenchulus reniformis,* is a species which is rapidly spreading throughout the southeastern United States. The concentration of the reniform nematodes is highest in Alabama, Louisiana, and Mississippi incurring an economic loss of over $128 million dollars in these three states alone. The use of nematicides is still a major management tactic in the absence of resistance in the currently marketed cotton varieties. However, there have been cotton varieties on the market that have shown excellent yield and performance in *Rotylenchulus* infested soils like SG 125 and DP 555 BR. Despite, not being resistant some cotton varieties have shown a great level of tolerance in these environments while there are germplasms that do not perform well in Rotylenchulus infested soils. By understanding the growth and development and identifying these varieties, growers can better position and select which germplasms fit a particular situation. Presently, there are no programs to identify the performance of cotton germplasms in *Rotylenchulus* infested soils.

Objective

The objectives were to identify, via in–the-season plant mapping, the growth and development pattern and yield of five currently marketed upland cotton varieties grown in heavily infested *Rotylenchulus reniformis* field environments with and without AERIES + VOTIVO. A final objective was to determine the contribution of the seed treatment (AERIES + VOTIVO) and variety in *Rotylenchulus* infested soils.

Materials and Methods

Field Evaluation: Studies were conducted to determine the growth and development of five currently marketed cotton varieties (PHY 375 WRF, PHY 499 WRF, FM 1740 B2RF, STV 5458 B2RF & STV 5288 B2RF) with and without the addition of the seed treatment AERIES + VOTIVO. All trials were established as RCB designs with five replications. Rows were 40 ft. long and separated with 38 inch row spacing.

Studies were conducted at Mississippi State University on two soil textures (Sandy Clay Loam, Clay 2.5%, Silt 20.5%, Sand 77.0% and a second soil with Clay 13.75%, Silt 21.5%, and Sand 64.75%. Data was pooled across the two soil types. Nematode samples were taken before planting and through the season to monitor nematode populations relative to plant progress. Plant development was evaluated by mapping specific parameters at 14 days after emergence (DAE), mid-square, mid bloom and mid open boll. The 14 DAE evaluation included plant stand, plant vigor on a scale of 1-5 and hypocotyl measurements. Evaluations at mid-square included node of first fruiting branch (NFFB), plant height (PH), total nodes (TN), and fruit retention by position. Mid bloom evaluations further included node above white flower (NAWF), basal stalk diameter and boll diameter at node 9 and 12 from the terminal. Mid open boll evaluation further included calculations of nodes above cracked boll (NACB). Harvest was measured in pounds of lint cotton/ac.

Results

Despite there not being any resistance among currently marketed cotton varieties, understanding growth and development of these germplasms can assist in product positioning and management in these environments.

Plant Stand: There were no differences in plant stand between the seed treatments and their untreated controls (UTC). However, vigor and hypocotyl elongation were improved in all varieties by AERIS + VOTIVO. PHY 375 WRF and FM 1740 B2RF showed the greatest change (Table 1).

Plant Height and Height:Node (H:N): At all development stages there was significant improvement in PH and H:N with the addition of AERIES + VOTIVO. The greatest improvement occurred between the bloom and open boll growth phase (Table 2).

NAWF, NACB & % Open Boll (OB): Seed treatment maintained development longer across all varieties. This was most prominent in the % OB where varieties which did not receive AERIES + VOTIVO exhibited a higher degree of earliness that later was found to be related to reduced root development in the presence of the reniform nematode (Table 3).

Boll & Stalk Diameter: All varieties had a positive influence with the addition of AERIES + VOTIVO for seed treatment relative to stalk diameter. However, boll diameter at N-9, from the terminal, from PHY 499 WRF seed treatment and non- treated seed were almost equal in diameter (Table 4) further indicating that the variety is providing assistance.

