Auburn University Crops:

Cotton Research Report

2018

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Extension System
(Alabama A&M University and Auburn University)

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Confidential Report

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I. Cotton Variety Trials

Alabama Cotton Improvement (17-587 AL)

J. Koebernick

Objective 1: *Develop cotton varieties with improved yield and seed size/weight for production in Alabama.*

a. *Investigate yield components in order to increase seed size/weight while maintaining yield, in order to gain premiums when cottonseed brings subsidies.*

   Seed index was collected on all germplasm this season. A WIRA fineness and maturity tester was purchased and fiber samples from all trials were set aside. Once a location for the WIRA is identified, samples will be processed and parent lines will be incorporated into the breeding process.

b. *Develop and evaluate cotton varieties for resistance to biotic stresses, primarily reniform nematode, and target spot.*

   Field trials were placed in Belle Mina, Headland, Brewton, Fairhope, Auburn, Prattville and Tallassee. Boll samples were taken at Headland but yield was affected by Hurricane Michael. Target spot field ratings were collected in 3 advanced trials at two locations. The reniform nematode by cultivar management trial was completed in 2018. These results should be published in 2019.

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

a. *Collaborate with other colleagues who are evaluating cultivar by management interactions.*

   The RBTN and *Fusarium* Trials were planted in Tallassee, AL. The RBTN had a detectable amount of CLRDV damage in 2018. A second RBTN was planted at Brewton to provide a target spot response rating. The FOV trial consisted of 40 entries, it was planted earlier than in 2017 and the material tested looked quite good. Those results should be published in a technical bulletin by the end of the month. The NCVT was grown at Belle Mina, AL, without any issues. An educational trip to visit Jack McCarty in Starkville, MS, was taken in late November to gain insight into other breeder’s programs and interact about our reniform results.

Unexpected Objective #3- CLRDV

In March, I was made aware that “blue disease” had been detected in Alabama. During the season, I was aware and in contact with Kathy Lawrence and Peng Chee. A meeting was held in August at the Headland station but at that point it was more speculation of what was to come. After the Headland meeting, I assembled key personnel from Auburn to discuss formulating an action plan. In October, positive samples started to be identified throughout the whole state. After feedback from Austin Hagan, I assembled a field day in Fairhope. This meeting was attended by representatives from all disciplines related to a virus-vector-resistance triangle, from multiple states. In addition, I alerted cotton incorporated and private seed companies. I thought it prudent to have those available to physically see the problem as I felt that they wouldn’t believe it.

A meeting was held at Auburn a couple weeks later in November, in which I was charged with doing the agenda. I felt it be more beneficial for open dialogue amongst the experts than re-hashing the earlier meeting. It was productive and awareness was raised. A follow-up meeting was held at the Beltwide and work by Judy Brown highlighted that the virus is a new species. Therefore, a large portion of my time has been devoted to CLRDV and it will continue into 2019.

On-Farm Cotton Variety Trials, 2018

E. McGriff, T. Sandlin, M. Farms, M. M. Farms, and R. Lindsey

Test location: Blount and Cherokee Counties

Variety	Blount County Jimmy and Lance Miller Lint Yield (lbs/A)	Cherokee County Nick & Randall McMichen Lint Yield (lbs/A)	Cherokee County Rich Lindsey/Coosa River Land Company Lint Yield (lbs/A)
DP1646B 2XF	1653	1872	1279
DP1820B 3XF	1596	1557	1279
DP1725B 2XF	1568	1789	1290
NG3729 B2XF	1521	1498	1337
NG4601 B2XF	1501	1686	1221
ST4949T GLT	1510	1598	1389
ST5471G LTP	1510	1533	1236
ST5122G LT	1391	1363	1464
PHY330 W3FE	1495	1416	1205
PHY430 W3FE	1416	1555	1254
PHY480 W3FE	1237	1597	1328
DG3385 B2XF	1363	1708	1030

	Jimmy & Lance Miller	Nick & Randall McMichen	Rich Lindsey/Coosa River Land Company
Planted	5/11/18	5/9/18	5/3/18
Harvested	10/13/18	10/30/18	11/29/18
Row Spacing	38”	2x1 30” skip	36”
Seeding Rate	41,000 seed/acre	42,000 seed/acre	39,000 seed/acre
Planting Method	No-Till	No-Till	No-Till
Environment	Dryland	Center Pivot	Dryland
Previous Crop	Cotton	Soybeans	Cotton
Soil Type	Wynville Fine Sandy Loam	Holston loam	McQueen Loam

Appreciation is expressed to Jimmy and Lance Miller; Nick and Randall McMichen; Rich Lindsey/Coosa River Land Company; and the Alabama Cotton Commission.

Enhancing Cotton Variety Selection- Statewide On-Farm Trials

T. Sandlin, W. Birdsong, D. P. Delaney, T. Reed, R. Smith, E. McGriff, C. Hicks, R. Yates, B. Dillard, and K. Wilkins

Results:

Harvest season was a challenge for many producers in 2018 to say the least. Frequent weather events stretched harvest beyond December for some cotton producers. On-Farm cotton variety tests were no different. A total of 17 on-farm variety tests were planted across the state with four being lost due to inclement weather. 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. Row lengths ranged from 800 to 3,000 feet for on-farm trials in 2018. 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 seven locations in North Alabama (table 1.) and for six locations in South Alabama (table 2.) can be found below. Results for all locations and entire publication can be found at alabamacrops.com.

Table 1. Cotton Lint Yield and Fiber Quality Means Across 7 On Farm Locations in North Alabama.

VARIETY	RANK	LINT YIELD (LBS/A)	LINT TURN-OUT (%)	MICRONAIRE	LENGTH (IN.)	STRENGTH (G/TEX)	UNIFORMITY (%)
DP1646B2XF	1	1416	41.8%	4.4	1.22	30.7	82.6
DP1725B2XF	2	1336	42.0%	4.5	1.15	30.9	81.8
ST4949GLT	3	1278	41.9%	4.6	1.12	29.3	81.7
***PHY480W3FE**	4	1269	38.8%	4.3	1.15	30.6	83.3
NG4601B2XF	5	1266	40.4%	4.7	1.17	31.7	83.2
NG3729B2XF	6	1265	38.6%	4.6	1.17	30.3	83.2

PHY430W3FE	7	1256	40.7%	4.3	1.12	31.3	83.0
DP1820B3XF	8	1249	41.4%	4.6	1.20	32.8	82.7
DG3385B2XF	9	1241	39.9%	4.6	1.15	29.1	83.3
ST5471GLTP	10	1239	39.3%	4.3	1.16	30.9	82.0
ST5122GLT	11	1220	38.9%	4.3	1.14	30.5	81.6
PHY330W3FE	12	1203	40.5%	4.4	1.17	31.6	83.6
AVERAGE:		**1270**	**40.4%**	**4.5**	**1.16**	**30.8**	**82.7**

*Variety planted at 6 locations.

Table 2. Cotton Lint Yield and Fiber Quality Means Across 6 On Farm Locations in South Alabama.

VARIETY	RANK	LINT YIELD (LBS/A)	LINT TURN-OUT (%)	MICRONAIRE	LENGTH (IN.)	STRENGTH (G/TEX)	UNIFORMITY (%)
PHY480W3FE	1	1178	36.5%	4.2	1.20	33.6	84.0
DP1646B2XF	2	1174	40.5%	4.1	1.22	30.5	81.8
ST5471GLTP	3	1174	39.0%	4.1	1.18	31.7	81.7
NG5007B2XF	4	1171	37.5%	4.1	1.18	32.4	82.4
DP1840B3XF	5	1157	39.2%	4.4	1.14	28.6	81.7
NG5711B3XF	6	1138	38.8%	4.2	1.18	30.6	82.5
PHY430W3FE	7	1123	39.2%	4.1	1.16	31.3	82.3
ST5818GLT	8	1101	39.6%	4.2	1.11	31.0	82.1
ST6182GLT	9	1058	39.2%	4.2	1.15	29.9	82.5
DP1851B3XF	10	1054	37.6%	4.1	1.14	30.5	81.4
PHY330W3FE	11	1034	37.7%	4.1	1.17	31.2	82.1
DG3445B2XF	12	1004	41.4%	4.3	1.13	29.0	81.2
AVERAGE:		**1114**	**38.9%**	**4.2**	**1.16**	**30.9**	**82.1**

II. Cultural Management

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. Basic information on cover crops, such as seeding rate and contribution of plant-available nitrogen, is needed for producers to maximize the benefits of cover crops for cotton production.

Experimental Methods

This study assessed five small grains (i.e., Wrens Abruzzi rye, FL401 rye, Horizon 306 oats, Legend oats, Trical 342 triticale) and four planting densities (i.e., 25, 50, 75, 100 lb/A) with and without crimson clover to determine contribution of biomass and plant-available nitrogen to the soil.

Experiments were performed at three AAES locations in Alabama: E.V. Smith Research Center (EVS), Wiregrass Research and Extension Center (WREC), and Tennessee Valley Research and Extension Center (TVREC). Treatments were organized in randomized complete block design and replicated 2 times at each location. Tillage was managed according to the most common practice in the region. Soil samples were collected from the top 0- to 6-inch depth and assessed for soil test nutrient concentrations and potentially mineralizable N. Biomass samples were collected at termination to assess the optimal seeding rate of each small grain.

Results

Effect of Small Grain Variety on Biomass Production

Data for biomass production for all Alabama locations (i.e., EVS, TVREC, WREC) was combined with data from 6 other locations from Georgia, Florida, and North Carolina. For data across all nine locations, the ‘FL401’ rye variety produced higher biomass than both oat varieties (i.e., ‘Horizon306’ and ‘Legend’). Both rye varieties (i.e., ‘FL401’ and ‘Wrens Abruzzi) and the ‘Trical342’ triticale produced greater biomass than ‘Legend’ oats. Overall, rye varieties produced greater biomass than triticale and oat varieties. The addition of clover did not significantly affect biomass production.

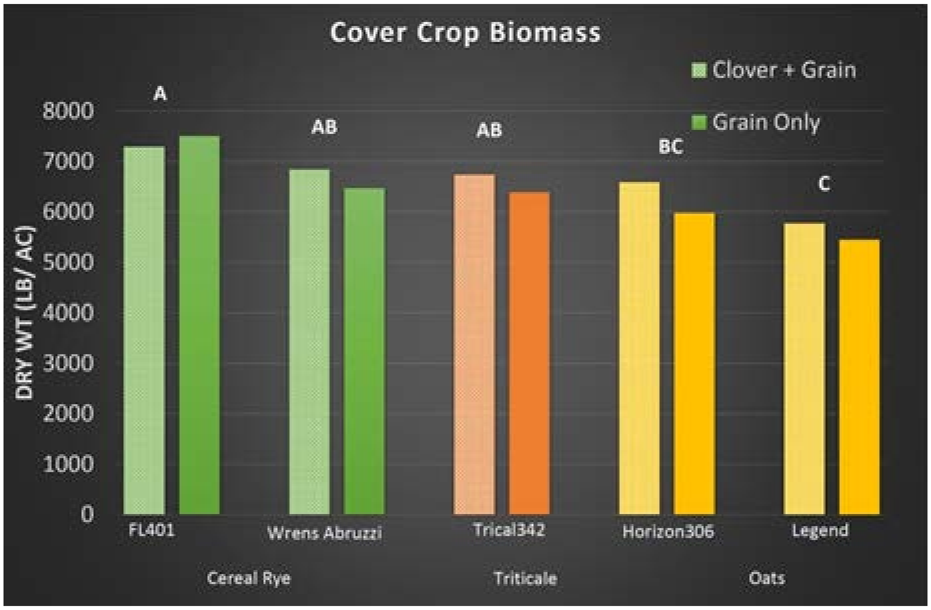


Figure 1. Cover crop biomass production in pounds per acre according to small grain variety without clover (darker columns) and with clover (lighter column) interseeded. Means separations (A’s, B’s) are for combined average biomass with and without clover. Data is averaged across all seeding rates.

Effect of Seeding Rate on Biomass Production

Increased seeding rates did not increase biomass production linearly (Figure 2). There was a quadradic relationship between seeding rate and biomass production. Biomass production at 25 lbs per acre tended to be as high as biomass production at 100 pounds per acre. This tendency was consistent across the nine locations in this study. This preliminary, first-year data indicates that recommended seeding rates for small grains used as cover crops may need to be decreased in the Southeast. This data will continue to be collected in 2019 and 2020 growing seasons to assess this hypothesis. Nitrogen data was not collected during the 2018 growing season. No funds were spent from this account. They will be used to collect N data for the 2018-2019 cover crop season and 2019 cotton season.

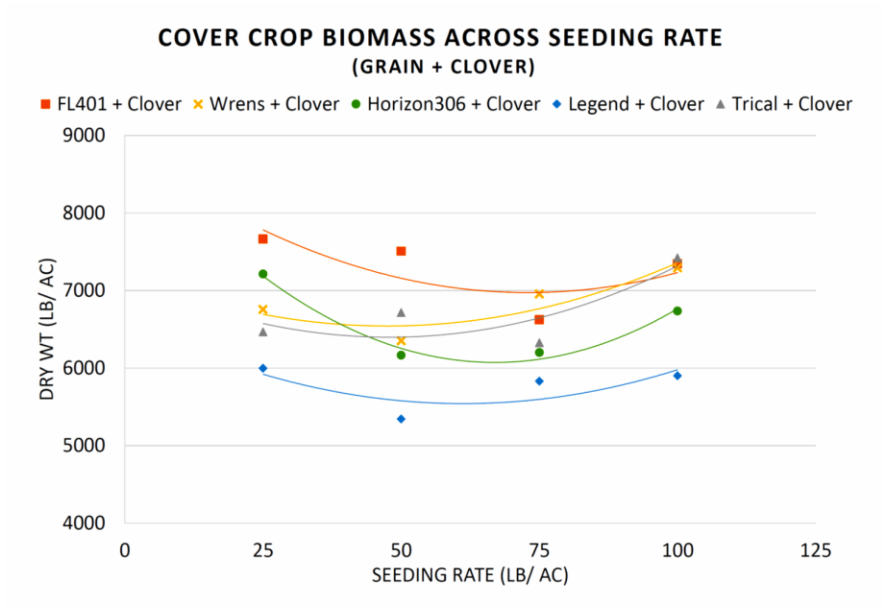


Figure 2. Cover crop biomass production in pounds per acre according to seeding rate for each small grain variety. Data for biomass production is averaged for small grains with and without clover.

Alabama Cotton Fertility Trials

A. V. Gamble, W. Birdsong, and N. Hull

Rationale

Current recommendations for cotton fertility are often based on varieties that are no longer in production. Experiments are needed to respond to producer questions about increasing fertilizer rates of potassium (K) in current varieties. Current recommendations for K are 60 lbs/A for soils rating medium in K, 90 lbs/A for soils rating low in K, and 120 lbs for soils rating very low in K. The objective of this research is to measure yield response of cotton to increased K rates to maximize cotton production for improved, higher-yielding varieties in the Southeast.

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). 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 per acre in 60 lb per acre increments. Plots were managed to optimize yields; therefore, all other nutrients were in adequate supply. Initial soil test K was 192 lbs per acre for TVREC (below critical level), 130 lbs per acre for GCREC (below critical level), 210 lbs per acre for PRU (above critical level), and 91 lbs per acre for EVS (below critical level). All experiments were managed under pivot irrigation and tillage was managed according to the most common practice in the region. Total leaf K concentration at approximately 60 days after planting was analyzed for the EVS location. Lint yield was analyzed according to plot at each location.

Results

Leaf K concentration increased linearly with increasing soil-applied K (Figure 1) for the location at which leaf K data was collected (EVS). Seed cotton yields for the 2018 cotton season averaged 1980 lbs per acre for TVREC, 1790 lbs per acre for EVS, 1750 lbs per acre for PRU, and 1250 lbs per acre for GCREC. Plots at WREC were not harvestable due to damage for Hurricane Michael. For the EVS location, linear increase of leaf K concentrations did not correspond to linear improvements in yield. The only yield improvements observed at EVS were in comparison to the control with (no K applied; Figure 2). No response to K fertilizer was observed for TVREC, GCREC, or PRU locations, even though soil test K was below the critical level for TVREC and GCREC. 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. First-year data indicate that current K recommendations are adequate to maintain maximum cotton yields, but additional site-years are necessary to confirm. Trials to assess cotton response to soil-applied K will continue for 2019 and 2020 growing seasons. Since K is also known to impact lint quality, lint quality metrics will be assessed in future trials.

