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I. Cotton Variety Trials

Enhancing Cotton Variety Selection – Statewide On-Farm Trials

T Sandlin, S. Brown, R. Smith, B. Freeman, A. Jacobsen, A. Page, W. Birdsong, E. McGriff, B. Dillard, and K. Wilkins

Results:

A total of 18 on-farm cotton variety tests were planted and harvested across the state in 2019. Different variety sets were planted for North and South Alabama with some varieties common to both sets. North Alabama locations consisted of Shelby County and north while South Alabama locations included Tallapoosa county and south. A total of 12 commercially available varieties were included for each set. The majority of locations consisted of two replications, while three large plot locations included three replications. Each on-farm test was harvested using standard equipment. Harvest weights were obtained by using either a calibrated boll buggy for trials harvest with basket pickers or a calibrated platform scale for trials harvested with round module pickers. In order to expedite results and obtain commercial quality turnouts, seed cotton samples were ginned at The University of Tennessee Cotton Micro Gin located at the West Tennessee Research and Education Center in Jackson, TN. HVI analysis was performed at the USDA cotton classing office in Memphis, TN. Results for locations in North Alabama (tables 1-2) and for locations in South Alabama (tables 3-5.) can be found below. Results for all locations and entire publication will be made available via www.aces.edu.

Table 1. Cotton Lint Yield and Fiber Quality Means Across 6 Farm Locations in North Alabama. Locations: Blount, Cherokee, Lawrence, Limestone, and Shelby counties in Alabama. Lincoln County, Tennessee.

VARIETY	Rank	Lint Yield (lbs/Acre)	Lint Turn-Out (%)	Leaf	Mic.	Length (in.)	Strength (g/tex)	Uniformity (%)
ST 4550 GLTP	1	1285	41.53 %	3	4.2	1.12	31.0	81.9
DP 1646 B2XF	2	1271	40.74 %	3	4.0	1.18	29.4	81.0

DP 1725 B2XF	3	1254	42.23 %	3	4.3	1.12	29.7	81.0
ST 5471 GLTP	4	1232	38.91 %	4	3.9	1.11	29.9	80.5
PHY 400 W3FE	5	1221	40.84 %	4	3.8	1.13	31.8	81.7
PHY 350 W3FE	6	1216	37.77 %	4	4.0	1.14	30.9	82.5
NG 5007 B2XF	7	1212	39.61 %	3	4.2	1.10	28.1	81.0
NG 4936 B3XF	8	1201	37.49 %	3	3.9	1.19	30.9	82.4
DP 1916 B3XF	9	1181	40.53 %	3	3.9	1.13	32.9	81.6
ST 5122 GLT	10	1144	38.62 %	4	3.9	1.09	29.8	80.7
NG 3994 B3XF	11	1105	40.09 %	4	4.4	1.12	29.8	80.6
PHY 480 W3FE	12	1046	38.62 %	4	4.0	1.13	30.1	82.7
AVERAGE:		1197	39.75 %	4	4.0	1.13	30.4	81.5

Table 2. Cotton Lint Yield and Fiber Quality Means of Xtend varieties Across 8 Farm Locations in North Alabama. Locations: Blount, Cherokee(2), Franklin, Lawrence, Limestone, and Shelby counties in Alabama. Lincoln County, Tennessee.

VARIETY	Rank	Lint Yield (lbs/Acre)	Lint Turn-Out (%)	Leaf	Mic.	Length (in.)	Strength (g/tex)	Uniformity (%)
DP 1646 B2XF	1	1291	40.51 %	3	3.9	1.18	29.6	81.2
DP 1725 B2XF	2	1281	41.54 %	4	4.2	1.12	29.7	80.9
NG 4936 B3XF	3	1217	37.07 %	3	3.9	1.19	30.7	82.3
NG 5007 B2XF	4	1208	39.26 %	3	4.1	1.11	28.1	81.0
DP 1916 B3XF	5	1186	40.67 %	3	3.9	1.13	33.1	81.9
NG 3994 B3XF	6	1105	39.69 %	4	4.2	1.12	29.2	80.7
AVERAGE:		1215	39.79 %	4	4.0	1.14	30.1	81.3

Table 3. Cotton Lint Yield and Fiber Quality Means Across 8 Farm Locations in South Alabama. Locations: Baldwin, Covington, Elmore, Escambia, Geneva, Macon (2), and Tallapoosa counties.

VARIETY	Rank	Lint Yield (lbs/Acre)	Lint Turn-Out (%)	Leaf	Mic.	Length (in.)	Strength (g/tex)	Uniformity (%)
DP 1646 B2XF	1	1143	40.02 %	3	4.5	1.16	30.2	81.8
PHY 400 W3FE	2	1107	40.25 %	3	4.4	1.12	31.6	82.2
ST 5600 B2XF	3	1092	38.55 %	3	5.0	1.12	31.3	81.7
DP 1851 B3XF	4	1078	38.88 %	3	4.6	1.12	32.2	82.8
NG 5007 B2XF	5	1064	39.00 %	3	4.5	1.11	28.5	82.2
DP 1840 B3XF	6	1060	38.21 %	3	4.6	1.15	31.0	82.1
NG 4936 B3XF	7	1058	37.46 %	3	4.6	1.15	30.2	83.0
PHY 480 W3FE	8	1037	38.39 %	4	4.3	1.11	30.7	82.8
ST 5471 GLTP	9	1034	37.49 %	3	4.5	1.10	30.9	81.8
NG 5711 B3XF	10	1026	38.41 %	3	4.5	1.15	30.9	82.0
ST 5818 GLT	11	1025	37.54 %	3	4.5	1.11	30.4	81.5
PHY 500 W3FE	12	1005	38.27 %	4	4.2	1.11	32.7	82.0
AVERAGE:		1061	38.54 %	3	4.5	1.12	30.9	82.2

Table 4. Cotton Lint Yield and Fiber Quality Means of Xtend Varieties Across 9 Farm Locations in South Alabama. Locations: Baldwin, Covington, Elmore, Escambia, Geneva, Henry, Macon (2), and Tallapoosa counties.

VARIETY	Rank	Lint Yield (lbs/Acre)	Lint Turn-Out (%)	Leaf	Mic.	Length (in.)	Strength (g/tex)	Uniformity (%)
DP 1646 B2XF	1	1187	39.95%	3	4.5	1.16	30.1	81.9
DP 1851 B3XF	2	1149	38.83%	3	4.6	1.12	32.1	82.7
ST 5600 B2XF	3	1144	38.42%	3	5.0	1.12	31.3	81.8
DP 1840 B3XF	4	1120	38.08%	3	4.5	1.15	30.8	82.1
NG 5711 B3XF	5	1110	38.35%	2	4.5	1.15	30.7	82.0
NG 4936 B3XF	6	1109	37.26%	3	4.5	1.15	30.2	83.1
NG 5007 B2XF	7	1103	38.85%	2	4.5	1.11	28.5	82.2
AVERAGE:		1132	38.53%	3	4.6	1.13	30.5	82.3

Table 5. Cotton Lint Yield and Fiber Quality Means of Enlist Varieties Across 9 Farm Locations in South Alabama. Locations: Baldwin, Covington, Elmore, Escambia, Geneva (2), Macon (2), and Tallapoosa counties.

VARIETY	Rank	Lint Yield (lbs/Acre)	Lint Turn-Out (%)	Leaf	Mic.	Length (in.)	Strength (g/tex)	Uniformity (%)
PHY 400 W3FE	1	1114	40.21%	3	4.4	1.12	31.5	82.1
PHY 480 W3FE	2	1041	38.18%	3	4.3	1.10	30.7	82.7
PHY 500 W3FE	3	1028	38.19%	4	4.2	1.11	32.5	82.1
AVERAGE:		1061	38.86%	3	4.3	1.11	31.6	82.3

Cotton Variety Evaluation With and Without Aldicarb for Root-Knot and Fusarium Wilt Management in Alabama, 2019

K. Lawrence, D. Dyer, W. Groover, M. Rondon, B. R. Lawaju, and K. Gordon

Seven cotton varieties were evaluated with and without the addition of aldicarb for management of the root-knot nematode and Fusarium Wilt at the Plant Breeding Unit of Auburn University's E. V. Smith Research and Extension Center, Tallassee, AL. The field plot area contains a kalmia loamy sand soil type (80% sand, 10% silt, and 10% clay). The field trial was arranged in a randomized complete block design with five replications. Plots were planted on 17 April and replanted on 15 May, with seeds planted at a depth of 2.5 centimeters. Test plots consisted of 4 rows (two treated with aldicarb and two untreated), that were 25 feet long with a 36-inch row spacing and a 10 foot alley between replications. Aldicarb was applied as an in-furrow granular at a rate of 5.0 lb/A to the right two rows of each variety leaving the left two rows untreated. All plots were maintained throughout the season with standard insecticide, herbicide, and fertilizer practices and watered as needed with an overhead irrigation system. Nematode population density (eggs/gram of root) and plant biomass measurements were taken 40 days after planting (DAP) by digging four plants at random from each plot. Extraction of nematode eggs from roots was accomplished by shaking the roots in 6% NaOCl for 4 minutes and collecting the eggs on a 25-µm sieve. The test was harvested and yield data were collected on 9 Oct. Plants were counted for vascular discoloration indicating Fusarium infection immediately after harvest. Data were analyzed with ARM and LS-means were compared using Tukey-Kramer's method ($P \leq 0.1$).

In this test, replanting reduced the nematode numbers compared to the initial population at the first planting. Differences in plant biomass were observed between varieties without aldicarb but once aldicarb was added the biomass was similar between all varieties. Root knot eggs per gram of root were lower in the aldicarb plots for every variety with the lowest populations found on the reistant variety DP 1747NRB2XF and DP 1725 B2XF. The percentage of plants with FOV ranged from 4 to 17.6 over all varieteis with DP 1646 B2XF having numerically the lowest incidence of FOV. Yields were similar with and without aldicarb and across all varieties. The grestest yield without aldicarb was produced by ST 5471 GLTP followed by DP 1646 B2XF which produced 400 lb/A more than the lowest yielding variety. The greatest yield with the addition of aldicarb was in DP 1646 B2XF and DP 1725 B2XF where a 650 lb/a increase was produced over PHY 333 W3FE. Deltapine 1646 B2XF ranked frist and second with and without aldicarb and also had the lowest FOV infection.

	Plant biomass at 40 DAP			Root knot eggs /g root		% Fusarium	Seed cotton yield	
	No aldicarb		Aldicarb	No aldicarb	Aldicarb	Combined	No aldicarb	Aldicarb
Cultivar	Biomass g		Biomass g	RK g root	RK g root	FOV %	lb/A	lb/A
DP 1646 B2XF	63.0	ab [x]	23.0	429	130	4.0	2608	2910
DP 1725 B2XF	47.4	ab	35.5	126	14	12.8	2544	2770
PHY 330 W3FE	39.5	b	28.4	552	136	15.9	2184	2190
PHY 350 W3FE	71.6	a	25.1	450	139	4.4	2556	2387
DP 1747NR B2XF	47.1	ab	25.1	212	25	13.2	2439	2370
ST 6182 GLT		ab	21.9	458	109	14.9	2376	2619
ST 5471 GLTP	52.4	ab	19.2	788	68	17.6	2672	2463

[x] values present are LS-means separated using the Tukey-Kramer method at $P \leq 0.1$. Values in the same column without letters do not differ significantly.

Cotton Cultivar Disease Incidence, Severity, and Yields when Challenged with Verticillium Wilt in the Tennessee Valley Region, 2019

K. Lawrence, T. Sandlin, A. Page, T. Raper, H. Young, B. Meyer, and N. Silvey

Abstract

Verticillium wilt most often occurs in the Tennessee Valley region of Alabama and Tennessee causing a decline in plant health and yield. The only effective management option producers have is to select a Verticillium wilt tolerant cotton cultivar. The life span of cotton cultivars is often less than 5 years, thus a producer must constantly look for cultivars that yield well when challenged with Verticillium wilt. Thus, the goal of this study is to identify cotton cultivars for best management by evaluating cotton cultivars for resistance as measured by disease severity and tolerance and by yield when challenged in Verticillium wilt fields. Cotton cultivars and lines were planted in commercial cotton fields naturally infested with *V. dahlia* in a strip plot design with four replications and at three locations. Ranking the cultivars by yield indicates NG 4936 B3XF, DP 2012 B3XF, PHY 400 W3FE, DP 2020 B3XF, and ST 4990 B3XF produced numerically greater yields averaging in both locations under these disease conditions and these cultivar yields were 33 % greater than the lowest yielding cultivars. Comparing the data between disease incidence and severity indicated a significant positive correlation (R^2=0.76954; $P \leq 0.000$) between visual foliar symptoms and the signs of the disease in the vascular system. Negative correlations between Verticillium wilt incidence and lint cotton yield (R^2= -0.77509; $P \leq 0.0001$) and Verticillium wilt severity and lint cotton yield (R^2= -0.63693; $P \leq 0.0001$) indicate that Verticillium wilt contributed to a 70% reduction of the cotton yield in 2019. Cotton cultivar selection is very important in a Verticillium wilt infested field.

Introduction

Losses from Verticillium wilt for the U.S., according to disease loss estimates, between the years of 1965-2018 are approximately 10 million bales (http://www.cotton.org/tech/pest/index.cfm). Verticillium wilt most often occurs in the Tennessee Valley region of Alabama and Tennessee causing a decline in plant health and yield. Two *Verticillium* species have been found in in the Tennessee Valley region, *V. albo-atrum* Reinke and Berthold (Palmateer et. al., 2004) and *V. dahliae* Kleb., (Land et. al., 2016). *Verticillium dahliae* is considered the primary causal agent of

Verticillium wilt in cotton and first colonizes the root and then moves upward through the vascular system of the plant (El-Zik, 1985). Typically, symptoms include wilting, lack of lateral growth, and decreases in yield, fiber quality, and seed quality (Wheeler et. al., 2012; Xiao et. al., 2000). Defoliation is thought to lead to yield reductions resulting from the lack of photosynthetic activity. Disease incidence is higher on heavier soils with higher clay and silt content and may be linked to the lower temperatures and higher moisture levels. Moist soils from irrigation enhance the incidence of Verticillium wilt in cotton. Irrigation cools the soil thereby enhancing pathogen survival and increasing infection rates. As the timing intervals of watering regiments increase, so do the disease incidences of cotton plants (Schneider, 1948). There are no fungicides recommended for management of Verticillium wilt in cotton. The only effective management option producers have is to select a Verticillium wilt tolerant cotton cultivar (Raper, et al. 2017) . The number of cotton cultivars available to producers, however, is limited. The life span of cotton cultivars is often less than 5 years, thus a producer must constantly look for cultivars that yield well when challenged with Verticillium wilt. The overall goal of this study is to identify cotton cultivars for best management by evaluating cotton cultivars for resistance as measured by disease severity and tolerance measured by yield to Verticillium wilt in the field.

Figure 1. Verticillium wilt symptomatic cotton plant (left); foliar symptoms including necrosis and chlorosis of the leaves (middle); and vascular browning discoloration typical of a Verticillium wilt infected cotton plant with a non-symptomatic plant adjacent to it (right) (infected plant on the right side) and *Verticillium dahlia* culture (right top) and whirled conidiophore (right bottom).

Materials and Methods

Cotton cultivars were planted in commercial cotton fields naturally infested with *V. dahliae* to determine cultivar disease response to Verticillium wilt under field conditions. Two field locations were selected for the 2019 tests based on severity of Verticillium wilt and the willingness of growers to participate in this research. Seed of adapted cultivars and experimental lines expected to be released in the next season were provided by AGRI-AFC, LLC of Land O'Lakes (Decatur, AL). Cotton cultivars and lines were planted in a strip plot design with four replications with plots being 1 row with a 1.02 m row spacing by 150 to 200 m plots evenly spaced throughout the field locations. Verticillium wilt disease incidence and severity ratings were conducted near cotton plant maturity from 4 randomly selected 3 m sections of row in each plot. Foliar symptoms of Verticillium wilt were evaluated on a scale from 1 to 5 as depicted in Figure 2. Plants were individually rated and averaged for a total plot disease severity rating. Vascular discoloration was determined by cutting the plant stem longitudinally exposing the vascular cylinder and the number of plants with a discolored vascular cylinder indicated the percent incidence (Figure 1 middle). Stem section with discoloration were collected for fungal isolation to confirm Verticillium spp. presence. Yields were collected at plant maturity from a measured section (71-118 ft) of each cultivar within each strip trial using a two row plot cotton picker. Samples were ginned at the UT Cotton MicroGin to determine turnout. Data collected from the field trials were analyzed in SAS 9.4 (SAS Institute, Cary, NC) using the PROC GLIMMIX procedure. LS-means were compared between the cultivars using the Tukey- Kramer test at significant level of $P \leq 0.05$. PROC CORR was used to determine relationships between disease incidence, severity, and yield.

Results

Verticillium wilt disease percent incidence and severity ratings were variable between the cotton cultivars and locations. Disease incidence was more severe in TN and ranged from 51 to 91 % of the plants of each cultivar with vascular staining. The lowest Verticillium wilt incidence percentage was observed in ST 5471 GLTP, ST 5600 B2XF, and NG 3930 B3XF in the TN location (Fig. 3). These cotton cultivars had the lowest percentage of plants with vascular discoloration and disease severity ratings of 2.6 or less. Disease incidence in AL ranged from 8 to 38 % of the plants of each cultivar which was significantly lower disease than in the TN location ($P > 0.05$). The highest Verticillium wilt incidence was measured in CP 9178 B3XF, PHY 400 W3FE, and NG 4936 B3XF in the AL location. These cotton cultivars had the highest percentage of plants with vascular discoloration and disease severity ratings of 2.5 to 3.0 (Fig. 4). Combining the two locations, the number of plants with vascular staining due to Verticillium wilt was most severe in DP 1725 B2XF (59%) with NG 3930 B3XF and ST 5471 GLTP having the lowest level of infection (34 and 32% respectively).

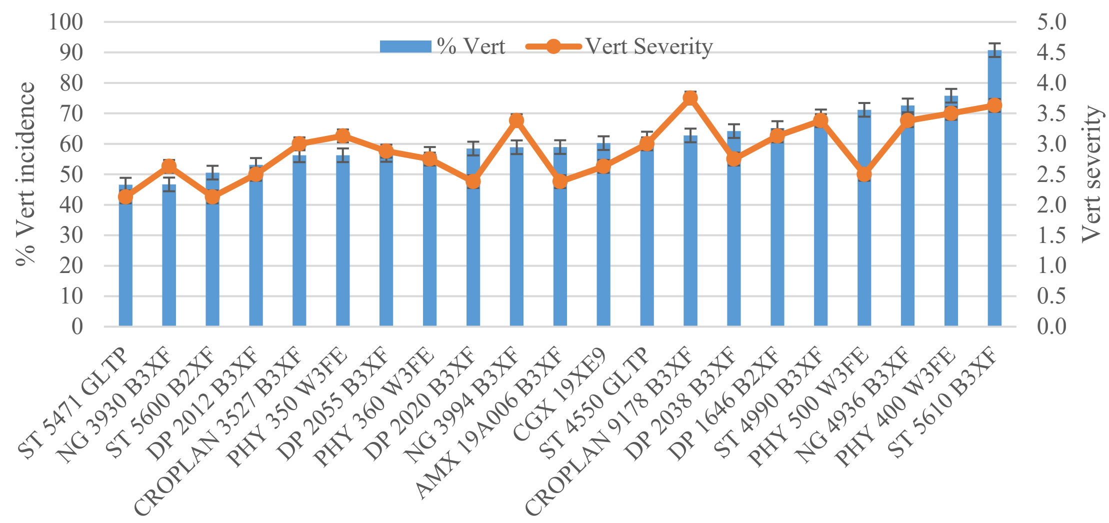

Figure 3. Verticillium wilt incidence and severity within cotton cultivars, 2019 TN

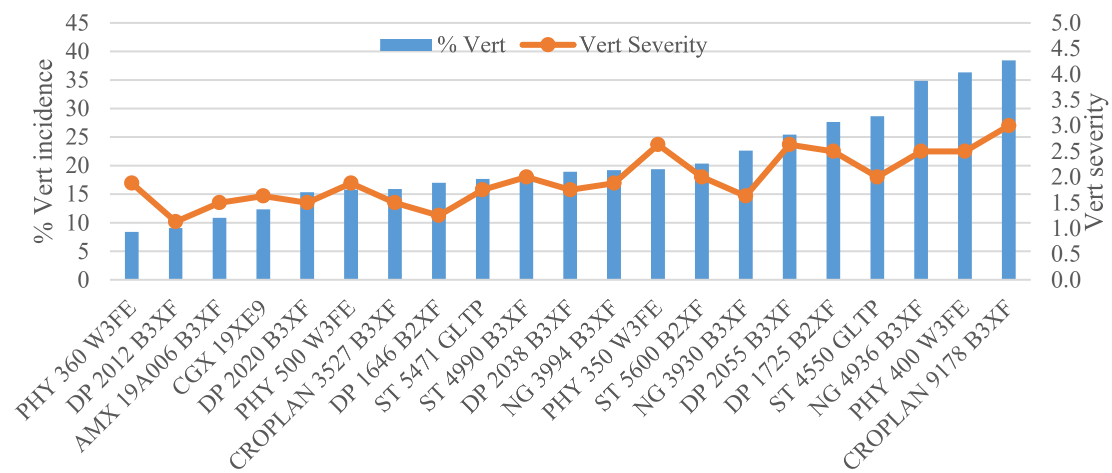

Figure 4. Verticillium wilt incidence and severity within cotton cultivars, 2019 AL

Yields indicated significant differences between cultivars when challenged with Verticillium wilt (Figure 5 & 6). Seed cotton yields varied by 2561 & 1504 lb/A in TN and AL respectively, with TN supporting lower yields with more Verticillium wilt than the AL location in 2019. Ranking the cultivars by yield indicates NG 4936 B3XF, DP 2012 B3XF, PHY 400 W3FE, DP 2020 B3XF, and ST 4990 B3XF produced numerically greater yields averaging in both locations under these disease conditions and these cultivar yields were 33 % greater than the lowest yielding cultivars PHY 500 W3FE and NG 3994 B3XF.

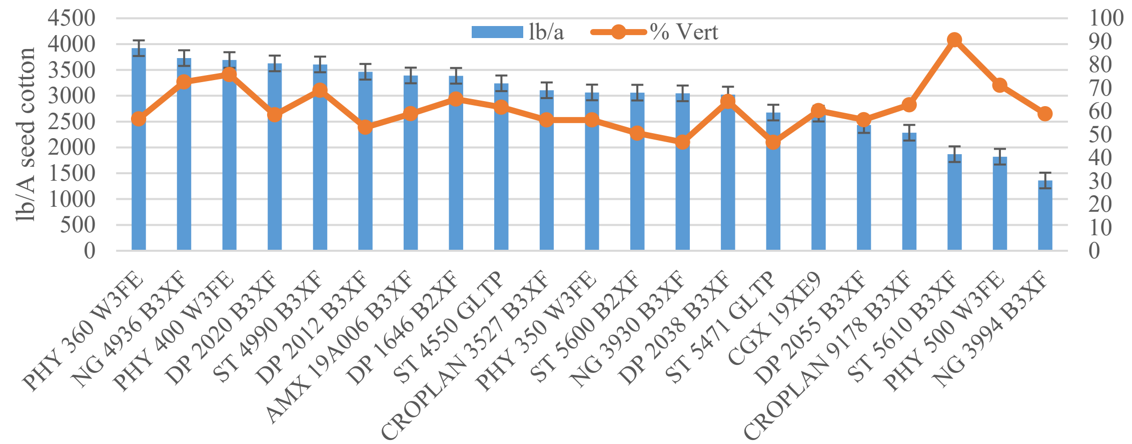

Figure 5. Cotton yield as influence by Verticillium wilt severity, 2019 TN

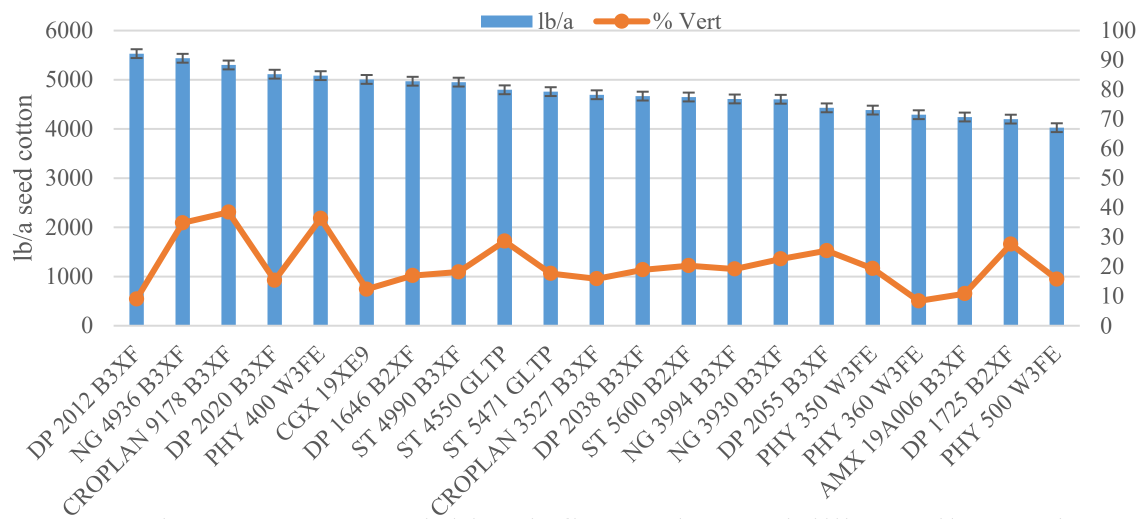

Figure 6. Cotton yield as influence by Verticillium wilt severity, 2019 AL

Comparing the data between disease incidence and severity indicated a significant positive correlation (R^2 =0.76954; $P \leq 0.000$) between visual symptoms and the signs of the disease in the vascular system. A correlation between Verticillium wilt incidence and lint cotton yield did indicate a negative relationship (R^2 = -0.77509; $P \leq 0.0001$). The correlation between Verticillium wilt severity and lint cotton yield (R^2 = -0.63693; $P \leq 0.0001$). Verticillium wilt contributed to a 70% reduction of the cotton yield in 2019.

Conclusions

Cotton cultivar selection is very important in a Verticillium wilt infested field. The lowest yielding cultivars appeared most susceptible to Verticillium wilt in 2019. Level of incidence, severity of symptoms, and yield all need to be considered when selecting a cultivar for a Verticillium wilt field.

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Beltwide DD-60 Trial

S. M. Brown and T. Sandlin

We participated in a Commission-funded, Beltwide study which examined the development of DP 1612 B2XF, DP 1646 B2XF, and DP 1851 B3XF, three current cultivars classed as Early, Mid, and Full maturity, respectively. The goal was to check growth rate patterns against the long-accepted calendar schedule based on heat unit accumulations (DD-60s). The three trial locations were at the Auburn University research facilities at Brewton, Shorter, and Belle Mina.

The table below shows an accepted calendar and heat unit accumulation schedule.

Average Number of Days and Heat Unit Required for Various Growth Stages		
Growth Stage	**Days**	**DD-60s**
Planting to Emergence	4 to 9	50 to 60
Emergence to 1st Square	27 to 38	425 to 475
Square to 1st Bloom	20 to 25	300 to 350
Planting to 1st Bloom	60 to 70	775 to 850
Bloom to Open Boll	45 to 65	850 to 950
Planting to Harvest Ready	130 to 160	2200 to 2600
Modified from Oosterhuis, 1990		

Beltwide DD-60 Trial									
		DAP					% Open	Harvest 10/2, 147 DAP	
Brewton	Variety	Emerge	1st Square	1st Bloom	Cutout	1st Crack B	126 DAP	Lint, %	Lint, lb/A
Planted 5/8	DP 1612 B2XF	5	37	54	91	111	54.5	38.6	1,721
Harvested 10/2	DP 1646 B2XF	5	37	58	91	111	69.8	44.1	2,175
	DP 1851 B3XF	5	42	58	91	119	51.0	41.2	1,966
Shorter							119 DAP	Harvest 11/14, 169 DAP	
Planted 5/29	DP 1612 B2XF	5	40	58	79	111	72.5	39.1	1,319
Harvested 11/14	DP 1646 B2XF	5	43	68	> 82	> 111	47.5	42.7	1,399
	DP 1851 B3XF	6	44	68	>82	> 111	47.5	42.7	1,578
Belle Mina							126 DAP	Harvest 10/1, 152 DAP	
Planted 5/2	DP 1612 B2XF	8	33	67	96	.	65.0	41.5	1,529
Harvested 10/1	DP 1646 B2XF	13	33	67	96	.	60.0	44.6	1,539
	DP 1851 B3XF	13	33	68	96	.	32.5	46.3	1,568

DAP = days after planting

At both southerly locations, the crop emerged as expected, 4 to 6 days after planting, but at Belle Mina emergence required 8 days or more. First (match head) square appeared as expected at Brewton and Belle Mina but was delayed at Shorter despite excessive heat units. This is often attributable to high temperatures and an associated increase in the node of 1st square. First bloom typically occurs around 55 to 60 days after planting, but delays in squaring delayed flowering at Shorter and Belle Mina. The interval between 1st square and 1st bloom is typically around 21 days but was clearly longer at Belle Mina. At Brewton and Belle Mina, the period from 1st bloom to cutout was only 4 to 5 weeks, yet yields were quite strong. This demonstrates that given good conditions, maximum yields can be achieved with a somewhat modest-length bloom period. That cutout occurred 3 weeks after bloom for the earliest variety at Shorter was probably related to drought, heat, and irrigation limitations.

These data will be included with a national set to confirm or adjust accepted growth calendars and heat unit models. These observations demonstrate that factors other than heat unit accumulation can influence growth rate and fruiting.

Do RKN-Resistant Varieties Require Less Nitrogen?

S. M. Brown and A. Gamble

Dr. Audrey Gamble and I established a trial at three locations in which we explored N rates with two varieties, one a root-knot nematode (RKN) resistant variety PHY 480 W3FE and an industry standard DP 1646 B2XF. The hypothesis is that RKN-resistant varieties may develop a superior root system and thereby require less N. Nitrogen rates ranged from 0 to 150. Locations were the Auburn University research facilities at Headland, Tallassee, and Shorter.

Application of N varied by locations. At Headland, all except the 0-N plots received an at-plant application of 30 lbs N, with the remaining N applied at sidedress. At the other sites, all N was applied shortly after planting. Nematode levels at the outset were unknown. Samples were taken at the end of the season, in mid-October concurrent with rainfall that relieved a sustained late season drought.

Overall yields were highest at Headland and comparable for Shorter and Tallassee. At the two locations where root-knot nematode levels were low to moderate, DP 1646 B2XF had superior yields compared to PHY 480 W3FE. Yields of the two varieties were similar at Shorter which had high levels of RKN. At Headland, 90 lb/A N was clearly sufficient for maximum yields. Rates responses at the other locations were somewhat scattered. At two locations, season-end RKN levels were significantly lower following PHY 480 W3FE as compared to DP 1646 B2XF.

Do RKN Varieties Require Less N?					
Variety	Headland	Tallassee	Shorter		**AVERAGE**
DP 1646 B2XF					
0	1,146	1,010	1,148		**1,101**
30	1,305	1,161	1,188		**1,218**
60	1,463	1,435	1,210		**1,370**
90	1,880	1,248	1,228		**1,452**
120	1,776	1,365	1,232		**1,458**
150	1,647	1,452	1,285		**1,461**
PHY 480 W3FE					
0	994	969	1,062		**1,008**
30	1,190	1,017	1,259		**1,155**
60	1,439	1,095	1,274		**1,269**
90	1,587	1,160	1,213		**1,320**

120	1,553	1,242	1,307		**1,367**
150	1,515	1,375	1,262		**1,384**
Variety	Headland	Tallassee	Shorter		**AVERAGE**
DP 1646 B2XF	1,536	1,279	1,215		**1,343**
PHY 480 W3FE	1,380	1,143	1,229		**1,251**
N Rate					
0	1,070	989	1,105		**1,055**
30	1,247	1,089	1,224		**1,187**
60	1,451	1,265	1,242		**1,319**
90	1,734	1,204	1,220		**1,386**
120	1,665	1,303	1,270		**1,413**
150	1,581	1,414	1,273		**1,423**
Average	**1,458**	**1,211**	**1,222**		**1,297**
RKN #/100 cc					
DP 1646 B2XF	45	250	728		
PHY 480 W3FE	63	0	116		
Reniform #/100 cc					
DP 1646 B2XF	0	0	16		
PHY 480 W3FE	0	0	2		

Impact of Variety Selection, Cropping Practices, Fungicide Inputs, and Crop Rotation on Cotton Yield and Quality as Influenced by Aerolate Mildew, Target Spot, Hardlock, and Bacterial Blight

A. Hagan, B. Miller, S. Scott, M. Pegues, D. Moore, W. Clements, C. Norris, and L. Wells

Project Overview: Target spot, areolate mildew, hardlock, and bacterial blight pose a significant threat to the yield and quality of Alabama's cotton crop. Management practices in combination with fungicide inputs are required to minimize the risk of damaging target spot outbreaks in Alabama cotton. For areolate mildew, hardlock and bacterial blight, selection of resistant or tolerant cotton cultivars along with management practices need to be examined to establish effective control programs for both diseases.

Duration of Project: 1 year (reviewed annually).

Funding: $8,500

Description of Project: Activities include assessing the reaction of commercial cotton cultivars and advanced breeding lines to target spot and other diseases in the OVT cotton cultivar trials, observe the yield response and disease reaction of commercial cotton cultivars to fungicide inputs in high target spot pressure settings, determine the efficacy of registered and experimental fungicides for the control of target spot and hardlock as influenced by cultivar target spot susceptibility, and establish the influence of management inputs on disease severity and cotton yield.

Key Partners and Study Locations in 2018:

1) Brewton Agricultural Research Unit (BARU) – Brad Miller
2) Field Crops Unit, E. V. Smith Research Center (FCU) – Shawn Scott
3) Gulf Coast Research and Extension Center (GCREC) – Malcomb Pegues
4) Prattville Agricultural Research Unit (PARU)– Don Moore
5) Sand Mountain Research and Extension Center (SMREC)- William Clements
6) Tennessee Valley Research and Extension Center (TVREC) – Chet Norris
7) Wiregrass Research and Extension Center (WREC) – Larry Wells

Project Objectives:

1. Evaluate the susceptibility of commercial cotton varieties to areolate mildew, target spot, hardlock, and bacterial blight.

2. Determine the impact of target spot and hardlock on the cotton lint yield and quality factors.
3. Establish the efficacy of registered and experimental fungicides for the control of areolate mildew and target spot along with their effect on hardlock incidence, lint quality and yield.
4. Seeding rate, and canopy architecture as influenced by variety selection on target spot intensity, hardlock incidence yield of selected cotton cultivars.

Project Results:

Objectives 1 and 2

For the cotton cultivar × fungicide trial at BARU, the experimental design was a factorial arranged in a split plot with the cotton cultivars PhytoGen 350 W3FE, PhytoGen 480 W3FE, PhytoGen 580 W3FE, Deltapine 1646 B2XF, Deltapine 1840 B3XF, Deltapine 1851 B3XF, Stoneville 5600 B2XF, Stoneville 5818 GLT, and Stoneville 6182 GLT as whole plots and a fungicide program consisting of four applications of Priaxor at 8 fl oz/A + Bravo Ultrex at 1.5 pt/A as the split plot treatment designed to minimize target spot incited defoliation and subsequent yield loss. As indicated by a significant cultivar × fungicide program interaction, lint yields for target spot differed by cotton cultivar and fungicide program. Other interactions between variables on target spot-incited defoliation and gin turn out were not significant. For all cultivars, final % defoliation values were significantly lower for the fungicide- than the non-fungicide-treated cotton. Stoneville 6182 GLT suffered significantly greater target spot-incited defoliation than all cultivars except for PhytoGen 580 W3FE and Deltapine 1851 B3XF with the latter cultivars also having the highest rate of disease development. In contrast, the low defoliation recorded for Deltapine 1646 B2XF was equaled by Deltapine 1840 B3XF, Stoneville 5600 B2XF, Stoneville 5818 GLT, PhytoGen 480W3FE and PhytoGen 350 W3FE. Turn out was greater for Stoneville 6182 GLT compared with all other cultivars except for PhytoGen 580 W3FE, while the lowest turn out value was recorded for Stoneville 5818 GLT. For the fungicide-treated cotton, Deltapine 1646 B2XF outyielded all cultivars except for Deltapine 1840 B3XF and Deltapine 1851 B3XF, while Stoneville 5818 GLT produced significantly less lint than all cultivars except for PhytoGen 480 W3FE and Stoneville 6182 GLT. With the non-fungicide cotton, greater yield was recorded for Deltapine 1646 B2XF than any other cultivar except Deltapine 1840 B3XF, while the low yield for Stoneville 5600 B2XF was matched by Stoneville 6182 GLT. With the exception of Stoneville

5600 B2XF, where greater yield was noted for the fungicide-treated than non-fungicide control, similar lint yield was recorded for the remaining cultivars within the respective fungicide programs.

A second cotton cultivar × fungicide trial was conducted at the Prattville Agricultural Research Unit (PARU) in Prattville, AL. Again, the experimental design was a factorial arranged in a split plot with the cotton varieties PhytoGen 350 W3FE, PhytoGen 440 W3FE, PhytoGen 480 W3FE, Deltapine 1646 B2XF, Deltapine 1840 B3XF, Deltapine 11851 B3XF, Stoneville 4550 GLTP, Stoneville 5471 GLTP, and Stoneville 5818 GLT as whole plots and a fungicide program consisting of three applications of Headline SC at 9 fl oz/A + Bravo Ultrex at 1.5 pt/A as the split plot fungicide umbrella treatment. As noted in the above study, the Priaxor + Bravo Ultrex umbrella program gave effective disease control but differences in defoliation levels across the non-treated cultivars resulted in a significant cultivar × fungicide program interaction. Across all cultivars, final % defoliation was significantly lower for the fungicide positive than the no fungicide control. For the no-fungicide program, the high defoliation level noted for Stoneville 4550 GLTP was equaled by PhytoGen 350 W3FE, Deltapine 1851 B3XF, Deltapine 1646 B2XF, and Stoneville 5818 GLT, while Stoneville 5471 GLTP suffered the least premature defoliation. With the exception of Stoneville 4550 GLTP and Stoneville 5818 GLT, defoliation ratings for all cultivars matched the low level of damage noted on Stoneville 5471 GLTP. While significant differences in yield were noted between cotton cultivars, similar yield was recorded for both the positive fungicide and no fungicide negative control despite significant levels of premature defoliation associated with the latter program at the final rating date. Delayed disease development in early to mid-Aug due to dry Jul weather patterns is likely the reason for the absence of a yield response to the fungicide umbrella program. Overall, greater seed yield was obtained with Deltapine 1646 B2XF than all cultivars except for Deltapine 1840 B3XF and Deltapine 1851 B3XF.

Lint grade values will be available for both of the above studies later.

Objective 3.

Studies were conducted in 2019 to determine the level of yield protection and efficacy of registered and experimental fungicides for the control of target spot on the Stoneville 6182 GLT cotton at the BARU in Southwest Alabama. The experimental design was a randomized complete block with four (4) replications. Despite late summer dry weather patterns, significant differences in the level of target spot-incited defoliation were noted among the fungicide programs with the non-fungicide control having the greatest premature leaf loss at 73% at the final 11 Sep rating date. When compared with the no fungicide control, significantly lower defoliation levels were noted for all rates of Revytek along with Priaxor, Miravis Top alone or tank mixed with Quadris and the Priaxor + Bravo WeatherStik positive control, all of which gave equally effective target spot control. In contrast, Propulse, Provost Silver, along with both Aproach programs failed to significantly reduce target spot-incited defoliation compared with the no fungicide control. Significant yield gains ($P<0.10$) were obtained with Miravis Top, 12 and 15 fl oz/A Revytek, and the Priaxor + Bravo WeatherStik positive control compared with the no fungicide control. High seed yields recorded with Miravis Top alone were matched by 12 and 15 fl oz/A Revytek along with Miravis Top + Quadris, 6 fl oz/A Aproach, Priaxor alone, and the Priaxor + Bravo WeatherStik positive control. Also, greater seed yield was noted for the two higher compared with lowest rate of Revytek. Propulse, Provost Silver, and 9 fl oz/A Aproach programs produced yield significantly less than Miravis Top.

Selected fungicides were compared at BARU with a recommended two application Priaxor program for the curative control of target spot on rainfed Deltapine 1646 B2XF cotton. Concurrent to the first fungicide application, leaf spotting and a low level of target spot-incited defoliation was observed. Disease intensification progressed from the 28 Jul through the 26 Aug rating dates. When compared with the no fungicide control, significant reductions in premature defoliation were obtained with all fungicide programs except for the one and two applications programs with both rates of Aproach along with the two application Provost Silver programs. Similarly low defoliation levels recorded for 12 and 15 fl oz/A Revytek along with Priaxor were equaled by Miravis Top, and Priaxor + Bravo WeatherStik. In addition, superior disease control was provided by the two higher than the lowest rate of Revytek. While counts of open and unopened bolls were not impacted by fungicide program, a significant reduction in hardlocked bolls compared with the no fungicide control was noted for the two higher rates of Revytek along with two applications of 9 fl oz/A Aproach. While differences in turn out values were noted among the fungicide programs, turn out values for the no fungicide control and all other fungicide programs did not significantly differ. Despite significant differences in turn out and disease-incited defoliation, lint yield for the no fungicide control and all remaining fungicide programs did not significantly differ.

Objective 4.

The impact of cotton cultivar selection, growth regulator, and fungicide program on the severity of areolate mildew and target spot was evaluated at BARU. As indicated by a significant cultivar × fungicide program interaction, target spot and areolate mildew defoliation along with lint yield differed by cotton cultivar and fungicide program. Areolate mildew defoliation also significantly differed by plant growth regulator (PGR) and fungicide program. Overall, target spot defoliation was lower across all treatments compared with previous study years. While target spot onset occurred on 28 Aug, noticeable disease related defoliation, which was first recorded on 5 Sep, gradually intensified through the 27 Sep rating date. PGR program did not impact target spot-incited defoliation. For the no fungicide control, PhytoGen 490 W3RF suffered significantly greater target spot-related defoliation than Deltapine 1646 B2XF. For the latter but not the former cultivar, significant reductions in target spot-related defoliation were obtained with the one application Priaxor program compared with the no fungicide control. On both cultivars, the two application Priaxor program gave equally effective target spot control, which was significant better compared with the single application program. Areolate mildew, which was first observed on 11 Sep, rapidly intensified, particularly on Deltapine 1646 B2XF, through 4 Oct. Similarly greater areolate mildew-related defoliation observed for both PGR programs was significantly reduced with both the one and two Priaxor application programs. With the aggressive PGR program, less areolate mildew-related defoliation was recorded for the two than one application Priaxor program. PGR program did not significantly impact lint yield. Regardless of the fungicide program, Deltapine 1646 B2XF yielded significantly more than PhytoGen 490 W3FE, where similarly low yields were obtained for the no fungicide control along with both Priaxor programs. With Deltapine 1646 B2XF, greater lint yield, which was recorded for the two application Priaxor program compared with the no fungicide control, demonstrated the impact of areolate mildew-related defoliation on lint yield.

Alabama Cotton Improvement (RE: 17-587 AL, Final Report 2018)

J. Koebernick

Objective 1: Develop and evaluate cotton varieties for resistance to biotic stresses, primarily reniform nematode, target spot and CLRDV

Field trials were placed in Headland, Brewton, Fairhope, Shorter, Prattville and Tallassee. Progeny rows from crosses whose parent had reniform resistance were evaluated in infested fields. A target spot greenhouse screening protocol for evaluating small plants was evaluated and will be published in 2020. Carly Moore graduated in May and will be first author on this paper.

This has been an interesting year for raising awareness about CLRDV. I gave presentations to the Undersecretary of Agriculture, Bill Northey, and at the Southern Southeastern Cotton Commission Meeting at Amelia Island. I also spent time travelling to meet Ritchie Seaton of the Georgia Cotton Commission and Frank Howell of the Delta Council to inform them of CLRDV.

My breeding objective for CLRDV is to identify varieties that are resistant in the form of complete immunity to the virus. This year I planted 824 lines at Tallassee along with an additional 400 at Fairhope. The results indicated that 6% of the lines tested negative. These lines will be tested in aphid assay trials that my graduate student Bri Heilsnis is currently working on in conjunction with Alana Jacobson. If they continue to test negative, they will be replanted for the 2020 season and undergo grafting to infected plants to determine true resistance.

Other breeding priorities relate to seed size and fiber quality. All breeding material was sampled for fiber quality and fuzzy seed index recorded. It is in the process of being evaluated for fibers per seed in order to improve fiber quality and seed size while maintaining yield.

Objective 2: Variety evaluation in the Regional Breeders Testing Network (RBTN), the National Cotton Variety Test (NCVT) and National Fusarium Wilt Trial.

The RBTN and Fusarium Trials were planted in Tallassee, AL. The RBTN lines all displayed symptoms of the virus. The FOV trial consisted of 54 entries with several Phytogen lines being entered. These lines showed a lot of promise. The NCVT was grown at Headland, AL, and had good yields. I also provided a location for an ongoing cotton breeding project focusing on characterizing a reference quality genome sequence with breeders from Arkansas, Georgia and South Carolina.

II. Cultural Management

Seeding Rate Trial

S. Brown

[Funding for this trial was requested by Christy Hicks before her departure. The study was conducted in 2018 but was lost due to excessively wet weather. Jarrod Jones at the Gulf Coast Research and Extension Center repeated this study in 2019. Steve M. Brown summarized the results.]

The variety was DP 1646 B2XF. Across all seeding rates, average plant stand establishment was around 80 to 85 percent of seed planted. Overall, yields were superior for the early versus late planted. Within planting date, there were minimal differences in yield across the range of seeding rates.

Seeding Rate Study, 2019						
Gulf Coast Research and Education Center						
Planting Date		**Seed/ft**	**Plants/10 ft**	**% Planted**	**Lint, lb/A**	**Lint, lb/A**
2-May	Early	1.5	11.8	79%	1,533	1,542
	Early	2.0	16.0	80%	1,401	
	Early	2.5	22.3	89%	1,653	
	Early	3.0	27.0	90%	1,580	
13-Jun	Late	1.5	12.3	82%	1,166	1,227
	Late	2.0	17.5	88%	1,232	
	Late	2.5	22.3	89%	1,244	
	Late	3.0	23.3	78%	1,266	
			AVG	**84%**		

Planter Down Force Trial

S. Brown

[Funding for this trial was requested by Christy Hicks before her departure. The study was conducted in 2018 but was lost due to excessively wet weather. Jarrod Jones at the Gulf Coast Research and Extension Center repeated this study in 2019. Steve M. Brown summarized the results.]

Stand counts were significantly higher for DP 1646 B2XF than ST 6182 GLT. For DP 1646 B2XF, there was little meaningful difference in stands across treatments. In ST 6182 GLT, the lowest down force had slightly lower stand counts.

Yield data were too varied to be helpful.

Planter Down Force Study, 2019			
Gulf Coast Research and Education Center			
Variety	**Down Force, lb**	**Plants/10 ft**	**Plants/10 ft**
DP 1646 B2XF	50	18.8	17.4
DP 1646 B2XF	100	18.3	
DP 1646 B2XF	150	16.5	
DP 1646 B2XF	200	17.5	
DP 1646 B2XF	250	15.8	
DP 1646 B2XF	300	17.8	
ST 6182 GLT	50	13.3	15.6
ST 6182 GLT	100	15.3	
ST 6182 GLT	150	15.3	
ST 6182 GLT	200	15.8	
ST 6182 GLT	250	16.8	
ST 6182 GLT	300	17.5	

Evaluation of Cover Crops in Cotton Production Systems: Biomass Production and Nitrogen Contributions

A.V.Gamble and K. Balkcom

Rationale

Restoration of soil health is vital to sustain productivity in Alabama row-crop systems. As demand for food increases, methods to improve soil health and water-use efficiency while increasing crop productivity must be identified. Cover crops have potential to improve soil health by increasing soil organic matter content, improving water-infiltration, and reducing nutrient runoff. Small grain cover crops are ideal for producing biomass which can eventually contribute organic matter to the soil. Legume cover crops can supplement nitrogen to other cover crops in a mixture and/or to subsequent cash crops. Deep-rooted brassica cover crops (e.g., "tillage" radish) may have potential to alleviate soil compaction in row crop production systems. Basic information on cover crops, such as nitrogen release from biomass, is needed for producers to maximize the benefits of cover crops for cotton production.