Percent (%) Fruit Retention: Fruit retention was improved at the upper fruiting zone on the plants that received AERIES + VOTIVO seed treatment. STV 5458 B2RF showed the highest retention at the final mapping (Table 5) indicating that variety assistance in *Rotylenchulus* infested soils is being gained. This was further manifested by total fruit retention of the whole plant where the AERIES + VOTIVO provided higher retention levels at position 1 and 2 at the open boll stage. There were little differences between the UTC and AERIES + VOTIVO during square. STV 5458 B2RF and PHY 499 WRF showed the greatest retention later in the season in the non-treated treatment (Table 6).

Yield: Cotton yields ranged from 1413 to 1593 lbs./ac from STV 5288 B2RF and FM 1740 B2RF, respectively when treated with AERIS + VOTIVO. In the non-treated seed yields ranged from1254 to 1506 lbs. of cotton /a. Yields were improved in PHY 375 WRF, PHY 499 WRF and FM 1740 B2RF with the addition of AERIES + VOTIVO (Table 7).

Summary: The use of AERIES + VOTIVO improved performance across all varieties and allowed the plant to avoid premature cutout. In addition, yield was increased across all varieties with the seed treatment. PHY 499 WRF and STV 5458 and 5288 B2RF may show tolerance to reniform nematodes.

Disclaimer

The interpretation of data may change with additional experimentation. Information is not to be constructed as a recommendation for use or as an endorsement of a specific product by Mississippi State University or the Mississippi Agricultural and Forestry Experiment Station.

Tables

Table 1. Plants/ac, Hypocotyl & Vigor

Early Development Evaluation (Plants/Acre, Node of First Fruiting Branch, Hypocotyl & Vigor)								
Variety	AERIES + VOTIVO				UTC			
	Plnts./A (1,000)	NFFB	Hyp. (")	Vigr. (1-5)	Plnts./A (1,000)	NFFB	Hyp. (")	Vigr. (1-5)
PHY. 375 WRF	40.21	6.7	4.5	1.3	38.5	7.3	3.95	1.95
PHY. 499 WRF	39.80	8.6	4.3	1.4	41.86	7.9	4.10	1.45
FM 1740 B2RF	38.17	6.05	4.7	1.4	39.33	7.2	3.95	1.5
STV 5458 B2RF	39.41	7.9	4.1	1.5	40.82	8.3	3.80	2
STV 5288 B2RF	36.80	7.1	4.2	1.2	39.70	6.8	3.90	1.8

Table 2. Plant growth through the season.

PLANT HEIGHT & Height : Node (")												
Variety	AEIES + VOTIVO (SQUARE)		UTC (SQUARE)		AERIES + VOTIVO (BLOOM)		UTC (BLOOM)		AERIES + VOTIVO (OB)		UTC (OB)	
	Ht.	H: N	H:N	H:N	Ht.	H:N	Ht.	H:N	Ht.	H:N	Ht.	H:N
PHY. 375 WRF	14.5	1.11	13.5	1.07	32.4	1.8	32.3	1.70	41.8	1.80	36.1	1.66
PHY. 499 WRF	15.9	1.20	14.2	1.0	34.8	1.84	32.3	1.66	45.8	2.10	40.1	1.78
FM 1740 B2RF	13	1.10	13.1	1.0	29.1	1.64	29.5	1.62	40.4	1.76	34.9	1.66
STV. 5458 B2RF	14.8	1.11	13.9	1.08	33.0	1.62	30.9	1.61	47.4	1.98	40.9	1.70
STV. 5288 B2RF	18.9	1.09	13.3	1.01	30.7	1.64	27.6	1.48	40.9	1.78	34.9	1.60

Table 3. Maturity progression across season.