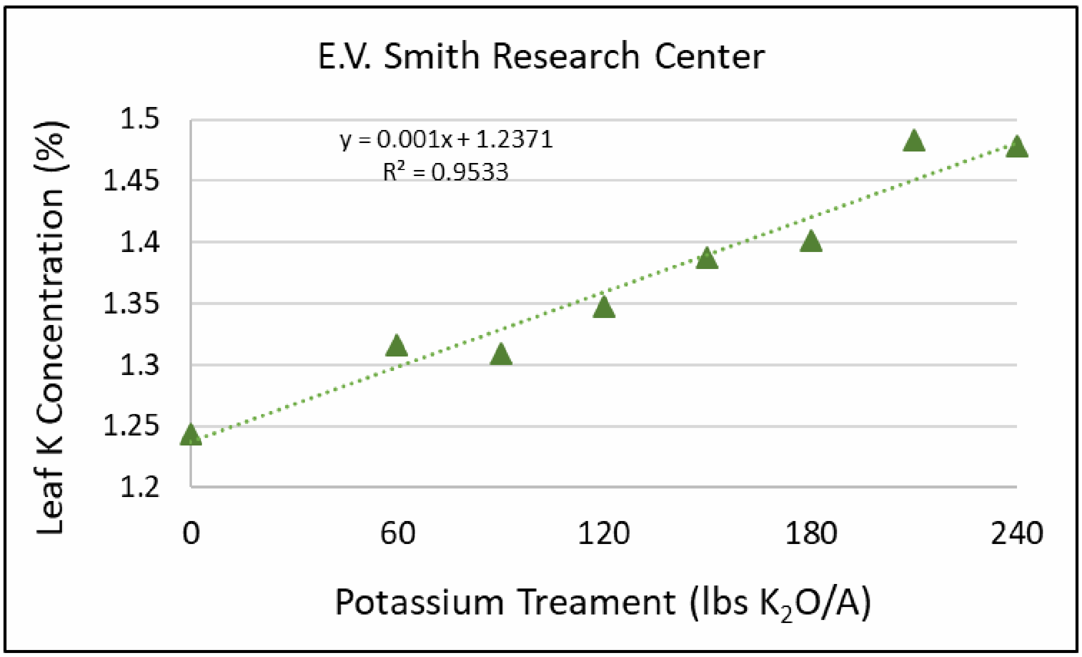


Figure 1. Leaf K concentration (%) according to soil-applied potassium (K) treatment at the E. V. Smith location.

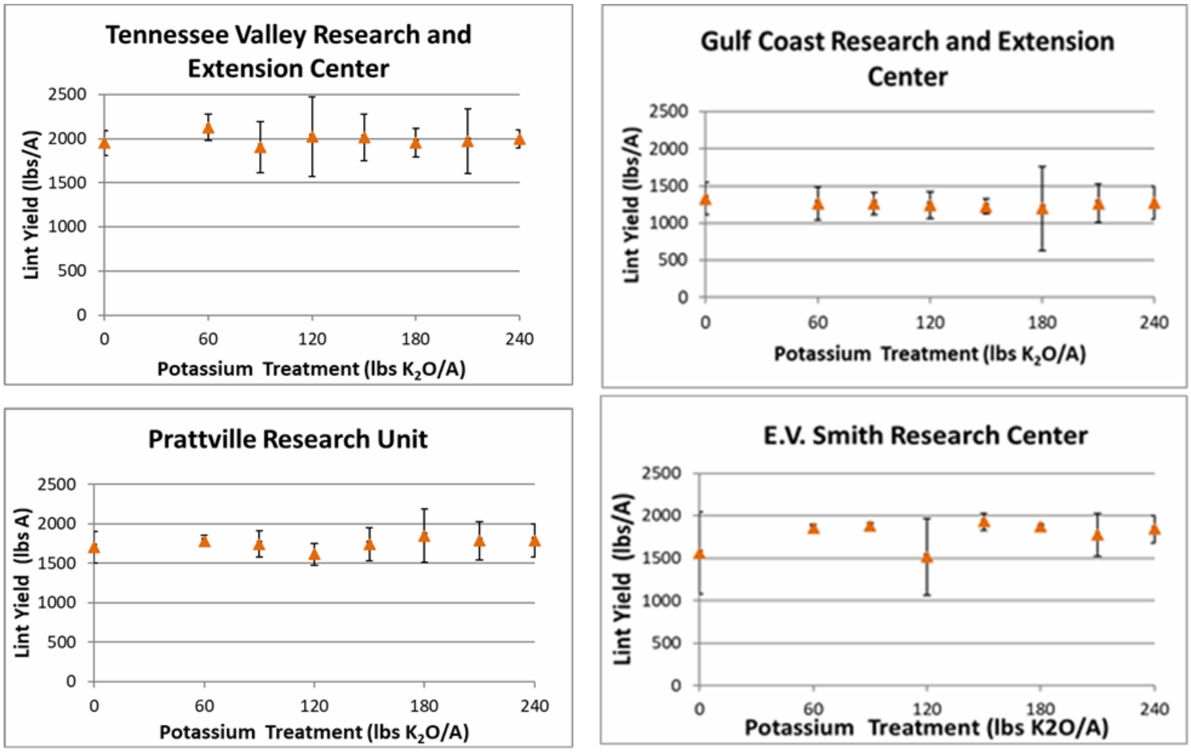


Figure 2. Cotton lint yield (lbs per acre) according to soil-applied potassium (K) treatment for each plot at TVREC, GCREC, PRU, and EVS locations. WREC was not harvested due to damage from Hurricane Michael.

Continued Support of Long-Term Research

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

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 121 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 2018 growing season, lint yields for continuous cotton with no crop rotation, no supplemental N, and no winter legume averaged 640 lbs per acre. Lint yields for cotton rotated with corn and a winter legume, still without supplemental N, averaged **1980 lbs per acre**. 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 (Table 1), leading to increased cotton yield potential.

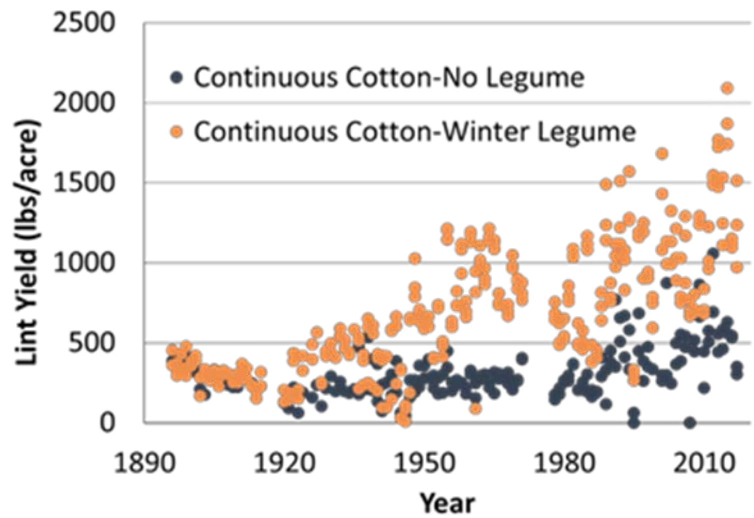


Figure 1. Lint yield for continuous cotton with no N fertilizer for plots with and without a winter legume cover crop included. Yield has remained relatively stagnant for continuous cotton without a cover crop, but yields have increased over time for cotton with a legume cover crop.

Table 1. Organic matter concentration and 10-yr average cotton lint yields (2007-2017) according to treatment from the Old Rotation.

Treatment				2007-2017 Avg. Cotton Lint Yield	
Rotation	Winter Cover Crop	N Fertilizer (120 lbs/A)	Organic Matter	Dryland	Irrigated
			-- % --	-- lb/acre--	-- lb/acre --
Continuous Cotton	No	No	1.6	476	589
Continuous Cotton	Yes	No	2.9	1118	1331
Continuous Cotton	No	Yes	2.7	1057	1407
Cotton-Corn	Yes	No	2.6	1305	1468
Cotton-Corn	Yes	Yes	2.9	1290	1680
Cotton-Corn-Wheat-Soybean	Yes	Yes	3.1	934	1255

The long-term rotations at Auburn University also continue to be invaluable "Outdoor Classrooms" for students and visitors to Auburn University. During the 2018 season, at least ten tours were given of the Old Rotation and/or the Cullars Rotation. Tours included two AGRI1000 (Introduction to Agriculture) classes, four CSES1000 (Basic Crop Science) classes, an Extension county agent group from Texas, the Southern Cover Crops Council (Photo 1), Yara interns, and a group of 5th and 6th graders as part of a Science Discovery Camp. Improved signage has been ordered to increase visibility of the Old Rotation and Cullars Rotation, which will be installed in 2019.

Photo 1. The Southern Cover Crops Council visiting the Old Rotation in July 2018.

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 five "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

This experiment was conducted during the 2017-18 cover crop season at the Auburn University 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 counts were collected one month after planting for each planting date treatment. Plant canopy width, root length and diameter, and total biomass were measured monthly throughout the growing season. At the last sampling date, effective rooting depth (i.e., the soil depth to which the fleshy portion of the taproot penetrates the soil) was measured. Following cover crop termination and subsequent strip-till cotton planting, plots were evaluated for soil compaction using a five-probe tractor- mounted penetrometer. Following cover crop termination, cotton was planted approximately two inches from the center of the tillage radish row. Yield according to plot was collected at harvest.

Results

Effect of Cover Crop Planting Date

Planting date affected all growth parameters except effective rooting depth (i.e., the soil depth to which the fleshy portion of the taproot penetrates the soil) at both locations. Earlier planting dates consistently produced radishes with greater dry matter and canopy width at both locations (Fig. 1).

Radish effective rooting depth reached consistent depths across planting dates at each location, likely coinciding with a root-limiting layer. Radishes did not consistently winter-kill at either location, but later-planted radishes had a greater tendency to survive winter and put on aboveground biomass during the spring. Penetrometer data showed no significant differences in penetration resistance for any radish planting date compared to the control after one year of radish cover crop.

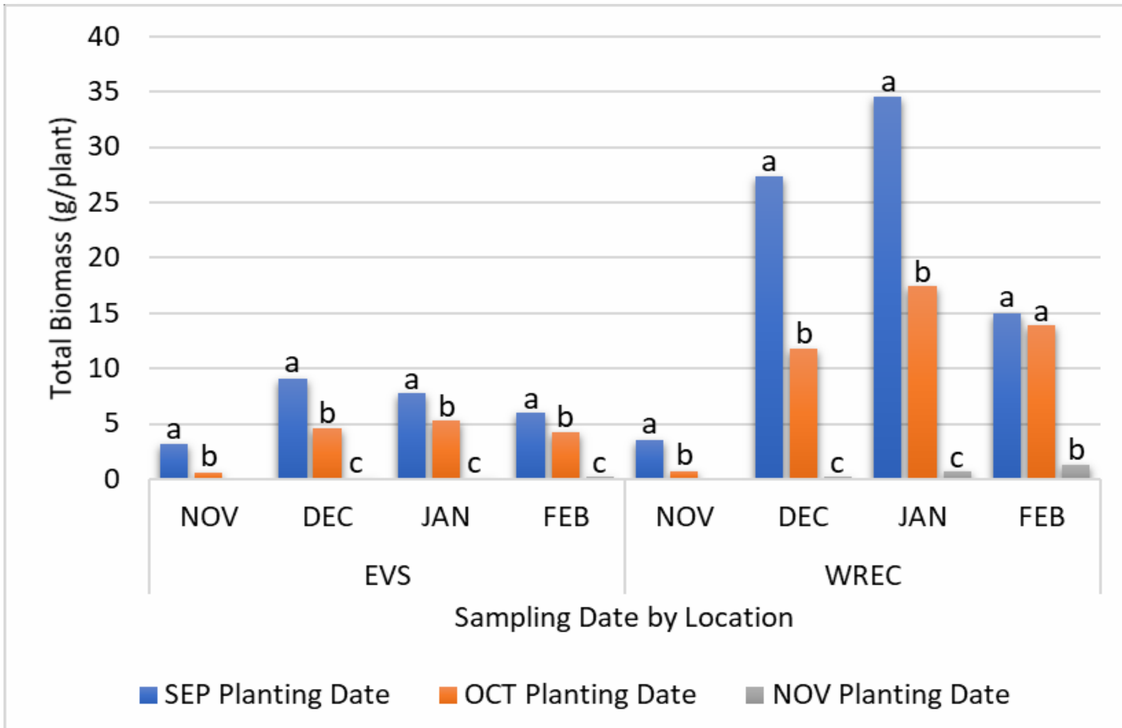


Figure 1: Total radish biomass production at E.V. Smith Research Center (EVS) and Wiregrass Research and Extension Center (WREC) according to sampling time for September, October, and November-planted radishes across radish cultivar treatments. Letters denote statistical significance at α=0.05.

Effect of Cover Crop Cultivar

There were no statistical differences between radish cultivars for most growth parameters (e.g., root dry matter, canopy width, etc.). However, the 'CCS779' radish had a greater effective rooting depth compared to 'Tillage' and 'Sodbuster' radish at WREC (Fig. 2), indicating that the 'CCS779' radish may have greater ability to penetrate root-limiting compaction layers compared to other cultivars. Penetrometer data showed no significant differences in penetration resistance for any radish cultivar compared to the control after one year of radish cover crop.

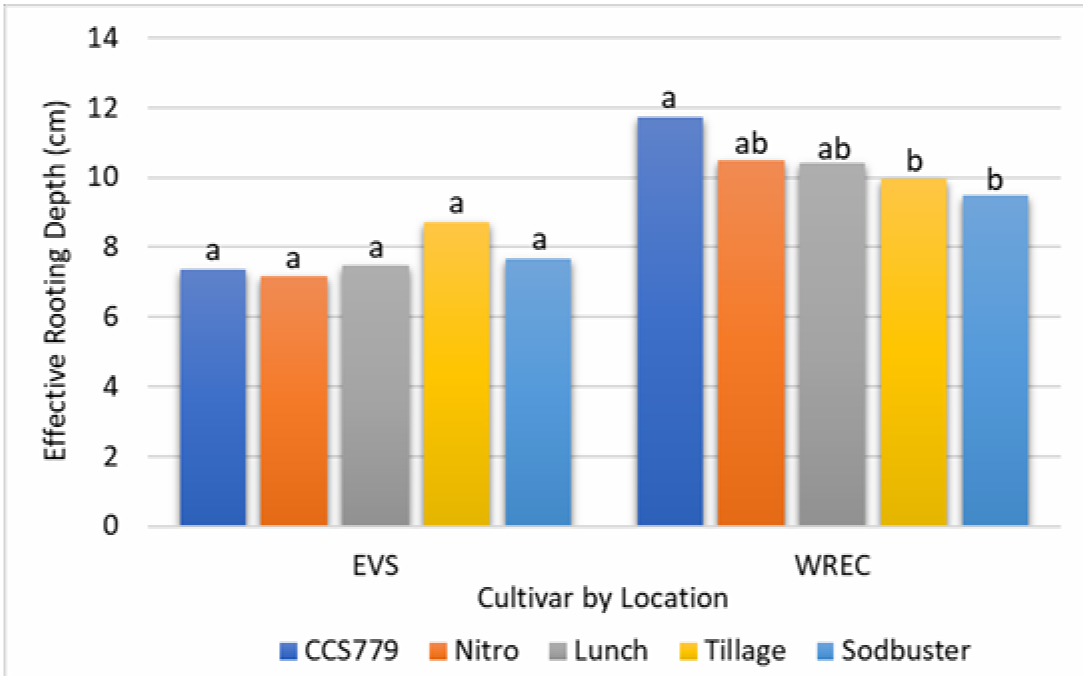


Figure 2: Effective rooting depth (i.e., depth to which the fleshy portion of the taproot penetrates into the soil) production at E.V. Smith Research Center (EVS) and Wiregrass Research and Extension Center (WREC) according to cultivar across radish planting dates. Letters denote statistical significance at $\alpha=0.05$.