Experimental Methods

This experiment took place at E.V. Smith Research Center (EVS) in Shorter, AL, Tennessee Valley Research and Extension Center (TVREC) in Belle Mina, AL and Wiregrass Research and Extension Center (WREC) in Headland, AL. Winter cover crop treatments included monocultures and mixtures of cereal rye, crimson clover, and tillage radish. Treatments were replicated four times in randomized complete block design. Experiment are repeat in irrigated and dryland systems. Summer cash crops varied according to location. At TVREC and EVS, cover crops were incorporated into an annual cotton-soybean rotation with cotton planted in 2018 and soybean in 2019. At WREC, cover crops were incorporated into an annual cotton-peanut rotation, with cotton planted in 2018 and peanut planted in 2019.

Prior to termination, cover crop dry biomass was determined by collecting biomass from 0.25 m^2 plots, drying, and weighing. Nitrogen release from cover crop residue was monitored at each location with litter decomposition bags. Six screen bags containing a known mass of cover crop residue were placed in each plot two weeks after termination. At six different time intervals, fresh weight of biomass in screen bags was recorded in the field, and a subsample of this dried back in the lab to estimate the total biomass, and biomass N contributed by the cover crop.

Results

In the 2019 growing season, soybean was planted at EVS and TVREC, and peanut was planted at WREC. Results for cotton yield in the 2018 growing season are shown in Figures 1 and 2. No yield data were collected at WREC in 2018 due to Hurricane Michael. At EVS, cover crop influenced cotton yield, regardless of whether treatments were irrigated or dryland. Mean yields across dryland and irrigated treatments are shown in Figure 1. The rye and rye-clover-radish mixture treatments increased cotton lint yield compared to the fallow treatment. The fallow treatment yield averaged approximately 1270 lbs lint per acre, while the rye and rye-clover-radish mixture treatment yields averaged approximately 1630 lbs lint per acre.

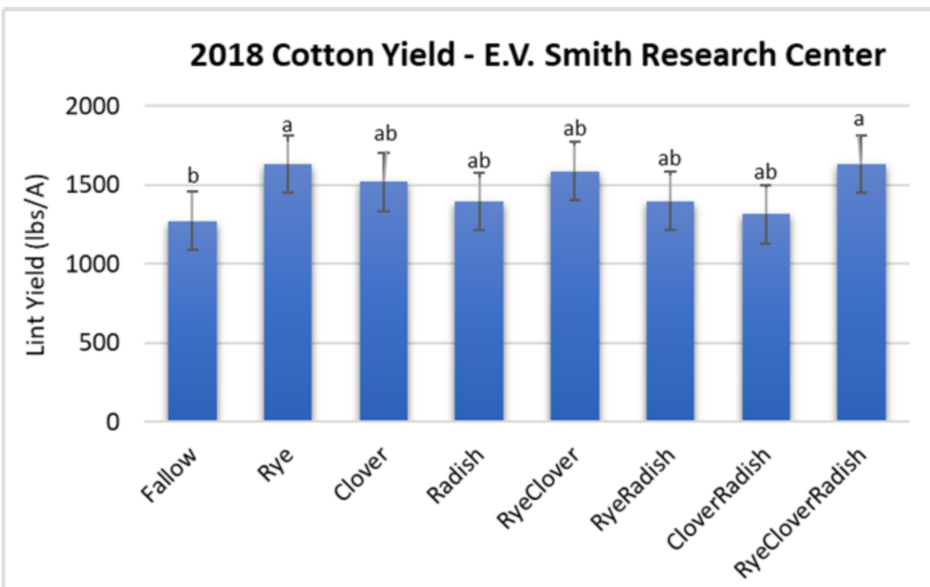


Figure 1. Cotton lint yield (lbs/A) according to cover crop treatment at the E.V. Smith location averaged across dryland and irrigated plots.

At TVREC, cover crop influenced cotton yield, regardless of whether treatments were irrigated or dryland. Mean yields across dryland and irrigated treatments are shown in Figure 2. No cover crop treatment had significantly different yield compared to the fallow treatment. However, the rye-radish treatment had higher yields than the clover and the clover-radish treatments. Yields for clover and clover-radish treatments averaged 1500 and 1540 lbs lint per acre, respectively, and yield for the rye-radish treatment averaged approximately 1800 lbs lint per acre.

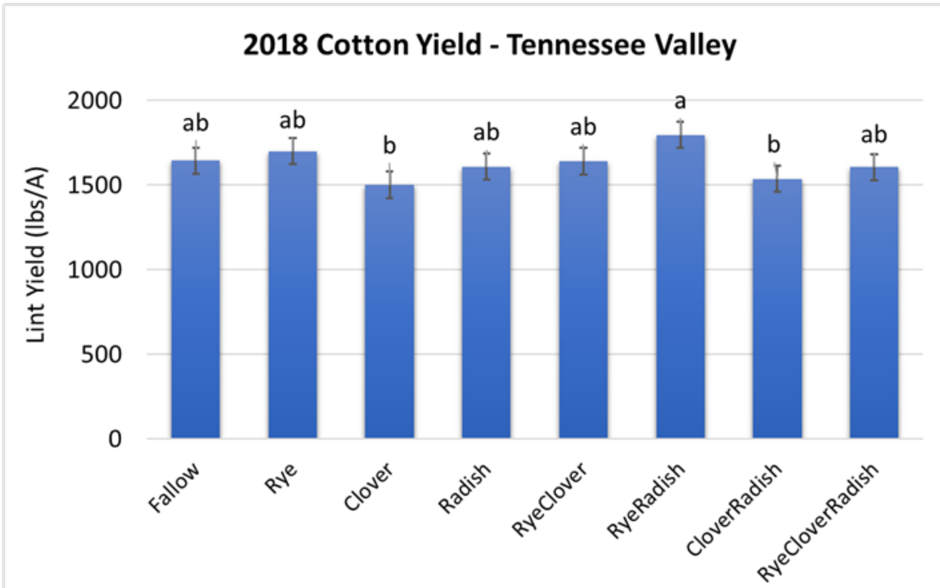


Figure 2. Cotton lint yield (lbs/A) according to cover crop treatment at the Tennessee Valley location averaged across dryland and irrigated plots..

Experiments will be planted in cotton during the 2020 growing season, and yield response according to cover crop treatment will continue to be monitored. Cover crop biomass samples were collected at termination for the 2018-19 cover crop growing season and residue samples were collected at five additional sampling times during the 2019 cash crop growing season. These samples have been weighed, and total carbon and nitrogen analysis will be performed in winter 2020 to analyze N release from cover crop residues.

Alabama Cotton Fertility Trials

A. V. Gamble and W. H. Wendland

Rationale

Soil test recommendations for upland cotton (*Gossypium hirsutum* L.) fertility are often based on varieties which are no longer in production, meriting questions on whether increased potassium (K) is needed for new varieties with higher yield potential. Additional K can be applied as soil-applied or foliar-applied K. However, recent studies have produced inconclusive data regarding the efficacy of foliar potassium applications in upland cotton. The objective of this work was to evaluate K uptake by cotton (Deltapine 1646 B2XF) as a function of soil-applied K.

Experimental Methods

Experiments were performed at five AAES locations in Alabama: E.V. Smith Research Center (EVS), Wiregrass Research and Extension Center (WREC), Gulf Coast Research and Extension Center (GCREC), Tennessee Valley Research and Extension Center (TVREC), and Prattville Research Unit (PRU) in 2018 and 2019 growing seasons. DeltaPine 1646 B2XF was planted on 36” rows at EVS, PRU, and WREC; 38” rows at GCREC, and 40” rows at TVREC. Treatments were organized in randomized complete block design and replicated 4 times at each location. Eight fertilizer rates included an untreated control with no K applied and rates from 60 to 240 lbs K_2O per acre in 60 lb per acre increments. Plots were managed to optimize yields; therefore, all other nutrients were in adequate supply. All experiments were managed under pivot irrigation, and tillage was managed according to the most common practice in the region. Leaf tissue samples were collected for leaf K concentration at early- and mid-bloom growth stages at EVS and WREC. Lint yield was analyzed according to plot at each location. Initial soil test K levels are listed in Table 1. At WREC and EVS in 2018 and 2019, soil test K levels fell below the critical soil test level (critical soil test K = 120 lbs per acre for a Group I soil). At GCREC in 2018 and 2019, soil test K was approximately 10 lbs per acre higher than the critical level (critical soil test K = 120 lbs per acre for a Group I soil). At PRU in 2018 and 2019, soil test K was above critical soil test level (critical soil test K = 180 lbs per acre for a Group II soil). At TVREC in 2018 and 2019, soil test K was below critical soil test level (critical soil test K = 240 lbs per acre for a Group III soil).

Table 1. Initial Mehlich1-extractable soil test K levels according to location and year. Values highlighted in red indicate soil test levels below AU critical value; values highlighted in yellow are within ~10 lbs/acre of critical value, values highlighted in green are above AU critical value.		
Location	**Initial Soil Test K (lbs per acre)**	
	2018	**2019**
E. V. Smith Research Center	94	-
Gulf Coast Research and Extension Center	130	133
Prattville Research Unit	240	289
Tennessee Valley Research and Extension Center	192	192
Wiregrass Research and Extension Center	-	67

Results

E.V. Smith Research Center

In 2018, soil test K levels at EVS were below critical soil test levels according to Auburn University Soil Testing Recommendations. A linear trend in cotton yield according to potassium rate was observed at, up to an applied K level of 150 lbs K_2O per acre. The most significant responses to applied K_2O were observed up to 90 lbs K_2O per acre. In 2019, a poor cotton stand prevented accurate yield data from being collected at EVS.

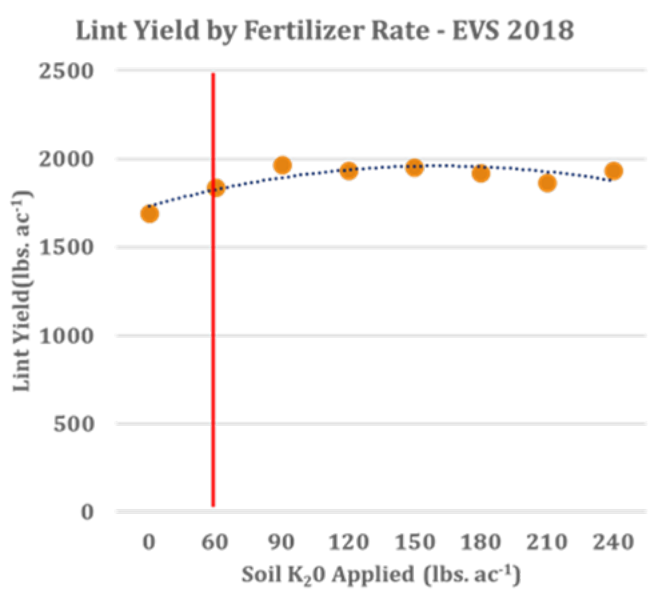


Figure 1. Lint yield according to potassium rate at the E.V. Smith Research Center for 2018 growing season.

Wiregrass Research and Extension Center

In 2018, Hurricane Michael destroyed the cotton crop in the potassium study at WREC. In 2019, soil test K was below the critical level for cotton production. However, there was no yield response to any added K (Figure 2).

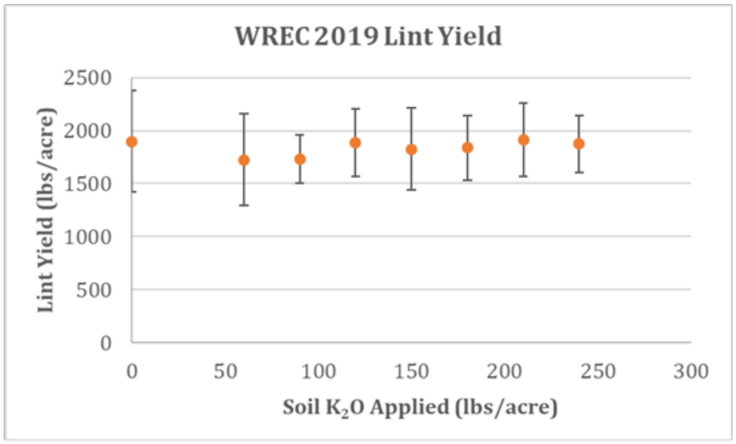


Figure 2. Lint yield according to potassium rate at the Wiregrass Research and Extension Center for 2019.

Tennessee Valley Research and Extension Center

At TVREC in 2018 and 2019, soil test K was below critical soil test level (critical soil test K = 240 lbs per acre for a Group III soil). However, no significant response to added K was observed at this location (Figure 3).

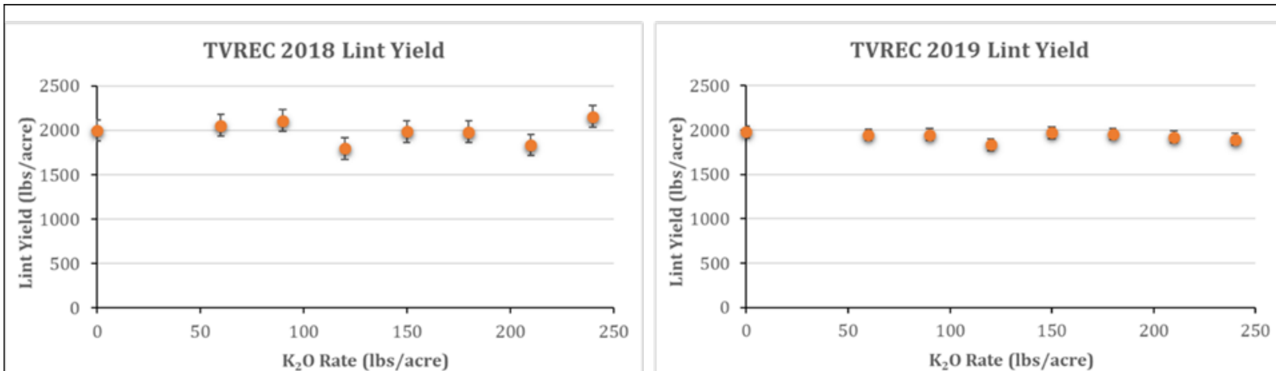


Figure 3. Lint yield according to potassium rate at the Tennessee Valley Research and Extension Center for 2018 and 2019 growing seasons.

Gulf Coast Research and Extension Center

At GCREC in 2018 and 2019, soil test K was approximately 10 lbs per acre higher than the critical level (critical soil test K = 120 lbs per acre for a Group I soil). However, no significant response to add K was observed (Figure 4).

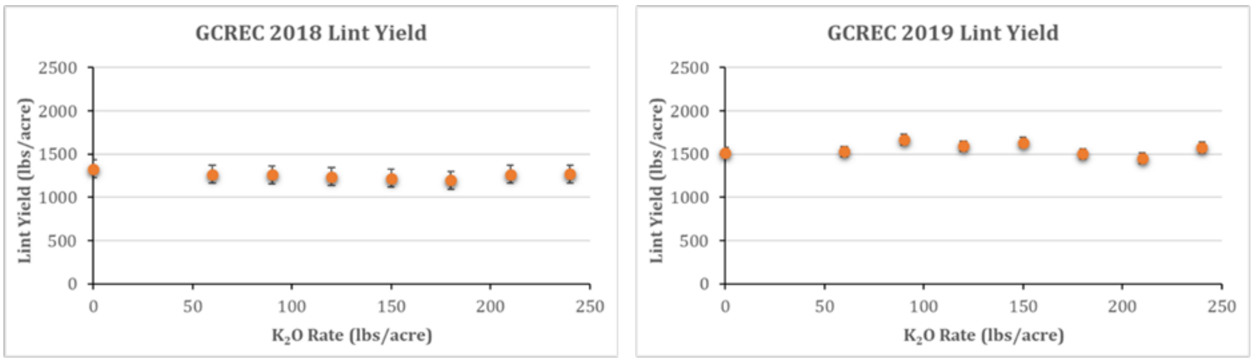


Figure 4. Lint yield according to potassium rate at the Gulf Coast Research and Extension Center for 2018 and 2019 growing seasons.

Prattville Research Unit

At PRU in 2018 and 2019, soil test K was above critical soil test level (critical soil test K = 180 lbs per acre for a Group II soil). However, no significant response to add K was observed (Figure 5).

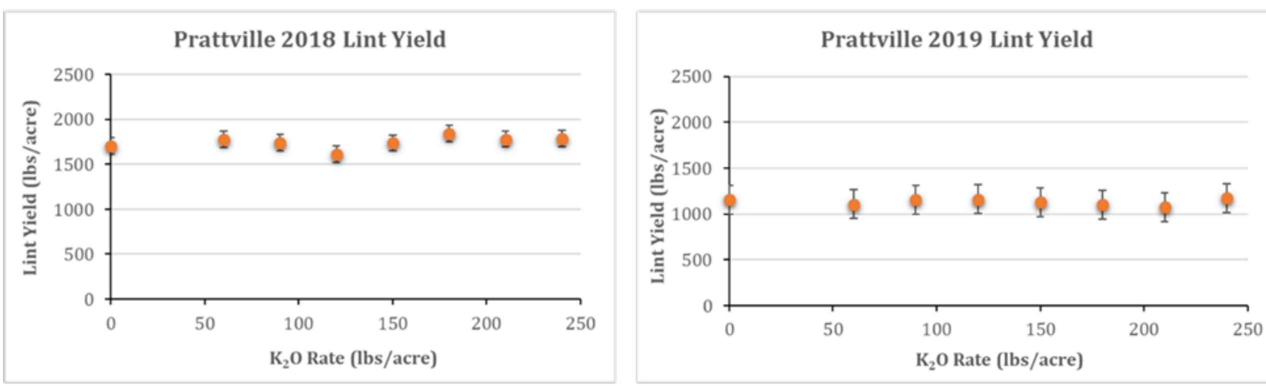


Figure 5. Lint yield according to potassium rate at the Prattville Research Unit for 2018 and 2019 growing seasons.

Conclusions

Out of eight site-years, there was only one in which a response to K above recommended soil test K was observed. At TVREC and WREC locations, no response to added fertilizer was observed, despite AU soil test recommendations calling for approximately 60 lbs of additional K. It can be concluded that when critical soil K levels are met that cotton yield response, if there is any, will be slight. It should be noted that K fertilizer rates of up to 240 lbs per acre did not have a negative effect on lint yield, indicating that additional K did not damage cotton plants. The first two years of data collection indicate that current K recommendations are adequate to maintain maximum cotton yield. Trials to assess cotton response to soil-applied K will continue in the 2020 growing season. Since K is also known to impact lint quality, lint quality metrics will be assessed in future trials.

Continued Support of Long-Term Research

A. V. Gamble, D. P. Delaney, and K. Balkcom

Rationale

The "Old Rotation" (c. 1896) at Auburn is the oldest, continuous cotton experiment in the world. It consists of 13 plots on 1 acre. Treatments include with and without winter legumes, timing of fertilizer application, 2-year rotations with corn with and without winter legumes, and a 3-year rotation with corn, wheat and soybeans. In 2003, plots were split and irrigation was installed on half of the plots.

The Cullars Rotation (c. 1911) at Auburn is a 3-year rotation of cotton (crimson clover/vetch)-corn (wheat)-soybeans with soil fertility variables on approximately 3 acres of land. This is the oldest soil fertility experiment in the South and has 14 soil fertility treatments replicated 3 times. It was placed on the National Register in April 2003. This experiment has become highly visible because of its location adjacent to the Jules Collins Smith Museum of Art in Auburn. It occupies the site where cotton rust was first associated with a potassium deficiency.

Experimental Methods

Experiments continued with long-term treatments applied and managed according to modern recommended practices, data recorded and summarized, and papers presented at state, regional, and national meetings. The Long-term Crop Rotations continued to be available for AU Student Special Projects, research by other Universities in Alabama and other states, for field labs by classes, and for numerous campus visitors.

Report

The Old Rotation continues to demonstrate the benefits of crop rotation and winter cover crops to sustainable cotton production in dryland and irrigated cotton production systems in the Southeast. After 122 years of the Old Rotation experiment, the highest lint yields are consistently observed for plots which rotate cotton with corn and contain a winter legume compared to continuous cotton. Rotations without legume cover crops remain stagnant even with improved varieties and technology, while rotations including a winter legume continue to improve even without additional N (Figure 1). For the 2019 growing season, lint yields for continuous cotton with no crop rotation, no supplemental N, and no winter legume yielded **433 lbs of lint per acre** in dryland plots and **455 lbs of lint per acre** in irrigated plots (Table 1). Lint yields for cotton rotated with corn and a winter legume, still without supplemental N, yielded **1581 lbs of lint per acre** in dryland plots and **1582 lbs of lint per acre** in irrigated plots. Organic matter has nearly doubled for treatments with high residue inputs (i.e. rotations with winter legume cover crops or grain crops in rotation) when compared to continuous cotton with no cover crop/no N applied, leading to increased cotton yield potential.

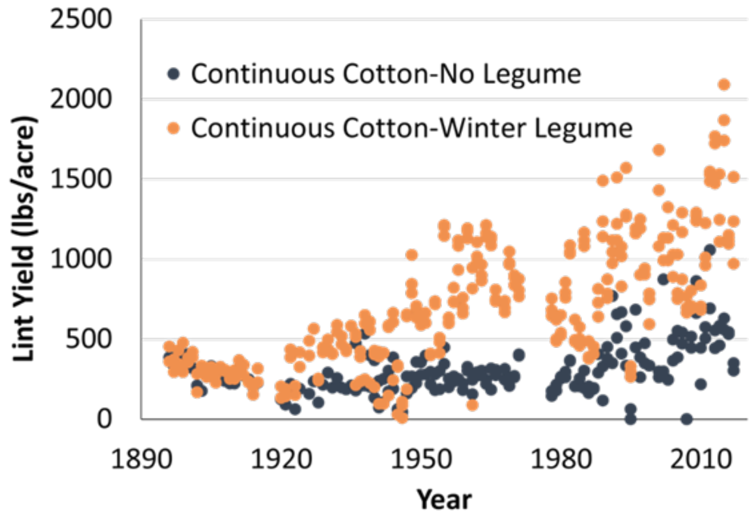


Figure 1. Lint yield for continuous cotton with no N fertilizer for plots with and without a winter legume cover crop included. Yield has remained relatively stagnant for continuous cotton without a cover crop, but yields have increased over time for cotton with a legume cover crop.

Table 1. Cotton lint yields for the 2019 growing season according to treatment from the Old Rotation.

Treatment			2019 Cotton Lint Yield	
Rotation	Winter Cover Crop	N Fertilizer (120 lbs/A)	Dryland	Irrigated
			-- lb/acre--	-- lb/acre--
Continuous Cotton	No	No	433	455
Continuous Cotton	Yes	No	1186	1443
Continuous Cotton	No	Yes	866	1543
Cotton-Corn	Yes	No	1581	1582
Cotton-Corn	Yes	Yes	1562	1285
Cotton-Corn-Wheat-Soybean	Yes	Yes	1355	1899

The Cullars Rotation continues to demonstrate the importance of maintaining soil fertility and is a valuable resource to teach nutrient deficiency symptoms to students. This year, the Cullars Rotation was used as an area to train students on the 2019 Auburn Crop Judging team how to identify nutrient deficiency symptoms in the field. Lint yields for the Cullars Rotation are presented in Table 2. Treatments that have no lime or no K applied, produced no lint yield in 2019, while treatments with complete fertility programs produced 1073 lbs of lint per acre.

Table 2. Cotton lint yields for the 2019 growing season according to treatment for the Cullars rotation.

Fertility Treatment	Lint Yield (lbs/acre)
No N, winter legume	715
No N, no winter legume	677
No fertility since 1911	0
Complete fertility, no legume	452
No P	56
Complete N-P-K, no micros	245
4/3 K rate	207
Rock phosphate	433
No K	0
2/3 K Rate	452
No lime (pH ~4.5)	0
No S	433
Complete fertility	1073
1/3 K rate	358

The Cullars rotation is also a valuable experiment for assessing interactions of soil fertility with disease incidence. For example, in the 2019 growing season, symptoms of CLRDV were observed on cotton plants in “no P” plot (Figure 2), but not in other plots within the Cullars rotation. Plants from the “no P” plot and “complete fertility” plot were submitted to the ACES Plant Diagnostics lab to test for the virus. A plant from the “no P” plot tested positive, while plants from the “complete fertility plot tested negative. Such observations can identify directions for future research, and virus incidence will continue to be monitored in the Cullars Rotation.

Figure 2. Symptoms of CLRDV were observed in "No P" plots within the Cullars Rotation. The ACES Plant Diagnostics Lab confirmed CLRDV in plants receiving no P. Plots receiving complete fertilization did not test positive for the virus.

Tours

Both long-term rotations at Auburn University also continue to be invaluable "Outdoor Classrooms" for students and visitors to Auburn University. During 2019, tours were given to the following groups:

- Students in AGRI1000 (Introduction to Agriculture) classes
- Students in CSES1000 (Basic Crop Science) classes
- Students in CSES1010 (Soil and Life) classes
- 2019 Southern Cover Crop Conference attendees
- CSES Department Centennial Celebration attendees
- Visiting scientists from Nepal
- Visiting scientists from China
- Visiting scientists from Brazil
- Group of University of Florida Plant Pathology students

Tillage Radish to Alleviate Compaction in Cotton Production

A. V. Gamble, B. Guertal, K. Balkcom, and T. Cofer

Rationale

Many soils in the southeastern Coastal Plain contain a compacted subsurface layer which can limit root growth and have a negative impact on cotton production. The use of deep tillage to alleviate compaction in these soils is expensive and often has a negative impact on soil structure. On the other hand, conservation tillage has been shown to improve soil structure, prevent erosion, and increase organic matter storage. Deep-rooted cover crops, such as "tillage" radish have the potential to penetrate soil compaction layers with minimal soil disturbance in a conservation tillage system. The objective of this research is to assess "tillage" radish cultivars for their effect on growth and development, biomass production, soil compaction alleviation, and cotton yield in the subsequent cotton crop.

Experimental Methods

Field Study

A field study was conducted during the 2017-18 and 2018-19 cover crop season at the E.V. Smith Research Center (EVS) in Shorter, AL, and the Wiregrass Research and Extension Center (WREC) in Headland, AL. Five radish cultivars (i.e., 'Lunch', 'Sodbuster', 'Nitro', 'Tillage', and 'CCS779') and a control winter fallow treatment were planted in rows spaced 36 inches apart on three planting dates (i.e., mid-September, mid-October, and mid-November) at a seeding rate of 6 pounds per acre. Each treatment was replicated three times. Plant canopy width and foliage, root, and total dry matter were measured at five sampling times during the growing season. Root diameter and root length aboveground, belowground, and in total were also measured. Plots were evaluated for soil compaction using a tractor-mounted penetrometer after cover crop termination, which revealed that radish cover crops did not reduce penetration resistance compared to fallow plots.

Greenhouse Study

To further test the ability of radish roots to alleviate compaction, a greenhouse study was conducted to determine the ability of radish taproots to penetrate compacted topsoil in PVC cylinders. Two radish cultivars (i.e., 'Tillage' and 'Smart') were planted into 40 cm PVC cylinders with and without a constructed hardpan (>1.75 g cm-3) located approximately 30 cm from the soil surface.

Canopy width and aboveground root length data were collected weekly. Cylinders were opened after three months to observe root length (aboveground and belowground) and biomass for radishes in each cylinder.

Results

Field Study

Planting date had a significant effect on radish growth—earlier planted radishes consistently produced larger canopy widths, more dry matter, and larger roots. In this study, Sep-planted radishes consistently produced the greatest root dry matter, Oct-planted radishes produced low to intermediate root dry matter, and Nov-planted radishes produced negligible root dry matter (Figure 1). No consistent differences between radish cultivars were observed. Radish growth was markedly different between the 2017-18 and 2018-19 growing seasons, suggesting that planting date and accumulated growing degree days are more important than cultivar selection for dry matter production and root growth. Results for foliage dry matter and canopy width follow similar trend

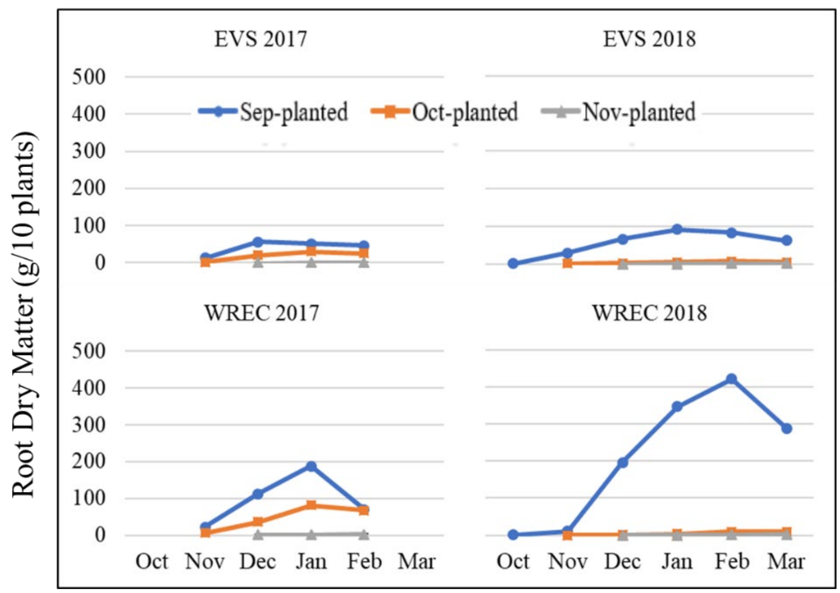


Figure 1. Root dry matter according to sampling date for November-planted, October-planted, and November-planted radishes.

to those observed for root dry matter.

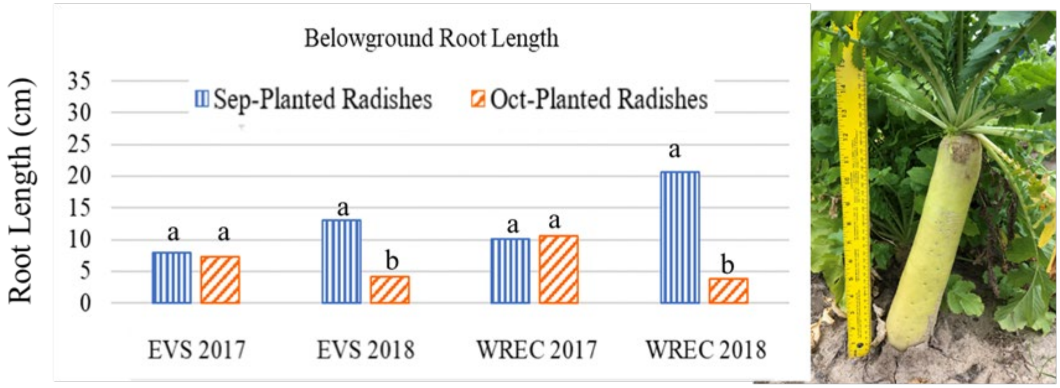


Figure 2. Root length according to location and growing season for September-planted and October-planted radishes. Mean radish belowground root length of the "fleshy" portion of the root did not exceed 20 cm (~8 inches) for any site-year. Roots often extended >12 inches above the soil surface.

Growth of the "fleshy" portion of the radish root did not extend deeper than 8 inches into the soil profile on average (Figure 2). Radishes did not affect cotton yield or penetration resistance in the field study.

Greenhouse Study

In columns with a soil compaction layer of 1.75 g/cm^3, no radish was able to penetrate into or through the hardpan (Figure 3). However, radish taproots reached the bottom of the cylinder (~2 ft) in columns which did not contain a compaction layer. 'Tillage' radishes produced wider canopies and longer aboveground and total root lengths than 'Smart' radishes, while radishes grown in compacted cylinders produced more foliage and total dry matter than those grown in uncompacted cylinders. These results indicate that while radish cultivars may have marked growth patterns and morphological differences, there is little evidence that those differences may lead to greater penetration into compacted soil layers. Further research is needed to assess the bulk density at which radish taproot growth is restricted.

Figure. Image depicting radish root growth in soil columns with no compaction layer (left) and a compaction layer of 1.75 g/cm³ (right). In soil columns which did not contain a compaction layer, the taproot reached the bottom of the cylinder (~2 ft). In soils with compaction layer, taproots did not penetrate the compaction layer.

Conclusions

This study illustrates the necessity of early planting dates for forage radish cover crops to achieve maximum biomass production. For canopy width and dry matter production, earlier planting dates consistently led to greater growth, in the order of Sep-planted>Oct-planted>Nov-planted radishes. For example, Sep-planted radishes produced 1.7 to 17.8 times more total maximum dry matter than Oct-planted radishes and 49.6 to 218.9 times more total maximum dry matter than Nov-planted radishes over the course of this study. For root variables (i.e., aboveground, belowground, and total root length and root diameter), earlier planting dates resulted in more growth in the 2018-19 growing season compared to the compared to the 2017-18 growing season, likely due to increased growing degree days. Radish growth was also greater at WREC than EVS. With respect to cultivar selection, there were very few cultivar effects observed in this study. Radishes did not affect penetration resistance, a measure of compaction, in the current study.

Evaluating Variable Input Levels in Cotton Production for Southeast Alabama

B. Dillard, B. Goodrich, and J. Kelton

Objective:

When inputs into cotton production are dictated by costs rather than recommended management practices, we can expect to see reduced yield at harvest. Reduced gross returns at the end of the season are hoped to be offset by reduced expenses of production. However, recent seeding rate demonstrations have not shown the reduction in yield that we are accustomed to seeing and current lower cost fungicides are still rating adequate in control of leaf spot and white mold. It is not known to what extent current practices of seeding rate reduction and lower nitrogen applications affect yield and return when used alone or in combination as a means to reduce costs. To that end, the objectives of this study are to: 1) evaluate cotton yield and net returns when seed and nitrogen inputs are reduced to determine if reduced yield is offset by lower input costs, and 2) determine the best grower strategy for reducing inputs while maintaining profitable production.

Justification:

Managing for profit rather than yield can mean reducing input costs starting with the most expensive inputs first. Seed costs and nitrogen applications are two of the largest costs in production that can be cut in order to save money when input costs are high or prices are low. There is a need to demonstrate how seeding rate and nitrogen applications can be adjusted while still resulting in profitable production for Alabama's cotton growers.

Procedures:

The project will be conducted at the Wiregrass Research Center in Headland, AL under irrigated practices. We will be evaluating six treatments of varying input levels with three replications. Input treatments will include: high input (recommended seeding rate of 5 seed/foot and highest nitrogen rate (90 lb/a)), low input (reduced seeding rate of 1 seed/foot and low nitrogen rate (30 lb/A), midlevel input (seeding rate of 3 seed/foot with a nitrogen rate of 60 lb/A, low seeding rate and high nitrogen rate, and a high seeding rate and low rate nitrogen application. All other management practices will follow Alabama recommended growing practices. Cotton yield and quality will be evaluated based on level of input. An economic analysis of return will also be calculated for each treatment.

Outcomes:

Due to weather conditions, the cotton trial was not established in 2018 and the study was implemented in 2019. Because of a late planting date in 2019, drought affected stands and yield. At harvest on November 25, 2019, yields ranged between 313 lb/A to 459 lb/A depending on treatment. Because of such low yields and lack of any significant differences in treatments, it is our goal to reestablish this trial under irrigation in the future.

Evaluation of Fertilizer (Boron) Programs to Maximize Cotton Yields and Profits

E. McGriff, A. Gamble, T. Sandlin, L. Miller, and J. Miller

Planted: May 2, 2019

Irrigated: No

Previous Crop: Peanuts

Tillage: Conventional, 38" rows

Variety: Phytogen 350 W3FE

Seeding Rate: 41,280 seed/acre

Soil Types: Wynnville FSL and Hartsells FSL

2019 Cotton Boron Trial

Rationale

Boron is an essential micronutrient for plant growth and plays a critical role in cell wall development, cell membrane function, and root elongation. Boron deficiency symptoms in cotton include stunted terminal growth, abnormally-shaped leaves, and aborted flowers. Less frequently, boron deficiency can cause dark rings to appear around cotton petioles. If B remains deficient throughout boll fill, deformed or dark-colored bolls may be observed. The Alabama Cooperative Extension System (ACES) recommends 0.3 pounds of B per acre as a soil- or foliar-applied fertilizer for cotton production to prevent boron deficiency. Many products on the market today supply B at very low rates (10 to 100 times less than ACES recommendations) at their product recommended rates.

Methods

A study was conducted on cotton at the Jimmy and Lance Miller Farm in Boaz, Alabama, to assess boron uptake in three commercial products (Table 1). The trial was replicated four times and organized in randomized complete block design. Treatments were applied two weeks after first bloom on July 11. Tissue samples were taken on leaves that were sprayed on July 18 after numerous rain events. Brandt's 10% Boron applied at one quart per acre and Drexel Beau-Ron D 20.96% Sodium Borate were applied at 1.25 pounds per acre to supply approximately 0.3 pounds of actual boron per acre. Data were analyzed using mixed models methodology as implemented in SAS® PROC MIXED. Block (i.e., replication) was treated as a random effect. Means were separated according to treatment using Dunnett's test, and significance was determined at $\alpha = 0.1$.

Table 1. Products, rates, and costs for products tested in the current study.

Product	Rate	Total Boron Applied (lbs/acre)	Cost of Material Per Acre	Cost Per Pound of Boron
Untreated Check	-	0	-	-
DeltAg Boron Plus (5%)	6 oz/acre	0.02	$1.24	$62
Brandt Liquid Boron (10%)	1 qt/acre	0.28	$2.50	$8
Drexel Beau-Ron D (20.96%)	1.25 lbs/acre	0.26	$1.40	$5

Results

Results from the test are presented in Figure 1. There was no difference in the untreated control treatments (42.5 ppm) and the DeltAg Boron Plus (41.3 ppm) sprayed at their recommended foliar application rate (treatment was applied at the high end of their 4-6 ounces per acre recommendation). Brandt Liquid Boron (48.8 ppm) and Drexel Beau-Ron (48.3 ppm) treatments contained significantly higher cotton leaf B than the untreated control and DeltAg Boron Plus (5%). This is not surprising, since these products were applied according to ACES recommended rates of 0.3 lbs per acre. The sufficiency range of boron for cotton is 20-60 ppm, so all treatments, including untreated, fell into sufficiency range. Producers should ensure that the recommended 0.3 pounds of B per acre is applies regardless of the product used, and products which do not supply this amount of boron are not recommended.

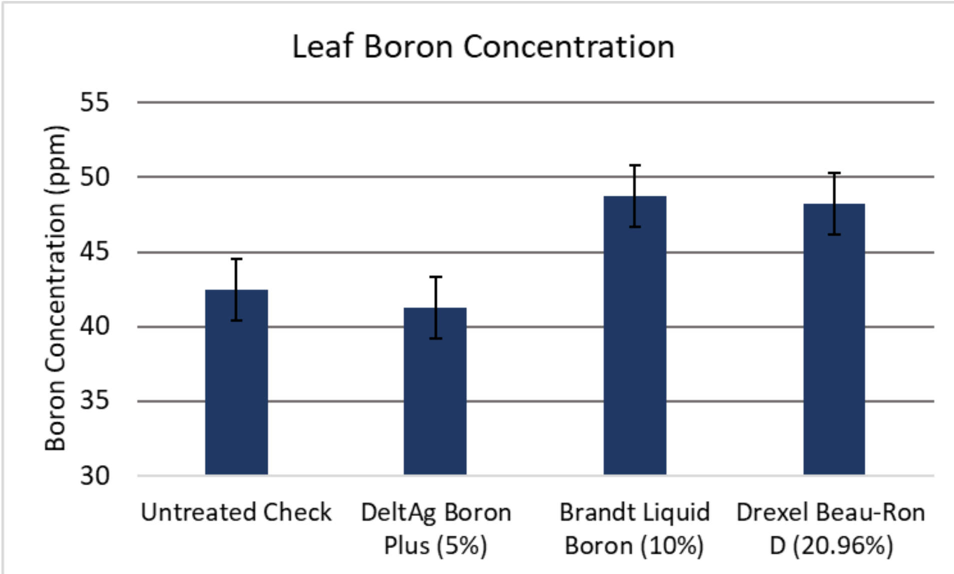


Figure 1. Cotton leaf boron *concentration (ppm) according to treatment. Error bars represent a 95% confidence interval*

Appreciation is expressed to Jimmy and Lance Miller, and the Alabama Cotton Commission for supporting this trial.

Evaluation of Fertilizer Programs to Maximize Cotton Yields and Profits

E. McGriff, A. Gamble, T. Sandlin, L. Miller, and J. Miller

Test Location: Blount County

Planted: May 2, 2019 | Tillage: Conventional, 38" rows

Irrigated: No | Variety: Phytogen 350 W3FE

Previous Crop: Peanuts | Seeding Rate: 41,280 seed/acre

Soil Types: Wynnville FSL and Hartsells FSL

2019 Evaluation of Fertilizer Programs to Maximize Cotton Yields and Profits

Objective and Justification

Cotton yields continue to increase with the release of new varieties. Higher yields have higher nutrient requirements. *Stemphylium* leaf spot, a disease that is caused by potassium deficiency, is becoming more prevalent. The objective of this trial is to test the validity of soil test recommendations along with additional applications of potassium and nitrogen in various forms, rates and timings to determine which treatments show the highest economic yield.

Procedures

Trials was conducted at the Jimmy and Lance Miller Farm in Blount County. Plots were four rows wide by 30 feet long with the middle two rows used to take petiole and tissue samples. Tissue and petiole samples were taken bi-weekly at one week before first bloom through fifth week of bloom. Soil samples will be taken preplant to determine fertilizer rates for Auburn and private lab recommendations. Treatments were (per acre):

1.) Untreated and Auburn Soil Lab Recommendations the same: 90 lbs N total (45 lbs N as 33-0-0 (AP) + 45 lbs N as 40-0-0-5 applied on July 11)
2.) Private Soil Lab Recommendations 110 lbs N + 80 lbs K (55 lbs N as 33-0-0 + 80 lbs K (AP) + 55 lbs N as 40-0-0-5 applied on July 11)
3.) Auburn Soil Lab Recommendations 90 lbs N total (45 lbs N as 33-0-0 (AP) + 45 lbs N as 33-0-0 and 200 lbs K-Mag applied on July 11)
4.) Two Tons Chicken Litter (AP)
5.) Two Tons Chicken Litter (AP) + 60 lbs N as 40-0-0-5 applied on July 11

6.) 200 lbs of K-Mag (AP) + 90 lbs N total (45 lbs N as 33-0-0 (AP) + 45 lbs N as 33-0-0 applied on July 11

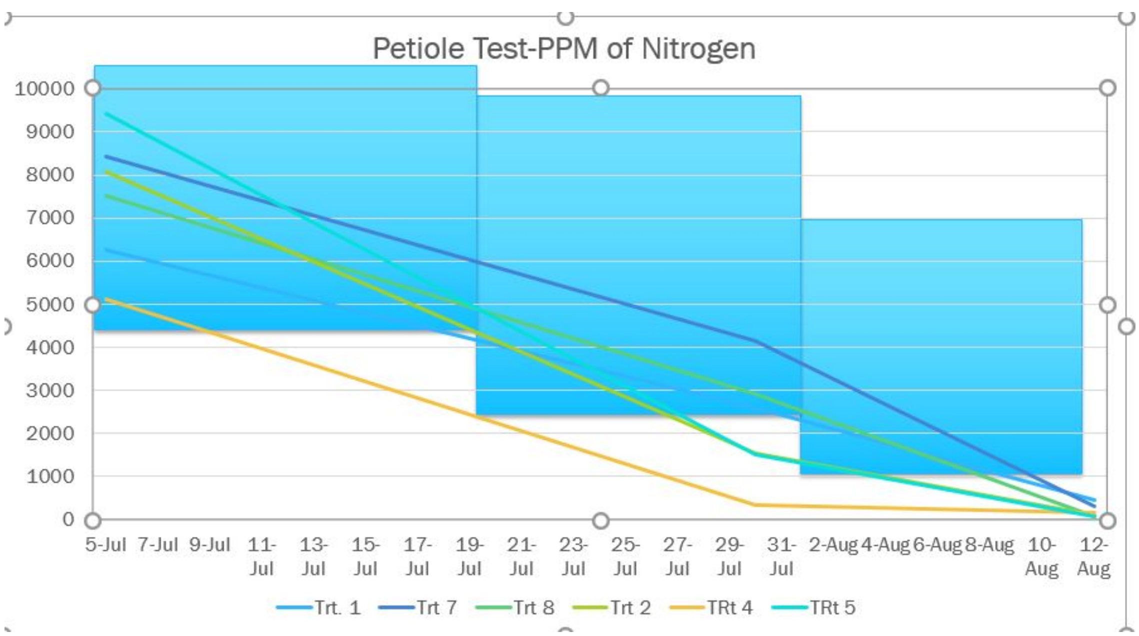
7.) 90 lbs N total (45 lbs N as 33-0-0 (AP) + 45 lbs N as 40-0-0-5 applied on July 11 + 10 lbs of Urea sprayed as foliar applications on July 15 and July 22

8.) 90 lbs N total (45 lbs N as 33-0-0 (AP) + 45 lbs N as 40-0-0-5 applied on July 11 + 10 lbs Potassium Nitrate sprayed as foliar applications on July 11 and July 22

9.) Check (no fertilizer)

Results

Both the Auburn and private soil testing labs showed soil K levels were in the high range. There was no significant different in the petiole results between any of the K treatments and K levels in petiole results. This was probably due to high K levels in the soil. The urea applications showed a significant difference in higher N levels in the petiole sample results compared to other N treatments. The petiole analysis also shown that a poultry litter application at-planting without a sidedress N application was not adequate to keep the N levels in the sufficiency range for most of the growing season. We were not able to get yields due to cotton picker brought up from EV Smith Research Station needing extensive and expensive repairs.



Appreciation is expressed to Jimmy and Lance Miller, and the Alabama Cotton Commission for supporting this trial.

A Decision Support Tool for Phosphorus Application in Cotton Fields that have a 'High' Soil Test Phosphorus Rating

R. Prasad, J. Shaw, A. Gamble, and K. Stanford

Background

This project was initiated with a goal to understand the phosphorus storage capacity (SPSC) of soils (in cotton fields) that receive poultry litter or soils that have a "high" soil test phosphorus rating. The data collected from this project will help the state of Alabama modify its P index and the stringent changes proposed under code 590 of the Natural Resources Conservation Service (NRCS).

The project required the participation of Alabama farmers to voluntarily allow taking soil samples from their fields. Several promotions /campaigns (promo card (Figure1), Facebook, announcements at ALFA expo etc.) were launched to encourage farmers to participate in the program. As a courtesy, we proposed to offer free soil test reports to the farmers. Additionally, we promised to keep the names and locations of the farms confidential.

Method

Soil samples were collected at the volunteer farms (Figure 2). The soil samples were collected at several locations (4 to 7) and four depths (0-2, 2-6, 6-12, 12+ inch) within a farm, depending on the ability of the soil probe to cut through greater depths. The soil samples were dried and ground. Soil samples were extracted with water to determine the water extractable phosphorus or water soluble phosphorus (WSP). Soil samples were also extracted with Mehlich1 (M1), Mehlich-3 (M3), and Oxalate (Ox) solution and concentrations of P, Fe and Al were determined. Results from 2018 sampling is presented below. Samples collected in 2019 are still being processed.

Results

The information presented below is based on 2018 samples and is not conclusive. Drawing strong conclusion is not recommended at this time.

1. Soil test values are often correlated with plant available nutrients mainly P and K. As the soil test P increases, it is assumed that more P is available to plants. This relationship is also used in NRCS 590 standard for P index calculation and determination of P loss risk from a farm. If the P index falls under "High" risk category, P applications through fertilizer or manure is not recommended. A soil test with higher P value is assigned greater risk for P loss during runoff

events. We studied the relationship between soil test values (Mehlich-1 P) and water soluble phosphorus (see Figure 3) for Alabama soils. The relationship indicated that a higher soil test does not necessarily mean a greater risk of P loss. There were many soil samples whose soil test P was greater than 350 lb/acre but had very low water soluble P (less than 10 lb/acre), and there were many samples that had lower soil test P (<50 lb/acre) had greater water soluble P (>10 lb/acre). Hence, based on the data we have collected so far, use of soil test P in P-index calculation can be misleading.

2. Iron and aluminum act as a surrogate for P retention capacity. We determined the concentration of Fe and Al using three different extractants- oxalate, Mehlich-3 and Mehlich-1. The data indicated that irrespective of depth, Alabama soils have high iron (Fe) and aluminum (Al) oxides. (Figures 4).

3. Soils with high iron and aluminum oxides have greater capacity to retain/store phosphorus. We determined the soil P storage capacity (SPSC) based on the methods developed by Nair and Harris (2004) and Dari et al. (2018) to predict the P retentive capacity of the soil. A relationship between water soluble phosphorus and soil phosphorus storage capacity (see Figure 5) indicated that when SPSC values are positive, the risk of P loss is minimal, whereas when the SPSC values are negative, the risk increases linearly with increase in negative SPSC values. In other words, when a soil has negative SPSC value, that soil has no more capacity to fix any additional P and the P retention capacity is exhausted. On the other hand, when SPSC value is positive, the soil has the remaining capacity to absorb/fix more P. As presented in Figure 5 many surface soil in 0-2 inch depth has negative SPSC value indicating those soils act as a P source and are susceptible to P loss. However, as we go down the soil profile we see the transition from negative to positive SPSC. This indicates the lower soil depths have P retentive capacity and are not susceptible to P loss.