In-season Maturity Progression (Nodes Above White Flower, Nodes Above Cracked Boll & % Open Boll)						
Variety	AERIES + VOTIVO (BLOOM) NAWF	UTC (BLOOM) NAWF	AERIES + VOTIVO (OB) NACB	UTC (OB) NACB	AERIES + VOTIVO % Open Boll	UTC % Open Boll
PHY. 375 WRF	8.5	9.0	8.95	8.5	17.8	19.7
PHY. 499 WRF	9.35	6.0	9.65	7.7	9.4	16.8
FM 1740 B2RF	8.4	7.0	8.5	8.3	14.6	19.1
STV. 5458 B2RF	10	6.0	10.8	9.3	7.4	10.3
STV. 5288 B2RF	8.8	9.0	9.7	9.3	14.6	13.5

Table 4. Boll and stalk diameter.

Boll and Stalk Diameter (mm)						
Variety	AERIES + VOTIVO (Boll Dia.)		UTC (Boll Dia.)		AERIES + VOTIVO (Stalk Dia.)	UTC (Stalk Dia.
	N-9	N-12	N-9	N-12		
PHY. 375 WRF	26.80	33.70	23.10	33.10	9.40	10.70
PHY. 499 WRF	27.0	32.60	27.70	33.0	11.30	10.70
FM 1740 B2RF	27.60	33.70	25.90	33.10	11.25	10.80
STV. 5458 B2RF	24.40	32.0	23.60	30.10	11.70	10.50
STV. 5288 B2RF	25.10	32.60	20.10	27.30	11.45	9.70

Table 5. Fruit retention between nodes 15-19.

Zone Three Retention (N15-19) (%)												
Variety	AERIES + VOTIVO Bloom			UTC Bloom			AERIES + VOTIVO Open Boll			UTC Open Boll		
	P-1	P-2	P>2	P-1	P-2	P>2	P-1	P-2	P>2	P-1	P-2	P>2
PHY. 375 WRF	82.5	23	0	85.9	20.8	0	56.9	16.2	4.1	34.5	3.2	0
PHY. 499 WRF	74.7	18.2	.65	76.8	20.2	0	51.7	15.7	2.1	36.2	12.9	0
FM 1740 B2RF	73.2	18.5	0	81.4	24.5	0	48.4	14.7	2.9	35.5	9.6	0
STV 5458 B2RF	84.7	29	1.3	89.9	25.2	0	57.0	19.4	3.3	50.3	4.2	0
STV 5288 B2RF	80.5	26.3	4.4	84.9	23.3	0	48.8	21.4	2.0	48.3	8.9	0

Table 6. Total fruit retention at position 1 and 2 across the season.

In-Season Total Fruit Retention (%)												
Variety	Square				Bloom				Open Boll			
	AER + VOT		UTC		AER + VOT		UTC		AER + VOT		UTC	
	P-1	P-2	P-1	P-2	P-1	P-2	P-1	P-2	P-1	P-2	P-1	P-2
PHY. 375 WRF	98.3	96.2	99.0	97.0	93.9	90.3	92.1	76.8	54.5	33.2	50.5	35.5
PHY. 499 WRF	97.6	90.3	98.8	88.5	93.4	87.9	94.1	76.9	55.4	36.1	57.2	37.1
FM 1740 B2RF	96.3	95.5	98.3	97.5	89.3	73.9	88.4	69.7	51.5	36.7	55.2	31.0
STV. 5458 B2RF	97.0	90.5	49.5	91.6	92.6	79.9	91.3	76.8	51.2	29.7	49.8	31.0
STV. 5288 B2RF	99.1	96.0	93.9	95.5	90.4	88.1	94.0	80.2	50.0	31.8	58.6	25.0

Table 7. Yield performance of cotton varieties in lbs/ac.

Yield of Lint Cotton/Acre (LBS)		
Variety	AERIES + VOTIVO (LBS/AC.)	UTC (LBS/Ac.)
PHY. 375 WRF	1518.0	1254.0
PHY. 499 WRF	1564.0	1506.0
FM 1740 B2RF	1593.0	1489.0
STV. 5458 B2RF	1484.0	1453.0
STV. 5288 B2RF	1462.0	1456.0