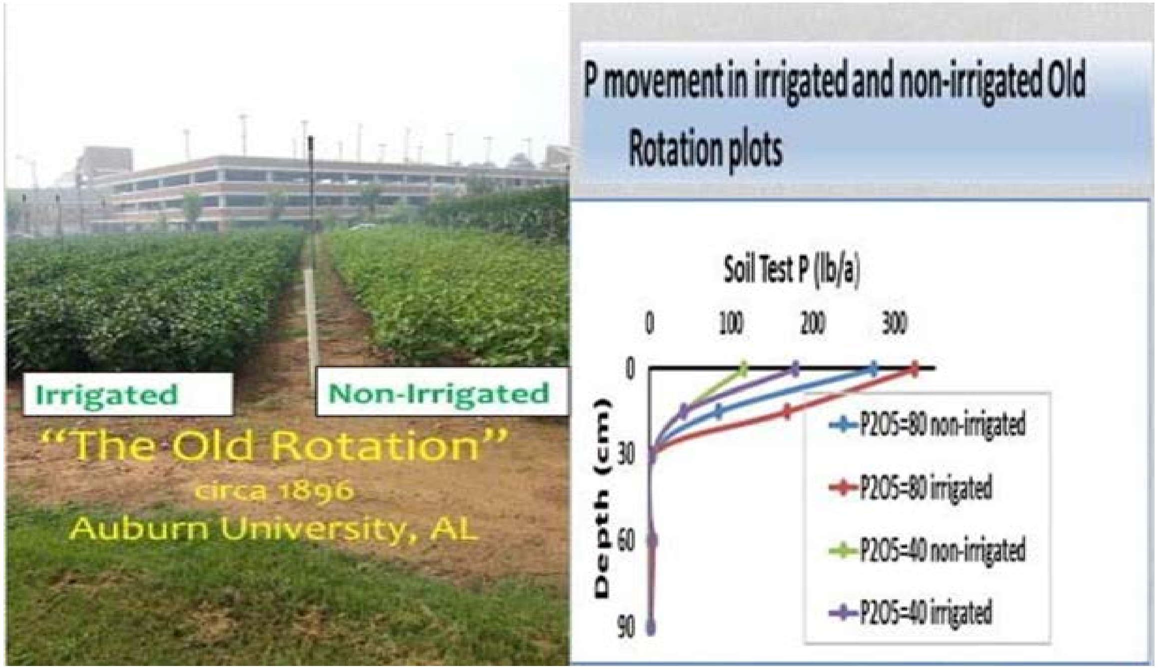
Continued Research

Cotton yield data for the 2018 growing season could not be collected from WREC due to damage from Hurricane Michael. Yield data was collected from the EVS location and is still being processed. Results will be discussed during the January report meeting. The second year of this study will continue to assess the effect of cultivar and planting date on various radish growth parameters. Additionally, a greenhouse study will be conducted to assess the ability of radishes to break through artificial compacted layers created in PVC cylinders.

Improving Soil Quality in Alabama (2018 #53)

T. Huluka

We took compaction measurements at 0-6 and 0-18 inch depths using a penetrometer. The measurement were taken at 10% and 20% soil moisture content in The Old Rotation, (c 1896), on Auburn University campus. This historic long-term agronomic field has conservation tillage since 1997. Irrigation was initiated 2003 in addition to the many agronomic treatments that include cover crops, N and P. In summary, soil compactions for 0-6 and 0-18 inches were 0-200 and 0-300 psi, respectively. Compaction readings decreased as moisture increased. Irrigated plots had lower compaction even at the same moisture levels. The 300 psi at 0-18 inch is a concern since it could limit plant root growth (root penetration) for nutrient and water extraction. Since penetrometer measures end-points only, a continuous reading of the compaction measurement will be needed at each increment of depth to make a better interference on its impact.



In addition, irrigated plots had significantly greater extracted phosphorus at each depth and phosphorus rate (see below). Hence, irrigation, increased plant available P, organic matter, etc., will improve soil quality for cotton production.

Reevaluating Growing Degree Days in Three Cultivars of Differing Maturity

T. Sandlin

Justification and Procedures:

The 'rule of thumb' DD60 to maturity guidelines published decades ago often fail to accurately predict crop growth stage. High/low night temperatures, excessive daytime temperatures, and variable solar radiation are all hypothesized to play a role in realized growth stage. While it is likely that the development of a new parameter which uses all of these factors would be too complicated for widespread use, it is also likely that slight modification to the current DD60 calculation or incorporation of a conditional statement using an additional factor could increase the accuracy of the estimate.

Objectives:

1. Compare numerous growing degree day calculations to determine which calculation provides the most accurate estimate of cotton phenology.
2. Evaluate alternative approaches to capture environmental parameters which drive cotton phenology.
3. Determine if there is variation between time to each growth stage in three cultivars of varying maturity.

Results:

Three cotton cultivars (DP 1612 B2XF, DP 1646 B2XF, DP 1851 B3XF) of differing maturities were evaluated to determine how closely they followed current heat unit accumulation modeling and days after planting models. These three cultivars were planted at the Tennessee Valley Research and Extension Center on May 18, 2018 and harvested October 23, 2018. This location served as one of twelve data points for a current project being conducted among the Beltwide Cotton Specialists Working Group. Other locations across the cotton belt ranged from Virginia to California. Six key growth stages (emergence, squaring, flowering, cutout, cracked boll, 60% open) were recorded before, during, and after occurrence along with plant mapping at each critical growth stage. Daily environmental conditions including hourly temperature, solar radiation, and daily precipitation were also recorded. Environmental data has been sent to a climatologist who is compiling this data for all locations participating in this project. Tables 1 and 2 below describe when critical growth stages were achieved for each cotton cultivar in accumulated heat units and days after planting, respectively. An upper and lower guideline based on Mid-South modeling is also present for reference (Growth and Development of a Cotton Plant: http://www.cotton.org/tech/ace/growth-and-development.cfm, modification from Oosterhuis, 1990).

Table1. DD60s accumulated by each cultivar at critical growth stages compared to current model guidelines.

Growth Stages	DP 1612 B2XF	DP 1646 B2XF	DP 1851 B3XF	Lower Guideline	Upper Guideline
Emergence	74.5	74.5	74.5	50	60
Squaring	639	639	639	425	475
1^{st} Week of Flower	1112	1112	1249	775	850
Cracked Boll	2064	2064	2064	1625	1800
60% Open	2193	2193	2327	2200	2600

Table 2. Days after planting to reach critical growth stages by each cultivar compared to current model guidelines.

Growth Stages	DP 1612 B2XF	DP 1646 B2XF	DP 1851 B3XF	Lower Guideline	Upper Guideline
Emergence	4	4	4	4	9
Squaring	38	38	38	27	38
1^{st} Week of Flower	62	62	70	60	70
Cracked Boll	117	117	117	105	135
60% Open	124	124	131	130	160

Key points/results from 2018 testing in Alabama:

- Heat units accumulated for all cultivars at each critical growth stage far exceeded the current Mid-South model with the exception of 60% open at this location.
- Despite rapid and excessive heat unit accumulation, days after planting to reach critical growth stages were not achieved any sooner than guidelines in the current Mid-South model with the exception of 60% open.
- Cotton cultivars tested at this location followed the days after planting model more closely than the current mid-south heat unit accumulation model for most of the critical growth stages.
- The latest maturing cultivar in this study, DP 1851 did take longer to reach flowering and 60% open boll than both DP 1612 and DP 1646. However, the difference in reaching these growth stages between cultivars was a matter of days, not weeks.
- Based on results in 2018, other parameters with respect to environment have the potential to more accurately predict cotton growth stages and maturity.

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

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

Background

This project was initiated with a goal to understand the phosphorus storage capacity of soils (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, 12-24 inch) within a farm, depending on the ability of the soil probe to cut through greater depths (Figure 2 and 3). The soil samples were dried, ground and extracted using extractants namely, Mehlich1, Mehlich-3, Oxalate and water, and P concentrations were determined. The relationships are currently being studied. Preliminary result is presented below.

Preliminary results

Here we present the data from two farms. The data below is preliminary and used for reporting purpose only. Drawing strong conclusion is not recommended at this time.

To maintain the confidentiality of the farms, we have named the farms as Farm A and Farm B. The soils at farm A is Nauvoo and Sipsey soils whereas soil at Farm B is Orangeburg loamy sand. Soil phosphorus storage capacity (SPSC) was calculated for the two farms using the methods described above. As presented in Figure 3, the soil in 0-2 inch depth has negative SPSC value. When the SPSC value is negative, the soil has no more capacity to fix any additional phosphorus and the phosphorus holding capacity is exhausted. On the other hand, when SPSC value is positive, the soil has the remaining capacity to absorb/fix more phosphorus. The preliminary results indicate that:

1) The magnitude of SPSC is different between farms and soil depths. Farm B has greater negative SPSC value than Farm A.

2) The SPSC values becomes positive as we go down the soil profile. This indicates that soils at lower depths are still holding the P and preventing it from leaching to the groundwater.

More participation of farmers is required to get a robust data set representative of Alabama soils. Due to wet condition in Fall, we could not collect samples as anticipated. We will continue soil sampling in Spring 2019.

Figure 1. Sample promo card used to encourage farmers to allow soil testing.

Figure 2. Soil collection and laboratory analysis of phosphorus.

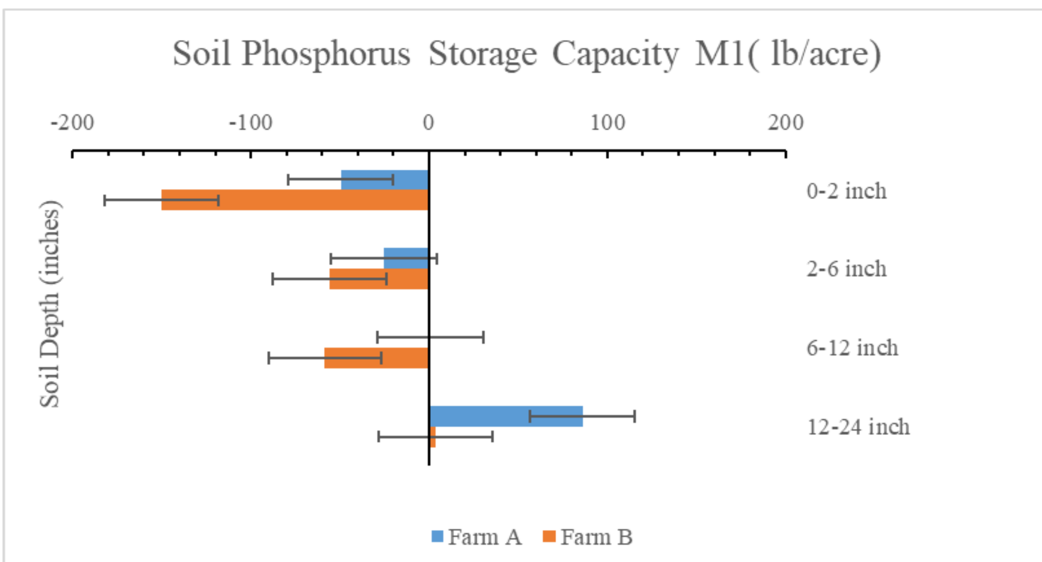


Figure 3. Comparison of soil phosphorus storage capacity of two farms.

Evaluating Variable Input Levels in Cotton Production for Southeast Alabama

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

Weather delayed planting of this trial to such a late date, we felt that results would be inaccurate if we tried to establish a stand so late into the season. This research will be established again in 2019. No additional funds are requested.

Comparison of On-Farm Irrigation Scheduling Practices in Alabama Cotton Production

B. Dillard, J. Kelton, W. Birdsong, A. Bouselmi, and B. Ortiz

Due to early season rain patterns in 2018, no irrigation was required for treatments and differences could not be assessed. Therefore, the research will be repeated in 2019 with no extra funding requested.

III. Disease Management

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

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

Project Overview: Target spot, 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 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.

Project Objectives:

1. Evaluate the susceptibility of commercial cotton varieties to 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 target spot along with their effect on hardlock incidence, lint quality and yield.
4. Impact of planting date, seeding rate, and canopy architecture as influenced by variety selection on target spot intensity, hardlock incidence yield of selected cotton varieties.

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 490 W3FE, PhytoGen 444 WRF, PhytoGen 450 W3FE, Deltapine 1646 B2XF, Deltapine 1538 B2XF, Deltapine 1553 B2XF, Stoneville 5115 GLT, Stoneville 6182 GLT, and Stoneville 4946 GLB2 as whole plots and a fungicide program consisting of four or five 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, final % defoliation levels for target spot differed by cotton cultivar and fungicide program. Other interactions between variables on target spot-incited defoliation along with seed yield were not significant. For all cultivars, final % defoliation values were significantly lower for the fungicide- than the non-fungicide-treated cotton. For the non-fungicide treated cotton, Stoneville 6182 had significantly greater target spot-incited defoliation levels than PhytoGen 444 WRF, Deltapine 1538 B2XF, Deltapine 1553 B2XF, Deltapine 1646 B2XF, and Stoneville 5115 GLT with the latter cultivar having lower defoliation ratings than the former two cultivars. For the fungicide treated cotton, Stoneville 5115 GLT suffered significantly less disease-related defoliation than Stoneville 6182 GLT, Stoneville 4946 GLB2, PhytoGen 450 W3FE, and Deltapine 1538 B2XF. Deltapine 1646 B2XF and Deltapine 1538 B2XF produced significantly greater yields than all cultivars except for Stoneville 5115 GLT and Stoneville 4946 GLB2. Similarly low yields were recorded for PhytoGen 444 WRF, PhytoGen 490 W3FE, and PhytoGen 450 W3FE. Significantly greater yield ($P<0.10$) was noted for the fungicide- than the non-fungicide treated cotton. Open boll counts were equally greater for Deltapine 1646 B2XF and Deltapine 1538 B2XF than PhytoGen 490 W3FE and PhytoGen 444 WRF but similar to the remaining cotton cultivars. In contrast, the latter two cultivar has greater locked boll counts than all cotton cultivars, which, except for PhytoGen 450 W3FE, had similarly lower hardlock levels. Ginned samples have been submitted for grading.

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 490 W3FE, PhytoGen 340W3FE, PhytoGen 450 W3FE, Deltapine 1646 B2XF, Deltapine 1553 B2XF, Deltapine 1538 B2XF, Stoneville 5115 GLT, Stoneville 5020 GLT, and Stoneville 4949 GLT as whole plots and a fungicide program consisting of four or five 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. Overall, the high defoliation levels on Stoneville 5020 GLT and PhytoGen 490 W3RF were matched by PhytoGen 340 W3RF, PhytoGen 450 W3RF, and Deltapine 1646 B2XF. In contrast, similarly low defoliation levels recorded for Deltapine 1538 B2XF and Deltapine 1553 B2XF were noted for Stoneville 5115 GLT and Stoneville 4949 GLT. With the fungicide umbrella program, Stoneville 5020 GLT had greater defoliation levels than the remaining eight cultivars, which all had similarly low disease ratings. Since the cultivar x fungicide interaction for yield was not significant, data were pooled across fungicide programs. Despite noticeable target spot-incited defoliation, Deltapine 1646 B2XF had greater yields than all cultivars except for Stoneville 5115 GLT. The low yield recorded for Stoneville 4949 GLT was matched by that of PhytoGen 490W3FE, Stoneville 5020 GLT, and PhytoGen 340 W3FE, with the latter three cultivars suffering severe target spot-incited defoliation. Significant difference open boll counts were noted between cotton cultivars with PhytoGen 340 W3FE and Deltapine 1646 B2XF having higher counts than Stoneville 4949 GLT and Stoneville 5115 GLT. Counts of hardlock bolls did not differ between cotton cultivars but overall counts were 30% of open boll counts. Ginned samples have been submitted for grading.