We will continue to explore these relationships with data collected from 2019 sampling event. We will be in a better position to draw meaningful conclusion from a robust data set that has samples included from different soil types, land use practices, fertilizer history etc.

Figure 1. Sample promo card used to encourage farmers to participate in soil

Figure 2. Soil collection and laboratory analysis of

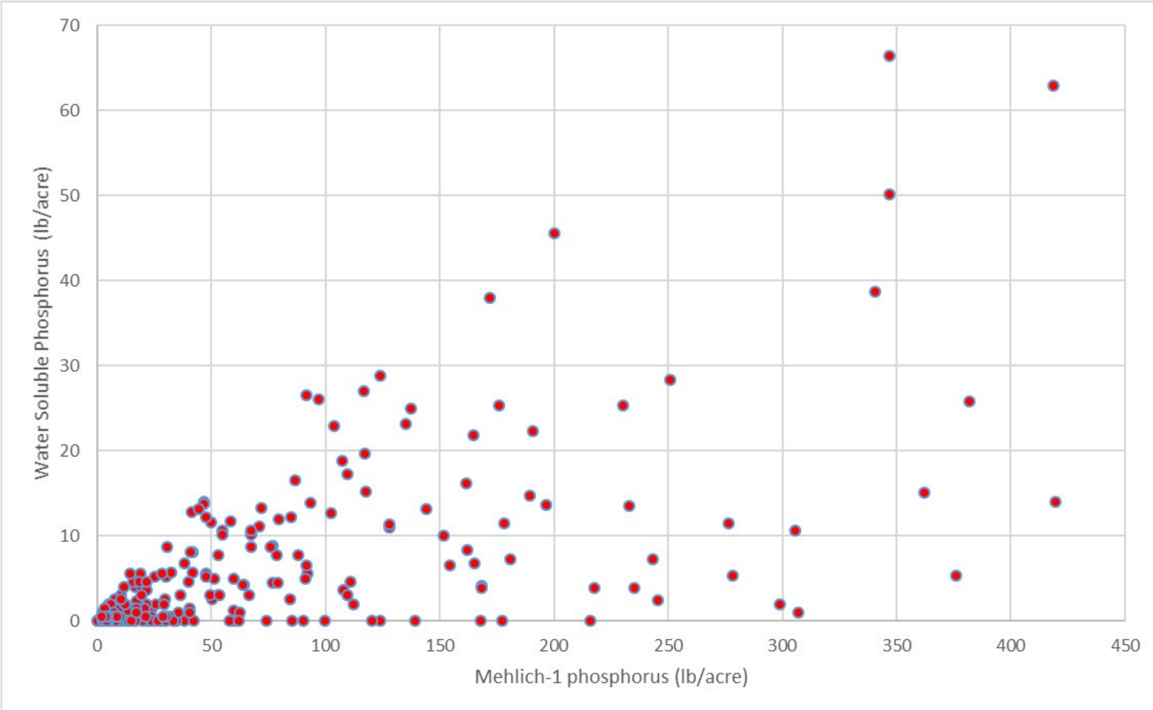


Figure 3. Correlation between water soluble phosphorus and soil test phosphorus (Mehlich-1) for 0-2, 2-6, 6-12, and 12+ inch soil depth.

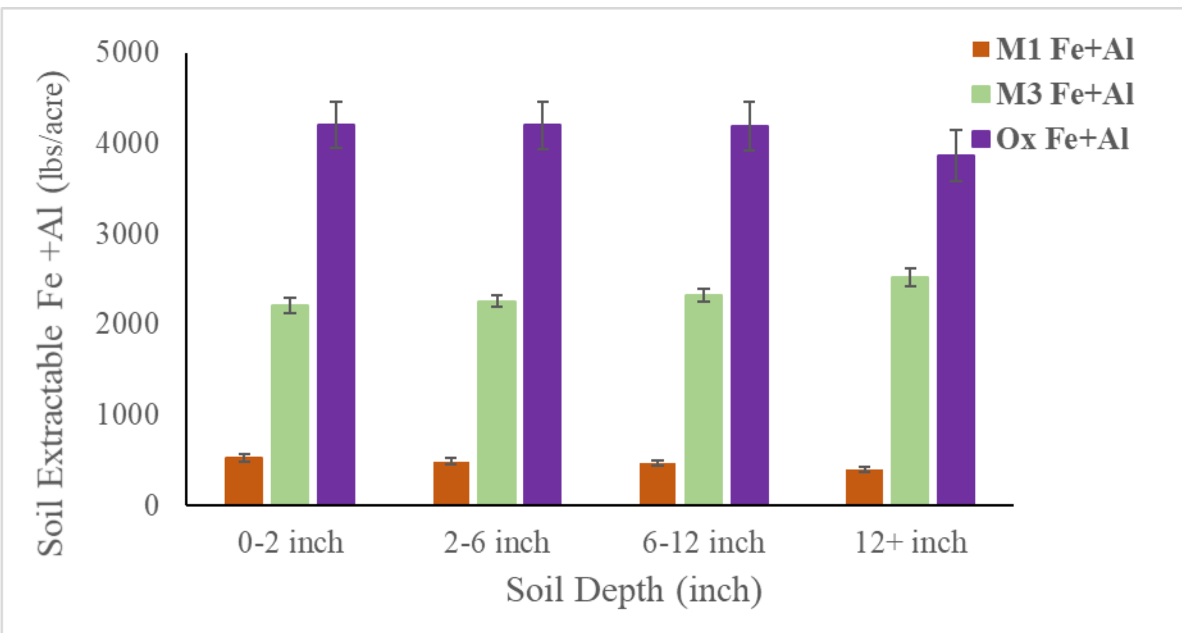


Figure 4. Comparison of soil extractable Fe+Al (lbs/acre) using Mehlich 1(M1), Mehlich 3 (M3), and Oxalate (Ox) for 0-2, 2-6, 6-12, and 12+ inch soil depth.

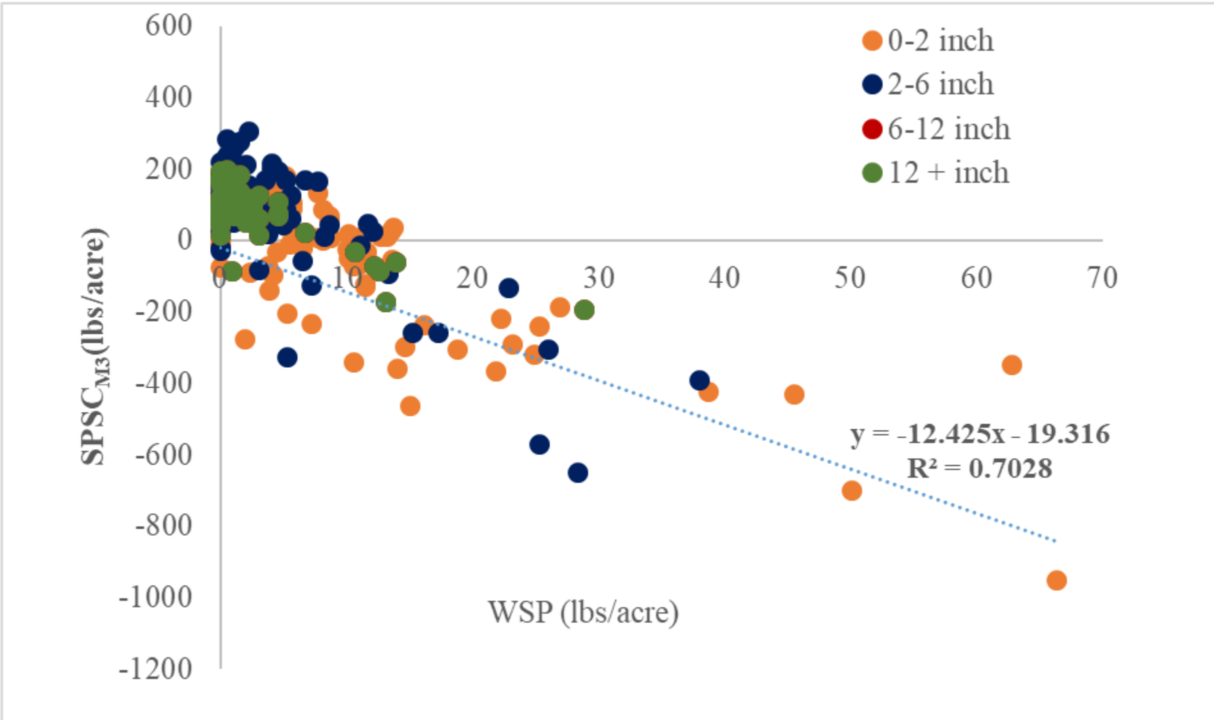


Figure 5. Relationship between soil P storage capacity (SPSC) and water soluble P (WSP) for Alabama soil samples with different soil depth (0-2, 2-6, 6-12, and 12+ inch). The R^2-value is for soils with negative SPSC.

Amount and Timing of Nitrogen Release from Poultry Litter in Cotton Systems

R. Prasad, T. Reed, and W. Birdsong

Project Overview and objectives:

Most cotton growers value chicken litter as an important slow release source of nutrient. However, growers are poorly informed as to when and how much N, P and K, is available to plants from litter application. Through this project, we tried to answer following questions:

1. How much and when is nitrogen released after application of poultry litter?
2. How much and when is P released after application of poultry litter?
3. How much and when is K released after application of poultry litter?

Methods

Buried bag method was utilized to study the release rates of N, P and K at Tennessee Valley Research and Extension Center and Wiregrass Research and Extension Center. Litter bags were prepared using screen mesh and filled with poultry litter. The bags contained litter at an equivalent application rate of 1 and 2 ton/acre at TVREC. They are designated in this report as R1 and R2 respectively. The litter rates at wiregrass were 1, 2.5 and 5 tons/acre and are designated as R1, R2, and R3, respectively. The litter source at TVREC was different from wiregrass and had slightly different nutrient content (see Table 1). Two bags per treatment were buried in cotton fields under dryland system. The litter bags were removed at regular intervals (see the figures 1-6 for removal dates). The bags were transported to the lab, litter removed, and analyzed for total nitrogen, total P, and total potassium using standard analytical methods. The N, P, and K release rates were plotted against their removal rates.

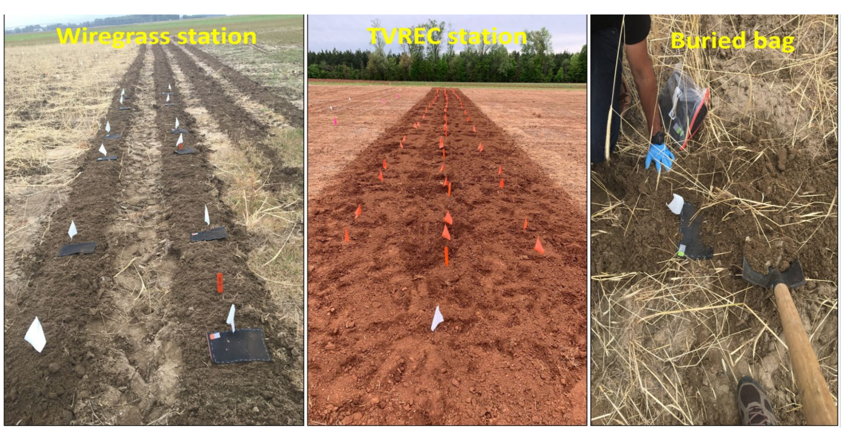


Table 1. Poultry litter nutrient analysis used in the study. The litter was collected from two different sources.

Location	**Parameter**	*Sampled Wet Basis*	*Dry basis*
TVREC	Moisture (%)	37.8	
	C (%)	26.21	42.14
	N (%)	3.58	5.76
	P_2O_5 (%)	2.87	4.61
	P(%)	1.25419	2.02
	K_2O (%)	3.43	5.51
	K(%)	2.83	4.56
	Ca (%)	2.21	3.55
	Mg (%)	0.51	0.82
	S (%)	0.83	1.33
	Al (%)	0.09	0.14
	B (%)	0.003	0.00
	Cu (%)	0.04	0.06
	Fe (%)	0.06	0.10
	Mn (%)	0.05	0.08
	Na (%)	0.61	0.98
	Zn (%)	0.03	0.05
Location	**Parameter**	*Sampled Wet Basis*	*Dry basis*
WREC	Moisture (%)	15.6	
	C (%)	33.77	40.0
	N (%)	2.78	3.3
	P_2O_5 (%)	1.18	1.4
	P(%)	0.52	0.6
	K_2O (%)	2.2	2.6
	K(%)	1.82	2.2
	Ca (%)	1.3	1.5
	Mg (%)	0.32	0.4
	S (%)	0.58	0.7
	Al (%)	0.04	0.0
	B (%)	0.002	0.0
	Cu (%)	0.02	0.0
	Fe (%)	0.06	0.1
	Mn (%)	0.03	0.0
	Na (%)	0.5	0.6
	Zn (%)	0.02	0.0

Results

Nitrogen release from litter varied between rates and location. Greater application rates (>2 ton/acre) mineralized slowly and took more time to release nutrient compared to lower application rate (1 ton/acre). Main findings are summarized below:

1. At TVREC, **45 % N** was released within **70 days** after application when litter was applied at **1 ton/acre**. On the contrary, only 39% N was released when litter was applied at 2 ton/acre (see figure 1).
2. At Wiregrass, **45 % N** was released within **122 days** after application when litter was applied at 1 ton/acre, 33% N was released when litter was applied at 2.5 ton/acre and 31% N was released when litter was applied at 5 ton/acre (see figure 2).
3. At TVREC, **93 % K** was released within **40 days** after application of litter irrespective of litter application rates. **60 % K** release happened during the first **10-15 days** after application (see figure 3).
4. At Wiregrass, **90 % K** was released within **40 days** after application. 70-85 % K release happened within first 20 days after application (see figure 4). Litter application rate of 1 ton/acre released K much faster than 5 ton/acre.
5. At TVREC, **70 % P** was released within **70 days** for 1 ton/acre application whereas only **11% P** was released for 2 tons/acre application rate (see figure 5).
6. At Wiregrass, **62-70 % P** was released within **100 days** after application but **20-25% P** released during **first 20 days** after application. Phosphorus release rates differed between litter application rates (see figure 6).

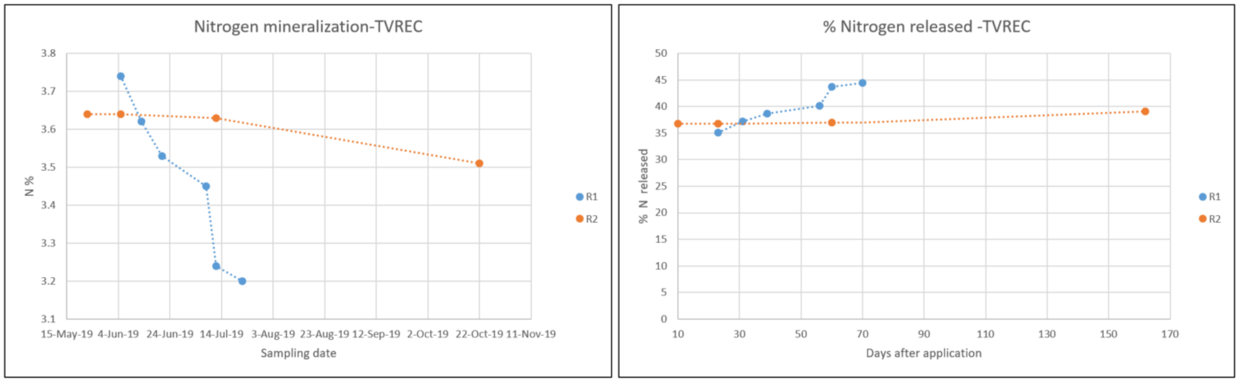


Figure 1. Nitrogen release from litter applied at 1 and 2 tons/acre at TVREC. R1= 1 ton/acre. R2 = 2 ton/acre.

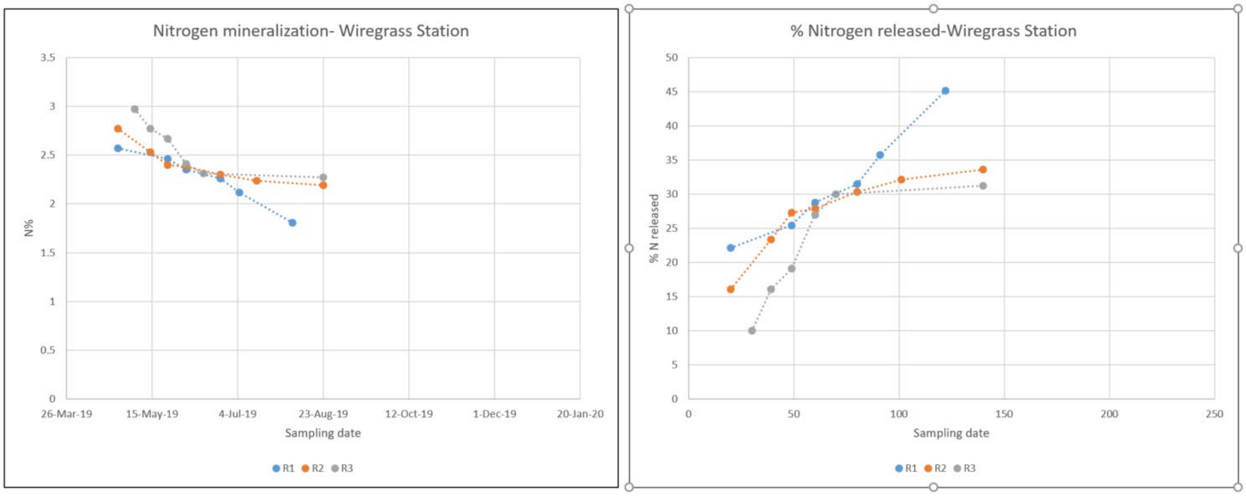


Figure 2. Nitrogen release from litter applied at 1, 2.5, and 5 tons/acre at Wiregrass station. R1= 1 ton/acre. R2 = 2.5 ton/acre and R3= 5 ton/acre.

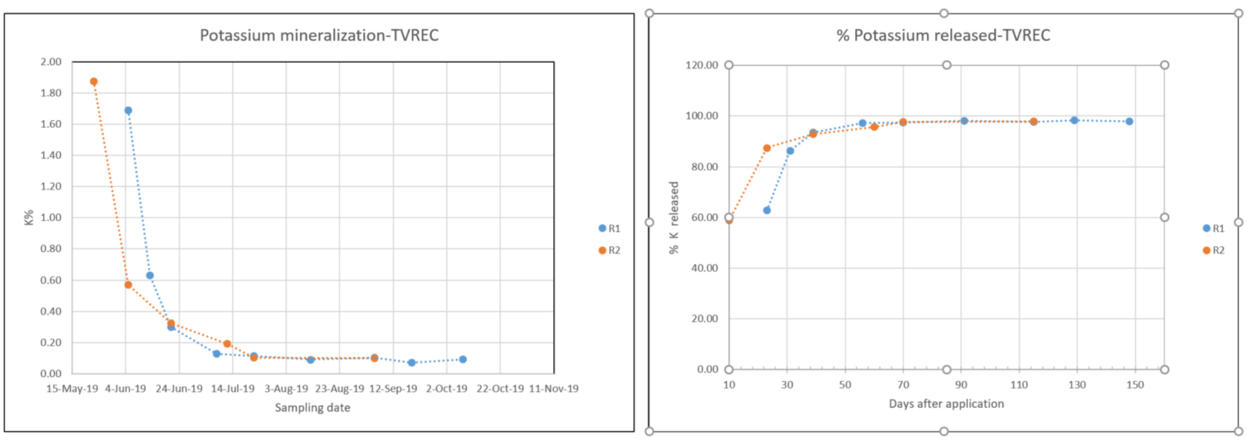


Figure 3. Potassium release from litter applied at 1 and 2 tons/acre at TVREC. R1= 1 ton/acre. R2 = 2 ton/acre.

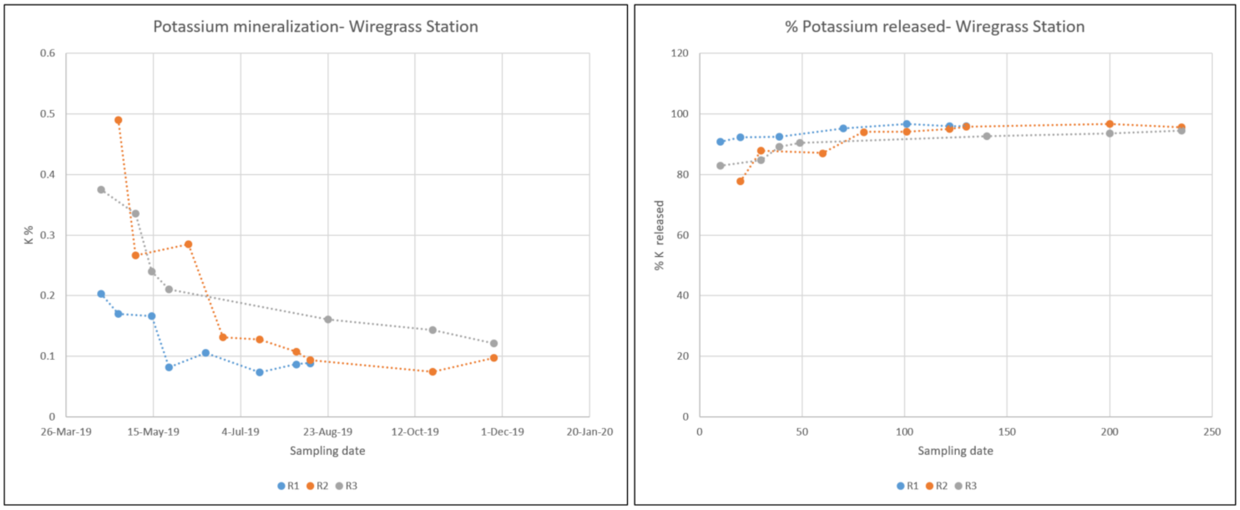


Figure 4. Potassium release from litter applied at 1, 2.5, and 5 tons/acre at Wiregrass station. R1= 1 ton/acre. R2 = 2.5 ton/acre and R3= 5 ton/acre.

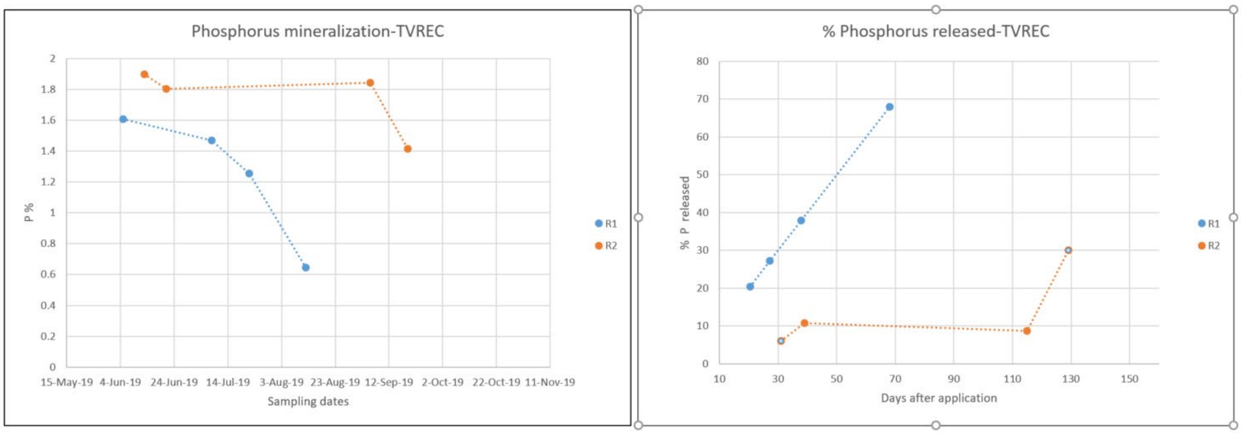


Figure 5. Phosphorus release from litter applied at 1 and 2 tons/acre at TVREC. R1= 1 ton/acre. R2 = 2 ton/acre.

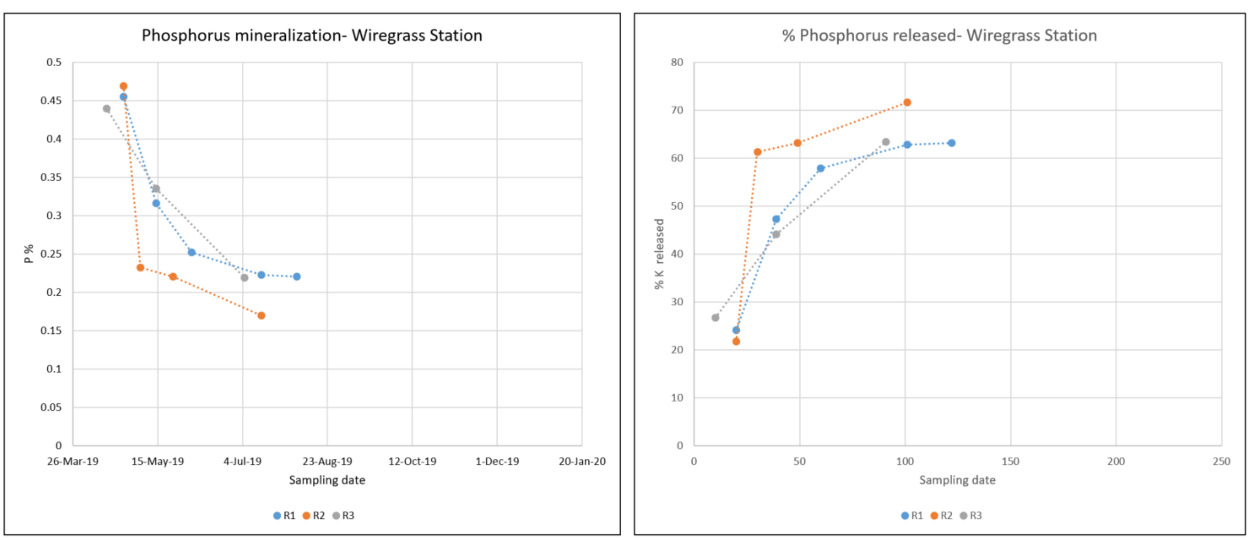


Figure 6. Phosphorus release from litter applied at 1, 2.5, and 5 tons/acre at Wiregrass station. R1= 1 ton/acre. R2 = 2.5 ton/acre and R3= 5 ton/acre.

Evaluating High Residue Cover Crop Mixtures for Glyphosate Resistant Weed Suppression, Compared to High Residue Monoculture Cove Crop and Winter Fallow Conservation-Tillage Cotton Systems

A. Price, K. Balkcom, T. Cutts, and S. Xi

Location: E.V. Smith Research and Extension Center, Shorter, AL.

Objectives: To reduce weed competition, herbicide resistant selection pressure, and subsequent yield loss utilizing integrated weed management practices.

Justification: Control of troublesome weeds has been increasingly challenging, mostly due to glyphosate-resistant horseweed and Palmer amaranth found throughout Alabama. Palmer amaranth is highly competitive and can decrease cotton lint yield 50% with one Palmer amaranth plant per meter row, a density easily attained when control is lost. Heavy infestations of resistant weeds in conservation-tillage cotton have challenged current chemical weed control and producers have increasingly utilized tillage for weed control. Previous research has shown increased weed suppression can be achieved through the use of high residue cover crops managed for maximum biomass. We hypothesize that the utilization of cover crop mixtures, and placement of different cover crop species within the row and row middle, will provide effective weed control and protect conservation tillage as a viable option for cotton producers.

Report: Two studies evaluated high residue cover crop mixtures and placement in conservation agriculture cotton systems. Cereal rye, crimson clover, and radish placement was planted either between row (cereal rye) or within row (clover and radish), or broadcast as a mixture, or each planted as a monoculture, compared to winter fallow. In a separate study, the same cover crops were compared planted broadcast in mixture or monoculture and followed with different herbicide program components. Cover crop biomass attained is presented in Table 1. Amaranthus control was lower in all herbicide-free treatments compared to all PRE+POST, and cotton lint yield was lower in the herbicide-free treatments compared to treatments with herbicide applications (Table 2,3). Lint yield was higher in PRE+POST treatments compared to herbicide-free treatments, regardless of cover crop. Lint yield under PRE only treatments were not different from PRE+POST while POST only treatments had lower lint yield than PRE+POST treatments in 2018. The second trial includes rye monocultures as whole-plot and row-middle only treatments, a clover-radish mixture in the whole plot and within the cotton row only, and three-species mixtures as whole-plot treatments and with precision placements; all treatments managed with a PRE+POST herbicide regime. In the cover crop placement trial, weed control was often similar between treatments in the same year, and cotton yield was only influenced by year.

Table 1. Effect of cover crop treatment and year on cover crop biomass in the spring of 2017, 2018, and 2019 for the cover crop placement study.

Treatments	Cover Crop Biomass (*P<0.0001*)
	kg ha^{-1}
Rye, whole plot (A)	4430 ab
Clover-Radish, whole plot (B)	3020 bc
Rye-Clover-Radish, whole plot (C)	4470 ab
Rye, row-middles (D)	5560 a
Clover-Radish, in-row (E)	2670 c
Rye-Clover-Radish, precision (F)	2650 c
Year	**Cover Crop Biomass (*P<0.0001*)**
	kg ha^{-1}
2017	7250 a
2018	2090 c
2019	3200 b

Note: Values followed by the same letter are not significantly different according to Tukey's HSD at α= 0.1.

Table 2. Effect of herbicide treatment by year on in-row and between-row above-ground weed biomass measured in June of 2017, 2018, and 2019 for the cover crop mixture and herbicide timing trial.

Herbicide Treatment	Weed Biomass					
	Between-row (*P<0.0001*)			In-row (*P<0.0001*)		
	2017	2018	2019	2017	2018	2019
	kg ha^{-1}					
Nontreated	170 bcd	340 bc	1490 a	220 bcde	540 abc	1410 a
PRE only	100 d	400 bc	400 bc	120 de	250 bcde	160 cde
POST only	240 bcd	500 ab	120 cd	460 abcd	690 ab	90 ef
PRE+POST	140 cd	190 bcd	20 e	140 cde	130 cde	10 f

Note: Values followed by the same letter are not significantly different according to Tukey's HSD at α= 0.1. Row positions were analyzed separately.

Table 3. Effect of herbicide by year on cotton lint yield for the cover crop mixture and herbicide timing trial.

Herbicide Treatment	Cotton Lint Yield (*P=0.0195*)		
	2017	2018	2019
	kg ha^{-1}		
Nontreated	342 d	0e	201 d
PRE only	890 abc	914 abc	633 c
POST only	822 bc	791 bc	881 abc
PRE+POST	989 ab	1228 a	895 abc

Note: Values followed by the same letter are not significantly different according to Tukey's HSD at α= 0.1. Lint yield was calculated at 40% seed cotton weight.
No yield potential in nontreated plots in 2018.

Cotton Planting Date Evaluation

T. Sandlin and E. McGriff

Justification and Procedures:

Cotton planting probably occurs more quickly than ever with advances in technology, tractors, and planting equipment. Farmers are often able to plant an entire crop in the span of five to ten days if weather allows. However, it is frequently stated that no two years are alike and unpredictable weather patterns can scatter cotton planting dates from the middle of April until late May. This can result in some challenges including PGR management, pest management, crop maturity and defoliation timing, especially if an early frost occurs. Given some of these factors and challenges, we evaluated planting dates for current varieties of differing maturities to determine what planting dates consistently produce optimal yields.

Materials and Methods:

This test was conducted at the TN Valley Research & Ext. Center (TVREC) at Belle Mina, AL. This test consisted of an early, early-mid (DP 1725 B2XF), and mid-maturing variety (DP 1646 B2XF) and was planted across six timings (Figure 1.). Plots were four rows wide, 25' in length, replicated four times, and managed according to planting date. The center two rows were harvested and weighed on October 2nd for the first four planting dates and on November 4th for the last two planting dates. Lint yield was assessed.

Results:

Maximum lint yield in this study for both varieties combined was 1,597 pounds per acre. Highest yield was achieved by the second planting date on April 25th (figure 1). Planting date one and three produced the next highest yield at 1,360 and 1,269 pounds per acre, respectively. Although planting date one had a higher yield in number than planting date three, results were not statistically different. Yields were decreased for the last three planting dates when compared to the first three. As expected, lowest lint yield (506 pounds per acre) was seen for the sixth planting date on June 17th. Although numeric yields trended higher for DP 1725 B2XF when compared to DP 1646 B2XF at all but one planting date, no statistical differences were seen (figure 2). Planting date, regardless of variety, determined yield differences in this study. Optimum yields were achieved between April 17th and May 7th at this location. This coincides with other trial results in 2019 at TVREC. Approximately three weeks of drought and high temperatures were incurred after May

10th in 2019. Conditions favorable for cotton germination and growth were significantly reduced during this time as is reflected by significant decreases yield after May 7th in this study.

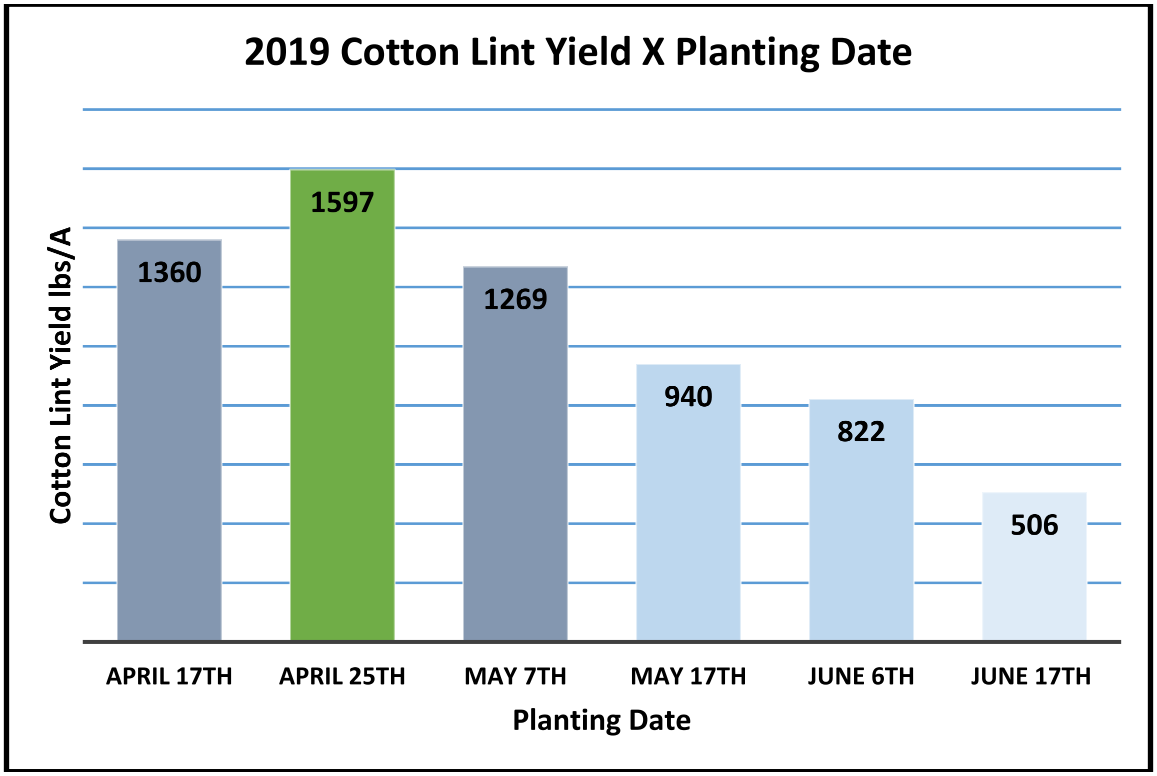


Figure 1: 2019 Cotton lint yield by planting date combined for two varieties.

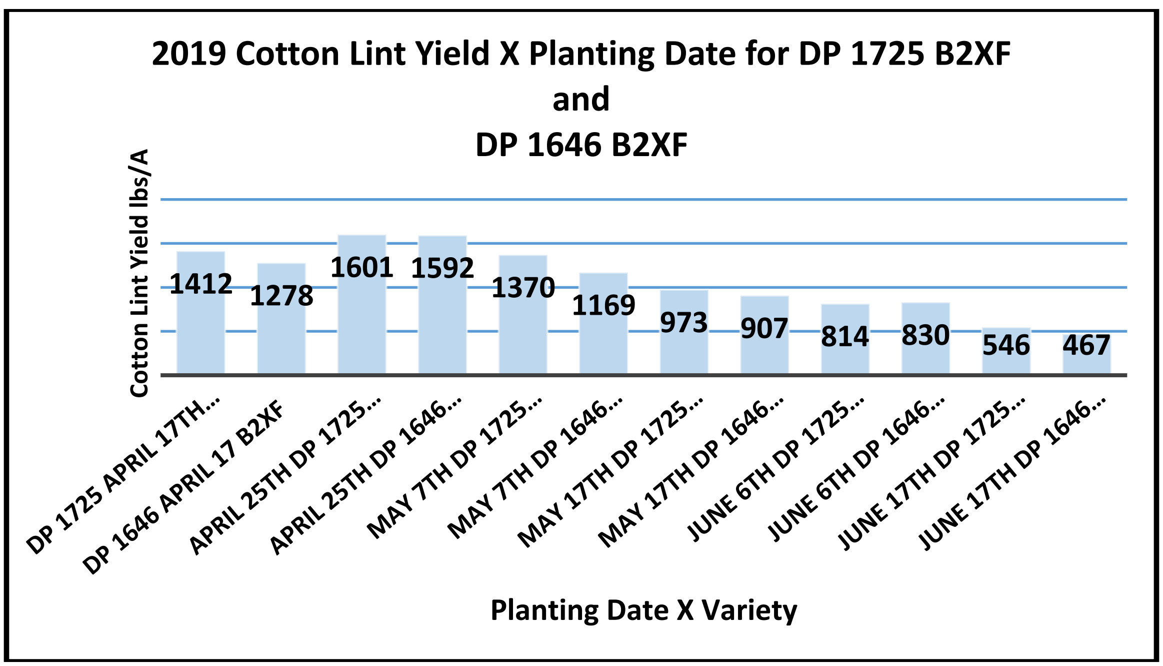


Figure 2. 2019 Cotton lint yield by planting date for DP 1725 B2XF and DP 1646 B2XF.

Conclusions:

Results from this trial agree with Birdsong et.al stating beginning planting window for northern Alabama is around April 15th. While this held true for 2019, environmental conditions should take precedence when determining optimal cotton planting windows rather than calendar date. Weather, especially in North Alabama, can be highly variable during the "cotton planting window" The first five days following planting are extremely important for cotton germination and growth. Ideally 35-50 DD60s should be accumulated within five after planting. Soil temperature, long range weather forecast, and seed quality should all be considered when determining time of planting. Yield potential has remained relatively high for cotton planted through May 15th for North Alabama in recent years, but typically declines quickly after that date. Multiple years of data and additional locations would be beneficial to adequately determine optimal planting window for Alabama.

III. Disease Management

Harnessing Suppressive Soils to Engineer Microbiome of Biotic-Stress Tolerant Cotton

N. Potnis, K. Lawrence, and Y. Feng

Rationale and Objective: A long-term goal of our labs is to offer durable disease management strategies to tackle against wide range of endemic soil-borne pathogens of row crops in Alabama. The long-term rotation trials in Alabama such as old rotation plots with cotton/corn/soybean rotated with winter legumes, have emphasized the importance of cover crops, crop rotation and no till practices to develop disease suppressive soils. Although no formal disease ratings have been published for these over hundred-year research trials, the row crops grown in these plots with cover crops and no-till practices have seen a steady increase in the overall yield and have managed to escape from the major disease outbreaks. These observations as well as several other literature sources have pointed us to revisit the importance of cover crops in improving soil health, and in turn, improving plant health. Since one of the major practical limitations that growers face is implementing these practices due to environmental factors, for example, failure to successfully establish cover crops, we aim to identify the microbial communities that impart the "disease suppressive" characteristic to the soils.

Methods: We have obtained composite soils from Old Rotation plots, mainly from monoculture plots (plots 1 and 6) and rotation plots (10, 11 and 12). These soils were used for planting cotton seeds in 4-inch pots in under greenhouse conditions. At the seedling stage, plants were challenge inoculated using root-knot nematodes. Control plants were included without any pathogen inoculation. We included two other set of controls, one with greenhouse soil and another with sterilized greenhouse soil. These soils were subjected to two successive passages. Symptom development, root weight measurements were conducted in different treatments and across the replicates. Nematode egg count measurements were conducted for each of the samples. The experiments conducted this year included optimization of the root-knot nematode inoculum.

Results: In the year 2019, we began with sampling soil from monoculture plots and rotation plots from old rotation trial. Upon planting root-knot susceptible cotton genotype, first passage involved no challenge inoculation with nematode. We obtained initial nematode counts on the soil and had very low numbers of resident parasitic nematode populations in the soil from both monoculture and rotation plots. Our observations indicated that cotton seedling growth was uneven among replicates. Upon first passage, second passage was challenge inoculated with root-knot nematode eggs (1000 eggs) at the seedling stage. Root samples were obtained 30-days post-inoculation. Only root samples obtained from treatment that contained 75% soil from plot 10/11/12 showed significantly higher root weight (Figure 1).

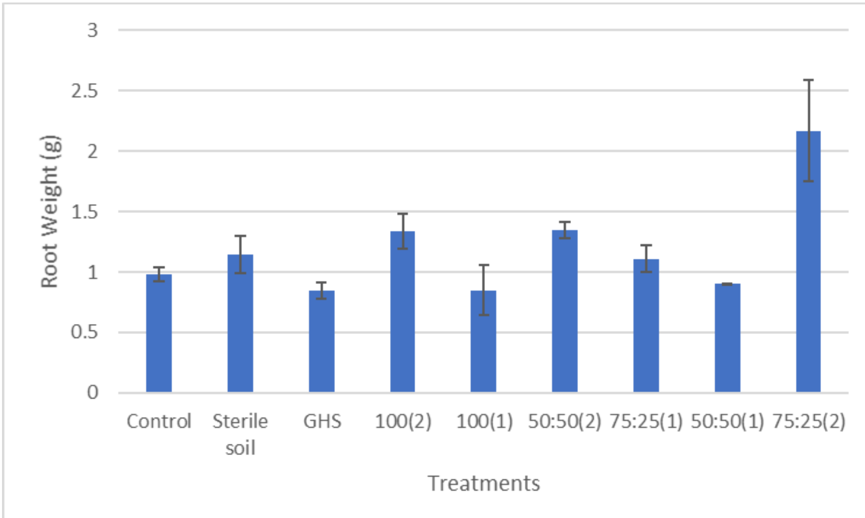


Figure 1. Root weight across different treatments, which include control (greenhouse soil without nematode challenge inoculation), sterile soil, greenhouse soil (GHS), and different proportions of soil obtained from rotation plots mixed with sterile greenhouse soil (all inoculated with root-knot nematode eggs). Numbers in parentheses refer to the type of soil. 1 refers to soil obtained from monoculture plots (plots 1 and 6), and 2 refers to soil obtained from rotation plots (plots 10, 11 and 12). For example, 75:25(1) indicates 75% of the soil obtained from monoculture plot mixed with 25% of sterile greenhouse soil; whereas 75:25(2) indicates 75% of the soil obtained from rotation plot (10/11/12) mixed with 25% of sterile greenhouse soil.

Next, we obtained nematode egg counts per gram of cotton root for different treatments. Although overall trend indicated greater number of eggs/gm root for treatments involving soil from monoculture plots (plots 1, 6) as expected, one of the exceptions was treatment 75:25 (2) that involved 75% of rotation soil from plots 10, 11 and 12 (Figure 2). This was also the treatment that had higher root weight.

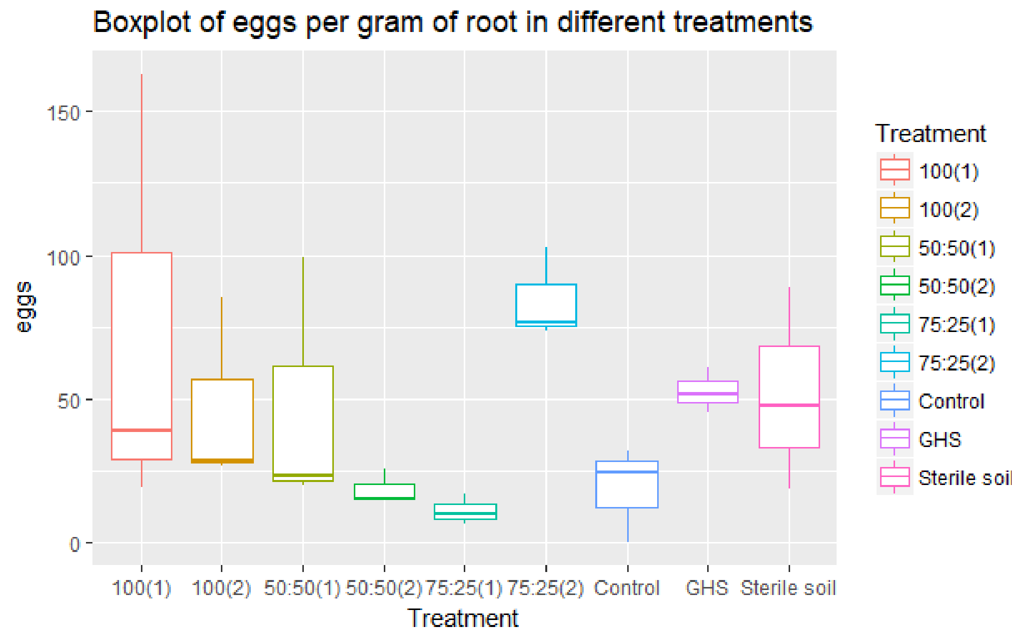


Figure 2. Comparison of recovered eggs/gm of cotton root at 1-month sampling time point after nematode-challenge inoculation.

When we compared these values with the soybean experiment that included same treatments and was ongoing in parallel to this experiment, the eggs/gm of root obtained for different treatments were significantly lower in case of cotton compared to soybean (Figure 3). This could be because of impact of greenhouse conditions on overall growth of cotton, or that inoculum concentration optimized for soybean was not optimal for cotton and that we might have to increase overall inoculum concentration on cotton to obtain optimal multiplication levels of root-knot nematodes under greenhouse conditions that would allow comparison across treatments.

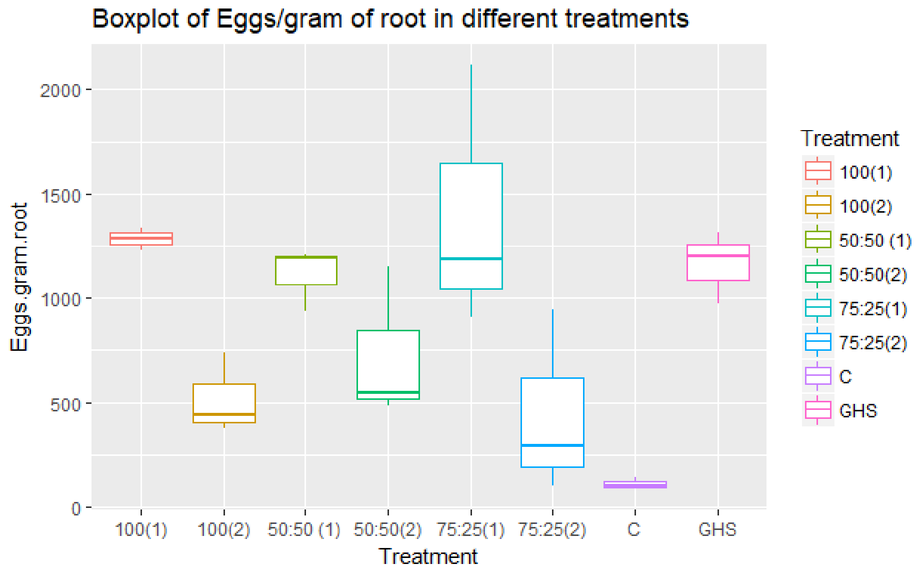


Figure 3. Comparison of recovered eggs/gm of soybean root at 1-month sampling time point after nematode-challenge inoculation.

Upon this second passage experiment under the greenhouse conditions, we sampled soil from the third passage in soybean to see if we carried over any root-knot nematode inoculum when we passaged the soil (100% or 75% or 50%) and we did not obtain any significant number of root-knot nematode eggs in this soil used for passage 3. This indicates that the experimental system is suitable to test our overall hypothesis that passaging the microbial communities under the challenge inoculation of root-knot nematodes will select for microbes that possess suppressive ability against challenge pathogens.