Trials were also conducted at the Field Crop Unit (FCU) and Plant Breeding Unit (PBU) at the E. V. Smith Research Center to assess cotton cultivar reaction to areolate mildew and target spot as influenced by an umbrella fungicide program. The experimental design was a factorial arranged in a split plot with the nine cotton cultivars as whole plots and a fungicide program as the split plot treatment. The fungicide program consisted of multiple broadcast applications of 8 fl oz/A Priaxor + 1.5 pt/A Bravo Ultrex or a non-fungicide treated control. Individual experimental units consisted of four 25-ft rows spaced 3 ft apart. Four replications of treatments were included. At FCU, the significant cultivar × fungicide program interaction for areolate mildew-incited defoliation and seed yield illustrated the differential response of cotton cultivars to the fungicide program, which consisted of multiple applications of 8 fl oz/A Priaxor + 1 pt/A Bravo WeatherStik. Across all cotton cultivars, the full-season Priaxor + Bravo WeatherStik program gave complete control of areolate mildew. For the non-fungicide program, areolate mildew-incited defoliation was greater on PhytoGen 340 W3FE (28.5%) than all other cultivars except for Stoneville 5020 GLT (17.4%)

and Stoneville 5471 GLTP (11.9%), while similarly low defoliation levels attributed to this disease were noted for Deltapine 1747NR B2XF (2.6%) and PhytoGen 490 W3FE (3.7%). With the full-season fungicide program, Stoneville 5471 GLTP had greater seed yields than all cultivars except for PhytoGen 450 W3FE and Deltapine 1538 B2XF, while lower yields recorded for PhytoGen 340 W3FE and PhytoGen 490 W3FE were matched by Stoneville 5020 GLT and Stoneville 5818 GLT ($P<0.10$). For the non-fungicide program, Stoneville 5818 GLT had significantly higher seed yields compared with Deltapine 1747NR B2XF and PhytoGen 340W3FE, which had similarly low seed yields. In addition, PhytoGen 340 W3FE, which had the highest areolate mildew defoliation rating, also yielded less than seven (7) cotton cultivars. Finally, significant yield gains were obtained with the fungicide compared with the non-fungicide program with Stoneville 5471 GLTP, PhytoGen 450 W3FE, Deltapine 1538 B2XF, and Deltapine 1747NR B2XF. For the early June-planted PBU cultivar x fungicide study, disease onset occurred between the 8 and 23 Aug rating dates with noticeable signs of areolate mildew observed on 29 Aug. By the 24 Sep final rating date, greater premature defoliation levels were recorded for PhytoGen 450 W3FE (43.2%) compared with the remaining cultivars except for Deltapine 1538 B2XF (28.3%). With the exception of latter two cultivars and Stoneville 5122 GLT (20.4%) and PhytoGen 340 W3FE (16.3%), the low level of areolate mildew defoliation observed on Deltapine 1553 B2XF (5.0%) was equaled by all remaining cotton cultivars. As was noted at FCU, the non-fungicide treated cotton (16.9%) had significantly greater areolate mildew defoliation ratings compared with the fungicide umbrella program, which provided complete control (0.0%) of areolate mildew. Yields are not yet available for the PBU cotton cultivar x fungicide study.

At the Wiregrass Research and Extension Center, 40 commercial cultivars and breeding lines in the full season OVT trial were evaluated for their reaction to target spot and areolate mildew. Sizable differences in cultivar and breeding line response to target spot were observed with the greatest disease-related defoliation recorded for Stoneville 5020 GLT (81%), Stoneville 6182 GLT (67%) and Bayer BX1974GLTP (64%) while the low level of defoliation recorded for Deltapine 1646 B2XF was statistically equaled by 23 cultivars and breeding lines. Noticeable areolate mildew development was observed by the 6 September rating date with Deltapine 1646 B2XF (14%) having higher defoliation ratings than all cultivars and breeding lines except for Deltapine MON17R829 B3XF. Little if any areolate mildew-incited defoliation was observed for the majority of cultivars and breeding lines. In contrast to the above study, considerable areolate mildew development was noted in the later-planted early flex OVT trial at the same location with Americot NG 3729 B2XF suffering greater defoliation than all cultivars and breeding lines except for PhytoGen 340 W3FE, Deltapine 1646 B2XF, Stoneville 5020 GLT, PhytoGen 333 WRF, PhytoGen 330 W3FE, PhytoGen 300 W3FE, Croplan 9178 B3XF, and breeding lines BX1973GLTP and Bayer BX1975GLTP. Minimal defoliation ratings were recorded for five PhytoGen advanced breeding lines along with PhytoGen 320 W3FE and PhytoGen 350 W3FE, and PhytoGen 480 W3FE. In contrast to the above study, considerable areolate mildew development was noted in the early June planted early flex OVT trial with Americot NG 3729 B2XF suffering greater defoliation (64%) on 6 Oct than all cultivars and breeding lines except for PhytoGen 340 W3FE, Deltapine 1646 B2XF, Stoneville 5020 GLT, PhytoGen 333 WRF, PhytoGen 330 W3FE, PhytoGen 300 W3FE, Croplan 9178 B3XF, and breeding lines BX1973GLTP and Bayer BX1975GLTP. Minimal areolate mildew defoliation was recorded for five PhytoGen advanced breeding lines along with the commercial cultivars PhytoGen 320 W3FE (0.3%) and PhytoGen 350 W3FE (6.7%), and PhytoGen 480 W3FE (2.3%). While differences in target spot-incited defoliation were observed between cultivars and advanced breeding lines, overall disease pressure was much lighter than was observed in the full season flex OVT trial at this same location. Yields and grades of the above OVT trials were lost due to Hurricane Michael. The irrigated early and full-season flex OVT trials at FCU, PARU, and Tennessee Valley Research and Extension Center were also evaluated for areolate mildew and target spot intensity. Results from the above trials will be reported at a later date.

Objective 3.

Studies were conducted in 2018 to determine the yield protection and efficacy of registered and experimental fungicides for the control of target spot on PhytoGen 490 W3FE cotton at the BARU and GCREC in Southwest Alabama. The experimental design was a randomized complete block with four (4) replications. At BARU, the low defoliation levels on 20 Sep observed for the Priaxor + Bravo WeatherStik umbrella program were matched by the Priaxor, Miravis TOP + Quadris, Miravis TOP, as well as multiple rates of the experimental fungicide BAS 75302F. All Propulse in-furrow (IF) and broadcast programs, Proline and Elatus failed to significantly reduce premature defoliation when compared with the non-fungicide treated control. Efficacy of Topguard was intermediate between the non-treated control and the Priaxor + Bravo WeatherStik umbrella program. The total disease rating recorded on 27 Jul accounts for defoliation caused by target spot and areolate mildew. Again, similarly high defoliation ratings were obtained for all of the Propulse, Proline, and Elatus programs, while similarly low defoliation ratings were noted for Miravis TOP, Miravis TOP + Quadris, BAS 75302F, and Priaxor + Bravo WeatherStik. Areolate mildew % defoliation ratings represent the difference between % defoliation ratings recorded on 17 and 26 Sep. Regardless of the application timing, Propulse and Proline along with Elatus failed to protect cotton from areolate mildew, while the remaining fungicide programs, except for Topguard, displayed superior residual activity against this disease and target spot. Due largely to delayed disease onset, yields for the yields for all fungicide programs except for the two application Propulse program did not significantly differ from the non-fungicide treated control. Similar yields were obtained for the fungicide programs and non-fungicide treated controls. Open hand locked boll counts (which were very high) recorded for the fungicide programs did not differ from the non-fungicide treated control. When compared with the non-treated control, significant reductions in final defoliation were obtained at GCREC with all fungicide programs except for Helmstar and Propulse IF and early post broadcast programs. Miravis TOP + Quadris provided better protection from target spot than all fungicide programs except for Miravis TOP, Elatus, and Propulse IF fb Propulse fb Proline 480SC. Significant reductions in premature defoliation were also obtained with Proline 480SC, both rates of Priaxor, Amistar TOP, and the Priaxor + Bravo WeatherStik umbrella program. Irregular stands along with lodging due to high winds associated with a severe thunderstorm in July negatively impacted disease development and yield. Similar yields were recorded across all fungicide programs, including the non-fungicide treated control. Boll count and lint quality data is not yet available.

Objective 4.

The impact of seeding rate on the occurrence of target spot as well as seed yield was evaluated at the GCREC. The experimental design was a factorial with cotton cultivar (PhytoGen 490 W3FE and Deltapine 1646 B2XF) as the main plot, seeding rate (2, 3, and 4 seed/ft row) as the split plot, and a fungicide program (treated and non-treated) as the split split-plot treatment. The study was planted on 1 June. While similar levels of target spot-incited defoliation were noted for both PhytoGen 490 W3FE and Deltapine 1646 B2XF, seeding rate and fungicide program significantly impacted disease severity. Defoliation levels were lower for the 2 compared with 4 seed/ft with an intermediate rating recorded for 3 seed/ft. The fungicide program also reduced defoliation levels when compared with the non-fungicide treated control. Seed yield was significantly impacted by cultivar selection and fungicide program but not seeding rate where similar seed yields were recorded at 2, 3, and 4 seed/ft of row. Deltapine 1646 B2XF outyielded PhytoGen 490 W3FE by 235 lb seed cotton/A. Despite relatively low target spot incited pressure, the Priaxor + Bravo Ultrex umbrella fungicide program gave a 295 lb/A increase in seed cotton yield over the non-fungicide treated control.

Planting date × cotton cultivar trials were conducted at the FCU and GCREC. Both studies were not rated for diseases or harvested for yield due to heavy weather-related stand losses in the first planting. This study will be relocated to BARU and PARU locations in 2019.

2018 Publications:

Journal Articles:

Bowen, K. L., A. K. Hagan, M. Pegues, J. Jones, and H. B. Miller. 2018. Epidemics and yield losses due to *Corynespora cassiicola* on cotton. Plant Dis. 102:2494-2499. https://doi.org/10.1094/PDIS-03-18-0382-RE

Hagan, A. K., K. L. Bowen, H. B. Miller, and R. L. Nichols. 2018. Target spot-incited defoliation and yields of selected cotton cultivars. Plant Health Progress 19 (2):156-162. https://doi.org/10.1094/PHP-12-17-0082-RS

Published PDMR Reports for 2017 Research Projects:

Hagan, A. K., K. L. Bowen, K. Burch, and H. B. Miller. 2018. Yield response and target spot control obtained with recommended fungicides in cotton, 2017. Plant Disease Management Reports 12:CF036. https://www.plantmanagementnetwork.org/pub/trial/PDMR/reports/2018/CF036.pdf

Hagan, A. K., K. L. Bowen, K. Burch, and H. B. Miller. 2018. Areolate leaf spot and target spot as impacted by cotton cultivar, plant growth regulator and fungicide, 2017. Plant Disease Management Reports 12:CF035. https://www.plantmanagementnetwork.org/pub/trial/PDMR/reports/2018/CF035.pdf

Hagan, A. K., K. L. Bowen, K. Burch, and S. Scott. 2018. Target spot severity and yield response of cotton cultivars to a full-season fungicide program, 2017. 12:CF143. https://www.plantmanagementnetwork.org/pub/trial/PDMR/reports/2018/CF143.pdf

Submitted PDMR Reports for 2018 Research Projects:

Hagan, A. K., K. L. Bowen, K. Burch, and H. B. Miller. 2019. Target spot intensity and yield as impacted by cotton cultivar, plant growth regulator and fungicide, 2018. Plant Disease Management Reports 13:

Hagan, A. K., K. Burch, and D. Moore. 2019. Yield and disease response of cotton cultivars to fungicide inputs in Central Alabama, 2018. Plant Disease Management Reports 13:

Hagan, A. K., K. L. Bowen, K. Burch, and S. Scott. 2019. Target spot severity and yield response of cotton cultivars to a full-season fungicide program, 2018. Plant Disease Management Reports 13:

Hagan, A. K., K. Burch, and D. Moore. 2019. Yield response of cotton cultivars to fungicide inputs under light target spot pressure in Central Alabama, 2017. Plant Disease Management Reports 13:

Published Proceedings 2018 Cotton Beltwide:

Hagan, A. K., K. L. Bowen, K. Burch, M. Pegues, and J. R. Jones. 2018. Disease control and yield response of a target spot susceptible and resistant variety as influenced by fungicide inputs over a three year period. 2018 Beltwide Cotton Conference:595-601.

Lawrence, K., A. Hagan, R. Norton, T. Faske, R. B. Hutmacher, J. Mueller, I. Small, R. C. Kemerait, C. Overstreet, P. Price, G. W. Lawrence, T. W. Allen, N. Goldberg, R. Bowman, J. Goodson, H. Young-Kelley, J. Woodward, and H. L. Mehl. Cotton Disease Loss Estimate Committee Report, 2017. 2017 Cotton Beltwide Proceedings:161-163.

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Develop Transgenic Cotton Varieties with Enhanced Resistance to Cotton Leaf Disease Using CRISPR-Cas9 System

Y. Wang, S.W. Park, C. Chen, S. Li, J.W. Kloepper, M.R. Riles, and J. Zhang

Cotton leaf curl disease (CLCuD) is a serious disease for cotton. Although this has not been identified in the U.S. yet, the U.S. does have the perfect environmental conditions for its establishment. There has always been the concern that CLCuD could spread worldwide to the other cotton-growing areas including U.S. Thus, it is highly desirable to develop CLCuD resistant cotton varieties in U.S., aiming to shore-up the defenses should this disease arrive in the near future, and also help enhance cotton production for other countries who suffer severe CLCuD. This aligns well with the mission of the Alabama Cotton Commission and the Cotton Incorporated. In this study, our objectives were to: 1) Identify the gene clusters that might be relevant to the CLCuD, and then 2) Develop transgenic cotton varieties with enhanced resistance to CLCuD using the CRISPR-Cas9 system.

Below are the primary results that we obtained during the project period:

1. Analysis of cotton leaf curl virus disease-resistant related genes

Gossypium hirsutum is the most widely planted species of cotton in the U.S. The genome for allotetraploid *G. hirsutum* L. acc. TM-1 has been recently sequenced, providing essential information for growth feature improvement through transgenic manipulation. By searching in the literature, we tried to identify the gene clusters that might be relevant to the cotton leaf curl disease (CLCuD) resistance. Initially, we identified three genes that are relevant to the CLCuD. Two of them ($R_{1CLCuDhir}$ and $R_{2CLCuDhir}$) are for CLCuD resistance and another ($S_{CLCuDhir}$) as a suppressor of resistance [1]. We decided to knock out the suppressor gene in order to enhance the resistance of *G. hirsutum* to CLCuD. However, later on, from the new literature, we noticed that the elimination of suppressor gene (and thus the overexpression of CLCuD resistance gene) could lead to inhibition of plant growth as well as inducing a phenotype that is consistent with the constitutive activation of the defense pathway. Thus, such an approach to overexpress the CLCuD resistance gene in the absence of the pathogen, can reduce the plant fitness.

Therefore, we decided to find an alternative gene that we can manipulate in order to elevate the

CLCuD resistance of cotton. By searching additional literatures, we found that, the 70 kDa heat shock proteins (HSP70s) are a family of conserved molecular chaperones and folding catalysts, which are expressed ubiquitously in almost all prokaryotic and eukaryotic cells [2]. HSP70s assist a wide range of protein folding and assembly processes, including folding and refolding of the native proteins and membrane translocation of proteins [3]. They also involve in folding of the non-native proteins [4]. In studies of plant viral diseases, the HSP70 of the plant is proposed to be associated with interaction of capsid protein, replication and cell-to-cell movement and of many plant virus, particularly of geminiviruses [5, 6]. In plants which were infected with tomato yellow leaf curl virus (TYLCV), downregulation of HSP70 indicated reducing of viral load and viral movement [7]. In *G. arboreum* with symptom of CLCuD infection, the induction of many genes involved in protein processing in endoplasmic reticulum, including heat shock protein HSP70, played a role in interacting with cotton leaf curl virus proteins and facilitating viral movement between plant cells [8]. The downregulation of HSP70 in asymptomatic plants might have negative effects on viral movement proteins. Therefore, to make *G. hirsutum* less susceptible to CLCuD, HSP70 can be a target to be knocked out.

2. **Construction of CRISPR-Cas9 vectors for the deletion of the *hsp70* gene**

To delete *hsp70* in *Gossypium hirsutum* using the CRISPR-Cas9 system, two plasmids (pCotton3 and pCotton4) were constructed. The plasmid HBT-pcoCas9 harboring the plant codon-optimized Cas9 gene driven by the hybrid constitutive 35SPPDK promoter was used as the mother vector [9]. A 357-bp fragment containing the U6 polymerase III promoter and 20-nt sequence (5'-cggagatgcagcaaagaacc-3') targeting on *hsp70* and another 171 bp fragment containing the 20-nt targeting sequence with the terminator were amplified from pUC119-gRNA with primers YW4059 and YW4060, YW4061 and YW4062, respectively (**Fig. 1**, Lanes 1 and 2). The two DNA fragments were inserted into the *Eco*RI site of HBT-pcoCas9 using Gibson Assembly. The positive colony containing the desirable plasmid construct was verified with colony PCR (cPCR) and named as pCotton3 (**Fig. 1**, Lane 4).

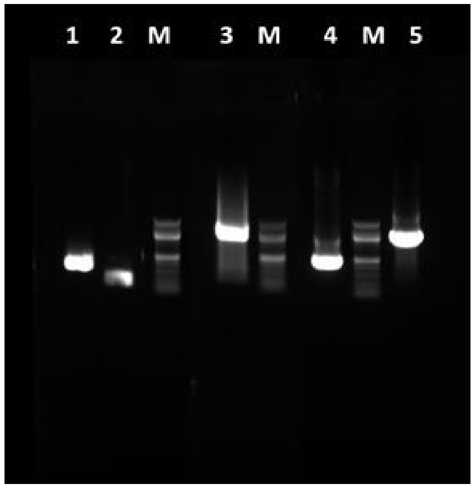

Fig. 1 Construction of pCotton3 and pCotton4.

Table 1 Primers used in this study.