Future steps: Overall these observations indicated that the overall proof-of-concept study in cotton could be successful if we optimize growth conditions as well as inoculum concentration levels for cotton. Overall hypothesis that soil obtained from plots 10/11/12 that undergo rotation with cover crops will harbor microbial communities involved in disease suppression was validated in case of soybean. We will continue to optimize inoculum concentration for root-knot nematodes to obtain sufficient multiplication of root-knot nematodes and to be able to decipher the effect of cover crops on soil microbial communities. Upon identifying optimum inoculum concentration, cultivation-dependent approach will be used for isolating bacteria/fungi, the aliquots of which will be stored in -80^{0}C. Microbial profiles will be determined by extracting total DNA and subjecting it to amplicon sequencing for identifying bacterial and fungal community composition of "suppressive soils". Parallel culture-dependent approach will allow us to isolate these microbes.

Cotton Cultivar Response to CLRDV as Influenced by Planting Dates

D. Schrimsher, B. Meyer, K.S. Lawrence, B. R. Lawaju, M. Rondon, W. Groover, D. Dyer, and K. Gordon

Abstract

In 2017 virus like symptoms were observed in a producer's field in Barbour County, AL. It was later confirmed as Cotton Leaf Roll Dwarf Virus (CLRDV) from plant and tissue samples collected from this field. After two seasons of virus observations and some understanding of the occurrence, incidence, and severity of the cotton virus the following objectives were determined and evaluated in 2019. The two objectives were 1.) What influence does CLRDV have on commercial cultivars and 2.) Determine what influence planting dates have on CLRDV incidence, severity, and yield. Cotton cultivars were selected by their popularity and recommendations based off performances in south Alabama and planted in three different field trials. The planting dates consisted of May 1st, May 15th, May 30th, and June 12. There were no effects by cultivars or the interaction of planting dates x cultivars at either location. However significant differences in incidence and yield were found at both Brewton and Fairhope as influenced by planting dates. At Brewton, CLRDV percent incidence was 15% on May 1st planting date and significantly increased in cotton planted on May 30th and June 15th, to 45% and 100%, respectively (Table 2). Yields were significantly lower in the May 30th and June 15th planting dates compared to cotton planted at May 1st and May 15th. Similar results were found at Fairhope in that CLRDV incidence significantly increased from May1st planting date to late May planting date, 7% to 12.4 %, respectively. Yields were also significantly reduced at Fairhope when comparing planting dates May1st to May 31st. Only numerical differences were found between cultivars in the On-Farm Trials at Santa Rosa County, FL. CLRDV percent incidence among cultivars in this trial was variable and ranged from 18.1% to 58%.

Introduction

Virus like symptoms were found and observed in a producer's field in Barbour County, AL in 2017. Symptomatic plants were sampled and sent to the University of Arizona to be analyzed for possible virus identification (Avelar et al., 2019). It was later confirmed through PCR Illumination Sequencing as Cotton Leaf Roll Dwarf Virus CLRDV and was the first report of this virus to infect cotton grown in the United States. The virus symptoms progressed in 2017 and became severe as the cotton matured and impacted yields at harvest. In the 2018 growing season, CLRDV symptoms began to appear in production fields in late August in many counties across south Alabama. Similar to 2017, the virus was believed to impact yields especially in fields along the coast in Baldwin County, AL. In both growing seasons, 2017 and 2018, the more severe cases occurred where planting dates were delayed to mid to late June. After two seasons of virus observations and some understanding of the occurrence, incidence, and severity of the cotton virus the following objectives were determined and evaluated in 2019. The two objectives were 1.) What influence does CLRDV have on commercial cultivars and 2.) Determine what influence planting dates have on CLRDV incidence, severity, and yield.

Materials and Methods

Cotton cultivars were selected by their popularity and recommendations based off performances in south Alabama and planted in three different field trials. Two separate field trials using a split plot design were established; one at the Brewton Agriculture Research Unit (BARU) in Brewton, AL, and another at the Gulf Coast Research and Extension Center (GCREC) in Fairhope, AL. A separate On-Farm Trial was established in Santa Rosa County, FL, to evaluate what influence CLRDV had on commercial varieties in a producer's field. Seed of cotton cultivars from several companies along with experimental lines were provided by Agri-AFC, LLC and planted at each of the locations. Planting dates at each location were at or near May 1st, May 15th, May 30th and June 15th. The On-Farm Trial in Santa Rosa County, FL was planted on June 11th. The percent incidence was evaluated by calculating the percentage of symptomatic plants versus healthy plants in five foot of row. The severity ratings were determined by using a 1 to 5 rating scale in which 1 is best (Figure 1). Seed cotton yields were collected from the two row plots by a two-row cotton picker at the Brewton and Gulf Coast Research Center. Each planting date was defoliated and harvested separately according to standard defoliation recommendations to reduce any environmental influence on yields. The data collected from trials at BARU and GREC were analyzed in SAS 9.4 using Proc Glimix and LS-means were compared using Tukey-Kramer's method ($P \leq 0.05$).

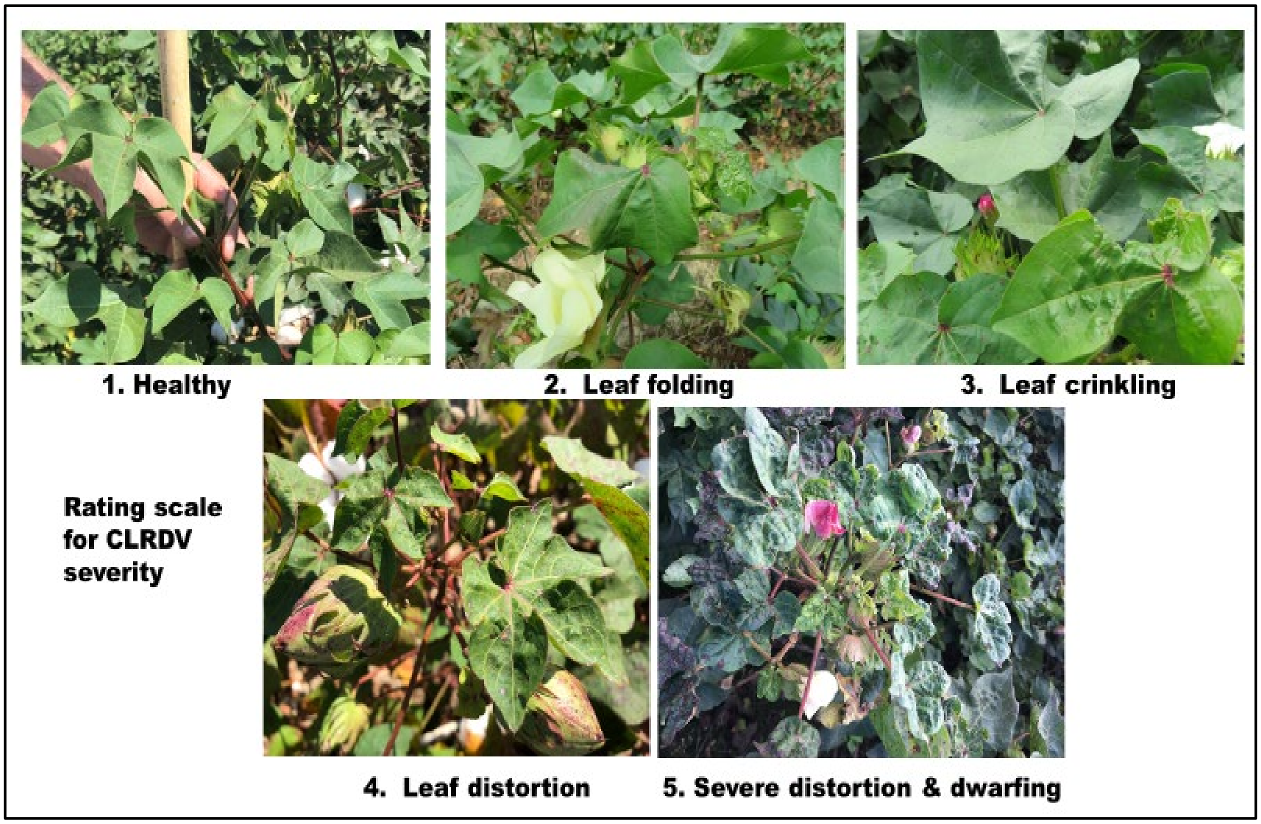


Figure 1: Scale used to rate CLRDV symptoms.

Results

In our planting date trials, greater disease pressure and higher incidence ratings were found at Brewton than at Fairhope. There were no effects by cultivars or the interaction of planting dates x cultivars at either location (Table 1). However significant differences in incidence and yield were found at both Brewton and Fairhope as influenced by planting dates. At Brewton, CLRDV percent incidence was 15% on May 1st planting date and significantly increased in cotton planted on May 30th and June 15th, to 45% and 100%, respectively (Table 2). Yields were significantly lower in the May 30th and June 15th planting dates compared to cotton planted at May 1st and May 15th. Similar results were found at Fairhope in that CLRDV incidence significantly increased from May1st planting date to late May planting date, 7% to 12.4 %, respectively (Table 2). Yields were also significantly reduced at Fairhope when comparing planting dates May1st to May 31st. Only numerical differences were found between cultivars in the On-Farm Trials at Santa Rosa County, FL. CLRDV percent incidence among cultivars in this trial was variable and ranged from 18.1% to 58% (Figure 4). Severity ratings ranged from 1.25 to 3.75 and nodes with foliar symptoms ranged from 1.5 to 3, indicating very low disease pressure was observed in this trial at Santa Rosa County, FL (Figure 3).

Table 1: Fixed effects from P values (< 0.05) at both Fairhope and Brewton locations.

Type III Tests of Fixed Effects P values at Brewton, AL					
	Incidence			Severity	Yield
Effect	June	August	September	Nodes	lb/A
DOP	0.0953	0.0021	<.0001	<.0001	<.0001
Cultivar	0.2638	0.8868	0.8435	0.922	0.956
DOP*Cultivar	0.9407	0.178	0.9874	0.9696	0.8968

Type III Tests of Fixed Effects P values at Fairhope, AL			
	Incidence		Yield
Effect	July	September	lb/A
DOP	0.0296	0.0353	0.0002
Cultivar	0.3469	0.9024	0.9587
DOP*Cultivar	0.3121	0.7548	0.9209

Table 2: Incidence and seed cotton yields for planting dates and cultivars at both Brewton and Fairhope locations.

	Brewton, AL		Fairhope, AL	
Date of planting	CLRDV Incidence %	Seed Cotton Yield lb/a	CLRDV Incidence %	Seed Cotton Yield lb/a
1-May	15 a	3909 a	7 ab	2367 a
15-May	30 a	3666 ab	5.9 ab	2567 a
30-May	45 b	3540 b	12.4 a	1434 b
12-Jun	100 c	2423 c	4 b	2189 ab
Cultivars	CLRDV Incidence %	Seed Cotton Yield lb/a	CLRDV Incidence %	Seed Cotton Yield lb/a
CG 3885 B2XF	55 a	3520 a	8.4 a	2207 a
CG 9608 B3XF	44 a	3463 a	9.8 a	2156 a
DP 1646 B2XF	51 a	3465 a	4.1 a	2217 a
DP 1840 B3XF	48 a	3363 a	8.4 a	2477 a
DP 1851 B3XF	50 a	3340 a	7.3 a	2167 a
PHY 430 W3FE	45 a	3324 a	7.8 a	2230 a
PHY 440 W3FE	44 a	3354 a	4.2 a	2087 a
PHY 480 W3FE	49 a	3412 a	6.3 a	2055 a
ST 5471 GLTP	43 a	3368 a	10.8 a	1844 a
ST 5600 B2XF	44 a	3234 a	6.1 a	1951 a

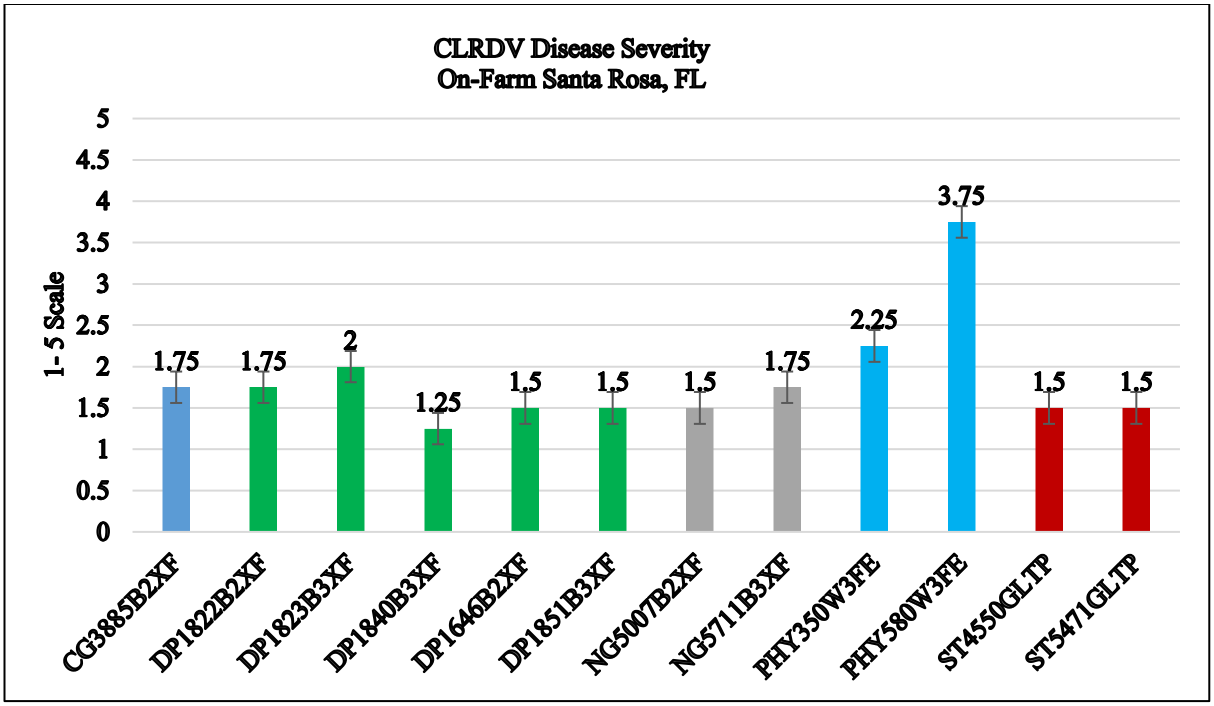


Figure 3: CLRDV Severity ratings from On-Farm Trial in Santa Rosa County, Florida.

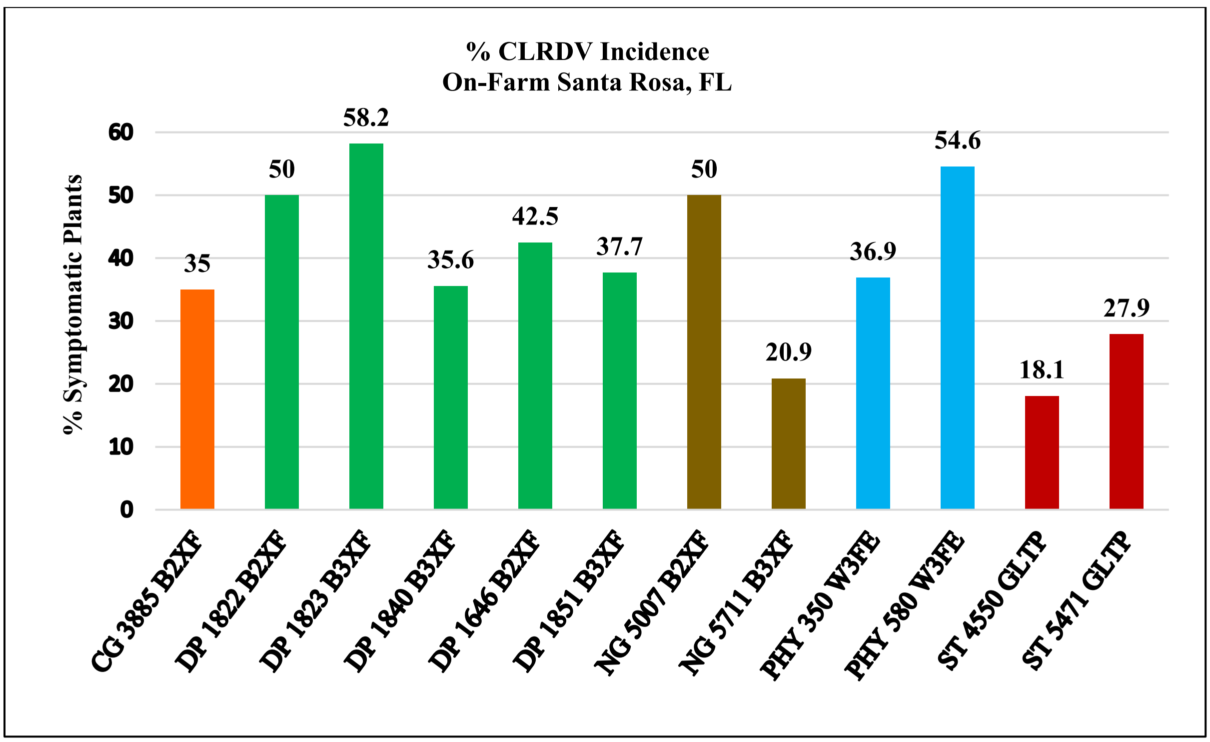


Figure 4: Percent Incidence of CLRDV symptomatic plants among cultivars in On-Farm Trial at Santa Rosa County, Florida.

Conclusions

The greatest impact that CLRDV had on cotton in our study was influenced by planting dates rather than cultivar. As planting dates were delayed in the southern coastal cotton growing regions, disease incidence was subject to increase and yields were reduced. Although there were numerical differences among cotton varieties in disease incidence and yield, all varieties in our trials were susceptible to CLRDV.

References

Avelar, S., Schrimsher, D. W., Lawrence, K., & Brown, J. K. (2019). First Report of Cotton leafroll dwarf virus Associated with Cotton Blue Disease Symptoms in Alabama. Plant disease, 103(3), 592-592.

Fungicide Seed Treatments for Management of Seedling Disease in Cotton in Northern Alabama, 2019

B. R. Lawaju, K.S. Lawrence, W. Groover, D. Dyer, M. Rondon, K. Gattoni, W. Sanchez, and K. Gordon

A field trial to evaluate fungicide treatment efficacy on seedling disease in cotton caused by *Rhizoctonia solani* was conducted at the Tennessee Valley Research and Extension Center near Belle Mina, AL. The soil type in the field was Decatur silt loam (24% sand, 49% silt, and 28% clay). All treatments were applied to the NexGen 3406 B2XF cotton as seed treatments. Base fungicide and insecticide (F&I) included imidacloprid, metalaxyl, fludioxonil, myclobutanil, and gaucho. The base F&I treated seeds served as control and the control plus additional product(s) served as the experimental treatments. Seed was planted on 17 Apr at the rate of 4 seeds per foot. Plots consisted of 4 rows, 25-foot long with a 40-in. row spacing. Two rows of each plot were inoculated with *R. solani*- infested millet (10 g/row) in-furrow at the time of planting. The plots were arranged in a randomized complete block design (RCBD) with five replicates of each treatment. The test plots were maintained throughout the season with standard production practices and irrigated with lateral line irrigation system as needed. Plant stand data were collected on 30 Apr (13 DAP) and 22 May (35 DAP). On 22 May (35 DAP), four plants were randomly collected from *R. solani*-inoculated and non-inoculated rows separately in each plot for the measurement of plant height, shoot and root fresh weight. The test was mechanically harvested and yield data were collected on 1 Oct (167 DAP), at this time 2,885 DD60's had accumulated. Data were analyzed with SAS 9.4 using PROC GLIMMIX and LS-means were compared using Tukey-Kramer's method (α=0.1). Monthly average maximum temperatures from planting in Apr through harvest in Oct were 83.5, 84.7, 88.3, 91.2, 91.8, 94.6, and 91.0°F with average minimum temperatures of 58.5, 63.1, 67.3, 70.5, 68.5, 66.4, and 64.9°F, respectively. Average temperatures from May to Oct were 71.0, 73.9, 77.8, 80.9, 80.2, 80.5, and 78.0°F. Rainfall accumulation for each month was 0.0, 3.5, 3.9, 4.5, 2.4, 0.7, and 1.5-in., with a total of 16.5-in. for the growing season.

Plant stands were similar among all the treatments, regardless of *R. solani* inoculation. The average plant stand per row among the treatments at 13 DAP and 35 DAP were 32 and 39 seedlings in non-inoculated rows, and 29 and 31 seedlings in inoculated rows. Cotton growth parameters were also similar among all treatments in non-inoculated rows; however, penthiopyrad-treated plants at 0.72 fl oz/cwt seed rate were significantly taller than its lower concentration (0.36 fl oz/cwt seed) in inoculated rows. Numerically, all the treatments increased the seed cotton yield compared to base F&I only, except penthiopyrad (0.36 fl oz/cwt seed) in inoculated rows. Compared to the base F&I treatment, an average of 109 and 120 lb/A of seed cotton yields were increased by the fungicide seed treatments in *R. solani* non-inoculated and inoculated rows, respectively.

Treatment[z]	Rate (fl oz/ cwt seed)	Non-inoculated					*Rhizoctonia* inoculated				
		13 DAP	35 DAP			Seed cotton yield (lb/A)	13 DAP	35 DAP			Seed Cotton yield (lb/A)
		Stand[y]	Stand	Height[x] (in.)	Biomass[w] (g)		Stand	Stand	Height (in.)	Biomass (g)	
Base fungicide & insecticide		33[v]	36	3.3	5.58	4,487	30	29	3.8 ab	8.40	4,313
Penthiopyrad	0.36	35	37	3.9	7.03	4,510	30	32	3.4 b	6.50	4,276
Penthiopyrad	0.72	32	44	3.9	7.76	4,503	30	33	4.0 a	8.82	4,550
Penthiopyrad	0.90	30	38	3.6	7.62	4,630	29	33	3.5 ab	7.42	4,481
Sedaxane	0.08	32	38	3.3	6.17	4,742	27	28	3.9 ab	8.99	4,423
P- value (α=0.1)		0.9340	0.6460	0.2903	0.3287	0.7801	0.9424	0.7564	0.0344	0.1361	0.8920

[z] Base fungicide and insecticide (F&I) included imidacloprid, metalaxyl, fludioxonil, myclobutanil, and gaucho (0.25 + 0.57 + 0.08 + 1.5 + 12.80 fl oz/cwt seed of each active ingredient). All other treatments included base F&I plus additional product(s).
[y] Plant stand was the number of live plants per 25-foot.
[x] Plant height was the average height of four plants.
[w] Biomass was the sum of shoot and root fresh weights of four plants.
[v] Values present are the LS-means separated by Tukey-Kramer method at α=0.1. Means followed by the same letter do not differ significantly.

Combinations of Seed Treatments for Seedling Disease Management in Northern Alabama, 2019

B. R. Lawaju, K.S. Lawrence, W. Groover, D. Dyer, M. Rondon, K. Gattoni, W. Sanchez, and K. Gordon

Seed treatment fungicides were evaluated for the management of cotton seedling disease at the Tennessee Valley Research and Extension Center, Belle Mina, AL. The field contained a Decatur silt loam soil (24% sand, 49% silt, and 28% clay). Seed treatments were applied pre-plant to the DynaGro 3605 B2XF cultivar. Metalaxyl, myclobutanil, thiram, trifloxystrobin, and Awaken were applied as base fungicide and insecticide (F&I) treatment. The base F&I treated seed served as control and the control plus additional product(s) served as experimental treatments. Planting occurred on 17 Apr at the rate of 4 seed per foot. Plots consisted of 4 rows that were 25 feet in length and spaced 40-in. apart. Two rows of each plot were inoculated with *R. solani*-infested millet seed (10 g/row) in-furrow at the time of planting. The plots were arranged in a randomized complete block design (RCBD) with five replications. All plots were maintained throughout the season with standard herbicide, insecticide, and fertility practices as recommended by the Alabama Cooperative Extension System. Plots were irrigated with a lateral line irrigation system as needed. Seedling stand data were collected at 13 days after planting (DAP) and 35 DAP. Only living plants were included in the stand counts. Plant height, shoot, and root fresh weight data were collected from four randomly selected plants from *R. solani*-inoculated and the non-inoculated rows of each plot separately at 35 DAP. Plots were harvested mechanically at 167 DAP. Prior to harvest, the cotton crop was determined to have been exposed to 2,885 accumulated DD60's. Data were analyzed with SAS 9.4 using PROC GLIMMIX and LS-means were compared using Tukey-Kramer's method (α=0.1). Average monthly maximum temperatures for the area from the time of planting in Apr until harvest in Oct were 83.5, 84.7, 88.3, 91.2, 91.8, 94.6, and 91.0°F with average minimum temperatures of 58.5, 63.1, 67.3, 70.5, 68.5, 66.4, and 64.9°F, respectively. Rainfall accumulation for each month was 0.0, 3.5, 3.9, 4.5, 2.4, 0.7, and 1.5-in., with a total of 16.5-in. for the growing season.

No significant differences among the treatments were observed in this test. In *R. solani* non-inoculated rows, plant stand counts across all treatments ranged from 22 to 28 and 28 to 39 plants per row at 13 and 35 DAP, respectively. Similarly, the plant stand counts in the inoculated rows were 21 to 25 and 24 to 29 plants per row at 13 and 35 DAP, respectively. Seed cotton yield was greatest with the base F&I treatment in non-inoculated rows. However, in inoculated rows, except the combinations with penflufen(0.64 fl oz/cwt) and penflufen + penthiopyrad (0.64 + 0.36 fl oz/cwt), all other treatments increased the seed cotton yield more than the base F&I treatment. The top three yield increasing treatments were penthiopyrad (0.36fl oz/cwt; 399 lb/A), penthiopyrad (0.72 fl oz/cwt; 339 lb/A), and penflufen +penthiopyrad (0.64+0.72 fl oz/cwt; 262 lb/A) with an average increase of 142 lb/A across all treatments compared to the base F&I.

Treatment[z]	Rate (fl oz/ cwt seed)	Non-inoculated					*Rhizoctonia* inoculated				
		13 DAP	35 DAP			Seed cotton yield (lb/A)	13 DAP	35 DAP			Seed cotton yield (lb/A)
		Stand[y]	Stand	Height[x] (in.)	Biomass[w] (g)		Stand	Stand	Height (in.)	Biomass (g)	
Base fungicide & insecticide		28[v]	39	3.78	6.53	4,741	21	25	3.86 ab	7.26	3,942
Penthiopyrad	0.36	22	28	3.74	6.15	4,225	23	27	4.06 ab	7.88	4,341
Penthiopyrad	0.72	27	32	3.82	5.37	4,177	25	26	3.58 ab	6.35	4,281
Penthiopyrad	0.90	28	31	3.94	6.09	4,548	24	26	4.06 ab	7.35	4,125
Sedaxane	0.08	27	30	3.94	6.61	4,594	23	24	4.17 a	7.47	4,008
Penflufen	0.64	22	31	3.62	5.61	4,473	24	28	3.94 ab	7.03	3,799
Penflufen + Penthiopyrad	0.64 0.36	24	34	3.90	6.23	4,241	22	29	3.54 b	5.89	3,828
Penflufen + Penthiopyrad	0.64 0.72	28	35	3.98	6.18	4,615	22	25	4.06 ab	7.25	4,204
P-value (α=0.1)		0.5506	0.2676	0.9072	0.9434	0.7187	0.9166	0.9331	0.0431	0.1668	0.6447

[z] Base fungicide and insecticide (F&I) include metalaxyl, myclobutanil , thiram, trifloxystrobin, and Awaken (0.75 + 1.5 + 2.5 + 0.64 + 1.7 fl oz/cwt seed of each active ingredient). All other treatments included base F&I plus additional product(s).
[y] Plant stand was the number of live plants per 25 foot.
[x] Plant height was the average height of four plants.
[w] Biomass was the sum of shoot and root fresh weights of four plants.
[v] Values present are the LS-means separated by Tukey-Kramer method at α=0.1. Means followed by the same letter do not differ significantly.

Evaluation of Fungicides for Management of Damping-Off in Cotton in North Alabama, 2019

B. R. Lawaju, K.S. Lawrence, W. Groover, D. Dyer, M. Rondon, K. Gattoni, W. Sanchez, and K. Gordon

Nine fungicide treatments were evaluated for their efficacy in reducing damping-off caused by *Rhizoctonia solani* on cotton at the Tennessee Valley Research and Extension Center near Belle Mina, AL. This field has been in a cotton monoculture for over 19 years and had a history of cotton seedling diseases. The soil was a Decatur silt loam (24% sand, 49% silt, and 28% clay). All treatments were applied to the DeltaPine 1646 B2XF cotton. Base fungicide and insecticide (F&I) treatment consisted of pyraclostrobin, metalaxyl, and myclobutanil. The base F&I treated seed served as a control and the control plus additional product(s) served as the experimental treatments. Seed was planted on 17 Apr at the rate of 4 seeds per foot. Plots consisted of 4 rows, 25 feet long with 40-in. row spacing. Two rows of each plot were inoculated with *R. solani* infested millet seed (10 g/row) in-furrow at the time of planting. The plots were arranged in a randomized complete block design (RCBD) with five replications. All plots were maintained throughout the season with standard herbicide, insecticide, and fertility practices as recommended by the Alabama Cooperative Extension System. Plots were irrigated with a lateral irrigation system as needed. Seedling stand data were collected 13 days after planting (DAP) and 35 DAP on 30 Apr and 22 May. Plant height, shoot and root fresh weight data were measured from four randomly selected plants from *R. solani*-inoculated and the non-inoculated rows of each plot separately at 35 DAP. Plots were mechanically harvested and yield data were collected at 167 DAP on 1 Oct, at this time 2,885 DD60's had accumulated. Data were analyzed with SAS 9.4 using PROC GLIMMIX and LS-means were compared using Tukey-Kramer's method (α=0.1). Monthly average maximum temperatures from planting in Apr through harvest in Oct were 83.5, 84.7, 88.3, 91.2, 91.8, 94.6, and 91.0°F with average minimum temperatures of 58.5, 63.1, 67.3, 70.5, 68.5, 66.4, and 64.9°F, respectively. Average temperatures from May to Oct were 71.0, 73.9, 77.8, 80.9, 80.2, 80.5, and 78.0°C. Rainfall accumulation for each month was 0.0, 3.5, 3.9, 4.5, 2.4, 0.7, and 1.5-in., respectively.

There were no differences in plant stand, growth parameters, and yield among the treatments in *R. solani* non-inoculated rows. However, base F&I and penthiopyrad (0.90 fl oz/cwt) treated rows had significantly higher plant stand count than sedaxane and fluxapyroxad treated rows at 13 DAP in *R. solani* inoculated rows. Numerically, all treatments increased the yield compared to base F&I alone in both *R. solani* non-inoculated (by 401 lb/A) and inoculated rows (by 581lb/A). The greatest yield increasing treatment was the combination of fluxapyroxad + HCSS+ sedaxane in non-inoculated rows (by 742 lb/A) and fluxapyroxad in inoculated rows (by 807 lb/A) compared to base F&I only.

Treatment[z]	Rate (fl oz/ cwt seed)	Non-inoculated					*Rhizoctonia*-inoculated				
		13 DAP	35 DAP			Seed cotton	13 DAP	35 DAP			Seed cotton
		Stand[y]	Stand	Height[x] (in.)	Biomass[w] (g)	yield (lb/A)	Stand	Stand	Height (in.)	Biomass (g)	yield (lb/A)
Base fungicide & insecticide		33[v]	38	3.74	6.54	4,324	34 a	29	3.94	8.14	4,020
Penthiopyrad	0.36	31	35	3.94	7.23	4,576	28 ab	30	3.27	5.36	4,705
Penthiopyrad	0.72	30	40	3.86	7.54	4,472	32 ab	30	3.94	8.30	4,535
Penthiopyrad	0.90	30	39	3.58	6.40	4,739	35 a	29	3.94	8.05	4,532
Sedaxane	0.08	35	37	3.94	7.26	4,659	25 b	29	3.94	8.89	4,638
Fluxapyroxad	0.94	31	35	3.90	7.44	4,937	23 b	29	3.47	6.49	4,827
Fluxapyroxad+ HCSS[u]	0.94 4	36	42	3.94	7.62	4,635	28 ab	34	3.39	6.66	4,559
Fluxapyroxad+ HCSS+ Sedaxane	0.94 4 0.08	30	38	3.94	7.26	5,066	30 ab	36	3.31	6.11	4,716
Fluxapyroxad+ HCSS+ Penthiopyrad	0.94 4 0.72	32	38	3.74	6.66	4,710	32 ab	31	3.90	6.87	4,295
P-value (α=0.1)		0.7213	0.6045	0.9880	0.9697	0.2516	0.0724	0.5274	0.2159	0.2164	0.3228

[z] Base fungicide and insecticide (F&I) included pyraclostrobin, metalaxyl, and myclobutanil (1.69+0.76+1.25 fl oz/cwt seed of each active ingredient). All other treatments included base F&I plus additional product(s).

[y] Plant stand was the number of live plants per 25-foot.

[x] Plant height was the average height of four plants.

[w] Biomass was the sum of shoot and root fresh weights of four plants.

[v] Values present are the LS-means separated by Tukey-Kramer method at α=0.1. Means followed by the same letter do not differ significantly.

[u] HCSS (Helena Cotton Seed Shield) is a premixed formulation of azoxystrobin (5.24%), fludioxonil (0.87%), mefenoxam (2.62%), and difenoconazole (0.35%).

Evaluation of Salibro for Increasing Cotton Plant Growth and Decreasing Root-Knot Nematode Population Density and Fusarium Wilt Incidence on Cotton in Central Alabama, 2019

D. R. Dyer, K. S. Lawrence, W. Groover, M. N. Rondon, B. R. Lawaju, W. Sanchez, and K. Gordon

Nematicide products were evaluated for their ability to increase cotton plant growth and yield as well as manage root-knot nematode population density and fusarium wilt incidence. Testing was conducted at the Plant Breeding Unit of Auburn University's E. V. Smith Research Center, Tallassee, AL. The trial field was a Kalmia loamy sand soil type, consisting of 80% sand, 10% silt, and 10% clay. Treatments were arranged in a randomized complete block design with five replications. The plots were planted on 15 May using Rowden cultivar of cotton which is known to be highly susceptible to fusarium wilt and root-knot nematodes. Test plots consisted of 2 rows, 7.6 meters long with a 1-meter row spacing and a 1.8-meter alley between replications. Salibro (a.i. Fluazaindolizine) and Velum Total (a.i. Fluopyram and Imidacloprid) were applied as in-furrow sprays. Salibro was applied at rates of 250, 500, and 1000 g ai/ha and Velum Total was applied at a rate of 183 g Fluopyram/ha. All plots were maintained throughout the season with standard insecticide, herbicide, and fertilizer practices as recommended by the Alabama Cooperative Extension System and watered as needed with a pivot irrigation system. Monthly average maximum temperatures from planting in May through harvest in October were 32.4, 31.9, 33.7, 33.8, 35.3, and 28.0°C with average minimum temperatures of 18.1, 20.7, 21.8, 21.8, 19.7, and 15.4 °C, respectively. Rainfall accumulation for each month was 2.1, 10.9, 5.1, 4.1, 0.3, and 8.4 cm, respectively. Four plants were dug randomly from each plot on 26 Jun at 42 DAP and were transported to the laboratory to collect nematode population density (eggs per gram of root), plant height, and biomass (root fresh weight + shoot fresh weight) data. Extraction of nematode eggs from roots was accomplished by shaking the roots in 6% NaOCl for 4 minutes and collecting the eggs on a 25-µm sieve. Fusarium wilt ratings were obtained on 24 September prior defoliation by slicing into the stems of each cotton plant in a five-foot section of each row to look for vascular discoloration. Fusarium wilt incidence reported is a percentage of plants that were infected with-in the five-foot of row. Seed cotton yield was collected on 24 October. Data were analyzed with SAS 9.4 using PROC GLIMMIX and LS-means were compared using Dunnett's method.

Plant height was increased by treatment with Salibro at the two higher rates compared to the control (7.45 and 8.60 cm respectively). Plant biomass (root fresh weight + shoot fresh weight) was increase with all three treatment rates of Salibro. All treatment rates also numerically reduced root-knot nematode eggs/g of root with the highest rate (1000 g ai/ha) resulting in a significant reduction equivalent to 76% of the control. The incidence of fusarium wilt was significantly reduced by treatment with Salibro at rates of 250, 500, and 1000 g ai/ha (47, 46, and 47% respectively). This could have resulted in the reduced nematode population density associated with these treatments as there is a known correlation between FOV infection and root-knot nematode population density. No yield increase was correlated with the reduced nematode levels and fusarium wilt incidence in this test.

Treatments	Plant Height (cm)	Biomass[z] (g)	RKN Eggs/g of Root	Fusarium wilt Incidence[y]	Seed Cotton Yield (kg/ha)
Control	26.45[x]	96.40	511	15.74	3457
Salibro (250 g ai/ha)	32.35	162.02 *	277	8.34 ***	3470
Salibro (500 g ai/ha)	33.90 *	186.09 **	238	8.50 **	3366
Salibro (1000 g ai/ha)	35.05 **	176.47 **	125 *	8.35 ***	3450
Velum Total (183 g Fluopyram/ha)	29.25	116.64	767	12.46	3873

[z] Biomass is the sum of shoot fresh weight and root fresh weights collected 42 DAP.
[y] FOV incidence is presented as a percentage of plants in a 5-foot section of the row that showed symptoms of vascular discolouration
[x] Values present are LS-means with significance determined using the Dunnett's method. Significance at the 0.1, 0.05, 0.01, and 0.001 level is indicated by *, **, ***, and **** respectively.

Onset and Development of Disease Caused by a Cotton Leaf Roll Dwarf Virus (CLRDV)-Related Virus in Alabama Cotton

J. Koebernick, A. K. Hagan, E. Sikora, K. Conner, A. Jacobson, and K. L. Bowen

Experimental Studies:

Sentinel Plots: Auburn was able to get 9 other states to volunteer to plant a sentinel plot. Koebernick's post doc, Marcio Zaccaron, evaluated all the trials with the total being 15. Hagan and Sikora focused on evaluating the 5 trials in Alabama. The BRS lines used were detected as being susceptible to the virus which made estimating yield loss hard. Across environments different symptoms were observed which was expected. In addition the virus appeared in all the locations except Arkansas. However, Arkansas has confirmed the virus in their state.

Germplasm Screening

Field: A large scale field screening trial took place in both Tallassee, AL, and Fairhope, AL where the disease was present in 2018. Over 1200 varieties were planted across the locations. PCR tests were used to confirm the presence or absence of the virus. The varieties tested consisted of elite breeding material, wild accessions and commercial cultivars. In total, 51 varieties were negative with each major company having at least one. These lines will be tested in the aphid transmission that we developed in 2019 to confirm these results.

Controlled environment: Used to characterize aphid transmission. Studies determined that the aphid can transmit the virus in as little as ten days using leaf disks assays. These protocols will be used for further identifying resistance. Grafting techniques were utilized and all but one graft type proved successful in cotton.

Entomology

Aphid monitoring and seasonal virus spread trials were conducted at Brewton. In addition, the impact of aphid management on reducing virus incidence. The results indicate that it did not reduce incidence. At Shorter, cage studies were preformed to determine aphid timing in terms of age of plant when it was infected and yield loss.

Field Survey

The virus was found in 44 counties in Alabama this year. Hagan reported ~22% yield loss in one growers field in Baldwin County.

Extension Activities:

Two articles were written, one extension bulletin and one popular press article. The distribution of the articles is presented below with how many views each one had.

Cotton Leafroll Dwarf Virus Present in Alabama Cot

Date	Outlet	Reach
7/18/2019	Cotton Grower Online	17,000
7/18/2019	Growing Alabama	741
7/17/2019	Ag Fax	11,000
7/17/2019	Southeast Ag Net	14,000
7/16/2019	Cotton Farming Online	8,000
7/16/2019	Alabama Farmers Federation	21,000
	Total:	71,741

A New Disease in Alabama Cotton

Date	Outlet	Reach
7/12/2019	Town Talk Online	180,000
7/12/2019	News Star Online	185,000
7/12/2019	Stevens Point Journal Online	60,000
7/12/2019	News-Press Online	870,000
7/12/2019	Star-Gazette Online	182,000
7/12/2019	Alamogordo Daily News Online	29,000
7/12/2019	Statesman Journal Online	317,000
7/12/2019	St. Cloud Times	188,000
7/12/2019	Baxter Bulletin Online	60,000
7/12/2019	Great Falls Tribune Online	269,000
7/12/2019	Lansing State Journal Online	317,000
7/12/2019	Desert Sun Online	592,000
7/12/2019	Des Moines Register Online	3,170,000
7/12/2019	Fort Collins Coloradoan Online	431,000
7/12/2019	WRCB-TV Online	431,000
7/12/2019	Press & Sun-Bulletin Online	187,000
7/12/2019	Herald Times Reporter Online	151,000
7/12/2019	Florida Today Online	874,000
7/12/2019	Asbury Park Press Online	1,540,000
7/12/2019	Lancaster Eagle Gazette	74,000
7/12/2019	Wisconsin State Farmer Online	23,000
7/12/2019	Observer & Eccentric Newspapers Onlin	186,000
7/12/2019	Detroit Free Press Online	11,830,000
7/12/2019	El Paso Times Online	550,000
7/12/2019	Commercial Appeal Online	1,100,000
7/12/2019	Springfield News Leader Online	862,000
7/12/2019	The Clarion-Ledger Online	881,000
7/12/2019	Daily World Online	24,000
7/12/2019	Ithaca Journal Online	142,000
7/12/2019	WTVY-TV	47,000
7/12/2019	The Cincinnati Inquirer Online	3,870,000

7/12/2019	Evansville Courier & Press Online		341,000
7/12/2019	TCPalm.com		866,000
7/12/2019	Central Florida Future		48,000
7/12/2019	Democrat and Chronicle Online		1,550,000
7/12/2019	USA Today Online		36,990,000
7/12/2019	att.net		1,190,000
7/12/2019	Home News Tribune		332,000
7/12/2019	Morning Ag Clips		34,000
7/11/2019	WVUA-TV Online		11,000
7/11/2019	CBS 42 Birmingham		118,000
7/11/2019	Opelika-Auburn News Online		184,000
7/11/2019	Alabama Public Radio		11,000
7/11/2019	WRBL		11,000
7/11/2019	WAFF 48		20,000
7/11/2019	USA Breaking News Online		11,000
7/11/2019	Moulton Advertiser Online		17,000
7/11/2019	The Argus Press Online		43,000
7/11/2019	Clay Center Dispatch Online		10,000
7/11/2019	Chattanooga Times Free Press Online		1,530,000
7/11/2019	U.S. News & World Report		23,920,000
7/11/2019	Mid-Atlantic Horse		9,000
7/11/2019	Huron Daily Tribune Online		28,000
7/11/2019	WHNT-Tv Online		846,000
7/11/2019	Washington Times Online		10,820,000
7/11/2019	Quincy Herald-Whig Online		183,000
7/11/2019	Centre Daily Times Online		830,000
7/11/2019	Modesto Bee Online		855,000
7/11/2019	SeattlePI.com		4,770,000
7/11/2019	TimesDaily Online		185,000
7/11/2019	Tri-City Herald Online		831,000
7/11/2019	The Decatur Daily Online		186,000
7/11/2019	Reading Eagle Online		430,000
7/11/2019	Telegraph Online		857,000
7/11/2019	Sun News Online		139,000
7/11/2019	WBRC News		56,000
7/11/2019	New Haven Register Online		433,000
7/11/2019	The Kansas City Start Online		4,770,000
7/11/2019	Laredo Morning Times		76,000
7/11/2019	Idaho Statesman Online		1,110,000
7/11/2019	WAFF News (3 shows)		25,000
		Total:	124,298,000

IV. Weed Management

Evaluate Soil Herbicide Injury on Cotton in North Alabama Soils in Replanted/Double Cropping Cotton

S. Li

Fund amount: $5,000

In 2019, a full season cotton test and a short season cotton test were planted at TN valley research and extension center at Belle Mina. Planting dates were April 29, 2019 and June 14, 2019 respectively, for each trial. Another short season test was conducted at Crop Unit at Shorter. This trial was planted June 5, 2019. The varieties used in these two trials were DP 1646 and PHY 333. Experiment was conducted in randomized complete block design with 4 reps. Plot size was 4 rows by 25 ft. Trial was kept weed free throughout the season including NTC. Treatments were sprayed immediately after planting within the same day with backpack sprayer at 15 GPA and were activated by irrigation or rainfall within 3 days of planting. Treatments used for both trials are listed below:

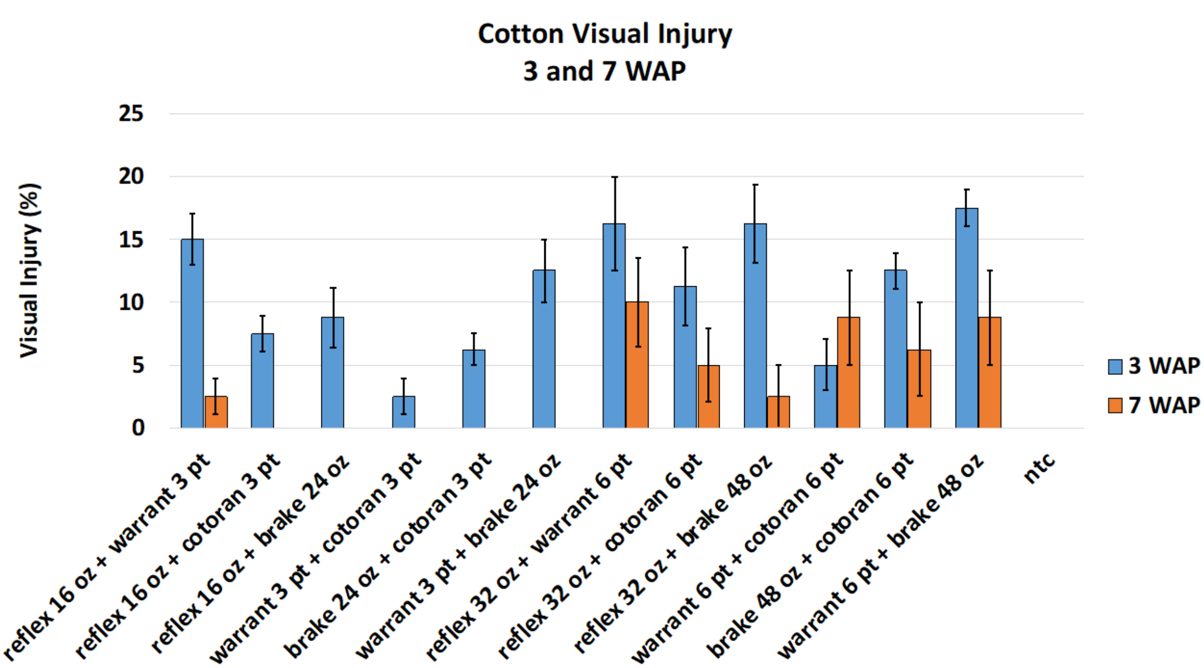
Table 1. Treatment list for the full season trial.

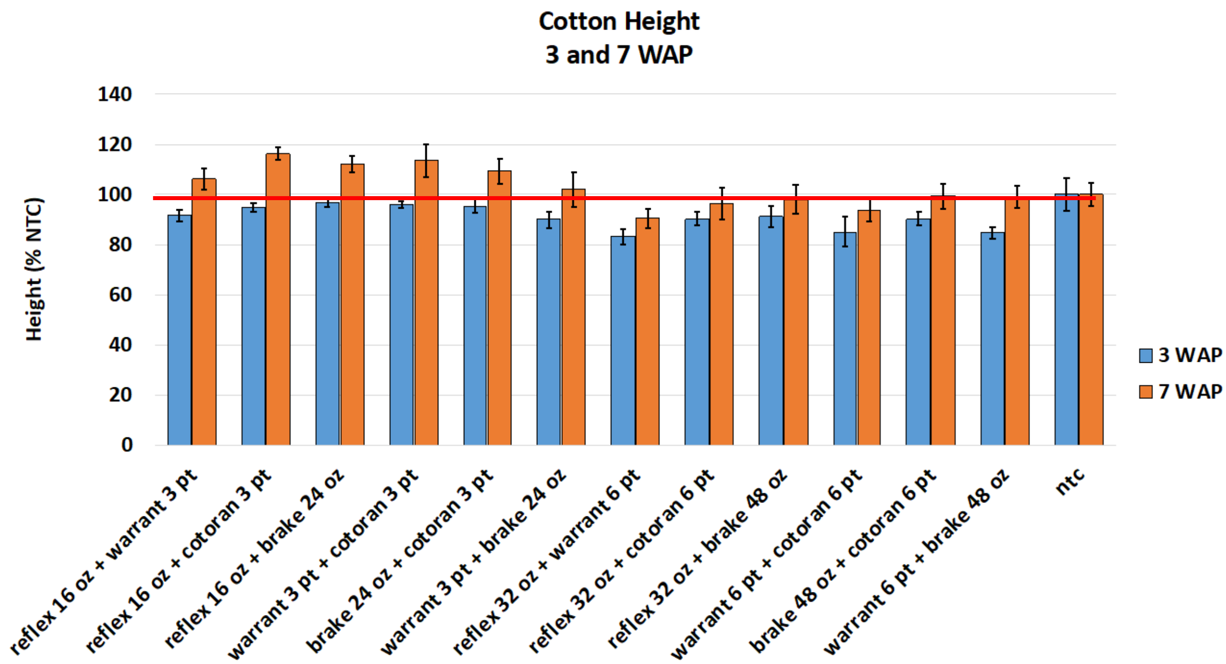
#	Treatment	Rate per Acre
1	Reflex Warrant	16 oz 3 pt
2	Reflex Cotoran	16 oz 3 pt
3	Reflex Brake	16 oz 24 oz
4	Warrant Cotoran	3 pt 3 pt
5	Brake Cotoran	24 oz 3 pt
6	Warrant Brake	3 pt 24 oz
7	Reflex Warrant	32 oz 6 pt
8	Reflex Cotoran	32 oz 6 pt
9	Reflex Brake	32 oz 48 oz
10	Non-treated check	

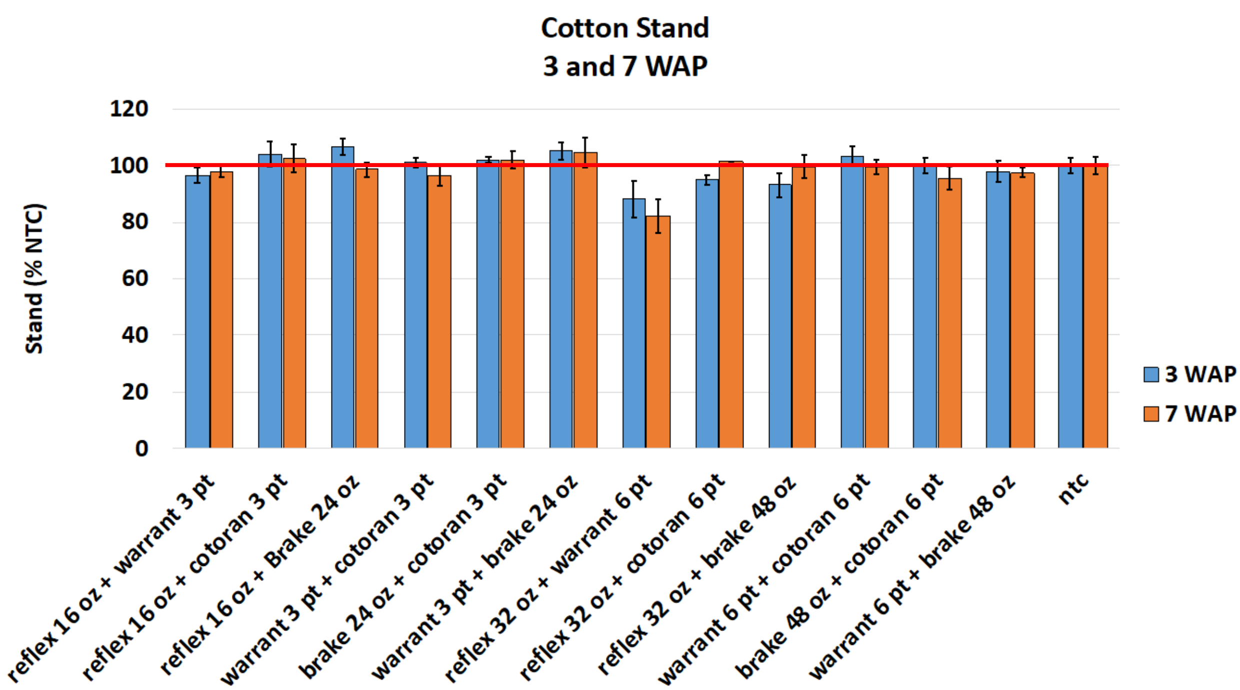
Table 2. Treatment list for the short season trial

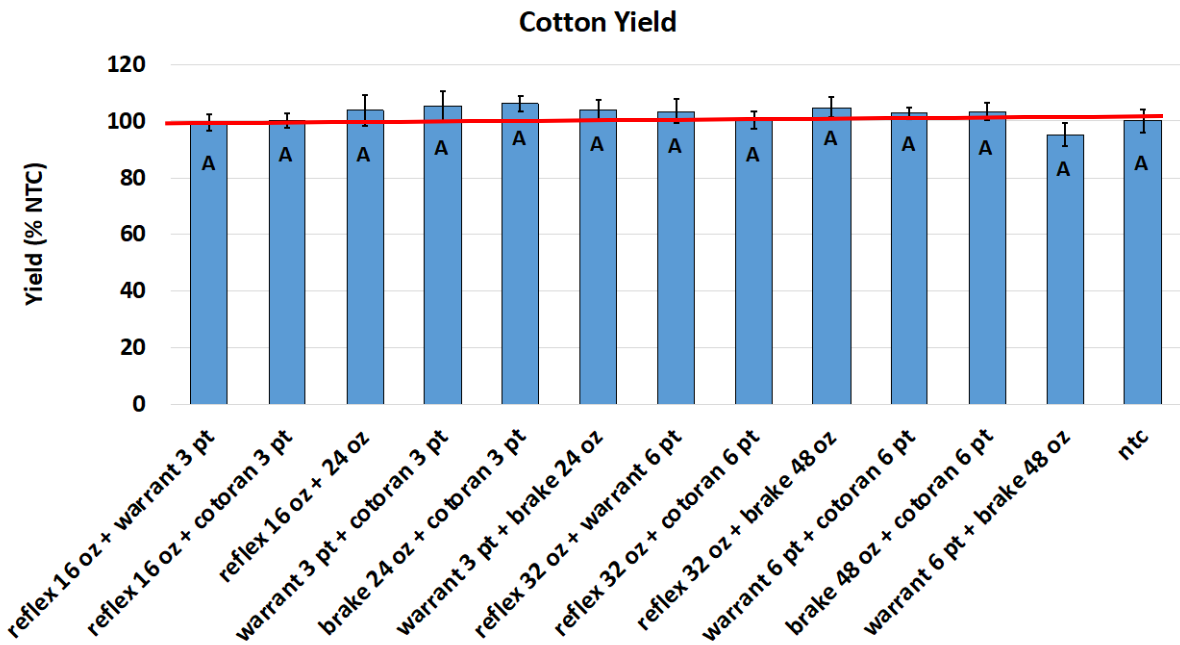
#	Treatment	Rate per Acre
1	Reflex Warrant	10 oz 2.5 pt
2	Warrant Cotoran	2.5 pt 2.5 pt
3	Reflex Brake	10 oz 24 oz
4	Cotoran	3.2 pt
5	Reflex	12 oz
6	Warrant	3.2 pt
7	Brake	32 oz
8	Reflex Cotoran	10 oz 2.5 pt
9	Cotoran Brake	2.5 pt 24 oz
10	Warrant Brake	2.5 pt 24 oz
11	Warrant Brake 32	3.2 pt 32 oz
12	Non-treated check	

Results of the full season cotton trial are shown below in bar graphs. No significant differences were found between treatments even up to 2X rate on cotton height, stand and yield. Cotton visual injury stayed below 20% which was not overly unacceptable at 3 weeks after planting (WAP).

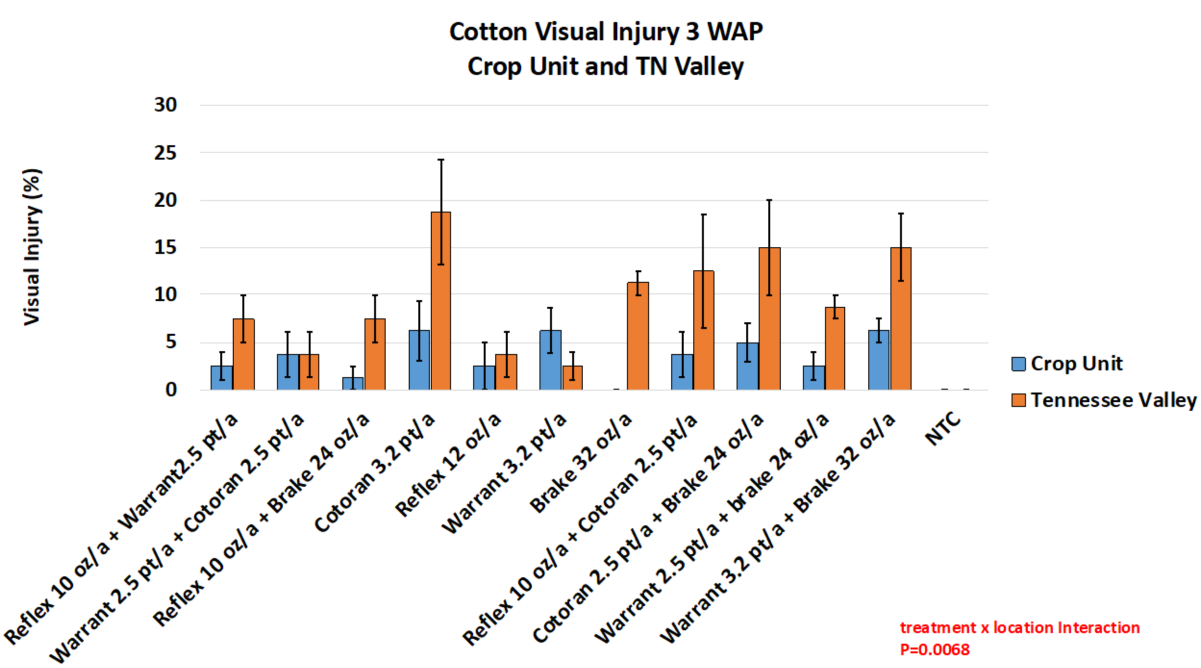


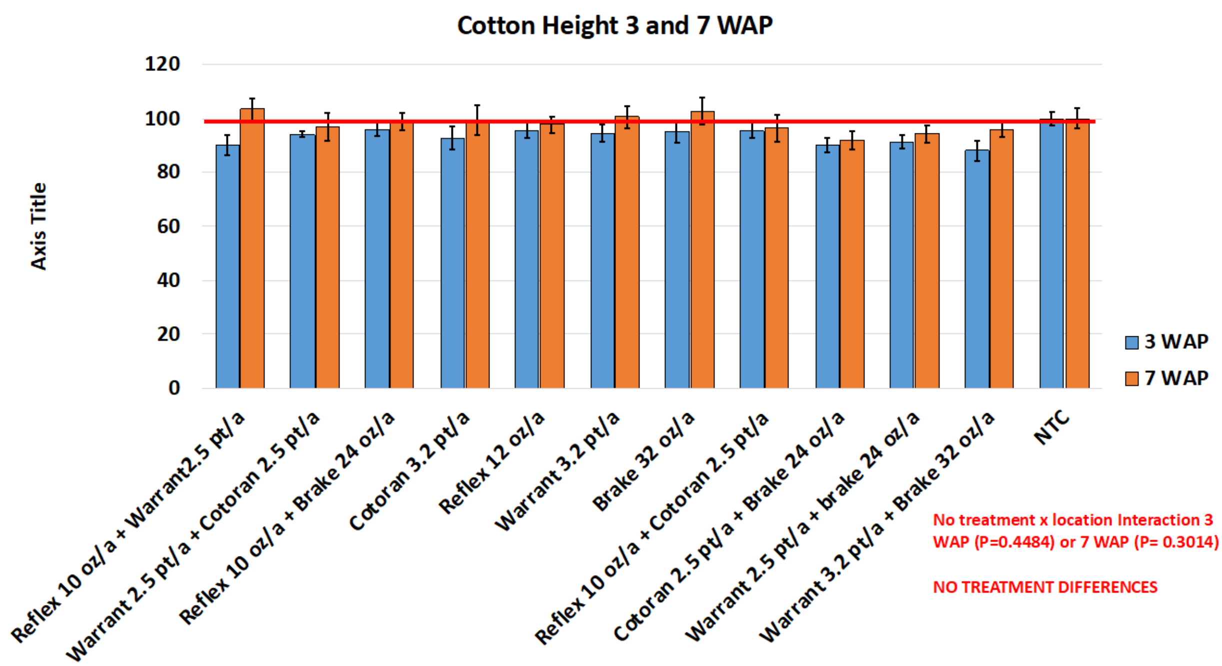

Cotton Height
3 and 7 WAP
Height (% NTC)
140
120
100
80
60
40
20
0
reflex 16 oz + warrant 3 pt
reflex 16 oz + cotoran 3 pt
reflex 16 oz + brake 24 oz
warrant 3 pt + cotoran 3 pt
brake 24 oz + cotoran 3 pt
warrant 3 pt + brake 24 oz
reflex 32 oz + warrant 6 pt
reflex 32 oz + cotoran 6 pt
reflex 32 oz + brake 48 oz
warrant 6 pt + cotoran 6 pt
brake 48 oz + cotoran 6 pt
warrant 6 pt + brake 48 oz
ntc
3 WAP
7 WAP


Cotton Stand
3 and 7 WAP
Stand (% NTC)
120
100
80
60
40
20
0
reflex 16 oz + warrant 3 pt
reflex 16 oz + cotoran 3 pt
reflex 16 oz + Brake 24 oz
warrant 3 pt + cotoran 3 pt
brake 24 oz + cotoran 3 pt
warrant 3 pt + brake 24 oz
reflex 32 oz + warrant 6 pt
reflex 32 oz + cotoran 6 pt
reflex 32 oz + brake 48 oz
warrant 6 pt + cotoran 6 pt
brake 48 oz + cotoran 6 pt
warrant 6 pt + brake 48 oz
ntc
3 WAP
7 WAP

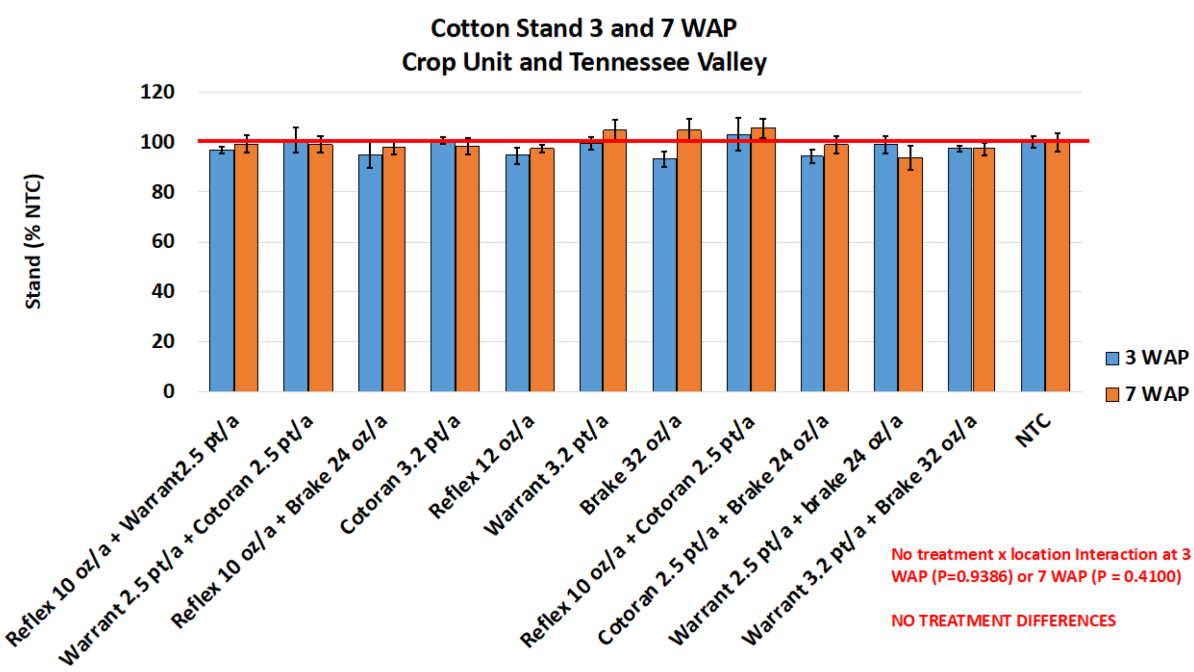


Results of the short season cotton test resembled the full season test very well. No significant cotton height and stand reduction was observed at any location. Cotton yield was not statistically reduced from the non-treated check. Cotton injury at 3 WAP was below 20% which was seen in the full season trial.

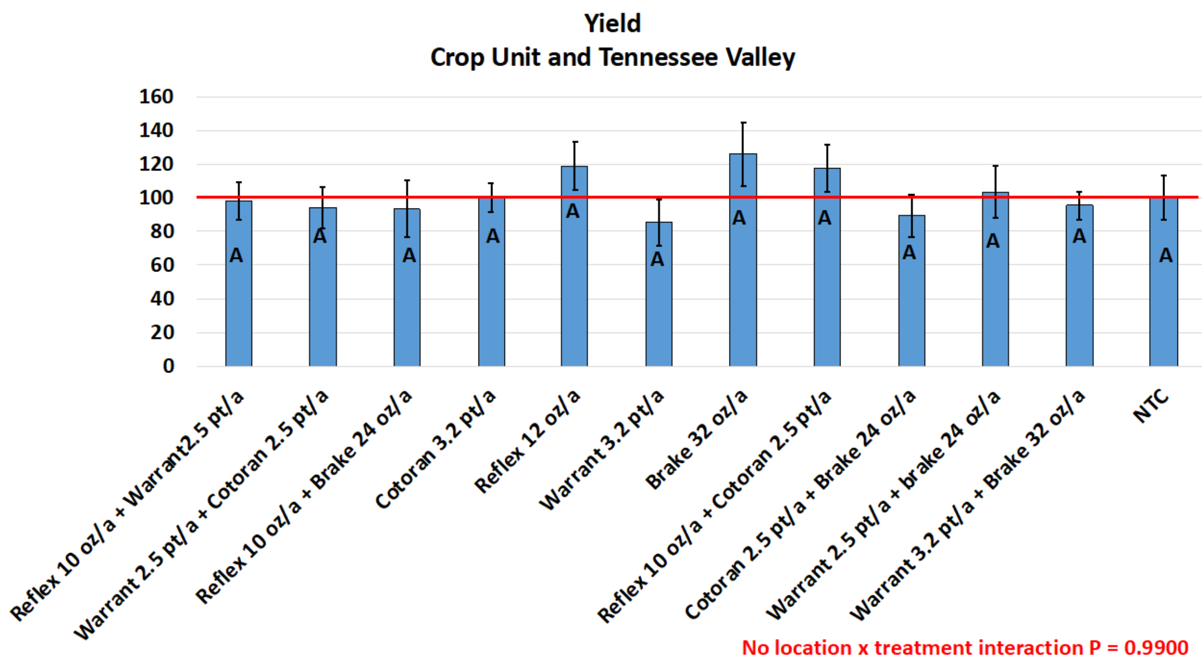




Cotton Height 3 and 7 WAP
Axis Title
120
100
80
60
40
20
0
3 WAP
7 WAP
Reflex 10 oz/a + Warrant2.5 pt/a
Warrant 2.5 pt/a + Cotoran 2.5 pt/a
Reflex 10 oz/a + Brake 24 oz/a
Cotoran 3.2 pt/a
Reflex 12 oz/a
Warrant 3.2 pt/a
Brake 32 oz/a
Reflex 10 oz/a + Cotoran 2.5 pt/a
Cotoran 2.5 pt/a + Brake 24 oz/a
Warrant 2.5 pt/a + brake 24 oz/a
Warrant 3.2 pt/a + Brake 32 oz/a
NTC
No treatment x location Interaction 3 WAP (P=0.4484) or 7 WAP (P= 0.3014)
NO TREATMENT DIFFERENCES



Cotton Stand 3 and 7 WAP
Crop Unit and Tennessee Valley
Stand (% NTC)
120
100
80
60
40
20
0
3 WAP
7 WAP
Reflex 10 oz/a + Warrant2.5 pt/a
Warrant 2.5 pt/a + Cotoran 2.5 pt/a
Reflex 10 oz/a + Brake 24 oz/a
Cotoran 3.2 pt/a
Reflex 12 oz/a
Warrant 3.2 pt/a
Brake 32 oz/a
Reflex 10 oz/a + Cotoran 2.5 pt/a
Cotoran 2.5 pt/a + Brake 24 oz/a
Warrant 2.5 pt/a + brake 24 oz/a
Warrant 3.2 pt/a + Brake 32 oz/a
NTC
No treatment x location Interaction at 3 WAP (P=0.9386) or 7 WAP (P = 0.4100)
NO TREATMENT DIFFERENCES



Results of this study indicated that none of the treatments caused unacceptable stand and height reduction, nor yield loss at any of the study location. However, herbicide injury on late planted cotton is still a concern since it will delay maturity and cause yield loss when growing season is limited. Our current recommendation is spray only one herbicide behind the planter, let the seedlings establish, then spray 1st post early around 15 DAP if weeds start to come up.

Conducting On-Farm Weed Control Demonstrations in Alabama

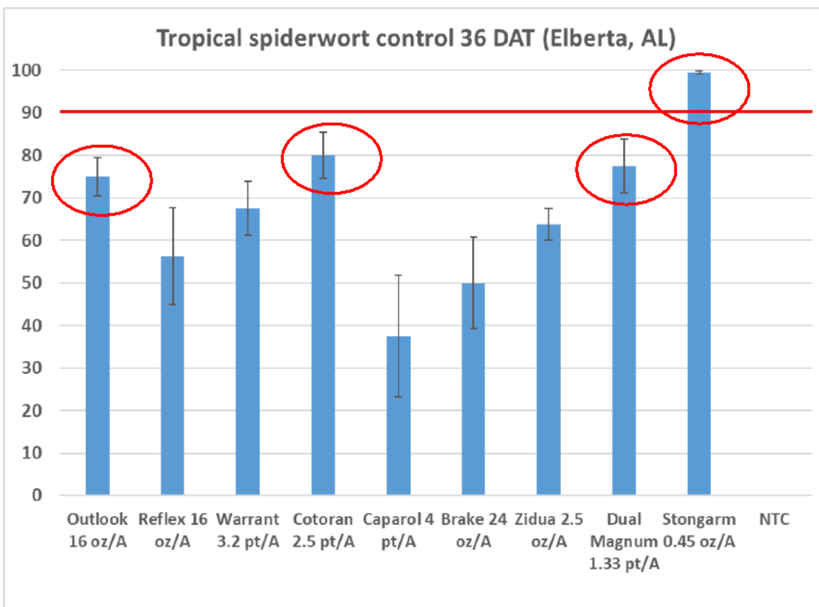
S. Li

Fund amount: $6,000

We conducted several studies and on-farm demos in 2019.

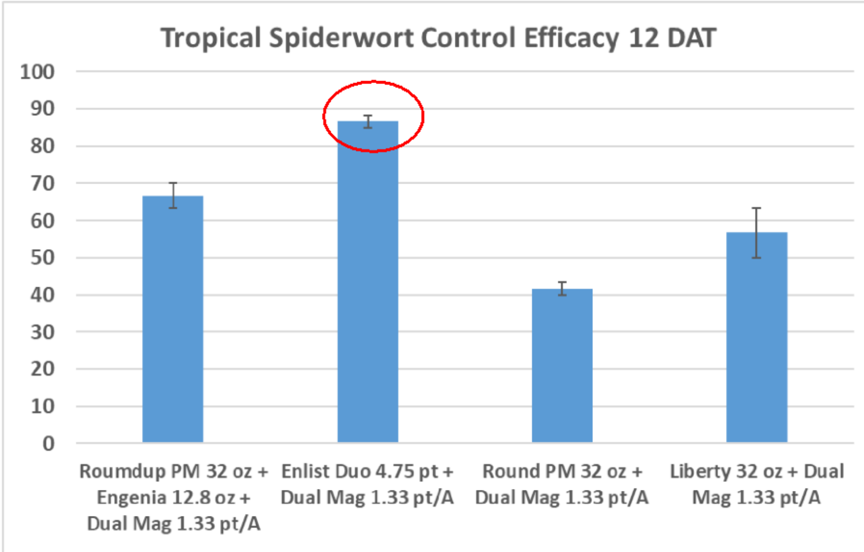
1. Tropical spiderwort control in cotton

We conducted two trials at Elberta AL, and Graceville, FL, in the summer of 2019 to evaluate control efficacy of tropical spiderwort with PRE and POST treatments. In Elberta, 9 PRE treatments were evaluated and sprayed on bareground before weed emergence on Jun 12. Both studies were randomized with 4 reps. Treatments were sprayed with backpack sprayer at 20 GPA. Rating suggested Strongarm is the best soil herbicide to prevent shoot emergence, followed by Dual Magnum, Cotoran and Outlook. Caparol, Brake provided poor control while Zidua, Reflex and Warrant provided with medium level of control. Results of the PRE herbicide study are shown below.



Treatments applied to bareground with no tropical spiderwort on Jun 12, 2019

For the POST study conducted at Elberta, Enlist Duo + Dual Magnum provided best control of large tropical spiderwort (10-12"wide) compared to other treatments. It is hard to control this weed in Xtend or Liberty system due to lack of efficacy of glyphosate and glufosinate on this weed. Results are shown below.



1 ft wide tropical spiderwort, sprayed on Aug 2
using TT or TTI nozzles at 20 GPA

POST treatment efficacy in Elberta, AL trial in 2019.

In Graceville FL study, we sprayed Gramoxone based treatment and compared them to Enlist system treatments. Gramoxone provided excellent control of this weed in bareground test. Roundup + Enlist one, Liberty + 2,4-D also generated excellent control. The worst treatment was Liberty + Staple LX which resulted in 81% control. However, this treatment is still valuable in Xtend or Liberty system since it is significantly better than dicamba, Roundup or Liberty alone on this weed.

2. Teaweed (prickly sida) control study

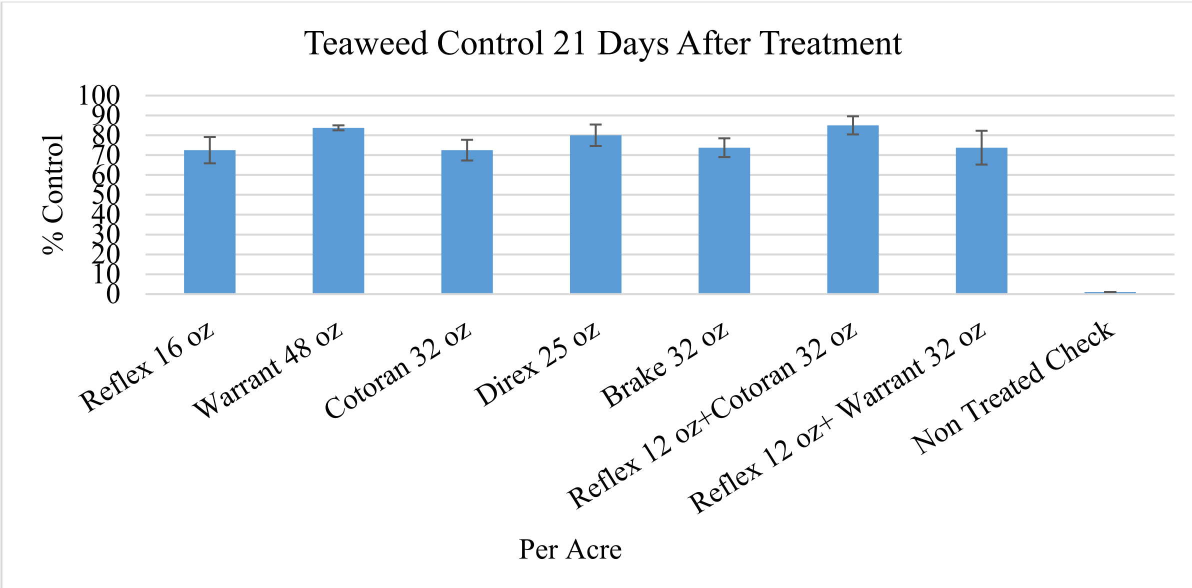
We conducted a teaweed control study in Deatsville AL, in the summer of 2019. It was a completely randomized block designed study with 4 replications. It was sprayed with TTI110025 (Auxin treatments) and TT110025 with a backpack sprayer at 15 GPA. Two studies were conducted, one evaluating PRE treatments only and a second which included PRE, POST 1, and POST 2 treatments as shown below. PRE treatments were sprayed May 8th 2019, POST 1 on June 3, 2019, and POST 2 on June 26, 2019.

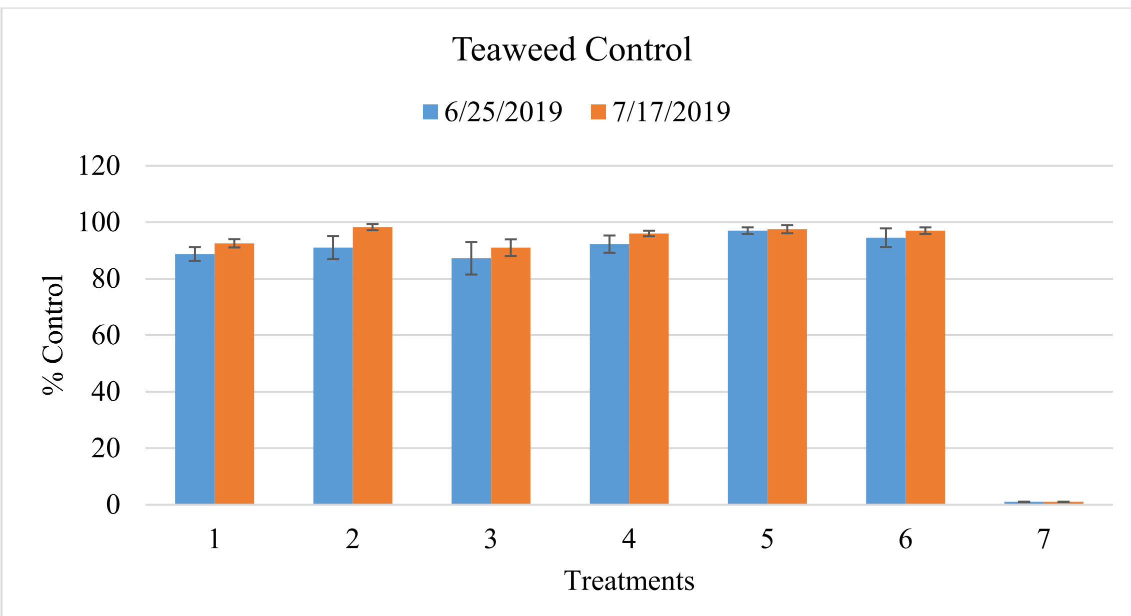
#	Treatment (PRE)	Rate per Acre
1	Reflex	16 oz
2	Warrant	48 oz
3	Cotoran	32 oz
4	Direx	25 oz
5	Brake	32 oz
6	Reflex Cotoran	12 oz 32 oz
7	Reflex Warrant	12 oz 32 oz
8	Non Treated Check	

#	Treatment POST 1	Rate per Acre	Treatment POST 2	Rate per Acre
1	Roundup PM Xtendimax Dual Magnum Class Act Ridion Intact	32 oz 22 oz 16 oz 1% v/v 0.5%v/v	Liberty Class Act Ridion	32 oz 1% v/v
2	Roundup PM Xtendimax Dual Magnum Class Act Ridion Intact	32 oz 22 oz 16 oz 1% v/v 0.5%v/v	Roundup PM Xtendimax Class Act Ridion Intact	32 oz 22 oz 1% v/v 0.5%v/v
3	Liberty Dual Magnum Class Act Ridion	32 oz 16 oz 1% v/v	Liberty Dual Magnum Class Act Ridion	32 oz 16 oz 1% v/v
4	Roundup PM Xtendimax Dual Magnum Class Act Ridion Intact	32 oz 22 oz 16 oz 1% v/v 0.5%v/v	Liberty Dual Magnum Class Act Ridion	32 oz 16 oz 1% v/v
5	Liberty Staple LX Class Act Ridion	32 oz 3 oz 1% v/v	Liberty Dual Magnum Class Act Ridion	32 oz 16 oz 1% v/v
6	Liberty Staple LX Class Act Ridion	32 oz 3 oz 1% v/v	Roundup PM Xtendimax Dual Magnum Class Act Ridion Intact	32 oz 22 oz 16 oz 1% v/v 0.5%v/v
7	Non Treated Check		Non Treated Check	

- All plots except for the Non Treated Check received a PRE treatment of Reflex 12 oz/A +Warrant 32 oz/A

For the PRE Treatment only study Reflex 16 oz + Cotoran 32 oz/A provided the best control at 21 days after treatment with 85% control. Interestingly, Reflex 16 oz/A and Cotoran 32 oz/A by themselves provided the worst control with only 73% each. Warrant 48 oz/A provided the second best control with 84%. However, Warrant 48 oz/A+ Reflex 12 oz/A provided worse control than Warrant on its own with 74%.





- See treatments from chart above

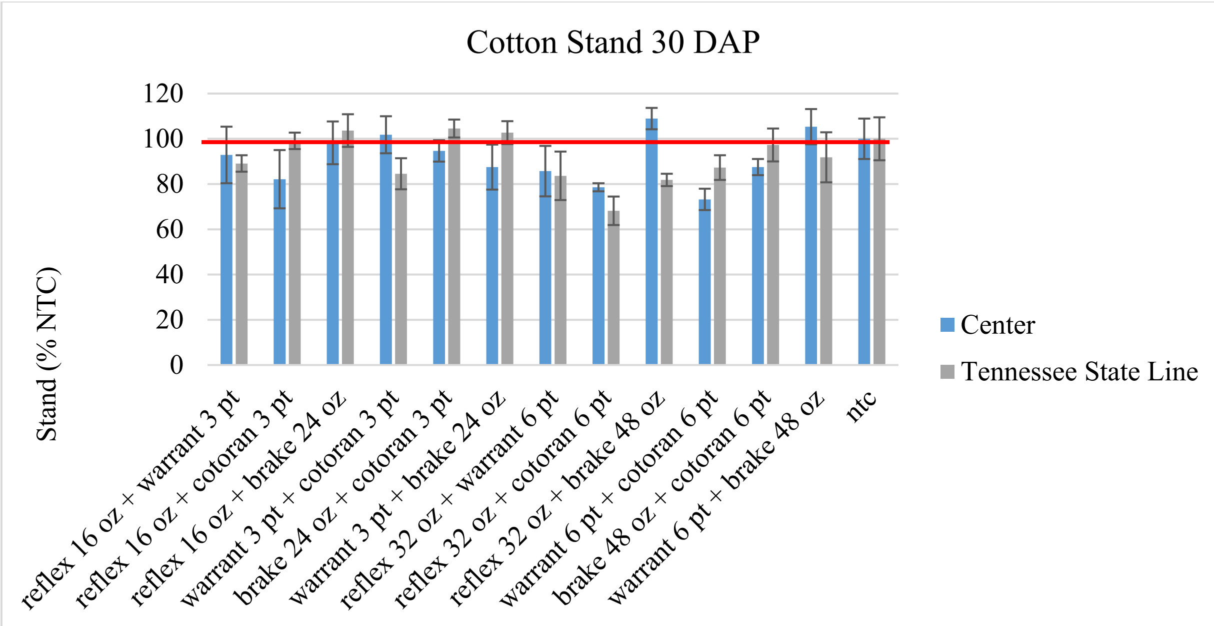
For the POST treatment programs Liberty 32 oz/A + Staple LX 3 oz/A+ Class act ridion 1% v/v followed by Liberty 32 oz/A +Dual Magnum 16 oz/A+ Class act ridion 1% v/v provided the best control with 98% control at 44 days after first POST treatment. Liberty 32 oz/A +Dual Magnum 16 oz/A+ Class act ridion 1% v/v followed by Liberty 32 oz/A +Dual Magnum 16 oz/A+ Class act ridion 1% v/v provided the worst control with 93%. Over all at 3 weeks after POST 1 all treatments had 87% or higher control of teaweed.

At 44 days after first POST treatment all treatments had 91% or higher control of teaweed. Overall, these POST programs provide effective control of teaweed especially those including Liberty.

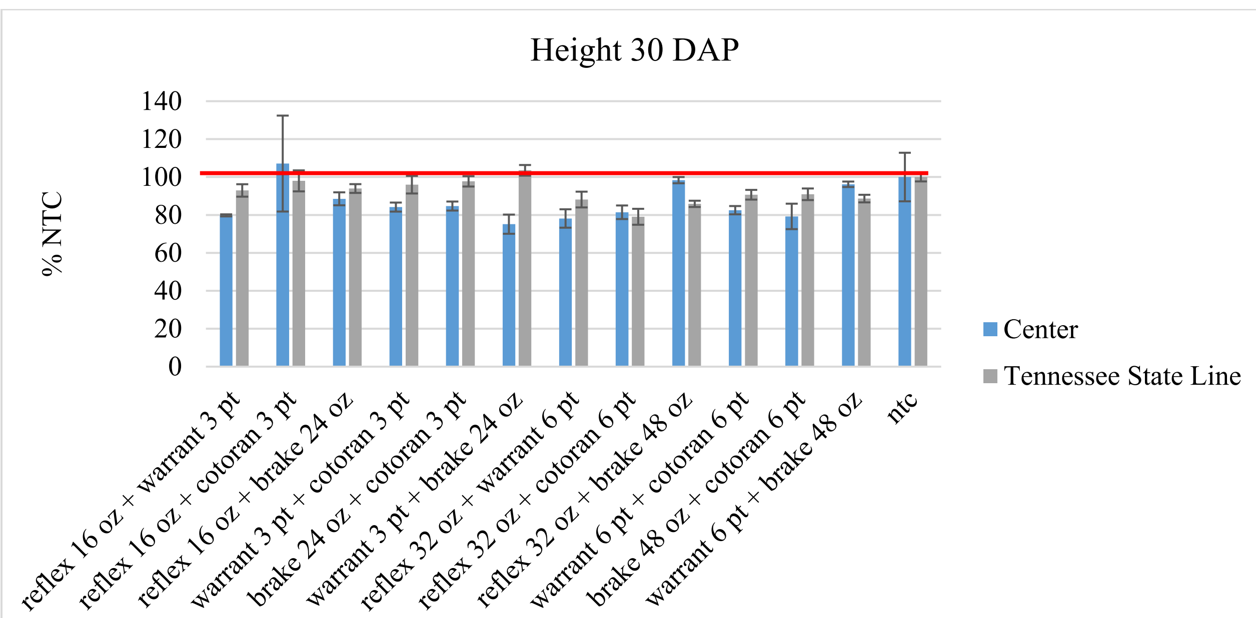
3. On-farm soil herbicide studies

In 2019, a full season cotton test (DP1646) were planted at 2 on-farm locations; Centre, AL, and at the Tennessee Line in Madison County, AL. Experiment was conducted in randomized complete block design with 3 replications. Plot size was 4 rows by 25 ft. Trial was kept weed free throughout the season including NTC. Treatments were sprayed immediately after planting within the same day with backpack sprayer at 15 GPA. 4-stand counts, 10-plant heights and whole plot injury ratings were taken at 30 days after planting. Treatments consisted of soil herbicides at the 1X and 2X the highest labelled rate and are listed below:

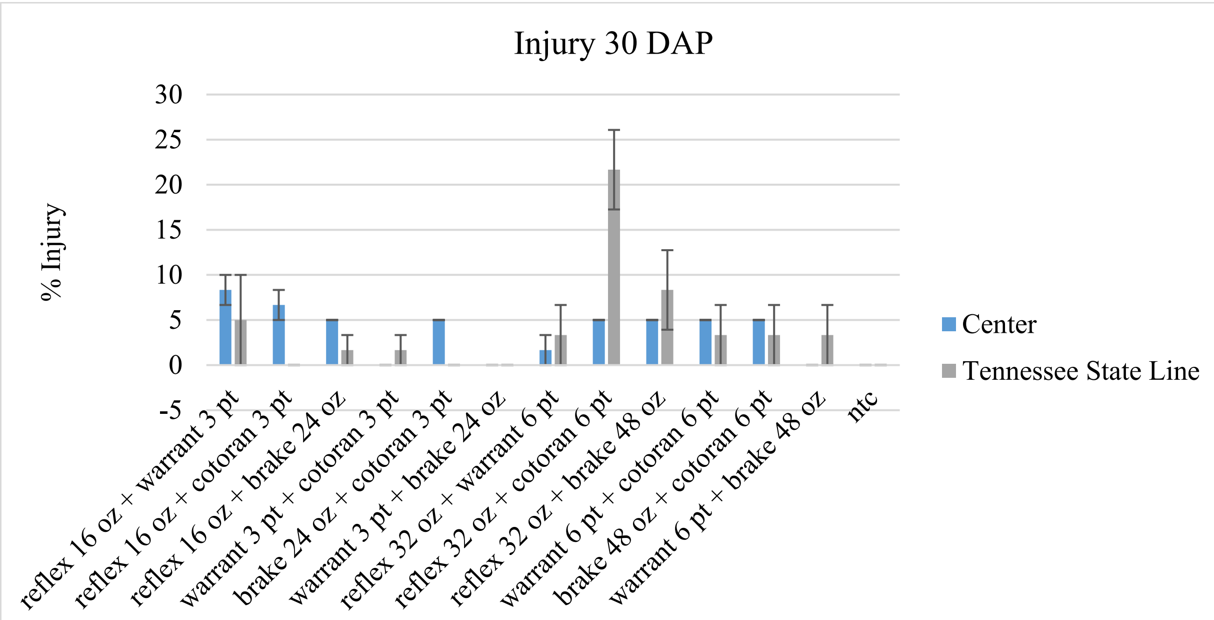
#	Treatment	Rate per Acre
1	Reflex Warrant	16 oz 3 pt
2	Reflex Cotoran	16 oz 3 pt
3	Reflex Brake	16 oz 24 oz
4	Warrant Cotoran	3 pt 3 pt
5	Brake Cotoran	24 oz 3 pt
6	Warrant Brake	3 pt 24 oz
7	Reflex Warrant	32 oz 6 pt
8	Reflex Cotoran	32 oz 6 pt
9	Reflex Brake	32 oz 48 oz
10	Warrant Cotoran	6 pt 6 pt
11	Brake Cotoran	48 oz 6 pt
12	Warrant Brake	6 pt 48 oz
13	Non-treated check	



Reflex 32 oz/A + Cotoran 6 pt/A caused a significant stand reduction of 32% compared to the non-treated check (NTC) at the Tennessee State Line location. Centre had a 22% stand reduction for the same treatment. In Centre, Warrant 6 pt/A + Cotoran 6 pt/A had a significant stand reduction of 77% compared to the NTC. Both of these treatments were 2X the labelled rate, the treatments with the highest labeled rate did not have a significant reduction compared to the non-treated check at either location. Overall, none of the 1X the labelled rate treatments caused a significant stand reduction at either location.



In Centre, the only treatment to have a significantly reduced heights by 25% was Warrant 3 pt/A + Brake 24 Oz/A, which is the highest labeled rate allowed for these two herbicides. No other herbicides caused a significant height reduction compared to the NTC at Centre. At the Tennessee State Line location all of the 2X labeled rate except for Reflex 32 oz/A+ Brake 48 oz/A and Warrant 6 pt/A+ Cotoran 6 pt/A, caused height reductions from 21%-12% compared to the NTC. Overall, height reductions did not exceed 25% for any of the treatments evaluated.

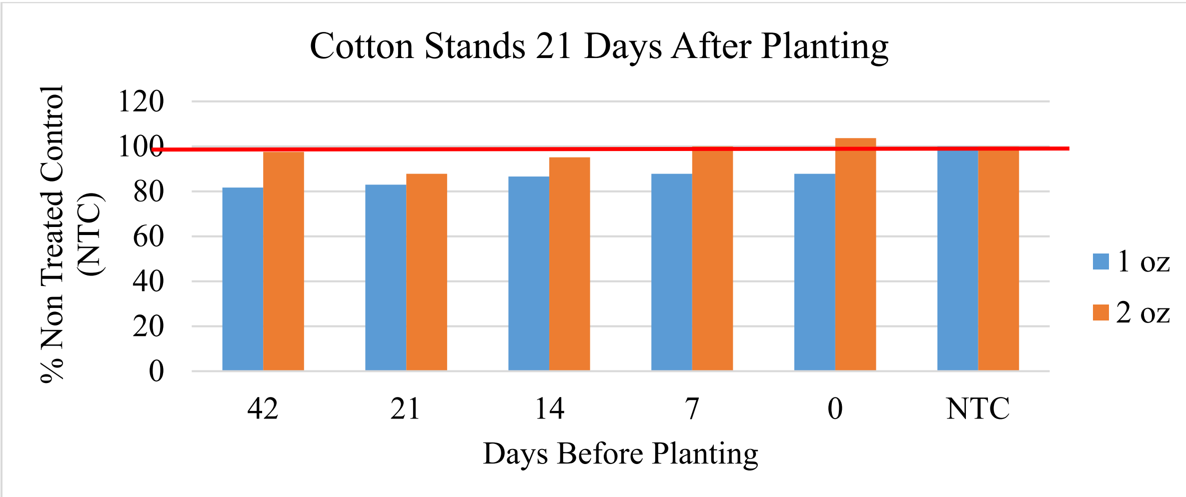


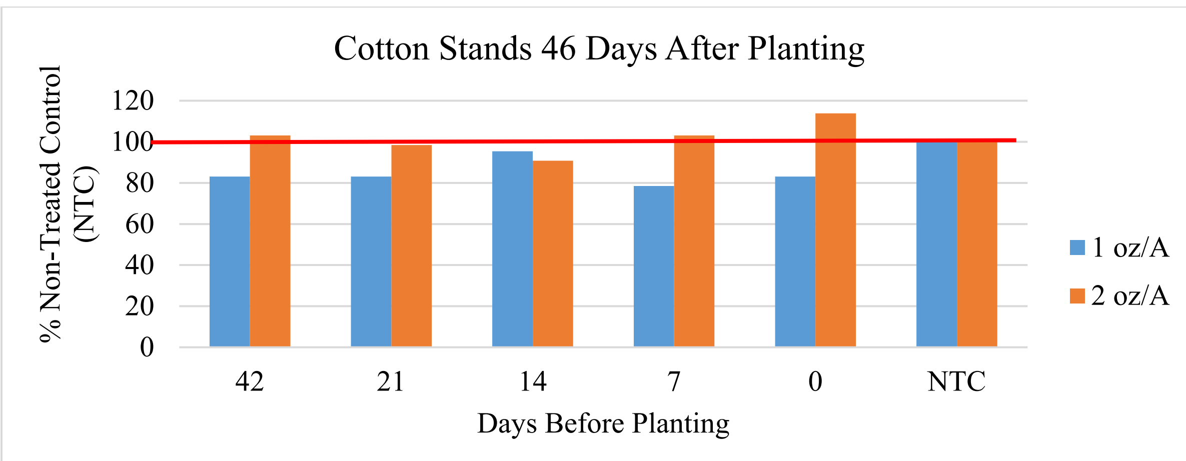
Overall, more injury was observed with the 2X the labeled treatments than any other treatments at both locations. Reflex 32 oz/A + Cotoran 6 pt/A at the Tennessee State Line location had the worst injury overall of 23%. All other treatments had less than 10 % injury at either locations which not an unacceptable level of cotton injury from soil residual herbicides.

Overall, soil residuals herbicides at the full labelled rate are safe to use with little to no stand or height reductions and visual injury occurring based off of this data. Cotton cannot tolerate 2X the labelled rate of many of these herbicides and stand reductions, injury and height reductions can occur.