Primers	Sequence (5’-3’)
YW4059	GATGATAAGCTGTCAAACATGAGAATTCAGAAATCTCAAAATTCCG
YW4060	AAAACggttctttgctgcatctccgAATCACTACTTCGTCTCTAACCATA
YW4061	TGATTcggagatgcagcaaagaaccGTTTTAGAGCTAGAAATAGCAAGTT
YW4062	GAAACAGCTATGACCATGATTACGAATTCTAATGCCAACTTTGTACA
YW4063	TGGACAGGCTAAGAAGAAGAAGTGACTGCAGGATTATTCATTTTCCTTTCTCCCGC
YW4064	CTTTATTGCCAAATGTTTGAACGATCTGCAGGTGTGTTTTATAGTTGCTGCAATCAT

In plants, genetic mutations can be introduced through two approaches, non-homologous end-joining (NHEJ) and homology directed repair (HDR) [10]. Higher DNA repair efficiency was obtained by NHEJ than HDR in *Arabidopsis* [9]. pCotton3 was used for inducing mutations through NHEJ mechanism. To compare the editing efficiency between NHEJ and HDR in cotton, pCotton4 was also constructed by inserting the homology arms into pCotton3. The upstream and downstream homology regions flanking the targeting sequence to delete were amplified from gBlock, which was synthesized by Integrated DNA Technologies (IDT;Coralville, IA). The 1,062 bp homology sequence was amplified using primers YW4063 and YW4064 (**Fig. 1**, Lane 3;), and inserted into the *Pst*I site of pCotton3, generating pCotton4. pCotton4 was also verified with colony PCR as shown in Lane 5, **Fig. 1**.

3. Develop transgenic cotton varieties with enhanced cotton leaf curl virus disease- resistant

The developed two plasmids containing CRISPR-Cas9, pCotton3 and pCotton4 were first transformed into *Agrobacterium* strain EHA105 by electroporation (2,500 V, 400 Ω, 25 μF with 2 mm cuvette). Single colonies from LB plates (containing 50 mg/L rifampicin and 100 mg/L ampicillin) were picked and cultivated in liquid medium for 24 h. The liquid culture was used for *Agrobacterium*-mediated transformation of the plant [11]. The general procedures for the plant transformation are briefly illustrated in **Fig. 2**. Before the transformation, seed coats of selected cotton seeds were removed manually, and the seeds were treated for surface-sterilize followed by cultivation in BMSB medium for germination. The cultivation was carried out in growth chamber with a 14-h day/10-h night cycle at 28 ^{o}C. Then well-developed 7-10-day-old young seedlings were selected. The cotyledons and hypocotyls of the seedlings were cut into small pieces with about 5-7 mm and placed into the PIM medium with *Agrobacterium* strain EHA105 containing pCotton3 or pCotton4 for 10-min co-culturing. After co-culturing, the cotyledons and hypocotyls were placed on the MSBC medium with filter paper and cultured for 48 h in the dark at 22 ^{o}C. Then the cotyledon disks or hypocotyls segments are transferred into the MSBIS medium in flasks for inducing callus resistant to ampicillin under a 14–16-h photoperiod at 28 °C.

The callus will be cultivated for the development of somatic embryos and further recovered and regenerated to plants. Then the genotype and CLCuD-resistance phonotype of the plant will be characterized.

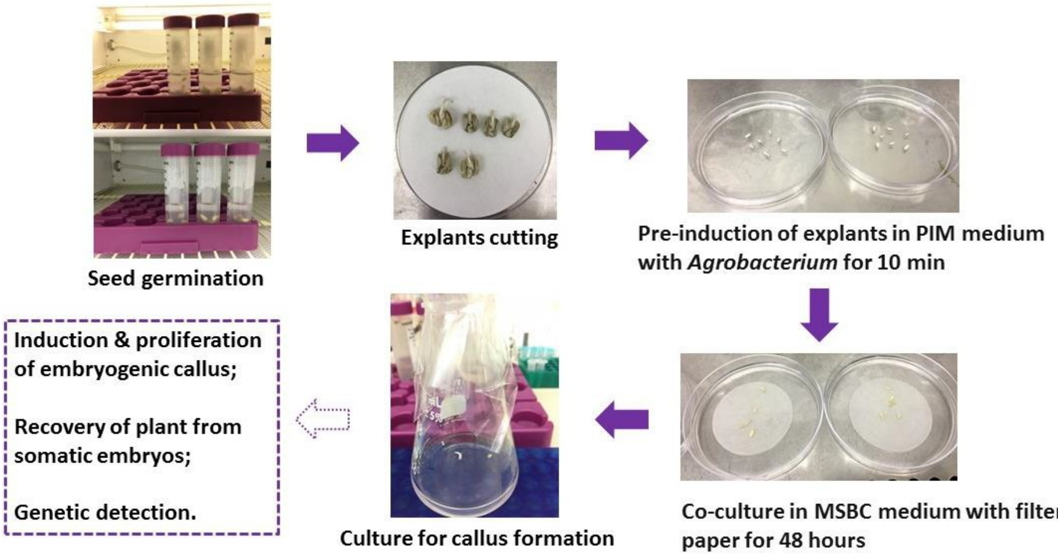

Fig. 2 Diagram of development of transgenic cotton varieties through *Agrobacterium*- mediated transformation method.

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Cotton Seedling Rate and Fungicide Combinations for Cotton Seedling Disease Management in North Alabama, 2018

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

Fungicide combinations were evaluated at two seeding rates for cotton seedling disease management on ST 4949 GBL2 cotton. The field site was located on the Tennessee Valley Research and Education Center near Belle Mina, AL. The field had a history of cotton seedling disease and was naturally infested with *Rhizoctonia solani*, *Pythium* spp., *Fusarium* spp., and *Thielaviopsis basicola*. The soil is a Decatur silt loam (24% sand, 49% silt, 28% clay). The cotton seed were treated with fungicide seed treatments by Bayer CropScience. Plots were planted on 13 April with a soil temperature of 16°C at a 10 cm depth and adequate soil moisture. Plots consisted of 2 rows, 7.6 m long with 0.91 m row spacing and were placed in a factorial arrangement in a randomized complete block design with five replications. Blocks were separated by a 4.5 m wide alley. All plots were maintained throughout the season with standard herbicide, insecticide, and fertility production practices as recommended by the Alabama Cooperative Extension System. Plots were irrigated with a lateral irrigation system as needed. Seedling stand was determined 28 days after planting (DAP). Plant vigor was rated on a 1 to 5 scale with 5 being the best. Uniformity is the linear row length of the 7.6 m row in 0.3 m sections with no plants growing thus the smaller the number indicates a more uniform stand. Plots were harvested on 10 Oct. Data were statistically analyzed using SAS 9.4 using the PROC GLIMMIX procedure and means compared using Tukey-Kramer with $P \leq 0.10$. Monthly average maximum temperatures from planting in May through harvest in October were 30.1, 32.7, 31.8, 32.7, 31.8, 25.1°C with average minimum temperatures of 18.1, 20.4, 21.4, 20.7, 20.8, 12.8 °C, respectively. Average temperatures from May to October were 24.1, 26.6, 27.1, 26.7, 26.3, 18.9°C. Rainfall accumulation for each month was 8.6, 11.4, 5.6, 11.2, 7.8, 6.2 cm, respectively.

Seedling disease pressure was high for irrigated cotton in 2018. The seeding rate x fungicide interaction was not significant for any of the variables so data are displayed separately (Table 1). Seeding rate affected plant stand at 28 DAP with the lower (3-seeded) rate having fewer plants than the higher (4-seeded) rate. The percent plant survival was 65 and 67% and similar between the two planting rates. Plant stand at 28 DAP was similar for all fungicide combinations. The base fungicide and premium fungicides combined with Aeris (3 + 5) both supported (P>0.10) a greater stand than either fungicide package alone. Plant vigor followed that same trends with both as the base fungicide and premium fungicide combined with Aeris (3 + 5) supporting more vigorous growth than the base fungicide alone. Plant uniformity was similar between all the fungicide treatments. Aeris alone had more open row length without plants than the Fungicide plus Aeris (3) combination. Seed cotton yields were higher in the higher seeding rate vs the lower seeding rate by 276 kg/ha. The greatest yield was produced in the premium fungicide plus Aeris (5) which increased yield by 703 kg/ha over the Aeris (2) alone.

Table 1. The impact of seeding rate and fungicides packages to plant stand at 28 days after planting and seed cotton yields at TVREC in 2018

Split-plot analysis *P* (F value)	Plant stand[x] 28 DAP		Vigor[y] 28 DAP		Uniformity 28 DAP		Yield (kg/ha)	
Seeding rate	0.0158		0.0259		0.0869		0.0476	
Fungicide	0.0001		0.0345		0.1393		0.0684	
Seed rate x fungicide	0.4453		0.1154		0.6815		0.8419	
Seeding rate LS-means								
3 seed per foot row	48.8	b[z]	1.8	b	6.2	a	3065	b
4 seed per foot row	67.3	A	2.3	a	5.3	a	3341	a
Fungicides LS-means								
1. Base fungicide	54.0	ab	1.5	b	5.5	ab	3049	ab
2. Aeris 0.75 mg ai/seed	47.0	B	1.9	ab	7.5	a	2931	b
3. Fungicide + Aeris	67.0	A	2.5	a	4.7	b	3135	ab
4. Premium fungicide	56.4	Ab	1.9	ab	5.2	ab	3267	ab
5. Premium fungicide + Aeris	65.7	A	2.4	a	5.8	ab	3634	a

[x] Plant stand is the number of live plants per 25 foot or row or 7.6 m of row.
[y] Plant vigor based on a 1 to 5 scale with 5 being the best.
[z] Column numbers followed by the same letter are not significantly different at $P \leq 0.10$ as determined by Tukey's multiple-range test

Cotton Cultivar, Disease Incidence, Severity, and Yields when Challenged with Verticillium Wilt in the Tennessee Valley Region, 2018

K. S. Lawrence, T. Sandlin, T. Raper, S. Butler, H. Young, B. Meyer, and N. Silvey

Introduction

Losses from Verticillium wilt for the U.S., according to disease loss estimates, between the years of 1990-2016 are approximately 480 million bales (Lawrence et al., 2018). 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.

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

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).

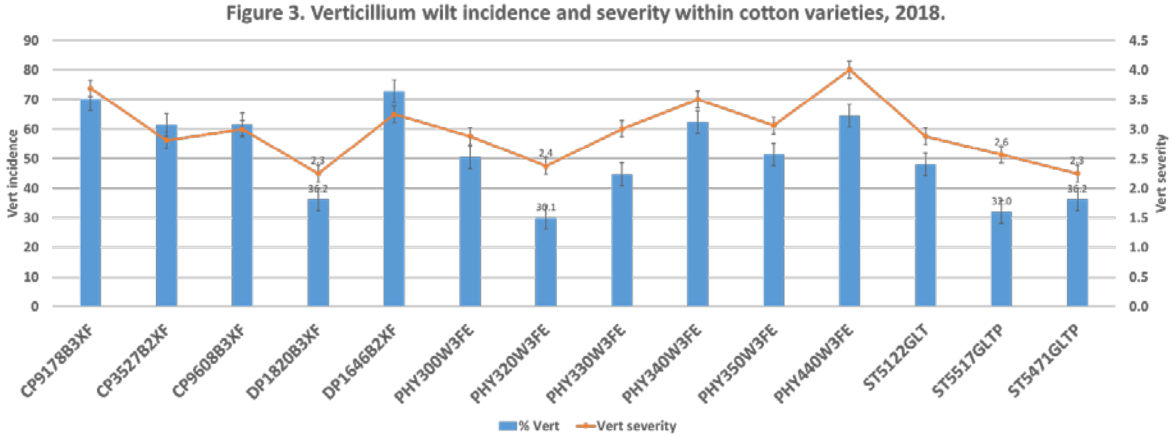
were selected for the 2018 tests based on severity of Verticillium wilt and the willingness of growers to participate in this research. Seed of adapted cultivars and experimental lines expected to be released in the next season were provided by AGRI-AFC, LLC of Land O'Lakes (Decatur, AL). Cotton cultivars 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 with 1 = no foliar wilting, 2 = interveinal chlorosis and necrosis of the leaves, 3 = interveinal chlorosis and necrosis of the leaves with 10-30% of the plant defoliated, 4 = interveinal chlorosis and necrosis of the leaves with 40-60% of the plant defoliated, and 5 = 70-100% defoliation. 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 75 feet 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 $P \leq 0.05$.

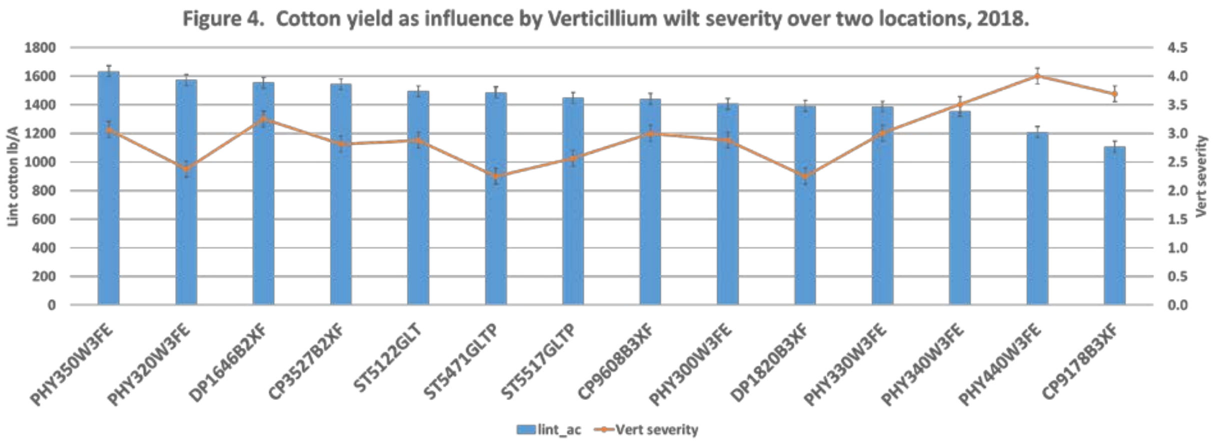
Results

Verticillium wilt disease incidence and severity ratings were variable between the cotton cultivars. Disease incidence ranged from 30 to 70 % of the plants of each cultivar with the lowest Verticillium wilt incidence percentage in PHY 320 W3FE, ST 5517 GLTP, ST 5471 GLTP, and DP 1820 B3XF. These cotton cultivars had the lowest percentage of plants with vascular discoloration. The severity of the Verticillium wilt foliar symptoms was also lowest for these same four cultivars. ($P \geq 0.05$). CP 9178 B3XF and DP 1646 B2XF were the cultivars with the highest level of infection by Verticillium wilt. The vascular staining in the stems of these two were above 70%. All the remaining cultivars had similar levels of Verticillium wilt incidence and severity (Figure. 3). Yields indicated significant differences between cultivars when challenged with Verticillium wilt (Figure 4.). Lint cotton yields varied by 528 lb/A. Ranking the cultivars by lint yield indicates PHY 350 W3FE and PHY 320 W3FE produced numerically greatest yield under these disease conditions and these cultivar yields were 30 % greater than the lowest yielding cultivars PHY 440 W3FX and CP 9178 B3XF.

Comparing the data between disease incidence and severity indicated a significant positive correlation (R^2=0.82509; $P \leq 0.0003$) 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 but was not significant (R^2= -0.35915; $P \leq 0.2073$). The correlation between Verticillium wilt severity and lint cotton yield (R^2= -0.59431; $P \leq 0.025$) did indicated that Verticillium wilt contributed to a 59% reduction of the cotton yield in 2018.

Figure 3. Verticillium wilt incidence and severity within cotton varieties, 2018.