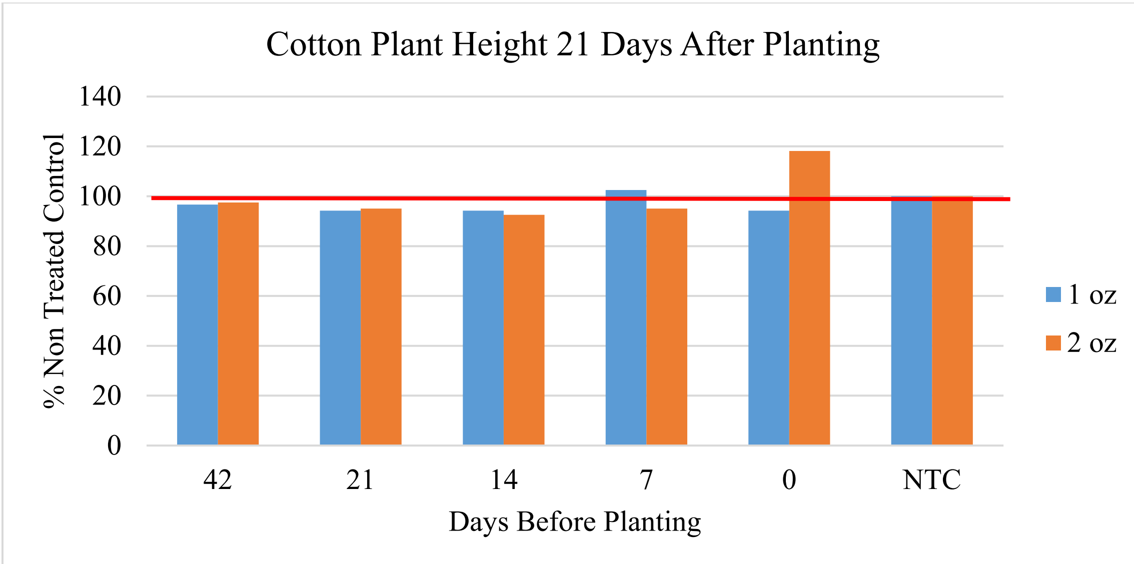
4. Sharpen On Farm

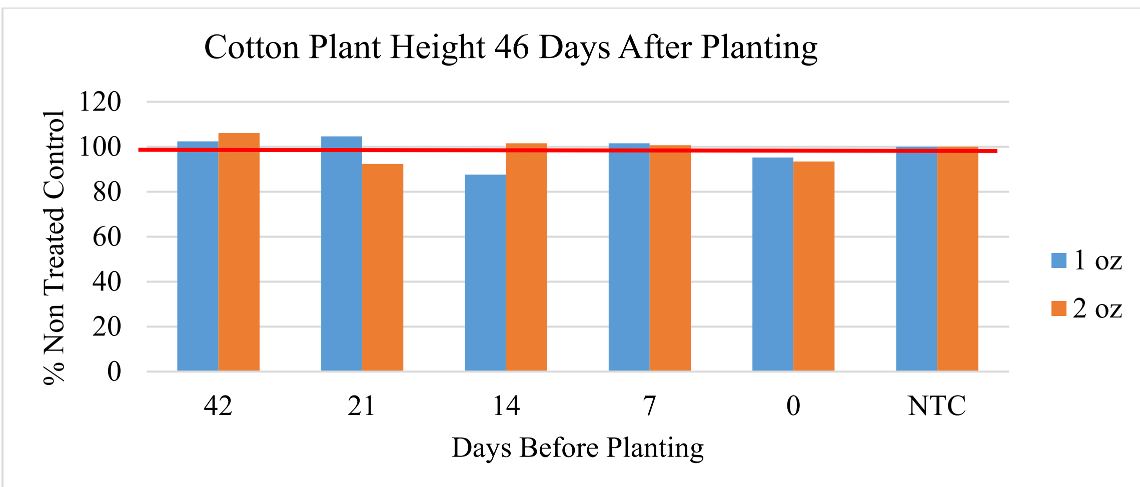
An on-farm sharpen plant back field demo was set up in Snead, Alabama, in dryland cotton. Each of the plots were 4 rows by 25 ft long with 2 replications. This trial was set up for a field tour to show potential sharpen plant back injury, additionally, at 3 and 7 weeks after the last application dates: 4 stand counts and 10 plant heights were also randomly collected from each plot. The field was planted with DP 1646 on May 22, 2019. Treatments were sprayed immediately after planting within the same day with backpack sprayer at 20 GPA. Treatments included 1 oz and 2 oz of Sharpen per acre applied at 42, 21, 14, 7, and 0 days before planting as well as a non-treated check.





Overall, there was not much difference in stand reductions between 1 oz and 2 oz applications when applied at 21, 14, 7 days before planting at 21 days after planting. The greatest cotton stand reduction occurred with 1 oz of Sharpen applied 7 day before planting with a 22% reduction at 46 days after planting. The 2 oz applied at 0, 7, 21, 42 days before application had 2% or less stand reductions.





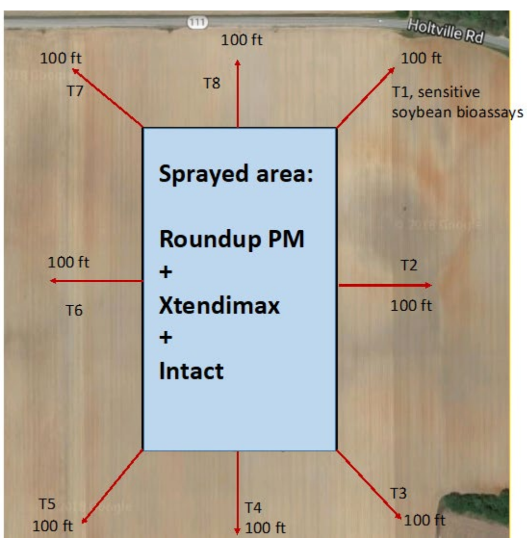
Overall, there was minimal cotton height reductions at either timing. Overall, there were stand reductions of up to 22% that did occur suggesting Sharpen can injure cotton and reduce stands if the label is not followed. However, since this field demo was not taken to yield it is unknown if this lead to significant yield losses or if given a full growing season the cotton can recover.

Evaluate 2, 4-D Vapor Movement Potential Under Field Conditions in Alabama

S. Li

Fund amount - $20,000

We located a potential field to conduct this study in 2019. However, due to our work load in the summer of 2019 and a large scale dicamba vapor study, we decided to conduct Enlist off-target movement study in 2020, preferentially in north Alabama where several Enlist drift incidences occurred. Meanwhile in 2019, we conducted a large scale dicamba vapor study in Deatsville. Five acres of DP 1646 were sprayed with Roundup PM 32 oz + Xtendimax 22 oz + Intact (DRA 1% v/v) with TTI 11004 nozzles at 15 GPA. It was a legal application following label requirements and application was conducted on June 26 in the late morning. Wind speed was around 3 MPH during application and maximum daily temperature was between 85-90F. Eight rows of sensitive soybean in pots were placed around the spray block in the fashion shown in the figure below. These soybean pots were placed in each transect 30 minutes after application to ensure only dicamba vapor can injure them, and they stay in this field for 72 hours. The pots are watered a minimum of 3 times a day to prevent additional plant stress in the field.



Dicamba injury rating on sensitive soybeans is shown below in these two tables.

Transact	T1	T2	T3	T4	T5	T6	T7	T8
0 ft	17	12	18	17	15	17	12	23
15 ft	8	8	15	10	7	-	13	8
25 ft	5	7	8	13	17	8	7	12
50 ft	12	12	8	12	10	13	15	12
100 ft	8	12	13	10	15	15	7	8

Table 1. Sensitive soybean bioassay averaged injury (%) at 14 days after application.

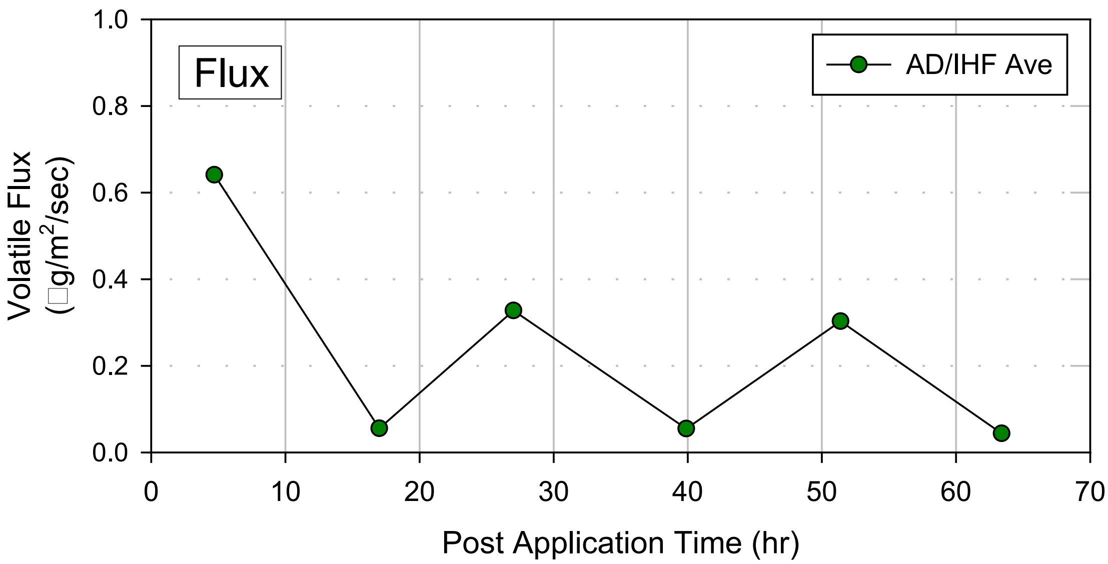
Transact	T1	T2	T3	T4	T5	T6	T7	T8
0 ft	12	8	10	10	8	10	8	13
15 ft	8	10	12	10	5	-	10	7
25 ft	7	10	5	7	7	8	8	7
50 ft	8	7	10	7	5	10	8	7
100 ft	8	8	12	10	7	8	5	7

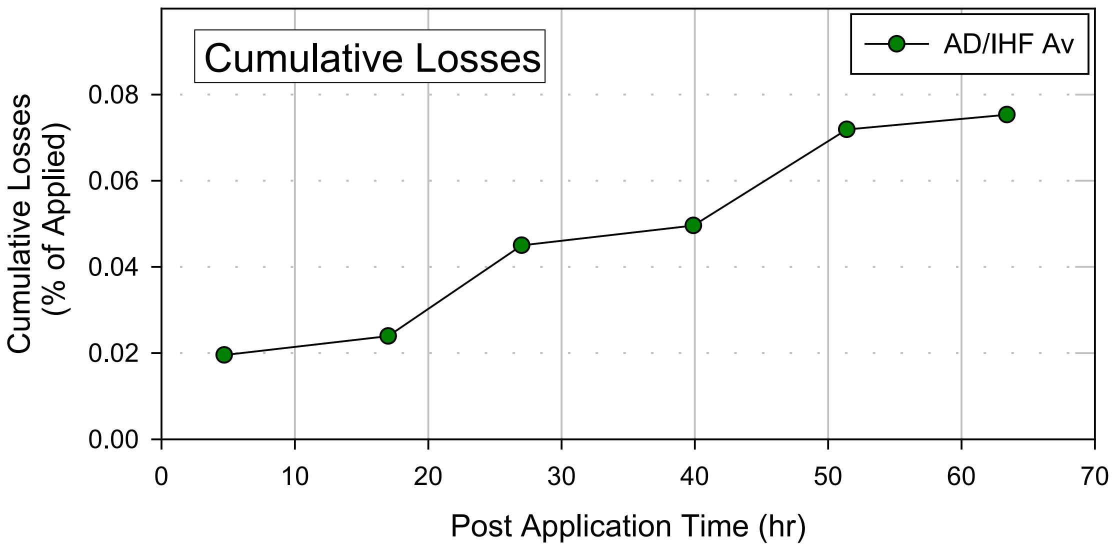
Table 2. Sensitive soybean bioassay averaged injury (%) at 28 days after application.

30% injury on sensitive soybean (pic up)

20% injury on sensitive soybean (pic up)

Figures below show the dicamba flux and cumulative losses from treated area in Deatsville study.





No average soybean bioassay showed more than 15% damage in the whole study at 28 days after application. Dicamba vapor caused minor injury on sensitive soybean placed 100 ft away from the spray block. Air samplers were placed around the spray block to sample dicamba vapor in air continuously from 0-72 hour after application. Data suggested highest flux (volatility rate) observed in that field was around 0.7 ng/m2/sec, with a cumulative loss of 0.075% of total dicamba applied through sprayer. The volatility rate and cumulative dicamba loss 0-72 hr after application from this location was much lower than another location (EV Smith REC), due to the fact that application at the other location was made in much higher temperature (98F-100F) and soil moisture plus air humidity were very low due to extended drought. Through this 3-yr study, we learned that most significant factor contributed to dicamba volatility is temperature. Double crop planted into heavy cover crop residue or wheat stubble has a higher potential to create more dicamba vapor than dry bareground. Low pH in tank mix will significantly increase dicamba volatility. Moisture on the ground and more green leaves in the field (both crops and weeds) will increase total dicamba loss from the treated area. Therefore, early season application of dicamba is the best practice to reduce dicamba volatility and damage potential to sensitive crop nearby the treated area.

Efficacy of Cotton Residual Herbicides in High Residue Cover Crop Systems

S. Li

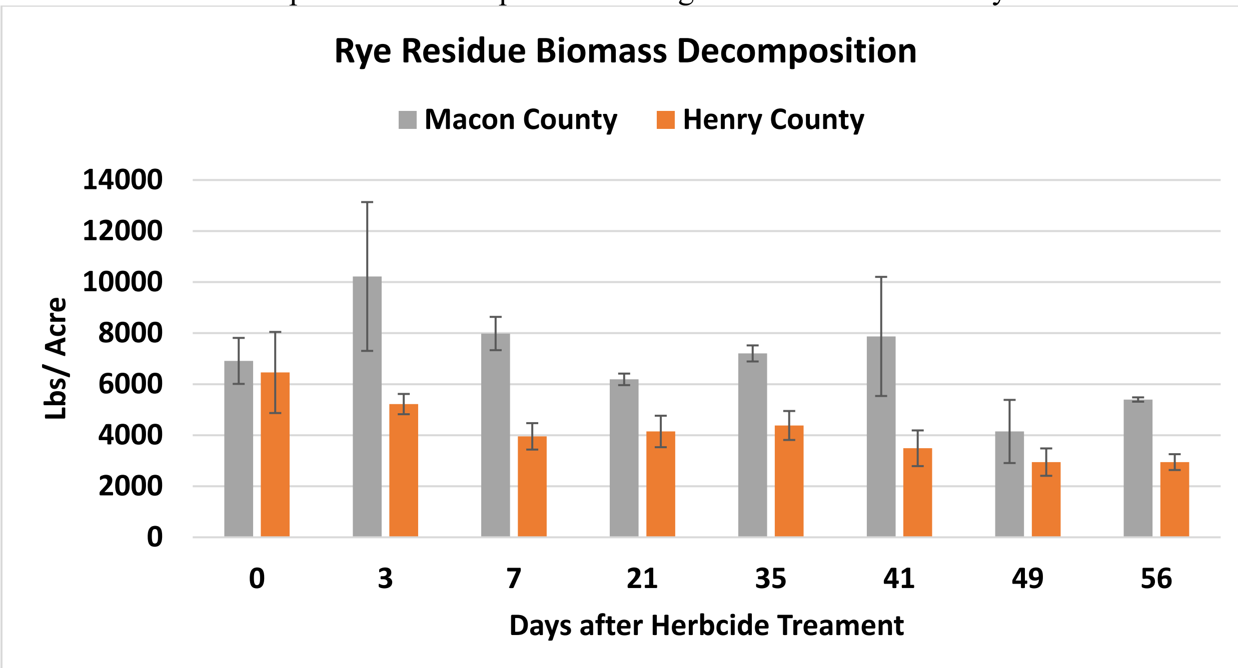
The overall objective of this trial was to determine if residual herbicides reach the soil surface providing weed control benefits in a system utilizing high residue cover crop by measuring percentage of weed control, weed population counts, the length of weed control and weed biomass compared to conventionally tilled systems. Field trials were conducted under irrigation in Henry and Macon County in Alabama at Wiregrass and EV Smith Research and Education Centers, respectively in 2019. Rye was planted in October and November at 100 lbs/A and then terminated in early March. It was rolled and then sprayed with Roundup PM. Next to the fields with the high rye residue were conventionally tilled fields to insure equal weed populations. Conventionally tilled cotton was planted May 17, 2019, while the high residue plots were no tilled planted May 22, 2019 in Henry County. In Macon County, all of the cotton plots were planted May 28, 2019. Herbicides were applied the day of planting and immediately watered in with 1.27 cm of irrigation. Treatments were applied with a backpack sprayer with TT110025 nozzles on a 4 nozzle boom calibrated at 20 GPA. It was a completely randomized block design with 4 replications. Plots were 4 rows by 25 feet. Stand counts and plant heights were taken 21 days after planting for each crop in conventionally tilled and high residue systems. Weed control ratings were taken for the entire plot every 7 days after planting. Weed population counts were taken by randomly placing two 2 ft^2 quadrats within the two middle rows and each species was counted every 7 days after planting. At 8 weeks after planting two 2 ft^2 quadrats were placed within each plot and total weed biomass was collected. Four 2 ft^2 quadrats of rye were taken at 0, 3, 7, 21, 35, 40, 49, and 56 days after herbicide application. These samples were dried and weighed to determine how the rye residue decomposed over the time. Three soil samples of the top 3 inches were randomly taken in each plot at 0, 3, 7, 14, 21, 28, 35, 42, 56 days after planting. These samples will be analyzed to determine the amount of herbicide remaining in the soil throughout the season. They will be analyzed later in spring 2020.

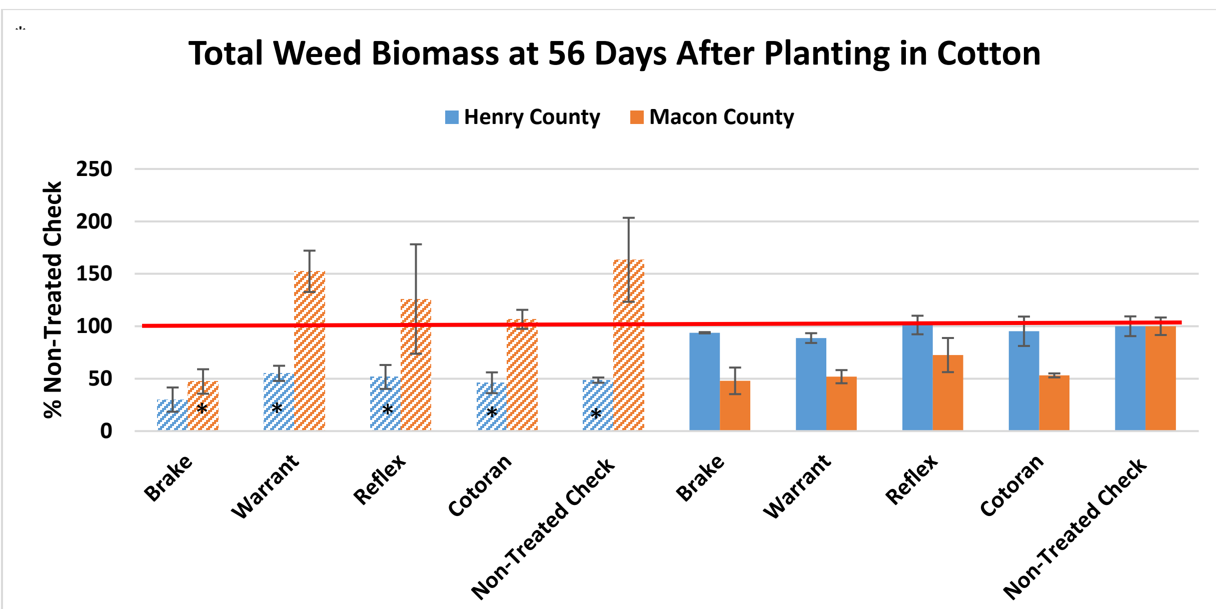
Treatment	**Rate per Acre**
Brake	32 oz
Warrant	3.2 pt
Reflex	1 pt
Cotoran	3 pt

Non-Treated Check	

Same treatments were applied to the high residue and to the conventionally tilled plots.

Below is the cover crop residue decomposition through the source of the study at both locations:





- Diagonal bars indicates it was the high residue cover crop plots
- *Indicates it was significantly reduced from the conventionally tilled non-treated check.

In Henry County, all treatments with high residue had significantly reduced weed biomass from 45-75% compared to the conventionally tilled non-treated check (CTNTC). In Macon County, no treatments had significantly reduced biomass compared to CTNTC. Brake in the high residue and conventional tilled plots were reduced by 52-53% respectively from CTNTC, however these reductions were not statistically significantly different. The high residue treatments in Macon County likely did not provide additional weed control compared to the CTNTC due to the large nutsedge population that was observed. Brake provided the best control in cotton when combined with high residue at both location. Overall, several of the treatments with high residue did provide better weed control than just herbicides alone. Therefore, integration of high cover crop residue with pre-emergent residual herbicides provides an effective option for integrated weed management based off of this study. An application of residual herbicide at crop planting is still needed in high-residue cover crop system to provide longer weed control. Further research needs to be done to conclude at what point do both systems need a POST application and does the high residue provide you a longer window to spray your first POST application.

Brake Henry County 56 DAP

High Residue **High Residue NTC**

V. Insect Management

Controlling Escape Bollworms in Two Gene Cotton ACC#11

R. Smith

This project was conducted in two separate but adjacent trials at the Prattville Agricultural Research Unit. Trial One was planted to PHY444 to allow for as many escapes as possible in order to study the effect of timing (egg versus larval threshold) and the choice of chemical class (pyrethroid versus Prevathon/Beseige). In this trial, Fipronil was applied to the soil prior to planting to eliminate the fire ant population season long. About one week prior to the July corn earworm flight from corn, Orthene at 1.0 lb/ac was applied to eliminate all beneficial insects. Designated bollworm treatments, based on egg thresholds, were applied on July 19. Other treatments based on larval thresholds were applied July 24. The number of worm damaged bolls per 30 row foot were made on August 12 and September 18 (Tables #1 and #2). On both dates the number of escape worms were higher in the untreated plots. However, the overall numbers of escape worms were so low that no conclusions could be made between timing or choice of chemical treatments. One thing that should be noted is that the number of escapes did vary greatly between the randomized replicates. This is important for those monitoring fields commercially, in that larger sample sizes may be needed to quantify the number of escape bollworms when low numbers of escapes are present.

Table 1. Bollworm Timing, Prattville Agricultural research Unit 2019

Date of Survey: 8/12/19

			Worm Damaged Bolls/30 row ft.				
TRT. NO.	TREATMENT	TYPE THRESHOLD DATE	Rep. I	Rep. II	Rep. III	Rep. IV	MEAN
1	Pyrethroid (Warrior @ 2.5 oz/A)	Larval 7/24/19	1	0	0	0	0.2
2	Pyrethroid (Warrior @ 2.5 oz/A)	Egg 7/19/2019	2	4	0	0	1.5
3	Beseige @ 8 oz/A	Larval 7/24/2019	0	0	0	0	0
4	Beseige @ 8 oz/A	Egg 7/19/2019	0	6	0	0	1.5
5	Prevathon @ 16 oz/A	Larval 7/24/2019	1	0	2	0	0.8
6	Prevathon @ 16 oz/A	Egg 7/19/2019	0	1	0	0	0.2
7	Prevathon @ 20 oz/A	Egg 7/19/2019	0	0	0	0	0
8	Untreated	------------------	12	2	3	4	5.2

Table 2: Bollworm Timing, Prattville Agricultural research Unit 2019

Date of Survey: 9/18/19

			Worm Damaged Bolls/30 row ft.				
TRT. NO.	**TREATMENT**	**TYPE THRESHOLD DATE**	**Rep. I**	**Rep. II**	**Rep. III**	**Rep. IV**	**MEAN**
1	**Pyrethroid (Warrior @ 2.5 oz/A)**	**Larval 7/24/19**	**1**	**0**	**0**	**0**	**0.2**
2	**Pyrethroid (Warrior @ 2.5 oz/A)**	**Egg 7/19/2019**	**2**	**4**	**0**	**0**	**1.5**
3	**Beseige @ 8 oz/A**	**Larval 7/24/2019**	**0**	**0**	**0**	**0**	**0**
4	**Beseige @ 8 oz/A**	**Egg 7/19/2019**	**0**	**6**	**0**	**0**	**1.5**
5	**Prevathon @ 16 oz/A**	**Larval 7/24/2019**	**1**	**0**	**2**	**0**	**0.8**
6	**Prevathon @ 16 oz/A**	**Egg 7/19/2019**	**0**	**1**	**0**	**0**	**0.2**
7	**Prevathon @ 20 oz/A**	**Egg 7/19/2019**	**0**	**0**	**0**	**0**	**0**
8	**Untreated**	**------------------**	**12**	**2**	**3**	**4**	**5.2**

The second part of ACC Project #11 (Trial Two), was a 10 treatment trial consisting of various 2 and 3 gene varieties, sprayed and unsprayed (Prevathon), with and without fire ants in the system (Tables #3 and #4). A survey was made by counting the number of worm damaged bolls (WDB) per 30 row feet on August 14 and September 18 where no fire ants were present. Only the end of season (Sept. 18) worm damaged boll counts were made where fire ants were present since damaged bolls could not be detected on August 14 with fire ants in the system. Where fire ants were absent, the greatest number of WDB's were found in the conventional cotton (DP 1822) untreated, followed by PHY444 untreated. It should be noted that even with a conventional variety untreated for worms, the number of WDB's per 30 row feet were less than 1 worm per 2 row feet. This is a reflection of the light worm pressure that was encountered in this trial at Prattville for the second consecutive year. The DP 1822 was the lowest yielder which was probably influenced more by the maturity group than by the amount of worm damaged bolls. With fire ants in the system, this identical adjacent trial had less WDB's on the September 18 survey (Table #4). The only variety that had a significant number of WDB's was the DP 1822 conventional. Again this treatment (DP 1822) was the lowest yielder. However, it should be noted that the overall yields in the presence of fire ants was lower than where they were not present. It was noted by this investigator that stink bug damage was much heavier in the area where fire ants were present. For the past 3-4 seasons 3 species of stink bugs have been a limiting factor in conducting small plot research at the Prattville Research Unit.

Table 3: Bollgard II, No Fire Ants, Prattville Agricultural Research Unit 2019

				Worm Damaged Bolls/30 row ft.		
TRT. NO.	**INSECTICIDE**	**WORM TRAIT**	**VARIETY**	**8/14**	**9/18**	**YIELDS- LBS. SEED COTTON/AC.**
1	**No**	**WSII**	**PHY 444**	**4.3**	**2.8**	**3632**
2	**No**	**WSIII**	**PHY 480**	**0**	**0.2**	**4003**
3	**No**	**Conv. with RR**	**DP 1822**	**13.3**	**4.5**	**3132**
4	**No**	**BGII**	**DP 1646**	**1.5**	**2.5**	**3645**

5	No	BGIII	DP 1840	0.2	0	3712
6	No	Twin Link Plus (3 gene)	ST 5471	0.2	0	3733
7	Prevathon	WSII	PHY 444	0.2	0.2	3834
8	Pyrethroid	WSII	PHY 444	1.0	0.5	3773
9	Prevathon	BGII	DP 1646	0.5	0	3733
10	Pyrethroid	BGII	DP 1646	0.2	0.2	3861

Table 4: Bollgard II, Fire Ants, Prattville Agricultural Research Unit 2019

				Worm Damaged Bolls/30 row ft.	
TRT. NO.	INSECTICIDE	WORM TRAIT	VARIETY	9/18	YIELDS- LBS. SEED COTTON/AC.
1	No	WSII	PHY 444	0.8	3186
2	No	WSIII	PHY 480	0	3618
3	No	Conv. with RR	DP 1822	6.8	3078
4	No	BGII	DP 1646	0	3692
5	No	BGIII	DP 1840	0.2	3584
6	No	Twin Link Plus (3 gene)	ST 5471	0	3476
7	Prevathon	WSII	PHY 444	0.8	3287
8	Pyrethroid	WSII	PHY 444	0.2	3868
9	Prevathon	BGII	DP 1646	0	3848
10	Pyrethroid	BGII	DP 1646	0	3814

State Pheromone Trapping Program for Bollworm, Tobacco Budworm, and *Heliothis armigera* (Old Worm Budworm) ACC#22

R. Smith

A season long (June to September) pheromone trapping program for cotton bollworm, tobacco budworm and the African bollworm (*Heliothis armigera*), otherwise known as the Old World bollworm, was conducted at five sites in central and south Alabama. The trapping is focused in the southern part of the state because most of these species migrate from south to north. Specific locations of traps were: Headland, Brewton, Fairhope Prattville and Tallassee, AL. This trapping program provided entomologists with advanced warning when certain species were present and/or increasing in a given region. Information from these traps was disseminated to Regional Extension Agents, consultants, agrifieldmen and growers by tweets, weekly AGFAX reports and 800 line Pest Patrol report. Traps utilized by this program were the entomological standard used in all southeastern and midsouth states. They are the Hartstack model cone shaped, 36 inch in diameter with a wire trap at the top which can be switched out weekly when the moths are collected, counted and preserved for analysis. The cotton bollworm and the African bollworm, known to occur as nearby as Puerto Rico, cannot be separated visually but instead must be separated by DNA analysis. The significance of the African bollworm is two fold: they can hybridize with our cotton bollworm and cannot be effectively controlled with our currently labeled insecticides. These two species will actually attract to the pheromone of each other, so all specimens have to be analyzed in order to separate. The numbers collected by species and date are shown on the following tables. DNA analysis will be done by Dr. Alana Jacobson's lab, Dept. of Entomology and Plant Pathology, Auburn University, during the winter months.

Cotton Bollworm

Location	Dates/No. Moths Captured							
			6/28	7/15	7/26	8/9	8/26	
Fairhope			7/8	7/19	8/2	8/16	9/4	9/10
			67	30	12	84	66	
			154	87	135	202	X	6
			7/1	7/15	7/30	8/12	8/26	
Brewton	6/17	6/23	7/8	7/22	8/5	8/19	9/3	9/9
			33	50	72	X	45	
	77	10	11	15	6	7	5	11

				7/1	7/15	7/29	8/12	
Prattville				7/8	7/22	8/5	8/19	8/26
				8	35	57	25	
				27	10	0	5	6
				7/1	7/15	7/29	8/12	8/27
Tallassee	6/12	6/17	6/24	7/8	7/22	8/5	8/20	9/3
				17	237	90	90	34
	77	14	20	140	501	191	209	19

African (Old World) Bollworm

Location	Dates/No. Moths Captured								
				6/28	7/12	7/26	8/9	8/26	
Fairhope				7/8	7/19	8/2	8/16	9/4	9/10
				36	3	3	38	23	
				2	88	92	99	2	2
				7/1	7/15	7/22	8/6	8/26	
Brewton		6/17	6/23	7/8	X	7/30	8/19	9/3	9/9
				2	0	0	0	3	
		30	19	0	X	10	1	4	3
	5/30			6/27	7/11	7/25	8/7	8/26	
Headland	6/6	6/13	6/20	7/5	7/18	8/1	8/19	9/2	9/12
	7			2	2	9	X	3	
	8	6	5	6	3	10	X	X	14

Tobacco Budworm

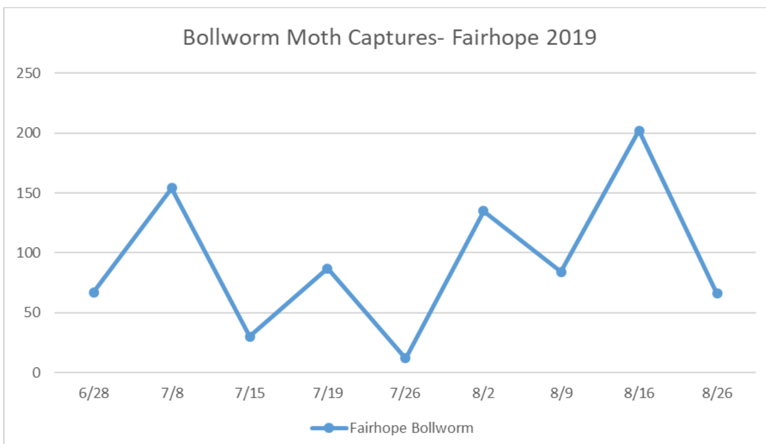
Location	Dates/No. Moths Captured							
	5/30	6/13	6/27	7/11	7/25	X	8/26	
Headland	6/6	6/20	7/5	7/18	8/1	X	9/2	9/12
	15	10	24	180	15	X	103	
	13	3	13	7	20	X	X	13
						8/12		
Prattville					8/5	8/19	8/26	
						57		
					25	105	61	

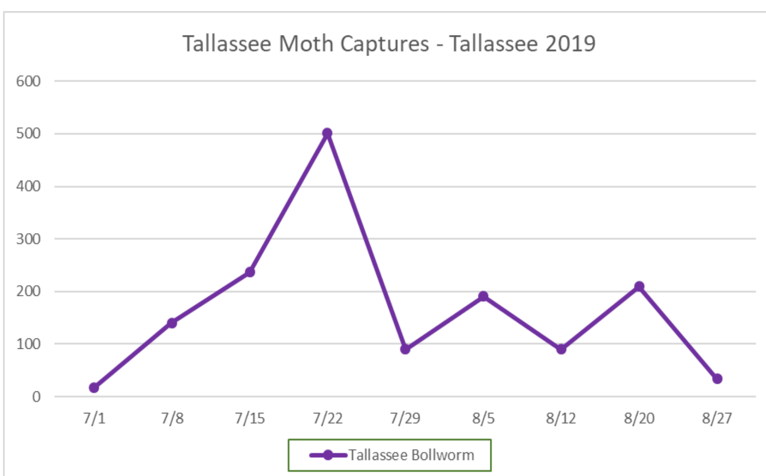
Fall Armyworm

Location	Dates/No. Moths Captured						
		6/17	7/1	7/15	7/28	8/12	8/27
Shorter(EVS)	6/12	6/24	7/8	7/22	8/5	8/20	9/3

	17	21	22	22	10	33
46	21	12	84	7	13	5

Conclusions: As noted by the numbers of moths trapped at the various sites, pheromone traps seem to be more effective at capturing moths at some locations than others. This trend changes by year at certain locations but continues over multiple years at others. Both Headland and EVS-Shorter consistently capture low numbers of moths of all species, even when the traps are placed in row crop proximity. Fairhope, Tallassee and most years Brewton and Prattville, capture high numbers of certain species of moths. Graphs are shown below of Fairhope and Tallassee bollworm captures for 2019. As can be observed, distinct generations of bollworms can be charted at both of these locations. As to the Old World bollworm species, moth captures were much higher at Fairhope than Brewton or Headland.



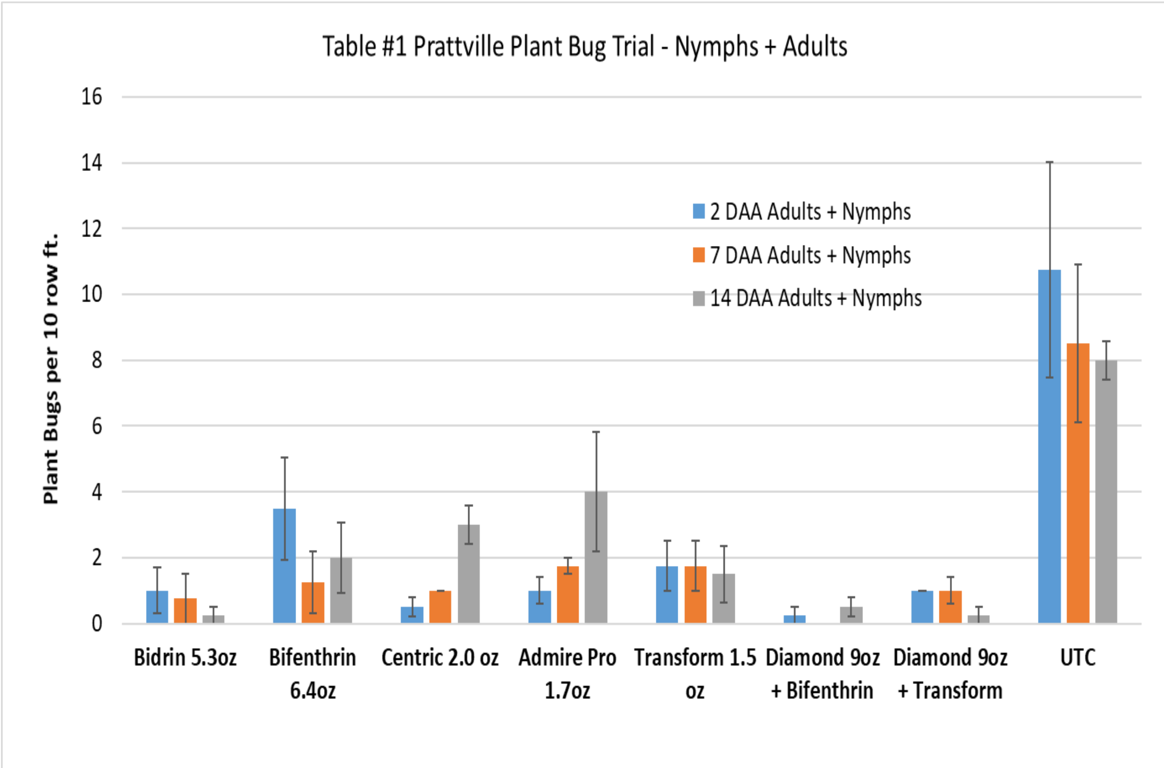


Initial and Residual Efficacy of Insecticides in Controlling Tarnished Plant Bugs Infesting Cotton ACC#26

R. Smith and B. Freeman

Small plot replicated trials to determine the initial and residual efficacy of several insecticides recommended for control of plant bugs were conducted at two locations in 2019, Tennessee Valley Research and Extension Center, Belle Mina, AL and the Prattville Agricultural Research Unit, Prattville, AL. The Prattville location was planted to DP 1646 on April 25. Plots were 4 rows by 30 feet in length with 4 replicates. This trial was initiated on June 25 when plant bug numbers reached a threshold level of slightly more than one immature plant bug per foot. Insecticides and rates, along with plant bug numbers are shown in Table 1. Two drop cloth samples of five feet each were taken from the center two rows by beating the plants over a cloth at 2, 7 and 14 days after application.

Conclusions: All treatments reduced the plant bug population below economic levels at 2 days after application and maintained this reduction through the 7 and 14 day post treatment counts (Table 1). The least effective treatment at 2DAA was bifenthrin at 6.4 oz/ac. The most effective treatments throughout the direction of the trial were Bidrin, bifenthrin + Diamond and Transform + Diamond. Treatments that gave the least residual control at 7 and 14 DAA were Centric and Admire Pro. The plant bug population in the untreated plots did not increase, but instead dropped slightly at 7 and 14 days following the initiation of this trial. Yields (lbs. of seed cotton per acre.) from the various treatments range from 3600 down to 3175. The untreated check yielded the highest at 3600 while Bidrin, one of the most effective treatments yielded the lowest at 3175. Therefore, factors other than those evaluated in this trial, likely had an influence on the yields. The trial was not oversprayed for other pests such as stink bugs until July 22 at which time it was discovered that internal boll damage due to stink bugs was at 47%. The trial was oversprayed with Bidirn on July 22 and bifenthrin on August 5.



YIELDS

3175	3475	3400	3300	3250	3300	3550	3600

LBS. SEED COTTON PER ACRE

Tarnished Plant Bug Control in Cotton-2019

B. Freeman, A. W. Page, and T. Sandlin

The tarnished plant bug has been a more consistent pest of cotton in North Alabama than in the rest of the southeastern United States. Plant bug numbers and damage during August have been increasing noticeably for at least the past four years in the Tennessee Valley area of North Alabama. There are two possible explanations for this: 1) plant bugs have undergone a change and have begun to immigrate into mid- and late-season cotton, or 2) the efficacy of our commonly used insecticides is no longer what it once was. This trial was designed to evaluate insecticides from multiple classes of chemistry against the tarnished plant bug and to observe the migratory habits of adult plant bugs in North Alabama.

Materials & Methods

The trial was conducted on the Tennessee Valley Research & Extension Center in Limestone County, AL, and the cotton was irrigated. The cotton was DP 1646 and planted on May 2, 2019. Plots were eight rows wide and 25 feet in length. Treatments (Table 1) were randomized and replicated four times each. The test area was scouted weekly from late June until initiation of the trial in early August. Plant bug pressure was light but consistent throughout July, averaging roughly one plant bug per foot of row. As the cotton was maturing rapidly, a decision was made to apply treatments on August 5, which was accomplished using ground equipment. Post-treatment counts for plant bugs and beneficial arthropods were made by taking one, five foot drop cloth sample per plot on August 9 and August 15. Beneficial arthropods sampled were: Orius (minute pirate bugs), Geocoris (big-eyed bugs), Nabis (nabids), lady beetles, lacewings, and spiders. Plant bugs and all beneficials except spiders were separated as adults or immatures. Ten white blooms and ten quarter-sized bolls were sampled from each plot on August 15 to determine the percentage of dirty blooms and bug damaged bolls. Two center rows of each plot were mechanically harvested on October 16.

Results & Discussion

The plant bug population was light during the trial, but it was an embedded infestation of all life stages. The plants were large and growthy, making insecticide coverage difficult. Plant bug control by treatments ranged from 0 to 81% at four days post-treatment and from 0 – 90% ten days after treatment (Table 2). Plant bug control with pyrethroids has eroded severely over the past four years in the Tennessee Valley region of North Alabama, moving from west to east. The results of this trial show just how severe this resistance has become (Table2). The two organophosphate entries, Bidrin and Orthene, provided good suppression of plant bugs but not much more at the rates used in this study (Table 2). The neonicitinoid entries, overall, were not particularly impressive either, despite Transform's results on Aug. 9 (Table 2). Diamond is an insect growth regulant and is only active against nymphal plant bugs. The two rates of Diamond alone by no means stood out at four days after treatment, but at 10 days post-treatment they provided the best control of all stand alone treatments and were only slightly bettered when Transform and Bidrin were added to Diamond (Table 2). Few adult plant bugs were present at the beginning of the trial, though a few more began to appear by mid-August in some treatments (Table 2). Virtually every adult plant bug sampled after July 10 in the weekly samples and the adults sampled after the initiation of this trail were callow adults, i.e., bred-in-the-field adults and not plant bugs migrating from some other host plant. At 10 days after treatment, no real improvement in overall plant bug control could be seen by the addition of Transform or Bidrin to the six-ounce rate of Diamond (Table 2).

When plant bug damage was examined on August 20, 15 days after treatment, the treatment effects on dirty blooms ranged from a reduction of 86% to 29% from the damage found in the control plots (Table 3). Due to lag time and other variables, treatment effects on square and boll damage are not as clear-cut as with a comparison of plant bug efficacy. Diamond and Bidrin were the best at reducing the number of dirty blooms, but when boll damage was examined, the results of Diamond were less impressive (Table 3). Orthene, Bifenthrin, and Centric reduced fruit damage less than other treatments (Table 3). Some, but not all, of the varied results between the treatment effects on fruit damage versus plant bug reduction can be explained by the stink bug population present during this trial. Stink bugs averaged 34 per 100 feet of row on August 9 and 128 on August 15. 60% of the stink bugs on August 15 were brown stink bugs, 39% were green stink bugs and 1% were brown marmorated stink bugs. Only Bidrin, Orthene and Bifenthrin would be expected to have meaningful activity against stink bugs, and Bifentrhin would only be expected to provide suppression against the brown stink bug, while Diamond and the neonicitinoids would be expected to have little or no stink bug activity.

Important predators of cotton insects were sampled on August 9 and August 15. The heteropteran predators sampled were big-eyed bugs, minute pirate bugs, and nabids. Excluding fire ants, these three species are our most critical predators against bollworms, and their being heteropterans is important because plant bugs are also of this order of insects and closely related. Lady beetles and lacewings are important predators of aphids, and spiders are general predators. Bollworm predators were initially reduced by a range of 25-80% and the reduction in all predators ranged from 15-79% (Table 4). Of all the treatments, Transform demonstrated the most selectivity (Table 4). The results from August 15 show a reduction in bollworm predators of 38-79% and an overall predator reduction of 25-66% (Table 4). The boasts of insecticide advertisements as being "easy on beneficials" are often overstated, and the results in Table 4 show that any of the products are capable of aggravating pest populations. Cotton yields were exceptional for all treatments, but there was a 425 pound seed cotton yield difference between the top and bottom treatments (Table 5). Since this trial was conducted later in the season, many of the plant bug damaged fruiting forms were affected by the severe September heat and drought, possibly negating some of the treatment effects on yield.

Please recall that this trial was conducted on a modest plant bug population. Additional data would be necessary to clearly separate some treatments, however, this trial does show how weak the pyrethroids have become against the tarnished plant bug, that the organophosphates are not performing as they have in the past and that higher rates probably should be used, and that Diamond has good efficacy against immature plant bugs. Furthermore, there is no evidence to show any late season migration of plant bugs to cotton.

Table 1. Insecticide treatments and rates.

	Treatment	Lbs. ai/acre
1	Untreated control	--
2	Bidrin 8	.25
3	Orthene 97	.40
4	Diamond .83 EC	.039
5	Bifenthrin 2EC	.08
6	Diamond .83 EC + Bidrin 8	.039 +.25
7	Transform 50 WG	.047
8	Diamond .83 EC	.058
9	Diamond .83 EC + Transform 50 WG	.039 +.047
10	Centric 40 WG	.05

Table 2. Plant bugs per 100 row feet.

		Aug. 9			Aug. 15			
Treatment	Adults	Nymphs	Total	% Change from Control	Adults	Nymphs	Total	% Change from Control
Control	5	130	135	--	10	95	105	--
Bidrin	5	55	60	-56	10	25	35	-67
Orthene	0	35	35	-74	15	25	40	-62
Diamond .039	10	45	55	-59	5	10	15	-86
Bifenthrin	5	140	145	+7	20	115	135	+29
Diamond + Bidrin	5	25	30	-78	0	15	15	-86
Transform	0	25	25	-81	0	50	50	-52
Diamond .058	0	60	60	-56	0	25	25	-76
Diamond + Transform	0	65	65	-52	0	10	10	-90
Centric	0	65	65	-52	0	35	35	-67

Table 3. Percent plant bug damaged fruit on Aug. 20.

Treatment	**% Dirty Blooms**	**% Change from control**	**% Damaged Bolls**	**% Change from Control**	**% Dirty Blooms + % Damaged Bolls**	**% Change from Control**
Control	35	--	53	--	88	--
Bidrin	10	-71	15	-72	25	-72
Orthene	20	-43	45	-15	65	-26
Diamond .039	5	-86	18	-66	23	-74
Bifenthrin	25	-29	33	-38	58	-34
Diamond + Bidrin	13	-63	13	-75	25	-72
Transform	23	-34	18	-66	40	-55
Diamond .058	8	-77	20	-62	28	-68
Diamond + Transform	8	-77	20	-62	28	-68
Centric	23	-34	33	-38	56	-36

Table 4. Predators per 100 row feet. Geocoris = big-eyed bug; Orius = minute pirate bug; Nabis = nabid; LB = lady beetle; LW = lacewing; Heteropteran predators = Geocoris, Orius, & Nabis.

	August 9									
Treatment	**Geocoris**	**Orius**	**Nabis**	**LB**	**LW**	**Spider**	**Heteropt. predators**	**% Change from Control**	**All pred.**	**% Change from Control**
Control	0	105	0	15	0	120	105	--	240	--
Bidrin	10	50	5	15	0	15	65	-38	95	-60
Orthene	35	15	5	0	0	40	55	-48	95	-60
Diamond .039	20	20	20	15	0	95	60	-43	170	-29
Bifenthrin	10	25	0	0	5	10	35	-67	50	-79
Diamond + Bidrin	15	30	5	20	0	20	50	-52	90	-63
Transform	0	75	5	20	0	70	80	-24	175	-27
Diamond .058	25	30	5	15	0	140	60	-43	205	-15
Diamond + Transform	10	20	0	15	0	85	30	-71	155	-35
Centric	5	20	0	10	5	50	25	-76	90	-63

	August 15									
Treatment	**Geocoris**	**Orius**	**Nabis**	**LB**	**LW**	**Spider**	**Heteropt. predators**	**% Change from Control**	**All pred.**	**% Change from Control**
Control	45	85	15	30	0	90	145	--	265	--
Bidrin	60	25	5	10	5	50	90	-38	155	-42
Orthene	55	10	5	10	0	80	70	-52	160	-40
Diamond .039	35	10	0	10	5	95	45	-69	155	-42
Bifenthrin	5	45	0	5	0	35	50	-66	90	-66
Diamond + Bidrin	0	20	10	35	0	45	30	-79	110	-58
Transform	15	30	0	15	5	85	45	-69	150	-43
Diamond .058	15	10	5	25	0	70	30	-79	125	-53
Diamond+ Transform	25	35	0	55	5	80	60	-59	200	-25
Centric	25	25	0	20	0	60	50	-66	130	-51

Table 5. Seed cotton yield; 10/16/2019

	Treatment	Lbs of seed cotton per acre
1	Control	4875
2	Bidrin	4827
3	Orthene	4848
4	Diamond .039	4938
5	Bifenthrin	4826
6	Diamond + Bidrin	4945
7	Transform	4813
8	Diamond .83	4892
9	Diamond + Transform	5238
10	Centric	4835

Efficacy of Different Thrips Management Options in Reducing Damage and Preserving Cotton Yields ACC#28

R. Smith and B. Freeman

Small plot replicated trials to evaluate varying thrips management options were conducted at two locations in 2019, the Tennessee Valley Research and Extension Center, Belle Mina, AL, and the Prattville Agricultural Research Unit, Prattville, AL. The Prattville location was planted to DP 1646 on April 17. Plots were 4 rows by 30 feet in length with 4 replicates. At planting and foliar treatments are shown in Table 1. Damage ratings (1-5 scale) were made at the 4th and 5th true leaf stages. Thrips counts (adult and immature) were made at the 2nd and 4th leaf stage by dipping 5 plants, selected fron the center 2 rows, in alcohol and transported to the lab for counting (Table 2). Plant height was measured at the 2, 4 ,6, 8 and 9th true leaf by measuring 5 plants per plot (Table 3). A measure of earliness?? was made the first and again the second week of white bloom by counting the numbers of white blooms per 30 foot of rows (Table 4). Yields in lbs. of seed cotton per acre are presented in Table 5 for each treatment.

Conclusions: The fewest thrips at the true leaf stage were in the Aeris seed treatment alone and Aeris oversprayed with Intrepid Edge. At the 4 leaf stage Aeris + Orthene foliar spray and AgLogic (aldicarb) had the fewest thrips. The thrips injury level (1-5 scale) was lowest at both the 2 and 4 leaf stage in the AgLogic treatment. All treatments had less thrips numbers and less damage than the untreated check (Table 2). Plant height was taken in each treatment at 5 stages of seedling cotton (Table 3). By the 5-6 true leaf stage, Velum, Admire Pro + Orthene in furrow, AgLogic and Aeris + Intrepid Edge treatments were the tallest plants. This trend continued for the next 7-10 days. During the first and second week of bloom counts were made on the number of white blooms per 30 row feet (Table 4) as a measure of earliness. The treatments with the fewest thrips, least damage and tallest plants also had the greatest number of white blooms. These were Admire Pro + Orthene IF, AgLogic and Aeris + Intrepid Edge foliar spray. The untreated plots had no blooms on week one and the fewest blooms the following week. In some cases, thrips injury may not impact yield, however, they usually delay maturity and reduce earliness. Yields from this trial ranged from about 2400 lbs. of seed cotton up to about 2800 lbs. but did not follow the same trends as the earlier measurements. One explanation for this might have been due to stink bug injury. On July 26, 10 day old bolls were sampled for internal stink bug injury. Approximately 94% of the

10 day old bolls on that date had stink bug damage. Oversprays of Bidrin was made on July 22 followed by bifenthrin on August 5 to reduce stink bug numbers.

Table 1

Trt. #	Treatment	Seed Type	Rate
1	Velum IF	Untreated	14 oz
2	AdmirePro IF	Untreated	7.4 oz
3	Admire Pro + Orthene IF	Untreated	7.4 oz + 0.75 lbs.
4	On Seed	Aeris	
5	On Seed	Avicta Elite	
6	Orthene FS	Aeris	
7	Orthene FS	Avicta Elite	
8	Radiant FS	Aeris	1.5 oz
9	AgLogic	Untreated	5.0 lbs.
10	Residue (Wheat straw)	Untreated	
11	Intrepid Edge FS	Aeris	3.0 oz
12	Untreated	Untreated	

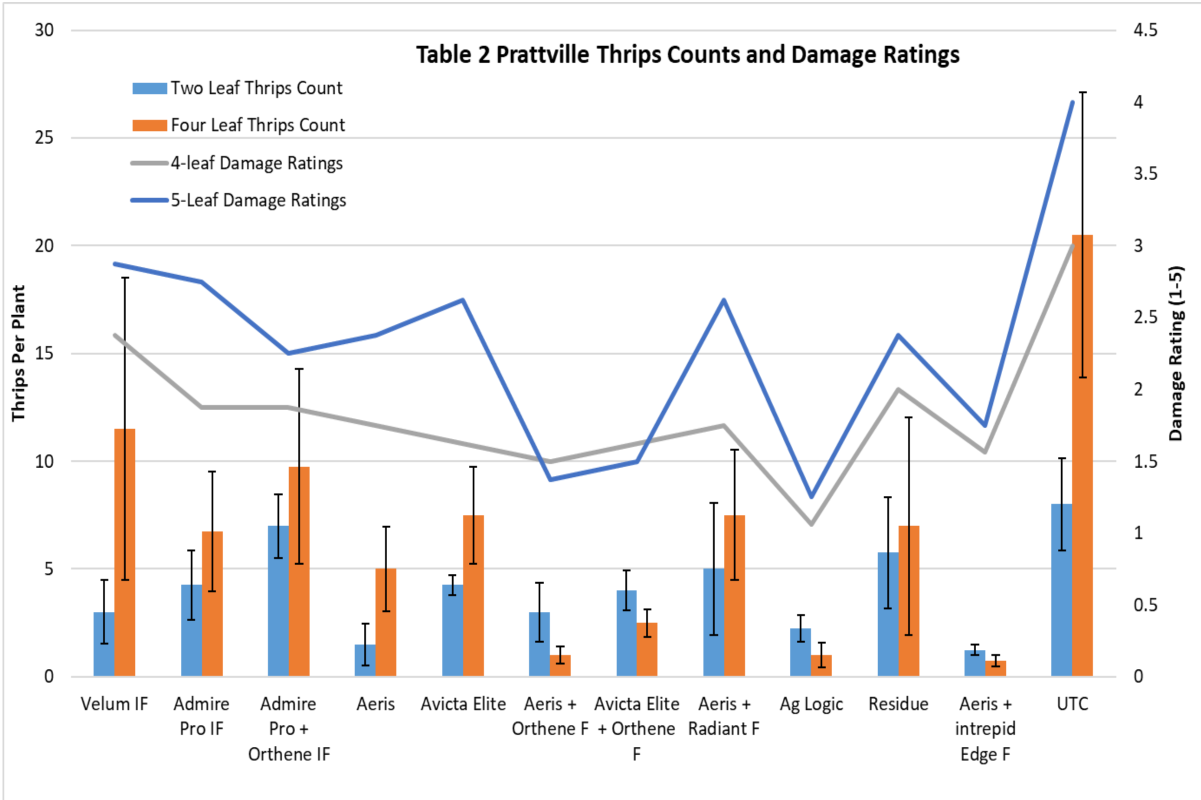


Table 2 Prattville Thrips Counts and Damage Ratings
Two Leaf Thrips Count
Four Leaf Thrips Count
4-leaf Damage Ratings
5-Leaf Damage Ratings
Thrips Per Plant
Damage Rating (1-5)
30
25
20
15
10
5
0
4.5
4
3.5
3
2.5
2
1.5
1
0.5
0
Velum IF
Admire Pro IF
Admire Pro + Orthene IF
Aeris
Avicta Elite
Aeris + Orthene F
Avicta Elite + Orthene F
Aeris + Radiant F
Ag Logic
Residue
Aeris + intrepid Edge F
UTC

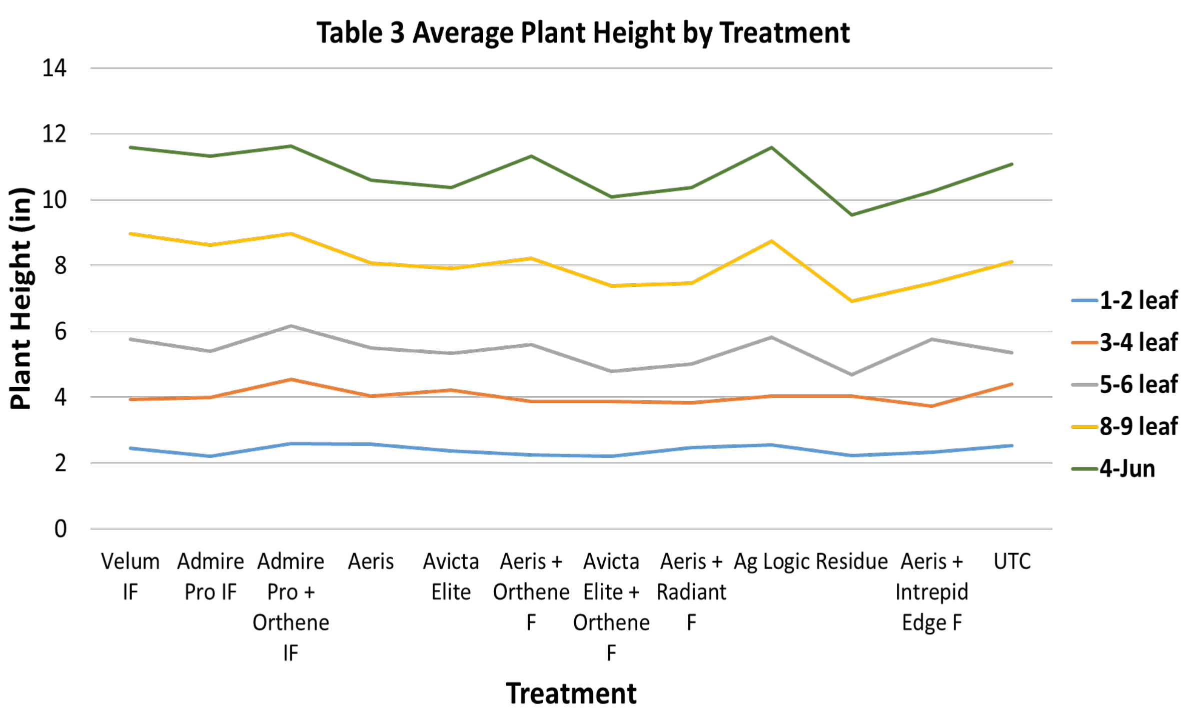


Table 3 Average Plant Height by Treatment
Plant Height (in)
14
12
10
8
6
4
2
0
Velum IF
Admire Pro IF
Admire Pro + Orthene IF
Aeris
Avicta Elite
Aeris + Orthene F
Avicta Elite + Orthene F
Aeris + Radiant F
Ag Logic
Residue
Aeris + Intrepid Edge F
UTC
Treatment
1-2 leaf
3-4 leaf
5-6 leaf
8-9 leaf
4-Jun

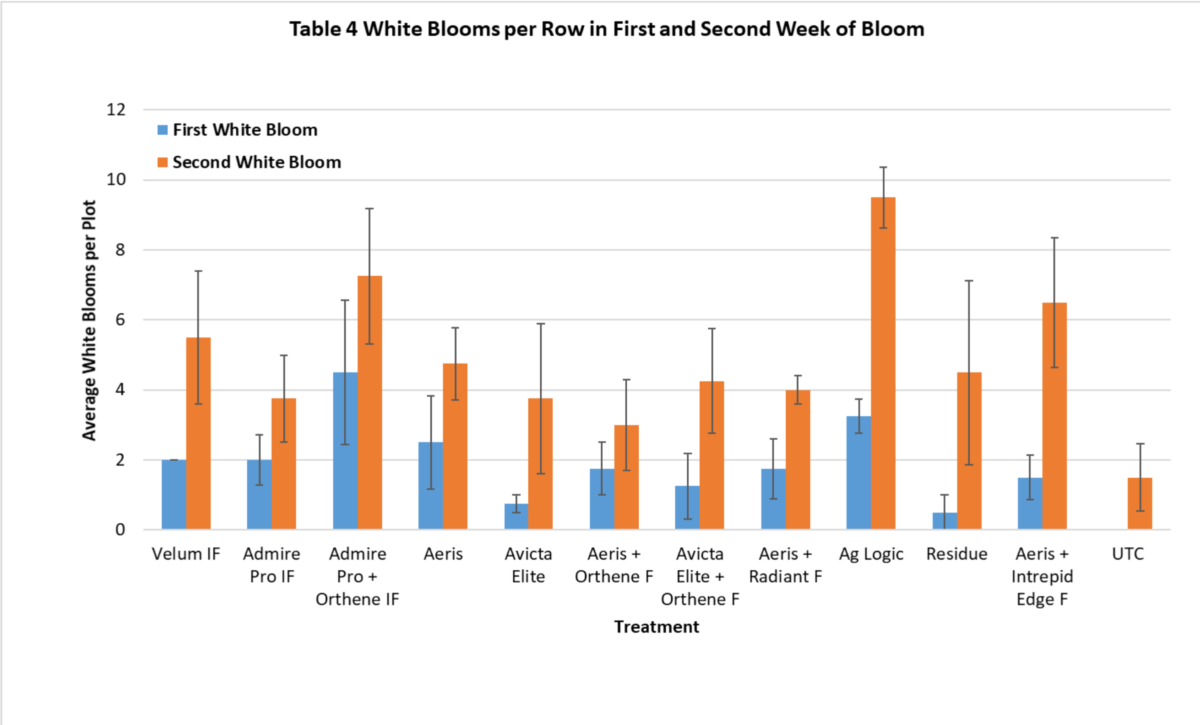


Table 4 White Blooms per Row in First and Second Week of Bloom
First White Bloom
Second White Bloom
Average White Blooms per Plot
0
2
4
6
8
10
12
Velum IF
Admire Pro IF
Admire Pro + Orthene IF
Aeris
Avicta Elite
Aeris + Orthene F
Avicta Elite + Orthene F
Aeris + Radiant F
Ag Logic
Residue
Aeris + Intrepid Edge F
UTC
Treatment

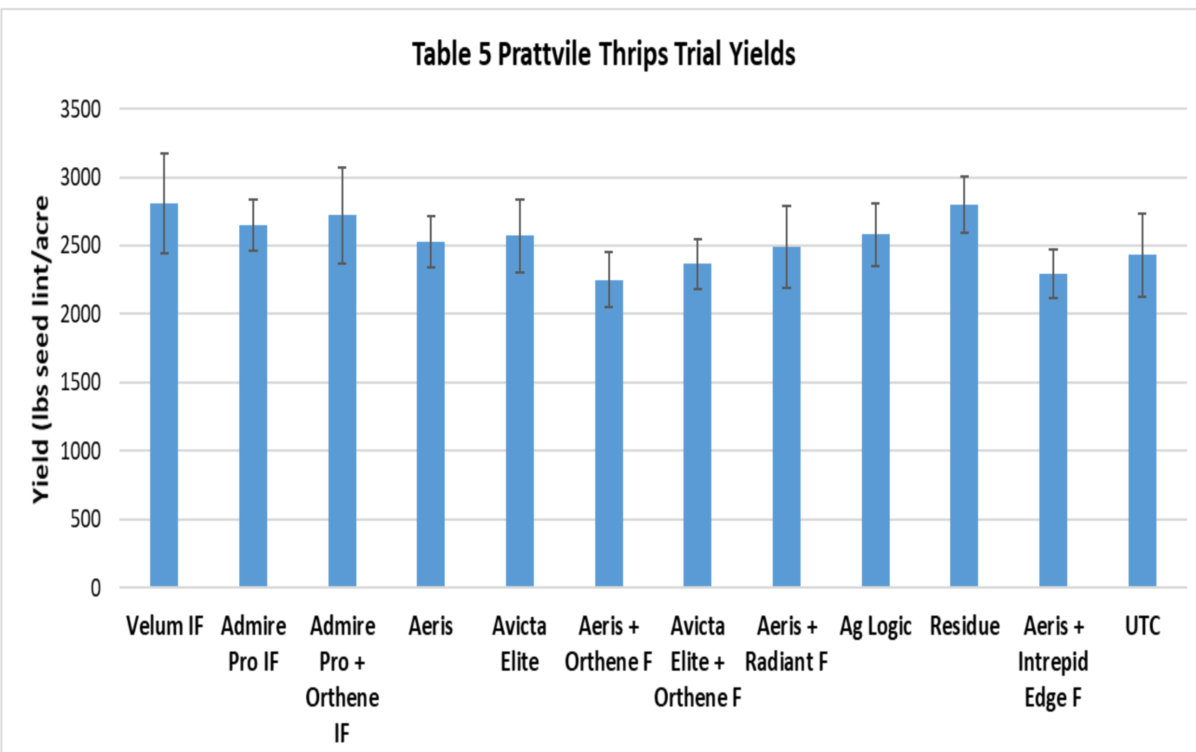


Table 5 Prattvile Thrips Trial Yields
Yield (lbs seed lint/acre
0
500
1000
1500
2000
2500
3000
3500
Velum IF
Admire Pro IF
Admire Pro + Orthene IF
Aeris
Avicta Elite
Aeris + Orthene F
Avicta Elite + Orthene F
Aeris + Radiant F
Ag Logic
Residue
Aeris + Intrepid Edge F
UTC

Thrips Control in Cotton-2019

B. Freeman, A. W. Page, and T. Sandlin

Left uncontrolled thrips are among the most damaging pest of cotton, and the toboacco thrips predominates the thrips complex attacking cotton. Knowing that thrips are an annual problem in cotton, producers almost always apply prophylactic controls at planting. The neonicitinoid seed treatments generally replaced in-furrow, granular insecticides for this purpose some 20 years ago. Resistance to the commonly used seed treatments, imidacloprid and thiamethoxam, by the tobacco thrips has been a serious issue throughout north Alabama for at least the past four years. As a result, foliar applications in addition to the seed treatments are now more necessary than in the past. This trial was designed to evaluate thrips control in cotton by two common neonicitinoid seed treatments alone and with three different foliar applied insecticides. A list of treatments can be found in Table 1.

Materials and Methods

This trial was conducted on the Tennessee Valley Regional Extension Center in Limestone County, Alabama. The cotton variety selected was DP 1646 and was planted on April 25 as thrips pressure tends to be worse on early planted cotton. Plots were not irrigated. Treatments were four rows by 25 feet and replicated four times. Over-the-top treatments were applied on May 12 when cotton averaged one true leaf per plant. Thrips samples were collected on May 17 & 24 and consisted of five dominant plants per plot. Plants were rinsed in 75% ethyl alcohol, subsequently filtered using a Buchner funnel, and then counted under a dissecting microscope. Adult and larval thrips were tallied separately and adults were identified to species. Plots were rated for thrips injury on May 20 & 24 using a 0-5 rating where 0 = no damage and 5 = extreme damage. Stand counts were made on June 10 by counting all plants in the center two rows of each plot. Yields were determined via mechanical harvest of the center two rows of each plot on September 23.

Results and Discussion

2019 was a most peculiar year as to thrips infestation of cotton in North Alabama as well as much of the southeastern U.S. Thrips pressure on early planted cotton was light in the extreme, and thrips populations for this trial were no exception. Oddly, thrips pressure became heavy in the latter half of May and many late planted fields were damaged when foliar applications were mistimed or not applied.

Thrips counts are presented in Table 2. Thrips numbers in the control plots were slightly elevated over the insecticide treated plots on May 17 and no difference was observed among the insecticide treatments. No differences in thrips populations were observed on May 24 among any of the treatments including the Control. 92.3% of all the adult thrips sampled were tobacco thrips. Thrips reproduction as evidenced by low larval counts (Table 2) was almost nonexistent. Thrips damage was apparent in the Control treatment on May 20 & May 24 but little damage and no differences were observed among the insecticide treatments (Table 3). Stand counts are presented in Table 4 and reveal no differences among treatments. The same holds true for cotton yields (Table 5).

It cannot be overemphasized how incredibly light the thrips pressure was during this trial – thrips numbers were lower than any level witnessed in more than 50 years. As a result, no direct conclusions should be drawn from this trial. It should be stressed, however, that neonicitinoid resistance in the tobacco thrips has not gone away, and that the increased need of well-timed foliar thrips applications to cotton will be observed in the future. One last indirect observation is that the tobacco thrips predictive model, developed at NC State University, was largely accurate in 2019 as it has been since its development.

Table 1. Insecticide treatments and rates.

1	Aeris seed treatment + Orthene 97 S @ 2.88 oz/acre OTT
2	Aeris seed treatment + Radiant 1 SC @ 1.5 oz/acre + ¼ % v/v surfactant OTT
3	Aeris seed treatment + Baythroid XL 1 EC @ 1.6 oz/acre OTT
4	Avicta Elite seed treatment + Orthene 97 S @ 2.88 oz/acre OTT
5	Avicta Elite seed treatment + Radiant 1 SC @ 1.5 oz/acre + ¼ % v/v surfactant OTT
6	Avicta Elite seed treatment + Baythroid XL 1 EC @ 1.6 oz/acre OTT
7	Aeris seed treatment
8	Avicta Elite seed treatment
9	Untreated Control

Table 2. Thrips per 5 plants.

	May 17			May 24		
Treatment	**Adults**	**Larvae**	**Total**	**Adults**	**Larvae**	**Total**
Aeris + Orthene	0.25	0.00	0.25	1.00	0.00	1.00
Aeris + Radiant	0.25	0.00	0.25	1.00	0.00	1.00
Aeris + Baythroid	0.50	0.00	0.50	0.75	0.00	0.75
Avicta + Orthene	0.00	0.00	0.00	0.75	0.00	0.75
Avicta + Radiant	0.75	0.00	0.75	0.00	0.00	0.75
Avicta + Baythroid	0.25	0.00	0.25	0.00	0.00	0.25
Aeris	0.75	0.00	0.75	0.50	0.25	0.50
Avicta	0.75	0.00	0.75	0.50	0.25	0.75
Control	2.00	1.00	3.00	0.25	0.25	0.50

Table 3. Thrips damage ratings. 0 = no damage; 5 = extreme damage.

Treatment	May 20	May 24
Aeris + Orthene	1.000	1.250
Aeris + Radiant	1.000	1.125
Aeris + Baythroid	1.250	1.000
Avicta + Orthene	1.000	1.125
Avicta + Radiant	1.000	1.000
Avicta + Baythroid	1.000	1.000
Aeris	1.000	1.000
Avicta	1.125	1.125
Control	2.875	2.625

Table 4. Cotton plants per acre.

Treatment	June 10
Aeris + Orthene	32,210
Aeris + Radiant	29,323
Aeris + Baythroid	31,882
Avicta + Orthene	32,275
Avicta + Radiant	29,782
Avicta + Baythroid	29,782
Aeris	33,653
Avicta	33,128
Control	32,734

Table 5. Yield in pounds of seed cotton per acre.

Treatment	Yield
Aeris + Orthene	3507
Aeris + Radiant	3288
Aeris + Baythroid	3273
Avicta + Orthene	3276
Avicta + Radiant	3373
Avicta + Baythroid	3351
Aeris	3373
Avicta	3294
Control	3286

Aphid Management Versus the Cotton Leaf Roll Dwarf Virus (CLRDV) in Alabama ACC#36

R. Smith

The objective of this study was to determine how or if aphid population density and timing of controls influence the physical appearance and spread of the CLRDV through a field. A block of cotton was intentionally planted late at two locations, Brewton and Fairhope, to increase the likelihood that the aphid population and the CLRDV would occur. At the first detection of aphids the block of cotton at each location was divided into thirds. Three thresholds were utilized for aphid control: no treatment; one application to represent what many growers would use and to duplicate the current IPM guide recommendations; and maximum aphid suppression for the reminder of the season. DP1646 variety was used for this trial. Transform was utilized at Brewton and Centric at Fairhope for aphid control. These plots were observed at intervals during the season for the presence of aphids and CLRDV symptoms.

LOCATION		**APHID TREATMENT DATES**					
Brewton	UT	------------					
	Threshold	6/10					
	Maximum	6/5	6/12	6/19	6/26	7/2	7/10
Fairhope	UT	-----------					
	Threshold	7/30					
	Maximum	7/16	7/30				

	OBSERVATION DATES					
Brewton	6/4	7/3	7/15	8/7	8/15	8/29
Fairhope	6/4	7/15	8/20	9/19	10/7	

No visible symptoms of CLRDV were observed on any of the observation dates at either location. No plants were sent to the AU Diagnostics Lab for CLRDV analysis due to the lack of symptoms and the backlog of samples at the lab.

Mortality and Responses of Adult Tarnished Plant Bugs to Commonly Applied Insecticides ACC#44

R. Smith

Tarnished plant bugs are exhibiting tolerance or resistance to several of the more commonly used insecticides used for their control in several regions of the U.S. cotton belt. Even within the state of Alabama there appears to be a wide range of susceptibility to certain insecticides. This project was an attempt to better document the susceptibility from several areas of the state. Plant bugs were collected from wild host plants, primarily daisy fleabane, and shipped FEDEX overnight to a research lab of Virginia Tech University in Suffolk, VA. Seth Dorman, a doctoral student working under the guidance of Dr. Sally Taylor, Extension/Research Entomologist screened these populations against bifenthrin, acephate (Orthene), sulfoxaflor (Transform) and thiamethoxam (Centric). Resistance ratios (RR50) were calculated using a susceptible lab colony from Mississippi State University. Collections were made from the following areas: Lee Co. Rd 53 near Auburn (June 3); Limestone Co. I-565 near Mooresville (June 19); and Cherokee Co. east of Centre on US 411 (June 20).

Results are shown in Table 1 (2019) and Table 2 (2018). The column titled RR50 is a measure of susceptibility when compared to the Lab colony. Note that the ratios from the three Alabama locations in 2019 were similar to each other and to the lab colony for thiamethoxam (Centric) and acephate (Orthene), but not so for bifenthrin. Against bifenthrin, the Auburn population was similar to the lab colony; however, the Cherokee Co. population was 13.6 times more resistant than the lab colony and the Limestone Co. population was 27.7 times more resistant than the lab colony. This information supports the poor results that entomologists and growers have observed when applying bifenthrin in northern Alabama. Field failures are usually not experienced unless the RR50 ratio is above 10.

2019 Results

Table 1. Mortality response of adult *L. lineolaris* to technical grade sulfoxaflor (99.5% purity), bifenthrin (98% purity), thiamethoxam (99.5% purity), and acephate (99.5% purity) for one to three collections from weedy hosts in May-June 2019. Ten concentrations were used in geometric

progression for each test that ranged from 0.0125 to 204.8 μg/vial. Data was corrected for control mortality using Abbott's formula.

Location	Host type[1]	Insecticide	*n*	LC_{50}	95% C.L.	RR_{50}[2]	Slope (SE)	χ2,df	P>χ2
Suffolk, VA (1)	Weeds	Bifenthrin	380	3.16	2.26-4.57	67.2	1.23 (0.16)	31.0, 23	0.123
Suffolk, VA (2)	Weeds	Bifenthrin	200	1.15	0.840-1.57	24.5	1.90 (0.24)	6.27, 17	0.991
Gates, NC	Weeds	Bifenthrin	200	1.74	1.23-2.40	37	1.89 (0.26)	8.84, 13	0.785
Plymouth, NC	Weeds	Bifenthrin	200	0.384	0.245-0.591	8.17	1.10 (0.14)	14.8, 18	0.675
Auburn, AL	Weeds	Bifenthrin	200	0.18	0.093-0.291	3.83	1.06 (0.16)	10.7, 18	0.908
Cherokee, AL	Weeds	Bifenthrin	200	0.637	0.389-1.04	13.6	0.972 (0.13)	12.6, 17	0.763
Mooresville, AL	Weeds	Bifenthrin	200	1.3	0.946-1.83	27.7	1.74 (0.21)	22.7, 18	0.202
Suffolk, VA	Weeds	Acephate	250	7.33	5.54-9.63	3.2	1.66 (0.18)	15.9, 23	0.86
Gates, NC	Weeds	Acephate	100	12.5	8.00-19.6	5.45	2.00 (0.37)	31.0, 23	0.591
Auburn, AL	Weeds	Acephate	200	1.42	0.868-2.10	-	1.40 (0.20)	10.9, 18	0.897
Cherokee, AL	Weeds	Acephate	100	7.69	4.41-14.2	3.36	1.26 (0.21)	6.30, 8	0.613
Mooresville, AL	Weeds	Acephate	100	7.3	4.18-13.3	3.19	1.31 (0.24)	6.99, 7	0.43
Suffolk, VA	Weeds	Sulfoxaflor	200	0.364	0.277-0.480	2.13	2.40 (0.31)	7.22, 8	0.513
Gates, NC	Weeds	Sulfoxaflor	200	0.302	0.216-0.421	1.77	1.61 (0.18)	10.6, 18	0.91
Auburn, AL	Weeds	Sulfoxaflor	200	0.249	0.187-0.325	1.46	2.55 (0.37)	8.95, 17	0.942
Cherokee, AL	Weeds	Sulfoxaflor	100	0.232	0.147-0.362	1.36	1.93 (0.34)	7.69, 8	0.465
Mooresville, AL	Weeds	Sulfoxaflor	100	0.207	0.118-0.342	1.21	1.51 (0.27)	6.36, 8	0.607
Suffolk, VA	Weeds	Thiamethoxam	200	0.505	0.299-0.858	1.98	1.18 (0.17)	18.2, 17	0.379
Gates, NC	Weeds	Thiamethoxam	200	0.047	0.040-0.128	-	1.40 (0.23)	9.70, 18	0.941
Auburn, AL	Weeds	Thiamethoxam	200	0.042	0.029-0.057	-	1.90 (0.29)	7.38, 18	0.987
Mooresville, AL	Weeds	Thiamethoxam	100	0.118	0.080-0.176	-	2.51 (0.48)	5.03, 8	0.754

[1]*Weedy hosts mostly included Asteraceae and Onagraceae species (i.e., daisy fleabane, cutleaf evening-primrose)*

[2]*Resistance ratios (RR50) calculated using a susceptible lab strain from Dr. Fred Musser's Lab at Mississippi State University*

Monitoring Corn Earworm/Bollworm for Resistance to Cry1 and Cry2 Gene Traits in Alabama ACC#45

R. Smith

SITUATION: The level of resistance in the Cry 1 cotton traits is above 90% and is widespread across the cotton belt. Resistance to the Cry 2 trait is present but more variable from location to location from Texas to Virginia. Resistance to the Cry 2 gene trait ranges from about 40% to 80%. Historically, when resistance occurs, it never goes away but increases over time. Near 100% of the CEW/BW population is being exposed to these genetic traits each season since they are present in both corn and cotton. For several years Alabama collections of CEW have been made from corn and shipped to Monsanto Labs for resistance monitoring.

ACTIVITIES: Corn earworm collections were made from the following locations (farms) in 2019:

6/11	Jenkins Farm	Corn (Conventional)	Montgomery, AL	To: Bayer Lab- Union City, TN
6/17	Danford Farm	Peanuts (Tobacco budworm)	Cottonwood, AL Houston County	To: Custom Bioproducts- Maxwell, IA
6/19	Wendland Farm	Corn (Herculex)	Autaugaville, AL	To: Bayer and NCSU
6/25	Wiregrass Research Center	Corn (Conventional)	Headland, AL Henry County	To: Bayer and NCSU
7/8	EV Smith Research Center	Corn (Conventional)	Shorter, AL Macon County	To: Bayer and NCSU

Each collection consisted of approximately 350 larvae collected from corn (corn earworm) or peanuts (tobacco budworm). Collections were shipped FedEx overnight to the designated labs along with GPS coordinates of the collection site and crop collected from, including variety and traits contained. Individual larvae are placed in diet cups containing a formulated bean diet prepared to sustain the larvae while enroute.

Conclusion: Resistance to the Cry1Ac protein was higher from the Headland, AL, collection than any other site tested (14% mortality) but not so with the Cry2Ab2 gene which showed 74% mortality. The third cotton gene, Vip3Aa39 protein gave 91, 100 and 100% mortality at Headland, Shorter, and Autaugaville, respectfully.

2019 Southeast Diet Overlay- Cry1Ac protein

Location	Source	LC50 (ug/cm2)	Lower FL	Upper FL	Res. Ratio	% mortality at 10 ug/cm2	% inhibition (weight at 10 ug/cm2)	% inhibition (instar at 10 ug/cm2)
Susceptible	.							
Headland, AL	non-Bt corn	301.27	40.23	6.71E9		14	86	45
Autaugaville, AL	Herculex corn							
Jay, FL	Obsession sweet corn	19.80	10.58	58.25		33	92	52
Blackville, SC 1	non-Bt corn	3.89	.	.		52	78	19
Blackville, SC 2	non-Bt corn	1.01	0.45	2.42		84	41	81
Florence, SC	non-Bt corn	0.62	0.28	1.13		81	91	75
Suffolk, VA	non-Bt corn							

2019 Southeast Diet Overlay- Cry2Ab2 corn leaf powder

Location	Source	LC50 (ug/cm2)	Lower FL	Upper FL	Res. Ratio	% mortality at 10 ug/cm2	% inhibition (weight at 10 ug/cm2)	% inhibition (instar at 10 ug/cm2)
Susceptible	.							
Headland, AL	non-Bt corn	5.04	3.28	7.93		74	95	85
Autaugaville, AL	Herculex corn							
Jay, FL	Obsession sweet corn	34.89	14.86	611.63		28	95	53
Blackville, SC 1	non-Bt corn	1.24	0.69	2.42		69	94	73
Blackville, SC 2	non-Bt corn	9.06	6.92	13.21		58	94	66
Suffolk, VA	non-Bt corn	12.46	8.36	25.78		47	95	67

2019 Southeast Diet Overlay- Vip3Aa39 protein

Location	Source	LC50 (ug/cm2)	Lower FL	Upper FL	Res. Ratio	% mortality at 10 ug/cm2	% inhibition (weight at 10 ug/cm2)	% inhibition (instar at 10 ug/cm2)
Susceptible	.							
Headland, AL	non-Bt corn	4.98	4.23	5.90		91	99	86
Shorter, AL	non-Bt corn	2.65	.	.		100	100	96
Autaugaville, AL	Herculex corn	3.16	.	.		100	>99	99
Jay, FL	Obsession sweet corn	6.80	4.82	7.96		89	39	99
Blackville, SC 1	non-Bt corn	4.59	2.96	7.52		75	97	76
Blackville, SC 2	non-Bt corn	5.22	4.13	6.53		98	>99	99
Suffolk, VA	non-Bt corn							

Ballworm Sentinel Plots 2019 ACC-Unfunded

R. Smith

Sentinel plots consisting of six varieties (conventional, 2 gene and 3 gene) were planted on four research farms in central and south Alabama in 2019. Plots were 4 rows wide by 50-100 feet in length. The varieties planted, locations and end of season worm damaged boll counts are presented below:

Locations:

EVS Research Center, Shorter, AL
Wiregrass Research Center, Headland, AL
Brewton Research Farm, Brewton, AL
Gulf Coast Research Center, Fairhope, AL

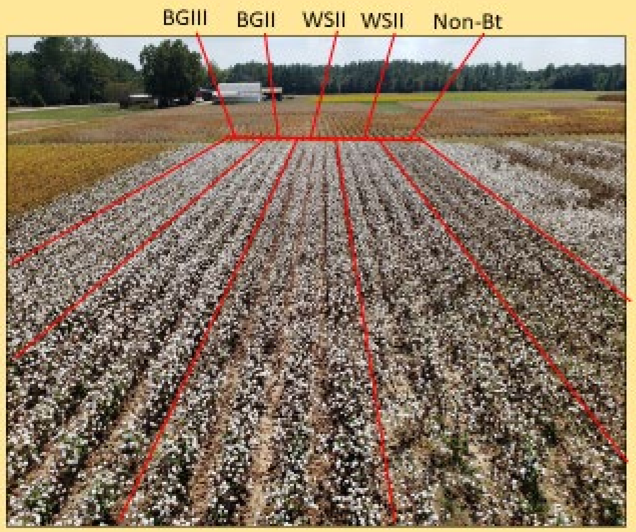
Varieties Planted		
1	CONV	DP1822XF
2	WSII	PHY444WRF
3	WSII	PHY480W3FE
4	BGII	DP1646B2F
5	BGIII	DP1840B3XF
6	Twin Link Plus	ST5471GLTP

Number of Worm Damaged Bolls
Per 50 row feet at harvest

Variety	Shorter	Headland	Brewton	Fairhope
1	2	4	28	15
2	0	0	4	1
3	0	0	0	0
4	0	0	0	0
5	0	0	0	0
6	0	0	0	0

Plant bugs and stink bugs were controlled as needed with Bidrin, which has no bollworm activity. End of season worm damaged bolls were counted in all varieties.

Summary: Sentinel plots at 4 locations in central and south Alabama incurred very light bollworm pressure in 2019. This was in line with the bollworm moth pheromone trap captures and the number of bollworm escape problems growers experienced in 2019.


BGIII
BGII
WSII
WSII
Non-Bt

Controlling Stink Bugs in Cotton

R. Smith

Over most of the 2 million acres of cotton planted in Georgia, Florida, Central and South Alabama, the stink bug complex is the most damaging insect. Several species including the brown, green, southern green and brown marmorated make up this complex which feeds on green bolls. A related insect, the leaffooted bug, also does similar damage as the stink bugs. In spite of control efforts this group of bugs cause the highest level of insect losses each season. Following mild winters, stink bug numbers and damage is at their highest level. Stink bugs are difficult to scout or survey for. Therefore many fields have greater than desired levels of damage. Since stink bugs move into fields from the border, damage is often greater near the border and the heaviest damage usually occurs in smaller fields, less than 20 acres in size. This trial conducted at the Prattville Agricultural Research Unit to demonstrate the effectiveness of various control options, including the need to add additional pyrethroid if the product Beseige (Prevathon + Karate) is utilized to control escape bollworms. The rate of Karate formulated in Beseige is too low to control stink bugs. Therefore, additional pyrethroid product must be added to obtain acceptable stink bug control. This trial was planted on April 25 to DP 1646. Treatments were 8 rows X 30 ft. with 4 replicates. The pretreatment stink bug internal damaged boll count was 45%. An application was applied to blooming stage cotton on July 12. Rainfall occurred approximately one hour after application. A second application was made 4 days later on July 16. Evaluations were made 6, 13 and 21 days after the July 16 application. Results are shown in Table #1. All treatments reduced damage below that of the untreated check. However, the treatments did not consistently separate out over the duration of this trial as expected, making it difficult to make definitive conclusions.

Table 1: Stink Bug, Prattville Agricultural Research Unit 2019

		% Internal Damaged Bolls				
					Mean	
		7/22 6DAA#2	7/29 13DAA#2	8/5 21DAA#2	All Sample Dates	Lbs. Seed Cotton/Ac.
Trt No.	Material/Rate/Acre					
1	Beseige 10oz	10	5	15	10.0	3087

2	Beseige + Karate 10 oz +.0067lbs	18	8	0	11.5	3246
3	Bifenthrin 6.4 oz	5	0	10	8.8	3223
4	Bidrin 0.33 lbs/ac.	10	18	12	10.0	3110
5	Untreated	12	10	25	19.2	3178

Applications made on: 7/12 (rain after 1.15 hours)
7/16 (pm)
8/5 Oversprayed trial with Bifenthrin

VI. Nematode Management

Management Strategies Utilizing Nematicides and Fertilizers to Combat Yield Loss from Reniform Nematode on Cotton, 2019

K. L. Gordon, K.S. Lawrence, W. Groover, D. Dyer, M. Rondon, and B. R. Lawaju

A combination of nematicides and fertilizers was used to evaluate the effects of yield on DP 1646 B2XF in a field with a high reniform population density. All seeds were treated with a base fungicide and insecticide by Bayer CropScience. Aeris seed treatment nematicide was added to select treatments at a rate of 25.6 oz./cwt. The additional granular fertilizer, $(NH_4)_2SO_4$ was applied by hand, directly to the plant base at a rate of 150 lbs./A while the liquid fertilizer 28-0-0-5 was knifed into the soil 2 in beside and 2 in below the plant at a rate of 128oz/A. Max-In Sulfur a foliar spray fertilizer and Vydate nematicide were applied as foliar sprays at rates of 32 oz/A and 17 oz./A. All chemicals except the Aeris were applied at pinhead square (PHS) and/or first bloom (FB). Treatments applied at PHS were administered 37 days after planting (DAP). Treatments applied at FB were administered 87 DAP. Research was conducted at the Tennessee Valley Research & Extension Center in Belle Mina, AL. This field is infested with a large density of reniform nematodes with 5000 vermiform reniform/100 cm3 of soil. The soil was a Decatur silt loam (24% sand, 49% silt and 28% clay). Plots consisted of 2 rows that were 25ft long with 40 in row spacing and a 20ft wide alley separated blocks. Plots were arranged in a randomized complete block design with five replications. The test was planted on 30 April. All plots were maintained throughout the season with standard herbicide, insecticide and fertility production practices. Irrigation through a lateral irrigation system was applied as needed to all plots. Seedling stand data were collected at 30 DAP on 30 May. Plant samples were collected by digging 4 plants from each plot 87 DAP to record plant parameters and nematode egg data. Reniform egg extraction was conducted by soaking the roots in 0.6 % NaOCl solution for 4 minutes on an orbital shaker and collecting eggs on a 25 µm sieve. Reniform population density was determined as the ratio of number of eggs per gram of root fresh weight. Plots were harvested 157 DAP on 3 October. Data were analyzed with SAS 9.4 using PROC GLIMMIX and LS-means were compared using the Tukey-Kramer method with ($P \leq 0.05$)

Plant stands were similar across all treatments, with no significant differences at 30 DAP. Plant height recorded at 87 DAP was also similar across all treatments. A treatment with Aeris, $(NH_4)_2SO_4$, Vydate and Max-In-Sulfur applied at PHS (9) resulted in a significantly larger root-fresh weight when compared to a treatment of 28-0-0-5 applied at PHS (2). Reniform population density expressed as number of eggs/g root showed a significant reduction in a treatment that contained Aeris, $(NH_4)_2SO_4$, Vydate, and Max-In Sulfur at PHS and FB (9) when compared to all other treatments. All treatments supported similar seed cotton yields with the exception of the application of Aeris, $(NH_4)_2SO_4$, Vydate and Max-In-Sulfur applied at PHS and FB (11) which proved to be significantly higher than treatments with the sole application of $(NH_4)_2SO_4$ and 28-0-0-5 at PHS (1 & 2). Seed cotton yield with the application of Aeris, $(NH_4)_2SO_4$, Vydate and Max-In-Sulfur applied at PHS and FB (11) increased 21 % when compared to treatments that did not have a nematicide (1 & 2).

No	**Treatments**	**Stand Count[w] 30 DAP**	**Plant Height (cm)[x] 87 DAP**	**Root fresh weight (g) 87 DAP**	**Reniform eggs/g root[y] 87 DAP**	**Yield (lbs/A) 157 DAP**
1	$(NH_4)_2SO_4$ - PHS	69 a[z]	75.9 a	13.7 ab	125 a	2301 b
2	28-0-0-5 - PHS	68 a	76.7 a	12.1 b	220 a	2302 b
3	Aeris + $(NH_4)_2SO_4$ - PHS	66 a	76.4 a	15.4 ab	86 ab	2482 ab
4	Aeris + 28-0-0-5 - PHS	66 a	75.8 a	14.7 ab	60 ab	2444 ab
5	Aeris + $(NH_4)_2SO_4$ – PHS + FB	67 a	78.4 a	13.9 ab	100 ab	2815 ab
6	Aeris + 28-0-0-5 – PHS + FB	69 a	77.3 a	13.5 ab	103 a	2659 ab
7	Aeris + $(NH_4)_2SO_4$ + Vydate - PHS	67 a	78.5 a	16.6 ab	35 ab	2711 ab
8	Aeris + 28-0-0-5 + Vydate - PHS	68 a	74.0 a	15.7 ab	113 a	2494 ab
9	Aeris + $(NH_4)_2SO_4$ + Vydate + Max-In-Sulfur - PHS	68 a	78.1 a	17.8 a	24 c	2766 ab
10	Aeris + 28-0-0-5 + Vydate + Max-In-Sulfur - PHS	65 a	76.5 a	14.1 ab	55 ab	2487 ab
11	Aeris + $(NH_4)_2SO_4$ + Vydate + Max-In-Sulfur – PHS + FB	71 a	81.8 a	15.3 ab	42 ab	2928 a
12	Aeris + 28-0-0-5 + Vydate + Max-In-Sulfur – PHS + FB	70 a	74.2 a	13.5 ab	45 ab	2676 ab

[w]Stand count is the number of seedlings per 25 ft. of row.

[x]Plant hieghts was the average of four plants measured in cm

[y]Reniform eggs/g per gram of fresh root weight.

[z] Values followed by the same letter are not significantly different at $P \leq 0.05$ as determined by the Tukey Kramer method.

Management Strategies Utilizing Nematicides and Fertilizers to Combat Yield Loss from Root-Knot Nematode on Cotton, 2019

K. L. Gordon, K.S. Lawrence, W. Groover, D. Dyer, M. Rondon, and B. R. Lawaju

A combination of nematicides and fertilizers was used to evaluate the effects of yield on DP 1646 B2XF in a field with a high root-knot population density. All seeds were treated with a base fungicide and insecticide by Bayer CropScience. Aeris seed treatment nematicide was applied at planting to select treatments at a rate of 25.6 oz./cwt. The additional granular fertilizer, $(NH_4)_2SO_4$ was applied by hand, directly to the plant base at a rate of 150 lbs./A. while the liquid fertilizer 28-0-0-5 was knifed into the soil 2 in beside and 2 in below the plant at a rate of 128oz/A. Max-In Sulfur a foliar fertilizer and Vydate nematicide were applied as foliar sprays at rates of 32 oz/A and 17 oz./A. All chemicals were applied at pinhead square (PHS) and/or first bloom (FB). Treatments applied at PHS were administered 50 days after planting (DAP). Treatments applied at FB were administered 87 DAP. Research was conducted at the Plant Breeding Unit in Tallassee, AL. This field is infested with a large density of root-knot nematodes. The soil type is Kalmia loamy sand (80% sand, 10% silt and 10% clay). Plots consisted of 2 rows that were 25 ft. long with 40 in row spacing and a 20 ft. wide alley separated blocks. Plots were arranged in a randomized complete block design with five replications. The test was planted on 15 May. All plots were maintained throughout the season with standard herbicide, insecticide and fertility production practices. Irrigation through a lateral irrigation system was applied as needed to all plots. Seedling stand data were collected at 32 DAP on 17 June. Plant samples were collected by digging 4 plants from each plot 67 DAP to record plant parameters and nematode egg data. Root-knot egg extraction was conducted by soaking the roots in 0.60 % NaOCl solution for 4 minutes on an orbital shaker and collecting eggs on a 25 µm sieve. Root-knot population density was determined as the ratio of number of eggs per gram of root fresh weight. Plots were harvested 160 DAP on 24 October. Data were analyzed with SAS 9.4 using PROC GLIMMIX and LS-means were compared using the Tukey-Kramer method with ($P \leq 0.05$).

The maximum input treatments Aeris seed treatment nematicide plus the granular fertilizer $(NH_4)_2SO_4$ with the addition of a foliar spray of Vydate nematicide with Max-In-Sulfur fertilizer applied at PHS + FB (11) and Aeris seed treatment nematicide plus the liquid fertilizer 28-0-0-5 with the addition of a foliar spray of Vydate nematicide with Max-In-Sulfur fertilizer applied at

PHS + FB (12) had significantly increased stand counts when compared to Aeries seed treatments with less additional additives(3, 5, 6 and 10. Plant heights remained similar with no significant differences across all treatments. Root-knot population density as number of eggs/g root was low across all treatment combinations. The lowest population of 25 eggs per gram of root was supported by Aeris and 28-0-0-5 at PHS and FB (6). Root biomass was similar across all of the nematicide fertilizer combinations. Seed cotton yields revealed applications of Aeris + $(NH_4)_2SO_4$ + Vydate + Max-In-Sulfur at PHS + FB (12) and Aeris + at PHS + FB (5) had significantly greater yields than an application of$(NH_4)_2SO_4$ at PHs (1).

No	**Treatments**	**Stand Count[w] 32 DAP**	**Plant height (cm)[x] 67 DAP**	**Root fresh weight (g) 67 DAP**	**Reniform eggs/g root[y] 67 DAP**	**Yield (lbs/A) 160 DAP**
1	$(NH_4)_2SO_4$ - PHS	72 ab[z]	96.1 a	20.7 a	45 ab	2529 b
2	28-0-0-5 - PHS	70 ab	96.0 a	18.7 a	68 ab	2622 ab
3	Aeris + $(NH_4)_2SO_4$ - PHS	66 b	100.3 a	22.4 a	50 ab	2889 ab
4	Aeris + 28-0-0-5 - PHS	71 ab	99.3 a	19.3 a	85 a	2953 ab
5	Aeris + $(NH_4)_2SO_4$ – PHS + FB	66 b	95.7 a	15.7 a	73 ab	3243 a
6	Aeris + 28-0-0-5 – PHS + FB	67 b	97.3 a	18.6 a	25 b	3151 ab
7	Aeris + $(NH_4)_2SO_4$ + Vydate - PHS	71 ab	91.4 a	17.2 a	102 a	3011 ab
8	Aeris + 28-0-0-5 + Vydate - PHS	73 ab	101.9 a	15.8 a	121 a	3139 ab
9	Aeris + $(NH_4)_2SO_4$ + Vydate + Max-In-Sulfur - PHS	69 ab	97.5 a	17.4 a	31 ab	3011 ab
10	Aeris + 28-0-0-5 + Vydate + Max-In-Sulfur - PHS	65 b	95.5 a	15.9 a	63 ab	2857 ab
11	Aeris + $(NH_4)_2SO_4$ + Vydate + Max-In-Sulfur – PHS + FB	76 a	95.2 a	17.9 a	87 a	2700 ab
12	Aeris + 28-0-0-5 + Vydate + Max-In-Sulfur – PHS + FB	77 a	97.0 a	18.4 a	62 ab	3304 a

[w]Stand count is the number of seedlings per 25 ft. of row.

[x]Total number of reniform eggs collected from 4 root systems.

[y]Reniform eggs/g per gram of fresh root weight.

[z] Values followed by the same letter are not significantly different at $P \leq 0.05$ as determined by the Tukey Kramer method.