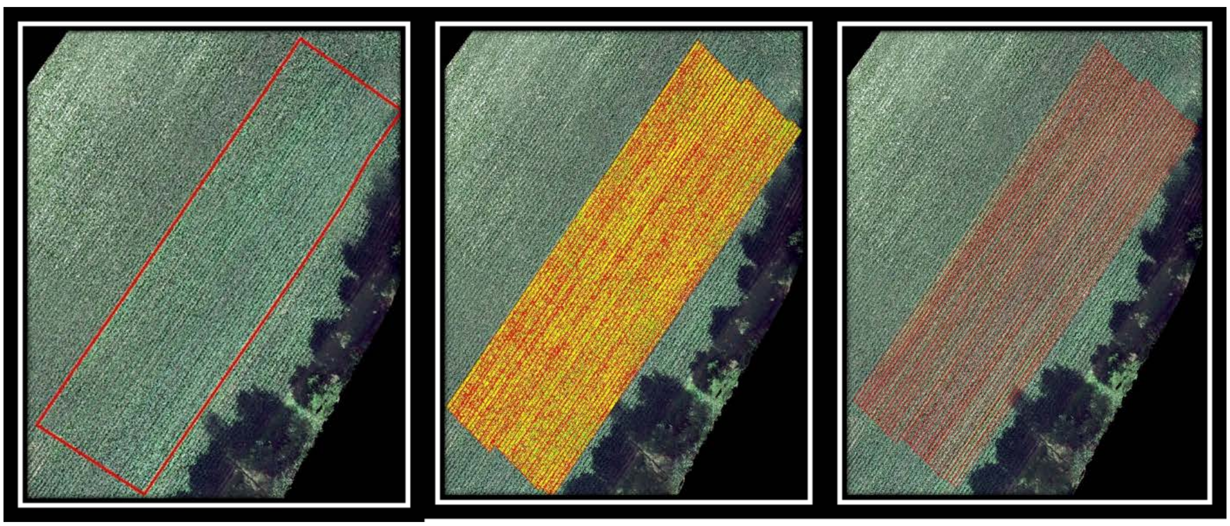


Figure 5. Left figure is the Brannon Verticillium wilt test outlined in the field; Middle is the NDVI image; and Right is the reverse. Images by Shawn Butler

Conclusions

Cotton cultivar selection is very important in a Verticillium wilt infested field. The highest yielding cultivars were moderately susceptible to Verticillium wilt. With the exception of DP 1646 B2XF, cultivars with the highest levels of Verticillium wilt incidence were the lowest yielding. This exception points to the complexity of selecting a cultivar for a Verticillium wilt infested field. DP 1646 B2XF had high incidence levels and high severity ratings, but relatively high yield. DP 1820 B3XF had low incidence levels and low severity ratings, but relatively lower yield. Level of incidence, severity of symptoms, and yield all need to be considered when selecting a cultivar for a Verticillium wilt field.

Verticillium wilt crew: from left to right top row: Shawn Butler , Nathan Silvey, Hannah Whitecotton, WinDi Sanchez, Cheyanne, Kaitlin Gattoni, Charlie Burmester, Marina Rondon, Bisho Lawaju, Brad Meyer, Tyler Sandlin and Andy Page.

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Evaluation of Seed Treatment Products for Increasing Cotton Stand and Yield of Cotton in Central Alabama, 2018

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

In this study, seed treatments are evaluated for their ability to increase yield by protecting the seedlings in the early stages of growth. The study was conducted at Auburn University's Prattville Agricultural Research Unit, Prattville, AL. Treatments were arranged in a randomized complete block design with four replications. The plots were planted on 13 Apr. using Stoneville 4949 GLT variety 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 chemicals in this test were applied as seed treatments. Treatment of Aeris was included as a negative control this treatment had no fungicide treatments. A base treatment was included as a positive control, these seeds were treated with Spera, Vortex, allegiance, and Evergol Prime fungicides. 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 an overhead irrigation system. Monthly average maximum temperatures from planting in April through harvest in October were 23, 31, 33, 33, 32, 33, and 28°C with average minimum temperatures of 9, 17, 21, 22, 22, 22, and 17°C, respectively. Rainfall accumulations for each month of the growing season were 8.41, 18.92, 8.56, 14.27, 11.76, 14.91, and 1.32 cm respectively for a total of 78.15 cm. Plant stand counts were taken 15 May which corresponded to 31 DAP. Seed cotton yield was collected on 10 October. Data was analyzed with SAS 9.4 using PROC GLIMMIX and LS-means were compared using the Tukey-Kramer method ($P \leq 0.1$).

The highest plant stands were recorded on treatments with the base seed treatment + Aeris insecticide/nematicide at the planting rate of 4 seed/foot of row and with the treatment of the base + Aeris + Trilex at a planting rate of 3 seed/foot. The largest yields were recorded on the Base + Aeris + Trilex Advanced treatment for both seeding rates. This combination of seed treatments appears to have provided sufficient protection in the early season that resulted in an increased yield compared to the plots treated with only Aeris and no base fungicide treatment.

Treatments		Stand[z]		Seed Cotton Yield (kg/ha)	
		Seeding rate			
		3 seeds/foot	4 seeds/foot	3 seeds/foot	4 seeds/foot
Base[x]		44 bc[w]	65 ab	3163 b	3672 ab
Aeris	0.75 mg ai/seed	38 c	57 b	3133 b	3438 b
Base + Aeris	0.75 mg ai/seed	58 ab	76 a	3540 ab	3489 b
Base + Trilex Advanced	0.93 ml/kg	42 c	71 ab	3448 ab	3876 ab
Base + Aeris + Trilex Advanced	 0.75 mg ai/seed 0.93 ml/kg	63 a	69 ab	3896 a	4252 a

[z] Plant stands per 7.6-meter row.
[y] Plant vigor was rated on a scale of 1-5 with 5 being the best.
[x] Base treatment consists of Spera, Vortex, Allegiance, and Evergol Prime applied at rates of 1.05, 0.05, 0.44, and 0.19 ml/kg of seed respectively.
[w] Values present are LS-means separated using the Tukey-Kramer method at $P \leq 0.1$. Values in the same column followed by the same letter do not differ significantly.

Seed Treatment Combinations for Damping-Off Control in North Alabama, 2018

W. Groover, K. S. Lawrence, B.R. Lawaju, D. R. Dyer, K. Gattoni, M. N. Rondon

This study was planted in the field at the Tennessee Valley Research and Extension Center near Belle Mina, Alabama. The soil type is Decatur silt loam, which contains 24% sand, 49% silt, 11% clay and 1% organic matter. Seed treatments were applied pre planting, and planting occurred on 2 May. Plots consisted of 4 rows that were 7 meters long with 1-meter row spacing. Two rows of each plot were inoculated at planting with 1 tablespoon per row of millet seed infested with *Rhizoctonia solani*. Seed was planted at 1.27 cm depth. The plots were arranged in a randomized complete block design with five replications of each treatment and a 6-meter-wide alley. Plots were maintained with typical pesticide and fertility production practices, and an overhead irrigation system was used for watering as needed. Plant stand data was collected at 7 and 22 days after planting (DAP). Only living plants were included in stand counts. Harvest occurred on 5 October at 156 DAP. Data was statistically analyzed by ANOVA in SAS 9.4 (SAS Institute Inc.), and means were compared using Tukey-Kramer with $P \leq 0.05$. Monthly average maximum temperatures from planting in May through harvest in October were 30.1, 32.7, 31.8, 32.7, 31.8, 25.1°C with average minimum temperatures of 18.1, 20.4, 21.4, 20.7, 20.8, 12.8 °C, respectively. Average temperatures from May to October was 24.1, 26.6, 27.1, 26.7, 26.3, 18.9°C. Rainfall accumulation for each month was 8.6, 11.4, 5.6, 11.2, 7.8, 6.2 cm, respectively.

Seedling disease was an issue for cotton stand establishment in the 2018 growing season. For the *Rhizoctonia* inoculated plots, plant stand was greatest for the Vibrance (5) seed treatment, and was higher than all treatments except HCSS (6). By 22 DAP there was no difference between plant stand across all seed treatments with very low stands in the inoculated plots. HCSS + Vibrance (8) had the highest yield, and was greater than Dynasty CST (1) and penthiopyrad 10g ai/cwt (2). The addition of penthiopyrad to Dynasty CST increased yield by an average of 437 kg/ha under inoculation. For the non-*Rhizoctonia* inoculated plots, stand was greatest for the Vibrance (5) treatment, which was similar to HCSS alone (6), penthiopyrad 25g ai/100 kg seed (7), Dynasty CST (1), and penthiopyrad at 10g ai/100 kg seed (2). Dynasty CST + penthiopyrad 25 g ai/cwt (4) had the highest plant stand at 22 DAP, and was higher than the Vibrance (5) and HCSS 4.0 fl oz/cwt (6) treatments. Yields were similar across all seed treatments in the low disease incidence plots, however, the addition of penthiopyrad to the base treatment of Dynasty CST increased yield by an average of 220 kg/ha under high disease pressure from inoculation.

			Rhizoctonia inoculation			Non-inoculated		
	Seed Treatment [z]	Rate	Stand [y] 7 DAP	Stand 22 DAP	Yield Kg/Ha	Stand 7 DAP	Stand 22 DAP	Yield Kg/Ha
1	Dynasty CST	2.5 fl oz/cwt	7 bc [x]	5	1013 b	30 ab	43 ab	6594
2	penthiopyrad	10g ai/100 kg seed	7 bc	5	1177 b	25 ab	43 ab	6407
3	penthiopyrad	20g ai/100 kg seed	7 bc	6	1458 ab	24 b	41 ab	6612
4	penthiopyrad	25g ai/100 kg seed	6 c	5	1716 ab	24 b	47 a	6102
5	Vibrance	0.6 fl oz/cwt	12 a	7	1967 ab	32 a	37 b	6763
6	HCSS	4.0 fl oz/cwt	10 ab	6	1627 ab	31 ab	37 b	5651
7	HCSS penthiopyrad	4.0 fl oz/cwt 25g ai/100 kg seed	8 bc	8	1798 ab	30 ab	42 ab	6236
8	HCSS Vibrance	4 fl oz/cwt 0.6 fl oz/cwt	7 bc	9	2201 a	24 b	43 ab	6570

[z] Dynasty CST was applied to all treatments as a base fungicide grower standard at 2.5 fl oz/cwt to all treatments in this study.
[y] Stand was the number of seedlings in 7 meters of row.
[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.

Seed Treatment Combinations for *Rhizoctonia solani* Control in Cotton in North Alabama, 2018

W. Groover, K. S. Lawrence, B. R. Lawaju, D. R. Dyer, K. Gattoni, M. N. Rondon

This study was planted in the field at the Tennessee Valley Research and Extension Center near Belle Mina, Alabama. The soil type is Decatur silt loam, which contains 24% sand, 49% silt, 11% clay and 1% organic matter. Seed treatments were applied pre planting, and planting occurred on 2 May. Plots consisted of 4 rows that were 7 meters long with 1-meter row spacing. Two rows of each plot were inoculated with 1 tablespoon of millet seed per row infested with *Rhizoctonia solani*. Seed was planted at 1.27 cm depth. The plots were arranged in a randomized complete block design with five replications and a 6-meter-wide alley. Plots were maintained as recommended via the Alabama Cooperative Extension System with typical pesticide and fertility production practices, and an overhead irrigation system was used for watering as needed. Plant stand data was collected at 7 and 22 days after planting (DAP). Only living plants were included in stand counts. Harvest occurred on 5 October at 156 DAP. Data was statistically analyzed by ANOVA in SAS 9.4 (SAS Institute Inc.), and means were compared using Tukey-Kramer with $P \leq 0.05$. Monthly average maximum temperatures from planting in May through harvest in October were 30.1, 32.7, 31.8, 32.7, 31.8, 25.1°C with average minimum temperatures of 18.1, 20.4, 21.4, 20.7, 20.8, 12.8 °C, respectively. Average temperatures from May to October was 24.1, 26.6, 27.1, 26.7, 26.3, 18.9°C. Rainfall accumulation for each month was 8.6, 11.4, 5.6, 11.2, 7.8, 6.2 cm, respectively.

Seedling disease was an issue for cotton stand establishment in the 2018 growing season. For the *Rhizoctonia* inoculated plots, there was no significant difference among plant stands at 7 DAP. Three weeks after planting the stands had improves slightly but were still at less than one plant per foot of row with less than 26 % survival rate. Base seed treatment + HCSS (6) had the highest yield, and was statistically higher than the base treatment alone (1). The addition of penthiopyrad to the base treatment increase yield by an average of 460 kg/ha under high disease pressure. For the low disease pressure, non-*Rhizoctonia* inoculated plots, stand was similar at 7 DAP but by 22 DAP Base + penthiopyrad 25 g ai/cwt (4) and Base + Vibrance 0.6 fl oz/cwt (5) had the highest plant stand compared to the base alone. Seed cotton yield ranged from a high of 7666 kg/ha to a low of 6418 kg/ha. In the non-inoculated plots, Base + penthiopyrad 25 g ai/cwt (4) seed cotton yield was higher than Base + penthiopyrad 20g ai/cwt, increasing yield by 1248 kg/ha. The addition of penthiopyrad to the base treatment increase yield by an average of 447 kg/ha under low disease pressure.

			Rhizoctonia inoculated			Non-inoculated		
	Seed Treatment [z]	Rate	Stand [y] 7 DAP	Stand 22 DAP	Yield Kg/Ha	Stand 7 DAP	Stand 22 DAP	Yield Kg/Ha
1	Base		11[x]	11 c	2835 b	32	44 b	6623 ab
2	Base penthiopyrad	10g ai/cwt	12	13 bc	3438 ab	29	47 ab	6928 ab
3	Base penthiopyrad	20g ai/cwt	11	16 abc	3156 ab	32	50 ab	6418 b
4	Base penthiopyrad	25g ai/cwt	12	12 c	3291 ab	32	53 a	7666 a
5	Base Vibrance	0.6 fl oz/cwt	13	15 abc	3648 ab	32	52 a	6921 ab
6	Base HCSS	4.0 fl oz/cwt	14	21 a	4006 a	32	48 ab	6974 ab
7	HCSS penthiopyrad	4.0 fl oz/cwt 25g ai/cwt	10	20 a	3765 ab	30	49 ab	6915 ab
8	Base HCSS Vibrance	4.0 fl oz/cwt 0.6 fl oz/cwt	13	19 ab	3695 ab	26	48 ab	6699 ab

[z] Base treatment was myclobutanial 105 oz/cwt; metalaxyl 0.75 oz/cwt; imidacloprid 0.80 oz/cwt; thiram 2.5 oz/cwt; penflufen 0.64 oz/cwt; trifloxystrobin 0.64 oz/cwt; and Awaken 6.0 oz/cwt base was applied to all treatments in this test.
[y] Stand was the number of seedlings in 7 meters of row.
[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.

Combination of Seed Treatments for *Rhizoctonia solani* Management and Yield increase in North Alabama, 2018

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

This study was planted in the field at the Tennessee Valley Research and Extension Center near Belle Mina, Alabama. The soil type is Decatur silt loam, which contains 24% sand, 49% silt, 11% clay and 1% organic matter. Seed treatments were applied pre-planting, and planting occurred on 2 May. Plots consisted of 4 rows that were 7 meters long with 1-meter row spacing. Two rows of each plot were inoculated with one tablespoon of millet seed per row infested with *Rhizoctonia solani*. Seed was planted at 1.27 cm depth. The plots were arranged in a randomized complete block design with five replications and a 6-meter-wide alley. Plots were maintained as recommended via the Alabama Cooperative Extension System with typical pesticide and fertility production practices, and an overhead irrigation system was used for watering as needed. Plant stand data was collected at 7 and 22 days after planting (DAP). Only living plants were included in stand counts. Harvest occurred on 5 October at 156 DAP. Data was statistically analyzed by ANOVA in SAS 9.4 (SAS Institute Inc.), and means were compared using the Dunnett's statistic with $P \leq 0.05$. Monthly average maximum temperatures from planting in May through harvest in October were 30.1, 32.7, 31.8, 32.7, 31.8, 25.1°C with average minimum temperatures of 18.1, 20.4, 21.4, 20.7, 20.8, 12.8 °C, respectively. Average temperatures from May to October was 24.1, 26.6, 27.1, 26.7, 26.3, 18.9°C. Rainfall accumulation for each month was 8.6, 11.4, 5.6, 11.2, 7.8, 6.2 cm, respectively.

Seedling disease was very pronounced for the 2018 growing season. For the *Rhizoctonia* inoculated plants, stand at 22 DAP was highest for the EverGol treatment (17), with 9 other treatments being similar. Yield was also highest for the Evergol treatment, however all but 3 treatments were similar. The untreated control (13) had the lowest yield, with 7 treatments being similar. For the non-*Rhizoctonia* inoculated plants, the Vortex + penthiopyrad 20g AI/cwt (7) was higher than Maxim 4FS 2.5g AI/cwt (1) and Maxim 4FS 2.5g AI/cwt + penthiopyrad 20g AI/cwt (3). Penthiopyrad 20g AI/cwt (15) had the highest yield, being higher than Maxim 4FS 2.5g AI/cwt, Dynast CST, Dynasty CST + penthiopyrad 20g AI/cwt, and nontreated seeds.