Cotton Cultivar and Nematicide Evaluation in a Reniform Infested Field in Northern Alabama, 2019

W. Groover, K. S. Lawrence, B. Lawaju, D. Dyer, K. Gordon, and M. Rondon

Six cotton cultivars were evaluated for their performance in a *Rotylenchulus reniformis* (reniform nematode) infested field along with the addition of the nematicides COPeO Prime and Nemastrike ST. This test was planted at the Tennessee Valley Research and Extension Center near Belle Mina, Alabama. The field was infested with the reniform nematode in 2007 and has been cultivated in cotton for over 17 years. The soil type is Decatur silt loam, which contains 24% sand, 49% silt and 11% clay and 1% organic matter. Planting occurred on 30 Apr. Plots consisted of 2 rows that were 7.6 meters long with 1-meter row spacing, and seeds planted at 2.54 cm depth. The plots were arranged in a RCBD with five replications. Plots were designed with a split-split plot arrangement, with the whole plot being cotton variety and subplot being nematicide application. Subplots consisted of 2 rows with Nemastrike, 2 rows with COPeO, and 2 rows with no nematicide. Both Nemastrike and COPeO were applied as seed treatments. All plots were maintained throughout the season with standard herbicide, insecticide, and fertility production practices and a lateral irrigation system was used for watering as needed. Stand was calculated per 7.6 meter of row at 30 days after planting (DAP). Plant height, biomass, and nematode population data were collected at 37 days after planting (DAP) by digging up four random plants per plot for both untreated and treated rows. Biomass was calculated as the sum of the root fresh weight and the shoot fresh weight in grams. Nematodes were extracted from the cotton roots using 6% NaOCl, collected on a 25-um sieve and recorded as total eggs per gram of root. Harvest occurred on 2 Oct at 155 DAP. Data was analyzed by ANOVA in SAS 9.4 (SAS Institute Inc.) and means were compared using Tukey-Kramer with $P \leq 0.05$. Egg numbers were log transformed for normalization. Monthly average maximum temperatures from planting in Apr through harvest in Oct were 28.6, 29.3, 31.3, 32.9, 33.2, 34.8, and 32.8°C with average minimum temperatures of 14.7, 17.3, 19.6, 21.4, 20.3, 19.1, and 18.3 °C, respectively. Average temperatures from May to Oct was 21.7, 23.3, 25.4, 27.2, 26.7, 26.9, and 25.7°C. Rainfall accumulation for each month was 0, 8.8, 9.9, 11.5, 6.1, 1.7, and 3.7 cm, respectively.

Reniform nematode disease pressure was high in the 2019 season. Cotton cultivar by nematicide was not significant for any of the variables, thus were pooled for analysis. Cotton cultivar selection had a significant impact on stand, plant height, biomass, and total yield ($P \leq 0.05$). Phytogen 350 stand was significantly higher than DeltaPine 1747 and Phytogen 330 ($P \leq 0.05$). COPeO Prime plant height was significantly higher than Nemastrike ST, and DeltaPine 1646 plant height was significantly higher than three other cotton cultivars ($P \leq 0.05$). COPeO Prime treated cotton had a significantly higher biomass than both Nemastrike ST and untreated cotton ($P \leq 0.05$). Stoneville 4571 biomass was significantly higher than two other cotton cultivars ($P \leq 0.05$). Reniform egg numbers were substantial at 34 DAP, and COPeO Prime treated cotton had significantly lower eggs per gram of root compared to both Nemastrike ST and untreated cotton ($P \leq 0.05$). DeltaPine 1725 had the highest yield, and was significantly higher than DeltaPine 1747 and Phytogen 330 ($P \leq 0.05$).

Treatment	Stand[z]	Plant Height (cm)	Biomass[y]	Eggs/g root	Yield (kg/ha)
Split-plot analysis ($P \leq 0.05$)					
Cotton Cultivar	0.0004[x]	0.0002	0.0158	0.7862	0.0006
Nematicide	0.9103	0.0278	0.0075	<0.0001	0.3797
Cultivar x Nematicide	0.2557	0.8332	0.2917	0.7634	0.2658
Nemastrike ST vs. COPeO Prime vs. No Nematicide Means					
Nemastrike ST[w]	61	11.65 b	13.40 b	9195 a	2334
COPeO Prime[v]	63	13.67 a	18.83 a	1372 b	2636
Untreated	63	12.52 ab	13.66 b	6782 a	2312
Cotton Cultivar Means					
DeltaPine 1646 B2XF	65 ab	14.42 a	15.75 ab	3826	2663 ab
DeltaPine 1725 B2XF	62 abc	12.66 ab	16.86 ab	3726	2936 a
DeltaPine 1747NR B2XF	58 bc	11.69 b	12.02 b	3470	2060 bc
Phytogen 330 W3FE	52 c	10.86 b	12.72 b	8752	1878 c
Phytogen 350 W3FE	70 a	12.03 b	15.03 ab	10885	2484 abc
Stoneville 4571 GLTP	69 a	14.51 a	20.29 a	3215	2667 ab

[z] Stand was total number of plants per 7.6 meter of row.
[y] Biomass is the sum of root and shoot weights in grams.
[x] Column numbers followed by the same letter are not significantly different at $P \leq 0.05$ as determined by Tukey's multiple-range test.
[w] Nemastrike ST (tioxazafen) was applied as a seed treatment at a rate of 1.0 mg AI/seed.
[v] COPeO Prime (fluopyram) was applied as a seed treatment at a rate of 0.3 mg AI/seed.

Yield Benefits of Nematicide Applications Across Multiple Cotton Cultivars in Root-Knot and Reniform Nematode Infested Fields

W. Groover, D. Dyer, B. R. Lawaju, M. Rondon, K. Gordon, and K. Lawrence

Abstract

In 2018, an estimated 204,700 bales of the total cotton crop in the United States were lost due to the reniform nematode *(Rotylenchulus reniformis)*, and an estimated 485,300 bales of cotton were lost to the root-knot nematode (*Meloidogyne* spp.). With large losses reported to both reniform and root-knot nematodes in cotton year after year, two studies were conducted in order to investigate yield losses to reniform and root-knot nematodes over multiple cotton cultivars currently available on the market during the 2019 growing season. In the root-knot nematode infested field, AgLogic 15G (Aldicarb) was evaluated as an in-furrow granular application at planting. In the reniform nematode infested field, COPeO Prime (Fluopyram) and NemaStrike (Tioxazafen) were evaluated as seed treatments. Plant parameters analyzed for both trials included plant stand, plant height, shoot fresh weight, root fresh weight, and nematode eggs per gram of root. In the root-knot nematode trial, AgLogic 15G significantly reduced average eggs per gram of root across all varieties by 90% (398 eggs/g root to 38 eggs/g root). In the reniform nematode trial, COPeO Prime significantly reduced eggs per gram of root by 79% (6782 eggs/g root to 1372 eggs/g root), and NemaStrike eggs per gram of root were 35% higher compared to the untreated plots (6782 to 9195 eggs/g root). AgLogic 15G did not significantly increase seed cotton yield in the root-knot nematode trial, with only a 2% yield increase by AgLogic (2511 lb/A) compared to the untreated plots (2478 lb/A). In the reniform nematode trial, neither nematicide significantly increased seed cotton yield compared to the untreated control (2312 lb/A), with Nemastrike increasing yield by 1% (2334 lb/A) and COPeO Prime increasing yield by 14% (2636 lb/A). Overall, 2019 was a favorable year for both root-knot and reniform nematodes to develop and significantly impact cotton production in Alabama.

Introduction

Plant-parasitic nematodes are one of the most damaging pests of cotton throughout the cotton belt in the United States. Two prime examples that cause consistent yield losses are the southern root-knot nematode (*Meloidogyne incognita*), and the reniform nematode (*Rotylenchulus reniformis*). Over the past ten years, the cotton production industry has averaged an estimated 2.63% of the cotton crop to the root-knot nematode, and 1.62% to the reniform nematode per year (Lawrence et al. 2019). The root-knot nematode is an endoparastic sedentary nematode, and the reniform nematode is a semi-endoparasitic sedentary nematode. Both of these nematodes have a worldwide distribution throughout most sub-tropic and tropic geographic regions, and can feed on the important agronomic crop of cotton. While both of these are a major pest of cotton, they prefer slightly different soil types. The root-knot nematode prefers a lighter soil type than the reniform nematode. Soil percentages with a high sand concentration are more favorable for root-knot nematode feeding, and soils with a high concentration of clay and silt are more favorable for reniform nematode reproduction. Feeding on cotton by both of these nematodes can lead to a wide array of symptoms, including stunting and wilting of the plant, a reduction of feeder roots, and interveinal chlorosis on the foliage. Traditionally, nematode management consists of a combined implementation of a crop rotation, nematicide applications, and using resistant cultivars when available. For root-knot nematodes, there are cotton cultivars commercially available with resistance, but there are none available for reniform nematode management. A common crop rotation for root-knot nematode and reniform involves following a cotton crop with a non-host such as corn, sorghum, or peanut. Currently, chemical nematicides are the most common form of nematode management. Thus, two trials were conducted for this study. The first evaluated the nematicide AgLogic 15G (Aldicarb) along with multiple cotton cultivars for its efficacy in root-knot nematode management, and the second evaluated Nemastrike (Tioxazafen) and COPeO Prime (Fluopyram) along with multiple cotton cultivars for their efficacy in reniform nematode management.

Materials and Methods

Data collection for both trials took place during the 2019 growing season. For the root-knot nematode trial, seven commonly grown upland cotton cultivars were evaluated for their performance in the presence of root knot nematode. AgLogic 15G (Aldicarb, 5 lb/A) was added as a granular at planting for the evaluation of the added yield benefit as well as the ability to decrease root-knot nematode egg proliferation. In the reniform nematode trial, six upland cotton cultivars were evaluated for their performance in the presence and absence of the reniform nematode.. Nemastrike (Tioxazafen, 1.0 mg a.i./seed) and COPeO Prime (Fluopyram, 0.3 mg a.i./seed) were added as a seed treatment for evaluation of the added yield benefit and ability to decrease reniform egg proliferation. The root-knot nematode trial was planted on May 17, 2019, and harvested on October 25, 2019, at the Plant Breeding Unit in Tallassee, AL. The field is classified as a Kalmia loamy sand (80% sand, 10% silt, 10% clay), and has a natural infestation of the root knot nematode. The reniform nematode trial was planted on April 30, 2019 and harvested on October 2, 2019 at the Tennessee Valley Research and Extension Center near Belle Mina, AL. Two adjacent fields were used for the research: one field that does not contain a reniform population, and one that has been artificially inoculated since 2007. Both fields are a Decatur silt loam (24% sand, 49% silt, 28% clay). Lateral irrigation was used at both field locations as needed to maintain water. Both tests were arranged in a RCBD with five replications. The root-knot nematode trial was four row plots: two rows with no nematicide, two rows with AgLogic. The reniform nematode trial was six row plots: two rows with no nematicide, two with Nemastrike, and two with COPeO Prime. Rows were 25-feet long with 40-inch row spacing and a 20-foot wide alley separating each replication. Four plants were randomly selected per plot for root-knot and reniform nematode egg numbers per gram of root at 41 days after planting (DAP) in the root-knot trial and 37 DAP in the reniform trial. Eggs per gram of root was calculated by taking the ratio of root fresh weight and the total eggs per plot. Yields were mechanically harvested at 162 DAP for the root-knot nematode trial and 155 DAP for the reniform nematode trial, with yield being reported as seed cotton. Data analysis occurred by ANOVA using Proc Glimmix via SAS 9.4 (SAS Institute, Inc., Cary, NC)and means were separated using Tukey Kramer's HSD test at the $\alpha \leq 0.05$ level.

Results and Discussion

Root-knot nematode population density was not high in this trial for the 2019 growing season, with nematode presence not being a significant factor on yield (Table 1). However, root-knot nematode eggs per gram of root were significantly reduced in the AgLogic treated plots compared to the untreated plots, with an average reduction of around 90% (Table 1). This was only a 2% yield reduction when comparing seed cotton yield of the untreated plots to the AgLogic plots. All yields were statistically similar when separated by variety, but some numerical differences were observed. Deltapine 1646 B2XF and Stoneville 5471 GLT had a 2 and 3% increase in yield with the addition of AgLogic, respectively (Table 2). Phytogen 330 WRF had the largest increase in yield with the addition of AgLogic, increasing from 1897 lb/A seed cotton to 2773 lb/A seed cotton, a 46% increase in yield (Table 2).

Reniform nematode population density was very high during the 2019 growing season, and nematode presence was a significant factor on yield (Table 3). On average, there was a 52% reduction in yield from the non-reniform infested field to the reniform infested field (Table 4). The addition of COPeO Prime in the reniform infested field significantly reduced reniform eggs per gram of root by an average of 80%, leading to an average increase of 261 lb/A seed cotton (14%). Nemastrike did not significantly lower reniform eggs per gram of root, and increased seed cotton yield by an average of 55 lb/A (1%) (Table 5). There were no significant differences in seed cotton yield among variety and nematicide combinations for the non-reniform field, but significant differences did occur in the reniform infested field (Table 6). Deltapine 1725 B2XF (2759 lb/A) with no nematicide was the highest yielding treatment in the reniform field, and was significantly higher than three other treatments ($P \leq 0.05$).

Table 1: Average number of root-knot nematode eggs/g of root and seed cotton yields in the root-knot infested field at Auburn University's Plant Breeding Unit for the 2019 growing season in Tallassee, AL.

Nematicide	Eggs/g root	LB/A
No Nematicide	38 b[z]	2478
AgLogic 15G[y]	398 a	2511
P-value ($P \leq 0.05$)	**0.0256**	0.9054

[z] Values present are LS-means separated by using Tukey-Kramer method at $P \leq 0.05$, and values followed by different letters differ significantly. No letters present means that no significance difference was observed.

[x] AgLogic 15G was applied at planting as a granular at 5 lb/a.

Table 2: Cotton cultivar seed cotton yields in the root-knot nematode field at Tallassee, AL.

Cotton Variety	No AgLogic LB/A	AgLogic[z] LB/A
Deltapine 1646 B2XF	2816[y]	2846
Deltapine 1725 B2XF	2817	2708

DPL 1747NR B2XF	2430	2076
Phytogen 330 WRF	1897	2773
Phytogen 350 WRF	2439	2236
Stoneville 6182 GLT	2333	2265
Stoneville 5471 GLT	2614	2672
P-value ($P \leq 0.05$)	0.9472	0.8833

[z] Velum Total was applied at planting as an in-furrow spray at 14 oz/a.

[y] Values present are LS-means separated using Tukey-Kramer method at $P \leq 0.05$, and values followed by different letters differ significantly. No letters present means that no significance difference was observed.

Table 3: Source of variation for seed cotton yield and eggs/g root at Auburn University's Tennessee Valley Research and Extension Center in Belle Mina, AL.

	Seed cotton yield (lb/A)		Eggs/g root	
Source of Variation	F Statistic	P-value	F statistic	P-Value
Nematode	1366.88	**<0.0001**[z]	-	-
Nematicide	0.50	0.6088	5.46	**0.0063**
Variety	11.99	**<0.0001**	0.59	0.7045
Nematode x Nematicide	2.77	0.0658	-	-
Nematode x Variety	2.62	**0.0268**	-	-
Nematicide x Variety	0.95	0.4913	0.73	0.6946
Nematode x Nematicide x Variety	0.96	0.9579	-	-

[z] Significance present at the $P \leq 0.05$ level.

Table 4: Average seed cotton yields in the non-reniform and reniform fields for the 2019 growing season in Belle Mina, AL.

Field Location	LB/A
Non-Reniform Field	4819 a[z]

Reniform Field	2309 b

[z] Values present are LS-means separated using Tukey-Kramer method at $P \leq 0.05$, and values followed by different letters differ significantly. No letters present means that no significance difference was observed.

Table 5: Average reniform eggs/g root and seed cotton yields in the reniform field in Belle Mina, AL.

Nematicide Treatment	Eggs/g root	LB/A
No Nematicide	5932 a[z]	2204
Nemastrike[y]	6652 a	2259
COPeO[x]	1141 b	2465

[z] Values present are LS-means separated using Tukey-Kramer method at $P \leq 0.05$, and values followed by different letters differ significantly. No letters present means that no significance difference was observed.

[y] Nemastrike was applied as a seed treatment at a rate of 0.3 mg a.i./seed.

[z] COPeO Prime was applied as a seed treatment at a rate of 1 mg a.i./seed.

Table 6: Cotton cultivar seed cotton yields in the non-reniform and reniform fields in Belle Mina, AL.

	Non-Reniform Field	Reniform Field
Cotton Variety + Nematicide	LB/A	LB/A
Deltapine 1646 B2XF	5010[z]	2424 abc
Deltapine 1646 B2XF + Nemasrike[y]	5087	2702 ab
Deltapine 1646 B2XF + COPeO[x]	4935	2628 abc
Deltapine 1725 B2XF	4850	2759 a
Deltapine 1725 B2XF + Nemastrike	4797	2414 abc

Deltapine 1725 B2XF + COPeO	4354	2601 abc
Deltapine 1747 B2XF	4556	1635 c
Deltapine 1747 B2XF + Nemastrike	4436	1963 abc
Deltapine 1747 B2XF + COPeO	4711	2302 abc
Phytogen 330 WRF	4494	1629 c
Phytogen 330 WRF + Nemastrike	4430	1748 bc
Phytogen 330 WRF + COPeO	4389	2255 abc
Phytogen 350 WRF	5363	2449 abc
Phytogen 350 WRF + Nemastrike	5274	2263 abc
Phytogen 350 WRF + COPeO	5320	2531 abc
Stoneville 5471 GLT	5012	2326 abc
Stoneville 5471 GLT + Nemastrike	4880	2463 abc
Stoneville 5471 GLT + COPeO	4845	2472 abc

[z] Values present are LS-means separated using Tukey-Kramer method at $P \leq 0.05$, and values followed by different letters differ significantly. No letters present means that no significance difference was observed.

[y] Nemastrike was applied as a seed treatment at a rate of 0.3 mg a.i./seed.

[z] COPeO Prime was applied as a seed treatment at a rate of 1 mg a.i./seed.

Summary

In summary, AgLogic 15G as a granular at 5 lb/A had a significant impact on root-knot nematode eggs per gram of root (90% reduction), and COPeO Prime at 0.3 mg a.i./seed had a significant impact on reniform nematode eggs per gram of root (80% reduction). While AgLogic 15G only increased average yield by 2% in the 2019 root-knot nematode trial, average population density was low across the entire trial regardless of nematicide application, so impact by the root-knot nematode in this trial was minimal. COPeO led to a 261 lb/A increase in seed cotton in the reniform infested field, which is approximately a 12% increase. However, the most striking results of the reniform trial are the differences observed between the non-reniform field and the reniform infested field. Reniform reduced yield on average by 52% in 2019, and all varieties and nematicide combinations saw a decrease in yield going from the non-reniform field to the reniform field. While it is apparent that cotton fields with a heavily infested reniform population density will never reach yield levels possible in a non-reniform infested field, using a seed treatment nematicide can help boost yields and limit impact of the reniform nematode.

Isolation of Cotton Resistance Genes Against a Plant Parasitic Nematode, *Rothlenchulus reniformis*.

S. W. Park and K. Lawrence

Objective: This proposed study aims at identifying novel and practical defense-associated genes in cotton roots, in order to engineer the new genetically modified (GM) cottons with enhanced resistance and/or tolerance against *R. reniformis* infections. The generic approach will yield environmentally more sustainable, and farmer friendlier solutions towards the infection of this devastating herbivores, than current, increasing usages of toxic chemicals.

Background: Currently, little was known about **1**) how nematodes can recognize host crops, and start infection of root tissues, and **2**) how plants can confer – if existed – innate resistance (or tolerance) against nematode attacks. To answer these two questions, our previous funded proposals have **i**) developed a unique nematode mobility assay, and **ii**) compared and determined that a tolerant plant (Barberen-713) develops a larger number of root hairs than a susceptible plants (Lonren-1 and SureGrow-714).

Results:

1) In soil, nematodes can sense and move towards a specific chemical compounds (signals) produced as a part of root exudates. Our findings have lately been published in the Journal of Nematology (e2019-63; Please see an acknowledgment to the Alabama Cotton Commission in page 8 of the attached article). In this paper, we provided – for the first time – the scientific reasoning of nematode and host specific interactions, and technical platform to identify the host plant signal(s) toward distinct nematode species.

   Lately, our team has initiated a collaboration with Dr. Y. Feng in an expert in metabolite profiling, Depart., of Crop, Soil and Environmental Sciences, to isolate in fine the plant signals.

2) Genome-scale search of nematode tolerance-associated genes (NTAGs) in cottons. We employed a systematic biology approach (i.e., RNA-sequencing) to isolate NTAGs from Barbaren-713, comparing to Lonren-1 and SureGrow-714 (see Fig. 1)

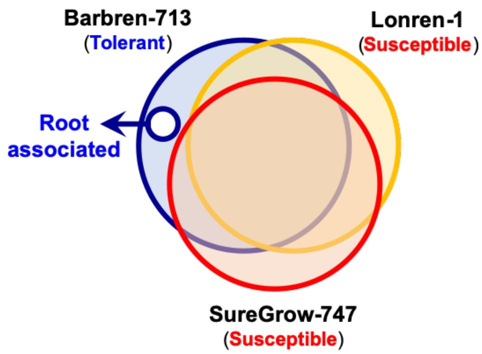


Fig. 1. Venn diagram Scheme of RNA-sequencing analysis. Transcripts enriched specifically in a tolerant plant (Barbaren-713) in comparison with susceptible plants (Lonren-1 and SureGrow-747) are determined (see the blue area).

2-A) Nematode tolerance and susceptible genotypes are differentially expressed a group of transcripts associated with energy transfer (ATP-binding), protein synthesis, maintenance and kinase cascades, and redox homeostasis.

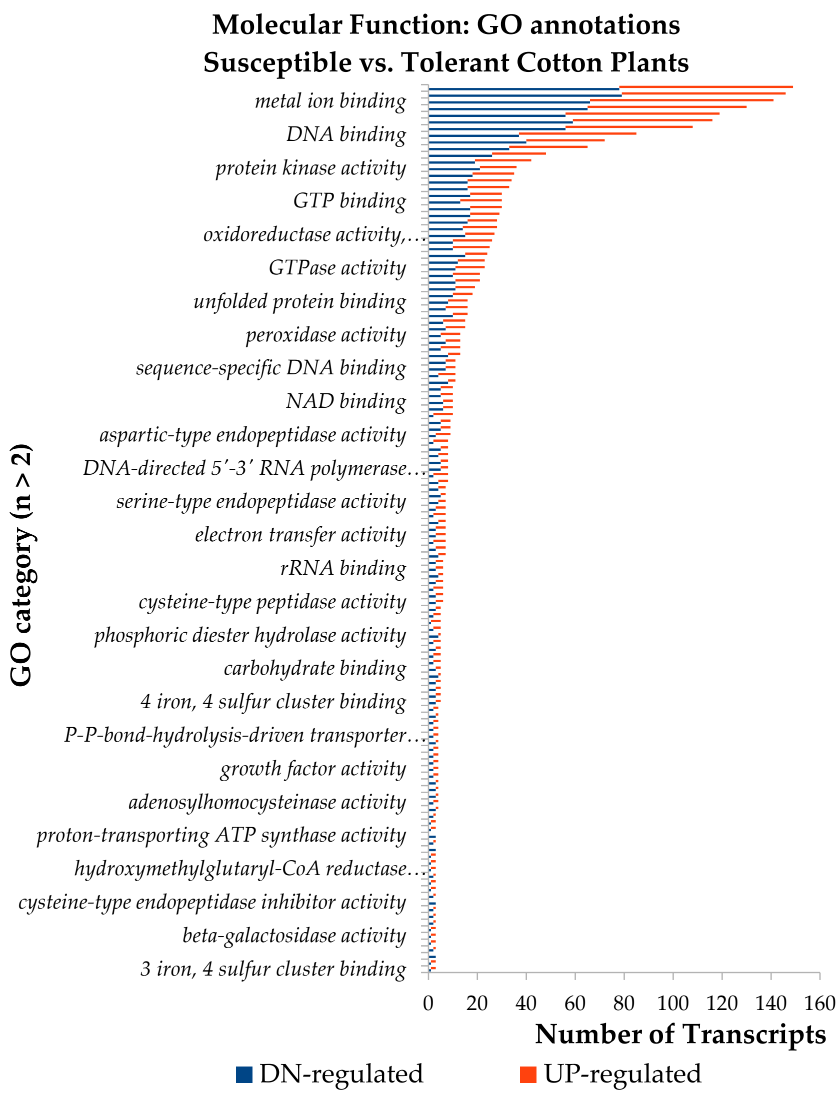


Fig. 2. Gene ontology categories (molecular functions) of differentially expressed transcripts from cotton root tissues comparing susceptible (Lonren-1 and SureGrow-747) to tolerant (Barbren-713) genotype without *R. reniformis* infection. The percentage of differentially transcripts between genotypes in each biological pathway category is shown. A transcript was considered to be differentially expressed if the RDR corrected P-value is smaller than 0.01 and the fold change value is more than 2.

2-B) Nematode tolerance and susceptible genotypes are differentially expressed a group of transcripts, in terms of biological process, associated with energy transfer (ATP-binding), protein synthesis, maintenance and kinase cascades, and redox homeostasis

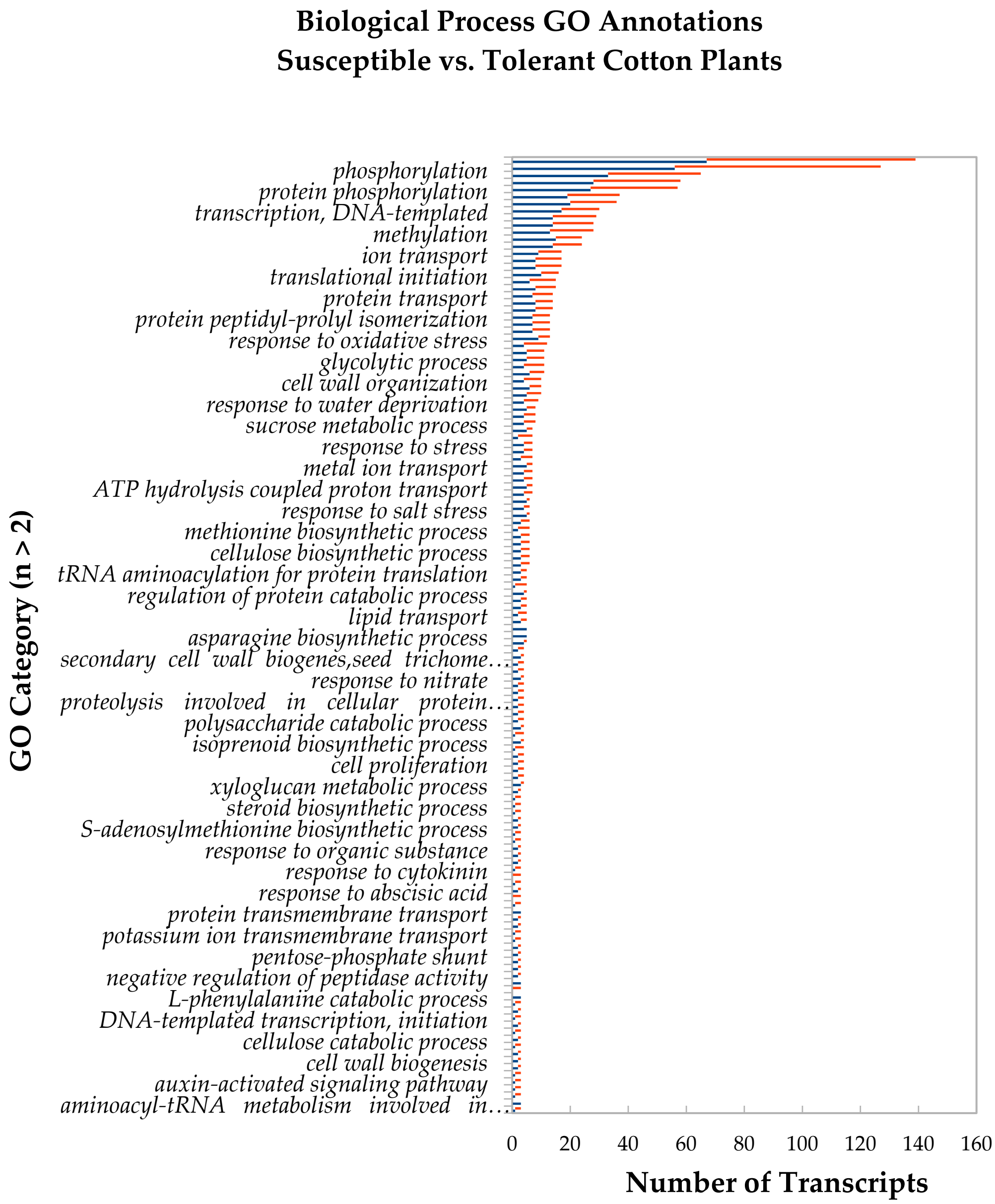


Fig. 3. Gene ontology categories (biological processes) of differentially expressed transcripts from cotton root tissues comparing susceptible (Lonren-1 and SureGrow-747) to tolerant (Barbren-713) genotype without *R. reniformis* infection. The percentage of differentially transcripts between genotypes in each biological pathway category is shown. A trans-cript was considered to be differentially expressed if the RDR corrected P-value is smaller than 0.01 and the fold change value is more than 2.

2-C) Isolation of nematode tolerance-associated genes. Eleven (11) unique genes associated with root hair growth and development were isolated from a group of overexpressed genes in the root tissues of tolerant (Barbren-713) in compared susceptible (Lonren-1 and Sure-Grow-747) cotton genotypes (see Table 1).

Table 1. A list of putative nematode tolerance-associated genes.

G. raimondii	Functions	Athomolog	functions
gi|763758803|	Hypothetical protein	AT1G30870	Peroxidase
gi|1050568919|	PRED: endoglucanase 9	AT1G48930	glycosyl hydrolase
gi|1028994943|	PRED: BEARSKIN1	AT1G79580	**NAC** (No Apical Meristem) TF
gi|1344097137|	Hypothetical protein	AT2G41970	Protein kinase superfamily
gi|1344104159|	Hypothetical protein	AT3G16857	ARR1, response regulator 1
gi|345104311|	Pectate lyase	AT4G22080	**RHS14**; root hair specific 14
gi|22324807|	WD-repeat protein	AT5G24520	TTG1; Transducin/WD40
gi|1028963079|	Alpha-xylosidase	AT5G63840	RSW3, Glycosyl hydrolases
gi|1029050711|	Cellulose synthase A		
gi|728833583|	Glutathione S-transferase		
gi|1029024189|	PRED: heat shock 80-like		

Future Aims: Characterization of the role and efficacy of putative nematode tolerance-associated genes (NTAGs).

1) Validation of the Barbren-specific overexpression of putative NTAGs. We will employ the high-resolution real-time quantitative reverse transcriptase (RT)-PCR to confirm the level expression of putative NTAGs in three cotton genotypes (Barbren-713, Lonren-1 and Sure-Grow-747).
2) Determination of NTAG functions in cotton defense responses against nematode infections. To save experimental time and expenditure, we will initially employ a simpler plant system such as *Arabidopsis thaliana* to generate NTAR knock-out (deletion) mutant plants and test them against nematode infections. These assays will uncover ‘true’ and commercially practical nematode resistance genes.

Evaluation of Nematicide Products for Increasing Cotton Plant Growth and Yield and Decreasing Reniform Nematode Population Density on Cotton in North Alabama, 2019

D. R. Dyer, K. S. Lawrence, W. Groover, M. N. Rondon, B. R. Lawaju, W. Sanchez, and K. Gordon

Nematicide products were evaluated for their ability to increase cotton plant growth and yield as well as manage reniform nematode population density. Testing was conducted at Auburn University's Tennessee Valley Research and Extension Center, Belle Mina, AL. The trial field was a Decatur silt loam soil type, which consisted of 23% sand, 49% silt, and 28% clay. Treatments were arranged in a randomized complete block design with five replications. The plots were planted on 30 April using DeltaPine 1646 B2XF cotton. Test plots consisted of 2 rows, 7.6 meters long with a 1-meter row spacing and a 1.8-meter alley between replications. All seeds were treated with a base fungicide package that contained Pyraclostrobin, Metalaxyl, Fluxapyoxad, and Mycolbutanil. The nematicides were applied as either seed treatments, in-furrow sprays, or foliar sprays at labelled rates. Velum Total and Propulse were applied as in-furrow sprays at the time of planting at rates of 1.02 L/ha, 0.99 L/ha respectively. COPeO Prime, BioST Nematicide 100, Nemastrike, Avicta, and Aeris were applied as seed treatments at rates of 0.3 mg ai/seed, 4.66 ml/kg, 0.75 mg ai/seed, 0.15 mg ai/seed, and 0.375 mg ai/seed respectively. AgLogic was applied to the seed furrow at a rate of 5.6 kg/ha. Vydate C-LV was applied as a foliar spray at pinhead square at a rate of 1.24 L/ha. All plots were maintained throughout the season with standard insecticide, herbicide, and fertilizer practices as recommended by the Alabama Cooperative Extension System and watered as needed with a lateral irrigation system. Monthly average maximum temperatures from planting in April through harvest in October were 28.6, 29.3, 31.3, 32.9, 33.2, 34.8, and 32.8°C with average minimum temperatures of 14.7, 17.3, 19.6, 21.4, 20.3, 19.11, and 18.33 °C, respectively. Rainfall accumulation for each month was 0, 8.8, 9.9, 11.5, 6.1, 1.7, and 3.7 cm, respectively. Plant stand counts were taken 22 May, which corresponded to 22 DAP. Nematode population density (eggs per gram of root), plant height, and biomass (root fresh weight + shoot fresh weight) were determined on 5 June at 36 DAP by digging four plants at random from each plot and plants were transported to the laboratory for further analysis. Extraction of nematode eggs from roots was accomplished by shaking the roots in 6% NaOCl for 4 minutes and collecting the eggs on a 25-µm sieve. Seed cotton yield was collected on 5 October, at this time 2979 DD60 had accumulated. Data were analyzed with SAS 9.4 using PROC GLIMMIX and LS-means were compared to the control treatment using Dunnett's method.

The largest increase in plant height compared to the control (2.22 cm) was recorded with treatment of Propulse. This treatment along with a combination treatment of COPeO Prime + Propulse also recorded the largest plant biomass (root fresh weight + shoot fresh weight) being 58% and 52% larger than the control at 36 DAP. Treatments of Velum Total, COPeO Prime + Velum Total + Propulse, Propulse, COPeP Prime + Velum Total, COPeO Prime + Propulse, and COPeO Prime all reduced reniform population density; reductions amounted to 96%, 95%, 95%, 93%, 89% and 88% respectively. Seed cotton yields were increased by 1 nematicide treatment in this test. A combination of a COPeO Prime seed treatment and a foliar spray of Vydate at pinhead square increased yields by 798 kg/ha compared to the control plots. No nematode reduction or early season plant growth increases were observed in association with the yield increase with this treatment. However, early-season plant growth data and nematode samples were taken 36 DAP prior to application of the Vydate C-LV spray. Increase in plant growth and decreases in reniform population density that may have been a result of the Vydate application were not measured. On average, nematicide treatments increased yield numerically by 8% or 241 kg/ha of seed cotton.

Treatments	Stand[z]	Plant Height (cm)	Biomass[y] (g)	Reniform eggs/g of root	Seed Cotton Yield (kg/ha)
Control[x]	58[w]	14.76	17.51	5675	2750
COPeO Prime (0.3 mg ai/seed)	59	14.42	16.35	702 ***	2643
COPeO Prime (0.3 mg ai/seed) Velum Total (1.02 L/ha)	53	15.42	20.89	370 ****	2957
COPeO Prime (0.3 mg ai/seed) Velum Total (1.02 L/ha) Propulse (0.99 L/ha)	60	16.28	22.17	258 ****	3087
Velum Total (1.02 L/ha)	51 *	15.26	20.52	250 ****	2883
Velum Total (1.02 L/ha) Propulse (0.99 L/ha)	53	15.28	19.02	1713	2698
COPeO Prime (0.3 mg ai/seed) Propulse (0.99 L/ha)	61	16.24	26.06 **	632 ****	3257
Propulse (0.99 L/ha)	60	16.98 *	27.61 **	290 ****	3353
BioST Nematicide 100 (4.66 ml/kg)	56	14.52	18.00	3585	3063
Nemastrike (0.75 mg ai/seed)	53	15.52	19.59	3186	2706
COPeO Prime (0.3 mg ai/seed) Vydate C-LV (1.24 L/ha)	59	13.54	22.81	2145	3548 **
Avicta (0.15 mg ai/seed)	59	16.28	23.69	1653	3021
Aeris (0.375 mg ai/seed)	61	15.82	22.02	2436	2836
AgLogic 15G (5.6 Kg/ha)	61	15.82	22.02	2436	2836

[z] Plant stands per 7.6-meter row.
[y] Biomass is the sum of shoot fresh weight and root fresh weights collected 36 DAP.
[x] All seeds including the control were treated with a base fungicide packager that contained Pyraclostrobin, Metalaxyl, Fluxapyoxad, and Mycolbutanil
[w]Values present are LS-means with significance compared to the control treatment determined using the Dunnett's method. Significance at the 0.1, 0.05, 0.01, and 0.001 level is indicated by *, **, ***, and **** respectively.

VII. Extras

AAES & ACES Information Transfer to Alabama Row Crop Producers

D. Monks, D. Delaney, and J. Brasher

Objective: Maintain, develop, and update the crop information that is on the AAES and ACES row crop web sites: AlabamaCrops.com & AUAgResearch.com

Note: Funding for this project was approved by the Alabama Soybean Producers, Alabama Wheat and Feed Grains Commission, and Alabama Cotton Commission in 2019.

Justification:

The Alabama Crops web site (www.alabamacrops.com) has served as the hub for crops-related information for the AAES and ACES since 2008 when Monks and Brasher purchased the site name. At this point it is still undergoing extensive renovation in an effort to merge with the new ACES website and requirements; however, the funds for this position will still serve to support conduits for posting research and extension information.

Historically, producers have been able to find information on on-farm research and development, IPM guides, enterprise budgets, and variety trials on **AlabamaCrops.com.** In addition, a new AAES website, **AUAgResearch.com**, has been purchased and is being populated with agricultural research information. This position will serve as the primary contact and conduit for this website as well.

Mr. Jon Brasher currently holds the web-support position for the crops team. Jon assists the team with the continued development and maintenance of the AUAgResearch and Alabama Crops web sites, on-farm tests, equipment maintenance and management, and a variety of other team activities such as handling and delivering seed and other supplies for on-farm testing and demonstrations. Jon assists in the planting and harvesting of on-farm tests and analyzes data, tabulates, and prepares results for posting from Official Variety Tests.

Cottonseed Assessment for Improvement of Beef Cattle Feed Recommendations

K. Mullenix, J. Koebernick, and J. L. Jacobs

Objectives:

1) To quantify intake potential of lower vs. higher-gossypol containing cotton varieties commonly used in the Southeast for growing beef bull diets and update recommendations on feeding levels of whole cottonseed for beef cattle diets
2) To characterize protein fractions of whole cottonseed produced from experimental cotton lines under evaluation for potential use in Alabama

2019 Project Accomplishments

Beginning in summer 2019, an undergraduate research assistant worked with Drs. Koebernick and Mullenix to identify and prepare seed from 100 cotton varieties and breeding lines for digestibility analysis. The seed packets are being further processed and prepared to undergo digestibility and protein analysis (total crude protein and both rumen degradable and undegradable levels) in spring 2020.

In fall 2019, a graduate research assistant was hired, and a feed intake study was conducted at the Auburn University Bull Test Evaluation Center to determine maximum free-choice whole cottonseed intake levels in beef cattle. This trial was designed to determine if current threshold feeding levels for whole cottonseed are still valid given the relative change and turnover in cotton varieties used in the Southeast. Six spring-born Angus calves were weaned in October 2019, and began a two week acclimation phase to eating whole cottonseed prior to the trial. Calves were assigned to a given cotton variety (an ultra-low gossypol variety or DP 1646 BIIXF seed), and individual animal intake was measured over a 14-day period using a Calan gate system. Whole cottonseed intake and free gossypol consumption levels are presented below:

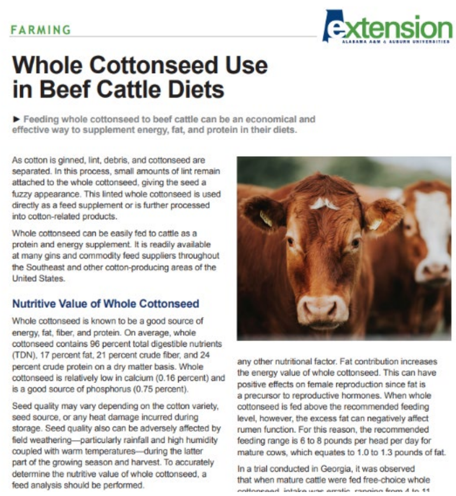
Cotton Variety	Average Intake (lb/head/day)†	Intake as a % of Calf Body Weight†	Free Gossypol Consumption (g/head)
Ultra-low gossypol	4.2	0.6	1.1
DP 1646	2.6	0.4	8.2

†Mean calf body weight of 633 pounds

Calves consumed more ultra-low gossypol cottonseed in a free-choice setting than DP 1646; however, both intake levels were close to recommended feeding levels of 0.5% of animal body weight per day. Estimated free gossypol consumption was 8.1 grams per head for DP 1646. Previous research has shown no negative effects on bull reproduction with free gossypol consumption up to 32 g/day. This would be the equivalent of ~10 pounds of DP 1646 whole cottonseed that could be fed to growing bulls without potentially negatively impacting reproduction. Based on this initial data, the current recommendation of feeding whole cottonseed at up to 20% of total daily animal intake, or about 6 to 8 pounds per head per day is an appropriate feeding level for beef bulls to maintain fat consumption at a moderate level without negative impacts on reproduction.

Extension Outputs and Resources for Stakeholders

In 2019, we released a new, peer-reviewed Extension publication on the use of whole cottonseed in beef cattle diets. This publication summarizes regional research on whole cottonseed, and provides a template for us to add in our new research data following completion of the project. The publication is available for download on www.alabamabeefsystems.com and was co-authored by Kim Mullenix, Steve Brown (Extension Cotton Agronomist), and Luke Jacobs (Graduate Student on this project).


FARMING

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Whole Cottonseed Use in Beef Cattle Diets

► Feeding whole cottonseed to beef cattle can be an economical and effective way to supplement energy, fat, and protein in their diets.

As cotton is ginned, lint, debris, and cottonseed are separated. In this process, small amounts of lint remain attached to the whole cottonseed, giving the seed a fuzzy appearance. This linted whole cottonseed is used directly as a feed supplement or is further processed into cotton-related products.

Whole cottonseed can be easily fed to cattle as a protein and energy supplement. It is readily available at many gins and commodity feed suppliers throughout the Southeast and other cotton-producing areas of the United States.

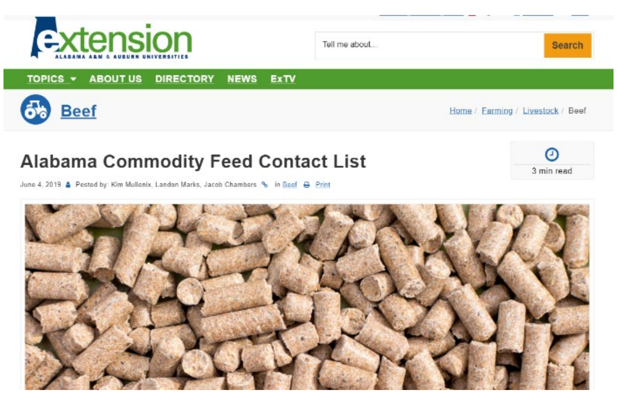
Nutritive Value of Whole Cottonseed

Whole cottonseed is known to be a good source of energy, fat, fiber, and protein. On average, whole cottonseed contains 96 percent total digestible nutrients (TDN), 17 percent fat, 21 percent crude fiber, and 24 percent crude protein on a dry matter basis. Whole cottonseed is relatively low in calcium (0.16 percent) and is a good source of phosphorus (0.75 percent).

Seed quality may vary depending on the cotton variety, seed source, or any heat damage incurred during storage. Seed quality also can be adversely affected by field weathering—particularly rainfall and high humidity coupled with warm temperatures—during the latter part of the growing season and harvest. To accurately determine the nutritive value of whole cottonseed, a feed analysis should be performed.

any other nutritional factor. Fat contribution increases the energy value of whole cottonseed. This can have positive effects on female reproduction since fat is a precursor to reproductive hormones. When whole cottonseed is fed above the recommended feeding level, however, the excess fat can negatively affect rumen function. For this reason, the recommended feeding range is 6 to 8 pounds per head per day for mature cows, which equates to 1.0 to 1.3 pounds of fat.

In a trial conducted in Georgia, it was observed that when mature cattle were fed free-choice whole



The Animal Science and Forages Extension team maintains a commodity feed list that is a starting point for stakeholders to review when sourcing winter feed needs. We have updated the list to include more cotton gins by adding four additional gins to the list. Our goal is to continue to grow this list and include contact information for gins around the state who wish to be listed.

This research project and the above Extension resources were also highlighted in the November 2019 issue of the Alabama Cattlemen magazine, which has a reach of ~12,000 subscribers.

Acknowledgements: Thank you to Dr. Steve Brown (Auburn) and Joey Scarborough with the Milstead Farm Group for their help in acquiring whole cottonseed for this feeding trial.

Support for Precision Agriculture Extension Programs

B. Ortiz, L. Bondesan, G. Morata, G. Pate, L. Pereira, K. Balkcom, B. Lena, and B. Dillard

Adoption of PA technologies and practices will increase as a result of trainings and on-farm demonstrations. As part of these efforts, we have been trying to establish the Alabama Precision Agriculture Learning network to support training and adoption of technologies and practices. Most of the Precision Ag. extension activities conducted in 2019 were focused on Irrigation. The establishment of two NRCS funded grants to conduct on-farm demonstration projects of soil-sensor based irrigation scheduling and variable rates irrigation occupied almost of the time of my Precision Ag team. Five irrigation on-farm demonstration sites were established in 2019, three in North Alabama, one in Samson and other in Gordon, Alabama. Two on-farm demonstrations of variable rate seeding were established. Four farmer focus groups were established at each demonstration site to train farmers on the use of those technologies and irrigation water management. Tables 1 and 2 list the meetings, field days, and on-farm demonstrations organized at each location. Besides the on-farm demonstrations, other activities (research studies) related to evaluation of the impact of precision planting technologies (down force) and precision irrigation (canopy temperature based irrigation) were used to raise awareness on the potential impact these technologies could have on crop production in Alabama. In addition to these activities, members of the Precision Ag. team gave presentations at national and international meetings.

Table 1. Precision Ag. Trainings Conducted in 2019.

Topics	**Location**	**Date**	**Speakers**	**Participants**
Irrigation water management workshop	Decatur, AL	January 22nd	10	100
Irrigation water management workshop	Dothan, AL	January 23rd	10	60
Irrigation field day	Town Creek, AL	June 26th	15	70
Precision Ag. workshop	Birmingham, AL	July 30th	10	70

Table 2. On-farm demonstrations conducted in 2018.

Topics	**Location**
Variable Rate seeding	E.V. Smith research center
Variable Rate seeding	Headland, AL
Sensor-based irrigation scheduling	Tanner, AL

Sensor-based irrigation scheduling	Athens, AL
Sensor-based irrigation scheduling	Gordon, AL
Sensor-based irrigation scheduling and Variable Rate Irrigation	Town Creek, AL
Sensor-based irrigation scheduling and Variable Rate Irrigation	Samson, AL

Alabama Row Crop Short Course

A. Gamble, S. Brown, S. Li, R. Prasad, T. Sandlin, K. Balkcom, R. Smith, B. Ortiz, D. Delaney, W. Birdsong, and B. Dillard

Results:

The 2019 Alabama Row Crops Short Course at Auburn University was of great success and value. Approximately 182 attendees were present at this year's short course. Numerous speakers from different backgrounds provided beneficial information with respect to cotton production and other cropping systems. A couple of our highlighted speakers with respect to cotton were Dr. Jody Campiche of the National Cotton Council and Dr. Daniel Whitley of the USDA Foreign Agricultural Service. Several farmers participated in grower panels. Information presented in these panels provided great information to all who attended. Our hope is that this is a program that can be conducted on an annual basis and will continue to be of value to farmers and agricultural professionals. Thank you for your support.

Support for Ginning of On-Farm Cotton Variety Samples

T. Sandlin

Results:

All seed cotton samples from the 2019 Auburn/ACES on-farm variety trials were sent to the UT Cotton Micro-gin in Jackson, TN. Subsamples from each sample were then sent to the USDA Cotton Classing office in Memphis, TN. Turnout and fiber quality data was reflective of commercial gins and much improved over our table top gin used previously. Turnout and fiber quality data was returned from the UT Cotton Micro-gin and classing office in a very timely manner. All data and results were received by mid-January 2019. Results were compiled and reported in our Cotton Agronomy On-Farm Variety Trial Results and disseminated in mid-late January