			Rhizoctonia inoculation			Non-inoculated		
Treatment[1]	Seed Treatment	Rate (AI/Cwt)	Stand[2] 7 DAP	Stand 22 DAP	Yield LB/A	Stand 7 DAP	Stand 22 DAP	Yield LB/A
1	Maxim 4FS	2.5 g	5.8 c	16 abcd	2199.56 abcd	36.8	54.6 b	5308.16 bcd
2	Maxim 4FS penthiopyrad	2.5 g 10 g	8.2 abc	10.8 cde	2074.16 abcd	37.4	56 ab	6039.64 ab
3	Maxim 4FS penthiopyrad	2.5 g 20 g	7.4 bc	13.4 bcd	1849.5 bcd	38.8	54.8 b	5663.46 abcd
4	Maxim 4FS penthiopyrad	2.5 g 25 g	8.4 abc	16 abcd	2288.36 abc	36.6	58.6 ab	5950.8 abc
5	Vortex		9.2 abc	14.2 bcd	2100.28 abcd	39	55.2 ab	6023.94 abc
6	Vortex penthiopyrad	10 g	10.4 abc	9.6 de	1807.7 cd	37.8	60.8 ab	5987.38 abc
7	Vortex penthiopyrad	20 g	12.6 a	16 abcd	2648.86 ab	39.6	62.4 a	5506.72 abcd
8	Vortex penthiopyrad	25 g	8.4 abc	15.8 abcd	2429.42 abc	41.6	60.6 ab	5757.5 abcd
9	Dynasty CST		6.4 c	15.6 abcd	2439.86 abc	39	60.4 ab	5355.2 bcd
10	Dynasty CST penthiopyrad	10 g	11.4 ab	16.2 abcd	2126.4 abcd	34.4	57.6 ab	5909 abc
11	Dynasty CST Penthiopyrad	20 g	8.4 abc	17.4 abc	2481.68 abc	39.6	56.4 ab	5088.76 d
12	Dynasty CST penthiopyrad	25 g t	9.8 abc	18 ab	2601.84 abc	34.2	60.2 ab	5783.6 abcd
13	No Treatment		8.8 abc	6.4 e	1400.2 d	36.6	58.2 ab	5250.7 cd
14	penthiopyrad	10 g	9.6 abc	18.4 ab	2638.42 ab	38.2	58.2 ab	5788.84 abcd
15	penthiopyrad	20 g	11.4 ab	14.2 bcd	2194.36 abcd	40.8	58.2 ab	6159.8 a
16	penthiopyrad	25 g	10.4 abc	13.6 bcd	2257.04 abc	40	58.2 ab	5877.68 abc
17	EverGol		9.4 abc	21.6 a	2680.22 a	37.6	54.4 b	5647.78 abcd

[1]Stand was the number of seedlings in 7 meters of row.
[2]Column numbers followed by the same letter are not significantly different at $P \leq 0.05$ as determined by Tukey's multiple-range test.

Cotton Leafroll Dwarf Virus-AL (CLRDV-AL) Incidence and Yield Effects of Cotton Varieties Planted in the Presence or Absence of the Root-Knot Nematode in South Alabama, 2018

K. S. Lawrence, D. Schrimsher, D. R. Dyer, W. Groover, M. N. Rondon, K. Gattoni, B. R. Lawaju, J. Jones M. Pegues

Ten cotton varieties were evaluated for management of the root-knot nematode *Meloidogyne incognita* (race 3) at Auburn University's Gulf Coast Research and Extension Center, Fairhope, AL. The root-knot infested field and a control field that was not infested with the root-knot nematode had the same ten varieties planted with and without the addition of Velum Total. Both fields were a Malbis sandy loam soil type (59% sand, 31% silt, and 10% clay). Test plots consisted of 4 rows, two treated with Velum Total and two untreated, that were 25 foot long with a 38 inch row spacing and a 6 foot alley between replications. Velum Total was applied at planting as an in-furrow spray at a rate of 14 oz/A to the right two rows of each plot leaving the left two rows untreated. The cotton tests were planted in a randomized complete block design with five replications on May 15 and replanted on June 9, 2018. All plots were maintained throughout the season with standard insecticide, herbicide, and fertilizer practices as recommended by Alabama Cooperative Extension. Nematode population density (eggs/gram of root) and plant biomass were taken 40 days after planting (DAP) by digging four plants at random for each plot. All plots were also visual evaluated for all diseases including symptoms associated with the *Cotton leafroll dwarf virus*-AL (CLRDV-AL*)* at 40 DAP and again at 132 DAP. Leaves from one plant per variety were collected and analyzed for presence of the virus with a two-step RT-PCR protocol. The test was machine harvested and yield data collected on November 30. Data were analyzed with SAS 9.4 using PROC GLIMMIX and LS-means were compared using Tukey-Kramer's method ($P \leq 0.05$).

Cotton virus symptoms were not observed on any of the cotton varieties at 40 DAP on July 19, 2018. Cotton virus symptoms were observed at 132 DPA on October 19 (Table 1). The incidence of virus symptoms on the plants was 100% for all cotton varieties in both field locations. Symptoms of CLRDV-AL included foliar distortion, leaf crinkling at the center of the leaf with 'rolling' in the direction of the leaf edge and a bluish-green discoloration of the foliage. All plants included in the test displayed visual symptoms of CLRDV-AL regardless of the presentence of nematodes or the application of Velum Total. Cotton yield averaged 2177 lb/A over combined cotton varieties in both fields (Figure 1). The yield was 84 lb/A greater in the control root-knot nematode free field with an average yield of 2219 lb/A as compared to the root-knot nematode field with an average yield of 2135 lb/A. However, even with 100% incidence of the virus infection in the late season, yields were in an acceptable range for 2018.

Table 1. ***Cotton leafroll dwarf virus- AL*** **(CLRDV-AL)** ***percent*** **incidence on the cotton varieties at 132 days after planting on October 19, 2018 at the Gulf Coast Research and Experiment Station.**

Variety	Root knot field	Control Root knot free field
Croplan Genetics 3885 B2XF	100	100
Croplan Genetics 9608 B3XF	100	100
DeltaPine 1747NR B2XF	100	100
DeltaPine 1558NR B2RF	100	100
DeltaPine 1646 B2XF	100	100
DeltaPine 1851 B3XF	100	100
Phytogen 480 W3FE	100	100
Phytogen 430 W3FE	100	100
Stoneville 6182 GLT	100	100
Stoneville 5818 CLT	100	100

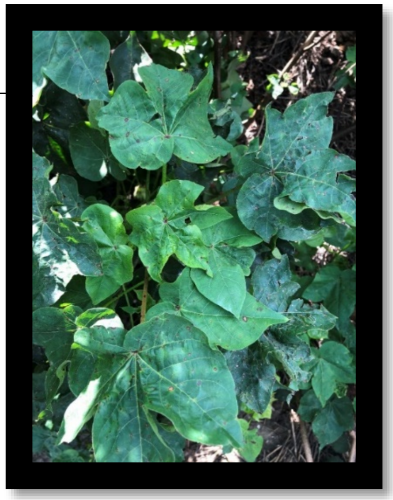
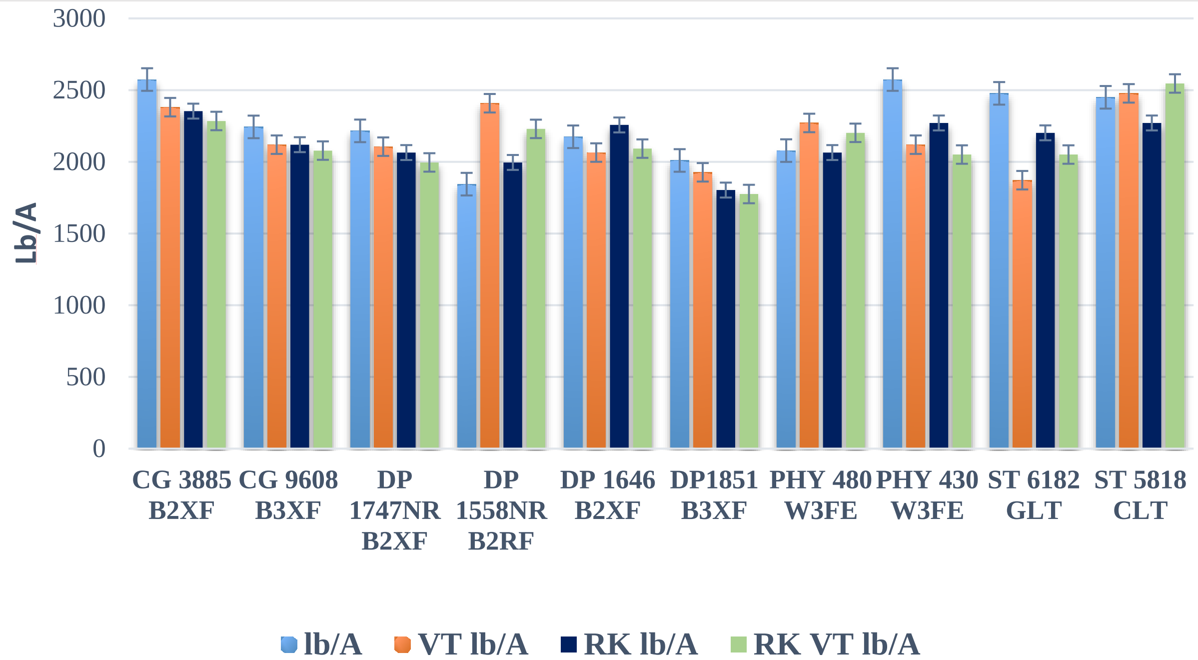


Figure 1. Cotton variety yields when naturally infected with *Cotton leafroll dwarf virus- AL* (CLRDV-AL) in a control field and a root-knot nematode infested (RK) field with and without Velum Total (VT) at the Gulf Coast Research and Experiment Station, 2018.



IV. Weed Management

Pre and Post Treatment Weed Control Evaluation in Rolled Oats

S. Li

Cover crops can provide many benefits in cotton production such as erosion control, soil moisture, increased soil organic matter and suppression of weeds. High residue cover crops have been shown to provide allopathic affects, physical impediment, resource competition and light suppression. There have been very few studies evaluating cover crop residue in combination with pre and post emergent herbicide treatments on weed control. Therefore, two studies were designed to evaluate weed control using common pre and post cotton herbicides utilized in cotton in a conservation tillage system. One study evaluated common cotton pre-treatments in a strip till system for control of ragweed and Florida pusley. The second study was designed to evaluate post treatment control of small flower morningglory and prickly sida.

In 2018, two fields were selected in Dale County in Alabama that had been planted with fall seeded oats to evaluate two cotton herbicide studies. Each field was set up as a completely randomized block design with 4 replications for each study. Plot sizes for both trials were 12 ft by 30 ft. Prior to herbicide treatments the oats were killed with glyphosate and rolled. In the pre-treatment study the plots were strip tilled and planted with cotton (DP 1646). The post treatment plots were treated as a non-crop trial and were not strip tilled or planted with cotton. Herbicide treatments were applied on May 14, 2018 using TeeJet AI11002 tips with the boom height at 24 inches above the oats at 20 gallons per acre. The pre-treatments were applied using a 4 wheeler, while the post treatments were applied using a hand held 6 nozzle boom. It rained within 48 hours of herbicide application at the site. Weed control ratings were conducted for each plot 30 days after application on June 14, 2018. Data was analyzed in SAS 9.4 and all means were separated with fisher's protected LSD ($P<0.05$).

Treatments:

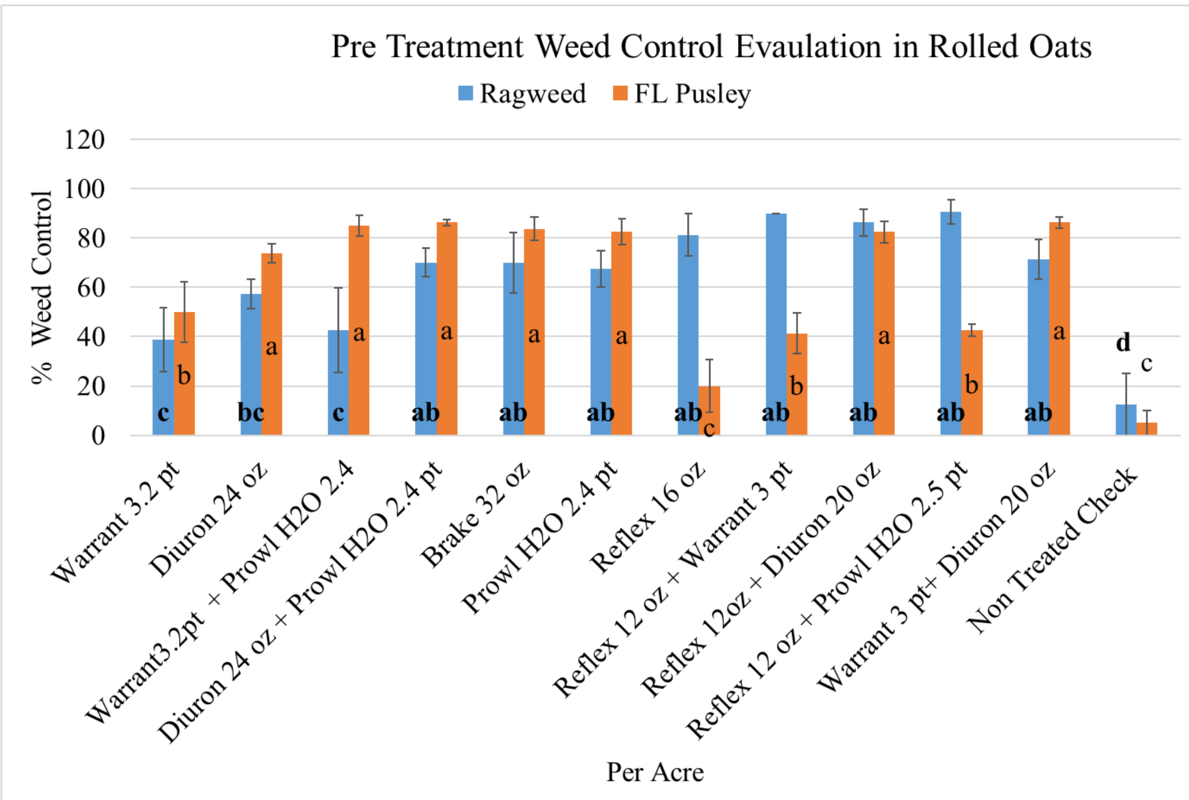
Pre- Treatment Weed Control Evaluation in Striped Till Cotton	
Herbicide Treatment [a]	Rate
Warrant	3.2 pt/A
Diuron	24 oz/A
Warrant + Prowl H2O	3.2 + 2.4 pt/A
Diuron + Prowl H2O	24 oz + 2.4 pt/A
Brake	32 oz/A
Prowl H2O	2.4 pt/A
Reflex	16 oz/A
Reflex + Warrant	12 oz + 3 pt/A
Reflex + Diuron	12 oz + 20 oz/A
Reflex + Prowl H2O	12 oz + 2.5 pt/A
Warrant + Diuron	3 pt/A + 20 oz/A
Non-Treated Check	
[a] All treatments included Gramoxone 32 oz/A + NIS 0.25%	

Post Treatment Evaluation in Rolled Oats	
Herbicide Treatment [a]	Rate
Dual Magnum	1.33 pt/A
Warrant	3.2 pt/A
Outlook	21 oz/A
Zidua	2.1 oz/A
Valor	3 oz/A
Prowl H2O	2.4 pt/A
Xtendimax	44 oz/A
Reflex	16 oz/A
Diuron	24 oz/A
Brake	32 oz/A
Cotoran	2.5 pt/A
Enlist One	2 pt/A
Valor + Prowl H2O	2 oz/A + 2 pt/A
Non- Treated Check	
[a] All treatments included Liberty 32 oz/A + NIS 0.25%	

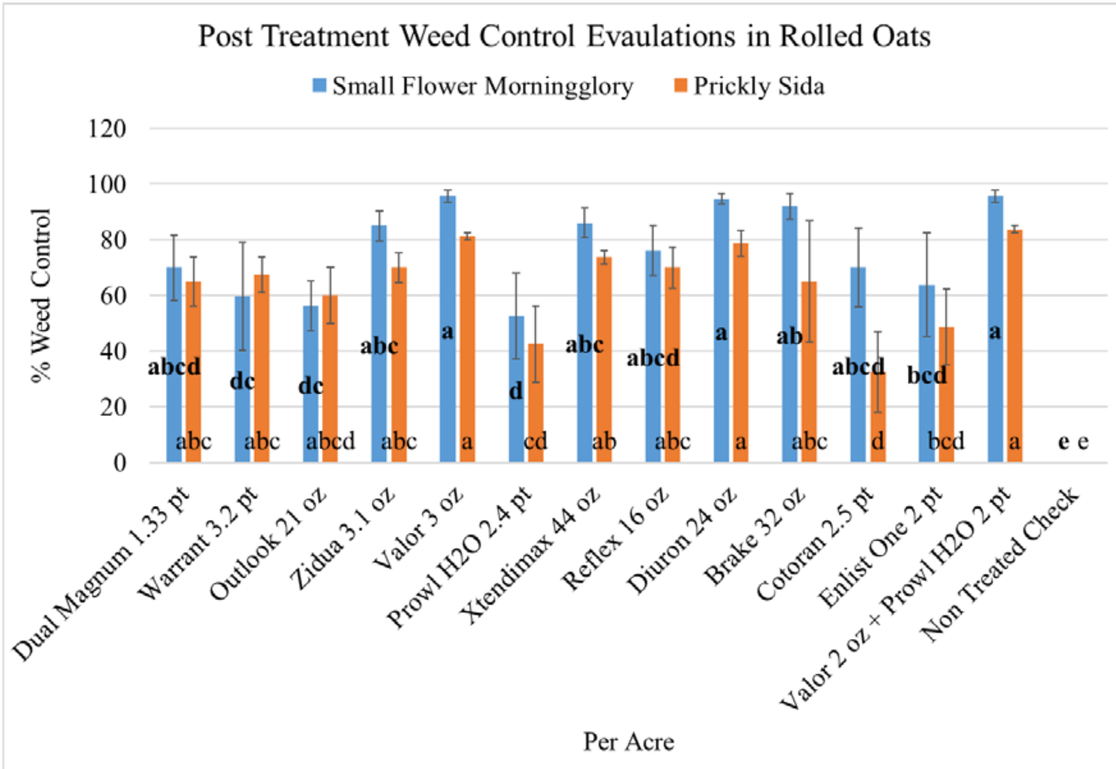
Results:

In the pre-treatment weed control evaluation Reflex at 12oz/A + Prowl H2O 2.5 pt/A provided the best control of ragweed with an average control of 91% compared to the non- treated check. Both Warrant 3 pt/A + Diuron 20 oz/A and Diruon 24 oz/A + Prowl H20 provided the best control of Florida pusley at 86%. Reflex by itself was not significantly different from the non-treated check for Florida pusley control with only 20%. All treatments were significantly different from the non-treated check for ragweed control. However, Warrant 3.2 pt/A, Diruron 24 oz/A, and Warrant 3.2pt/A+ Prowl H2O 2.4 pt/A did not provide as much ragweed control as the other herbicides that were evaluated (See the first graph). Warrant 3.2 pt/A, Reflex 12 oz/A+ Warrant 3 pt/A and Reflex at 12oz/A + Prowl H2O 2.5 pt/A provided less than 50% control of Florida pusley. Overall, Reflex 12 oz/A + Diuron 20 oz/A provided the most consistent control for both weed species together with 86% of ragweed and 83% of Florida pusley.

In the post treatment evaluation study, all herbicide treatments were significantly different from the non-treated check for both small flower morningglory and prickly sida (see the second graph). All treatments provided at least 50% control of small flower morningglory. Valor 3 oz/A, Diruon 24 oz/A, and Valor 2 oz/A+ Prowl H2O 2 pt/A provided an average of 95% control of small flower morningglory. Prowl H2O 2.4 pt/A provided the least amount of control of morningglory with an average of 53%. Valor 3 oz/A and Valor 2 oz/A+ Prowl H2O 2 pt/A provided the best average control of prickly sida with 81% and 84% control, respectively. As with the morningglory control Prowl H2O provided little weed control with 42% control of prickly sida. Cotoran 2.5 pt/A provided the last amount of prickly sida control with only 33% control compared to the non-treated check. Overall Valor 3 oz/A and Valor 2 oz/A+ Prowl H2O 2 pt/A provided the best control for both small flower morningglory and prickly sida in the field with 95% and 81% as well as 96% and 84% control respectively.



Bold letters indicate multiple comparison results at p=0.05 for ragweed. Non bold indicate multiple comparison results at p=0.05 at Florida Pusley.



Bold letters indicate multiple comparison results at p=0.05 for small flower morningglory. Non bold indicate multiple comparison results at p=0.05 at prickly sida.

Evaluate Decamba Vapor Movement and Sensitive Cotton Response to Decamba Vapor Under Field Conditions

S. Li

The project team has spent $3,738 to purchase 1 unit of HI-Q CF1001 large volume air sampler and currently testing its efficacy and feasibility for large scale field trials. In the meantime, the project team is also evaluating the feasibility of using small battery powered pump to collect air samples. Final decisions will be made in the next several weeks about which air sampler model will be purchased and used in field studies in 2019. An extraction method is currently under testing in lab using organic solvents and Soxhlet extraction. The process is very time and labor consuming, however, purchasing Soxhlet extraction apparatus can also be very costly ($500 each piece and it can only process one sample each time). Therefore, the project team is conducting cost analysis to justify using a commercial lab to analyze these PUF samples for dicamba concentration.

Procedures regarding conducting field trials, collecting dicamba vapor in air, laying out sensitive bioassay in pots, and using low tunnels to creating micro-climate have all been practiced in the summer of 2018. The project team has decent confidence that we are experienced and logistically prepared for large field dicamba vapor movement study in summer of 2019. One location will be in a field in north Montgomery county (170 acre open field and will be planted with dicamba resistant cotton). Project team may conduct a second location if funding and resources allow. In the meantime, project team will conduct a low tunnel study using a dicamba sensitive cotton variety to study its response to dicamba vapor as compared to particle drift. The project is expected to be fully completed by the end of 2019.

V. Insect Management

State Pheromone Trapping Program for Cotton Bollworm, Tobacco Budworm, and *Heliothis armigera* (The Old World Bollworm)

T. Reed, R. Smith, and A. Jacobson

Study Protocol: A statewide pheromone trapping program was conducted in 2018 to assess the moth activity level for 3 species of lepidoptera which can be pests of cotton. Species monitored were cotton bollworm (CBW), tobacco budworm (TBW), and the potentially invasive species *Heliothis armigera (HA)*. All moths collected in HA traps were tested using a DNA based technique to confirm the species present. The trapping program was conducted from the 2nd week of June through the 2nd week of September for all species except HA which was trapped through the 2nd week of October at 2 sites. CBW traps were monitored for all 13 weeks in Escambia, Baldwin, Elmore, Autauga and Limestone counties. In Henry county CBW and TBW traps were monitored 9 weeks. TBW traps were monitored in Henry, Elmore, Autauga and Limestone counties. HA pheromone was placed in traps in Baldwin, Escambia and Henry counties.

Results: **Cotton bollworm—**Henry county traps were not checked weekly until the 1st week of August. Numbers of cotton bollworm (CBW) moths remained below 20 per week at the Henry county site from the 1st week of August through the 1st week of September and then increased to a peak catch of 142 the 2nd week of September.

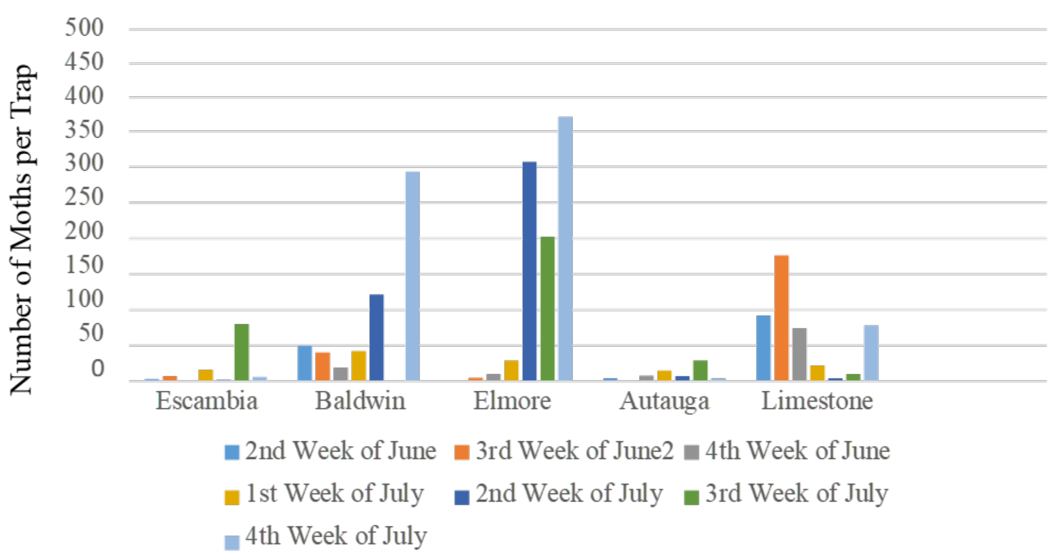


Figure 1A. Cotton bollworm moths per trap by location, 2018

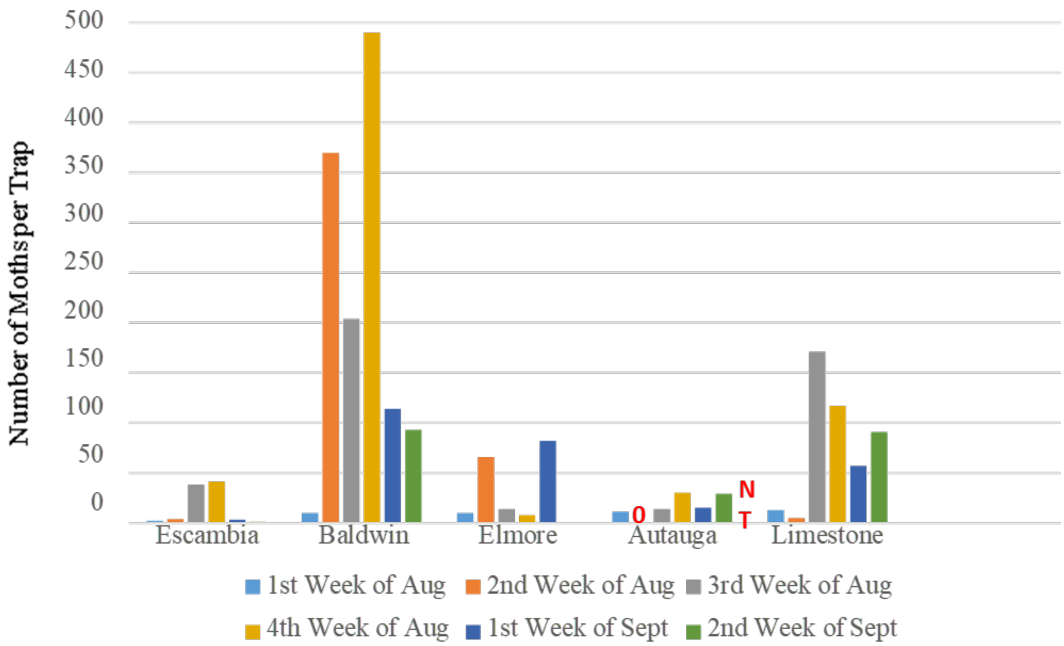


Figure 1B. Cotton Bollworm Moths per Trap by Location, 2018

Numbers of moths captured at the other CBW trapping locations are presented in Figures 1A and 1B. CBW numbers peaked at 80 during the 3rd week of July in Escambia County. There were no CBW larvae found in the non-Bt cotton sentinel planting at the Brewton Ag Station. CBW moth trap catches were highest at the Elmore and Baldwin county sites as they were in 2017. CBW moth trap catch numbers in Elmore County jumped from 29 in the first week of July to 307 during the 2nd week of July and then peaked at 370 moths during the 4th week of July. Moth catches then declined dramatically. The CBW moth trap catch at the Baldwin county site jumped the 4th week of July to 293 and peaked at 490 during the 4th week of August. The Autauga CBW trap catch numbers remained low all 13 weeks. The highest numbers trapped were 29 the 3rd week of July and 30 the 4th week of August. CBW larvae numbers in cotton at the Prattville Agricultural Research unit were very low in non-Bt cotton. Numbers of CBW moths peaked at 176 and 171 during the 3rd week of June and 3rd week of August, respectively in Limestone County at the Belle Mina research station. There was an increase in the Belle Mina CBW trap catch from 10 the 3rd week of July to 78 the 4th week of July. This seemed to correspond to the jump in CBW larvae in the non-Bt plots during late July and into the1st week of August. CBW larvae were present in very low numbers across north Alabama in 2018.

Tobacco budworm (TBW): Extremely low numbers of TBW moths were trapped at 3 locations. The total number of TBW moths caught at the Elmore, Autauga and Limestone county sites combined was 32 through the 2nd week of September. The most caught during one week at any of these 3 sites was 5 in Limestone county the 1st week of July. Consistent trapping of TBW moths did not begin until the 1st week of August at the Wiregrass research station.

TBW moth trap catches in Henry County during the 1st through 4th weeks of August were 0, 0, 85 and 50 respectively. During the 1st through 4th weeks of September TBW moth trap catches were 57, 405, 67 and 97 respectively. Another 23 moths were caught the 1st week of October.

Heliothis armigera: A total of 2436 moths were trapped at the 3 *Heliothis armigera* trapping sites in south Alabama. A total of 96 captured moths had tested negative as of January 18, 2019. Cotton bollworm moths are attracted by the *Heliothis armigera* pheromone and all the moths that were tested to date were CBW moths. The remaining moths will be tested as quickly as possible and the results will be shared.

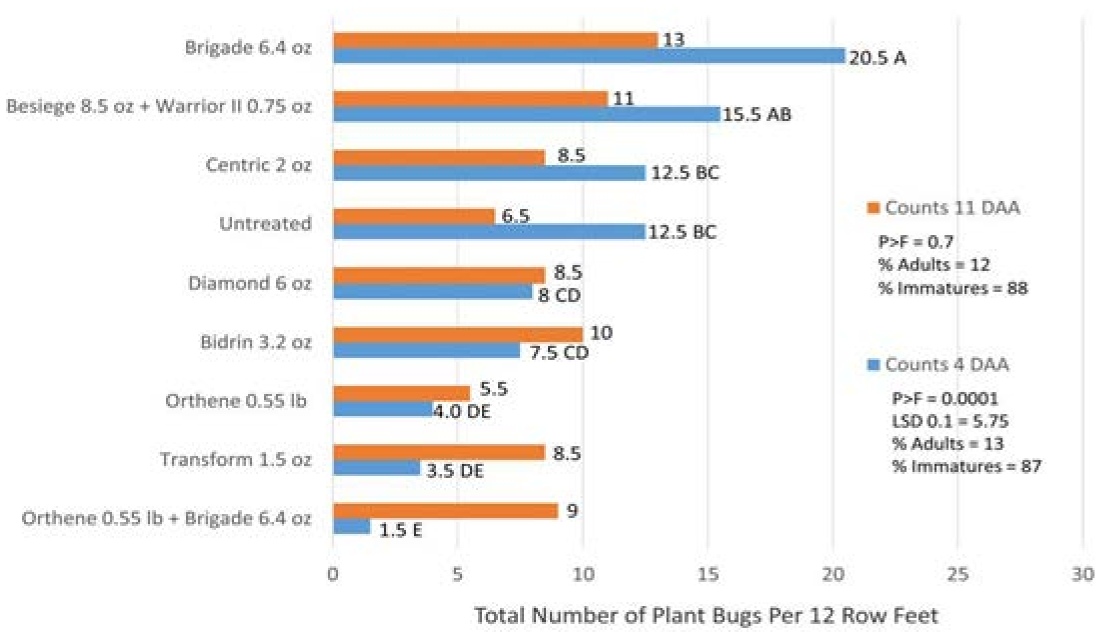
Initial and Residual Efficacy of Insecticides in Controlling Tarnished Plant Bugs Infesting Cotton

T. Reed

This study was conducted at the Tennessee Valley Research and Extension Center at Belle Mina. Plots were planted May 10 using the variety ST 4747 GLB2. Plots were 8 rows wide and 25 feet long with a 38 inch row spacing. Treatments were arranged in a RCB design with 4 replications of each insecticide treatment and 8 replications of the unsprayed treatment. Insecticide treatments and rates are shown in Figure 1. Treatments were applied August 9 using a Spyder sprayer equipped with Teejet Twin Turbo 110025 that delivered a spray volume of 15 gallons per acre at 43 psi. Tarnished plant bugs (TPB's) were sampled at 4 and 11 days after application by placing a 3 foot long drop cloth between two rows and shaking both rows vigorously.

Results: -Total numbers of TPB's per 12 row feet and seed cotton yields at Belle Mina are presented in Figures 1 and 2, respectively.

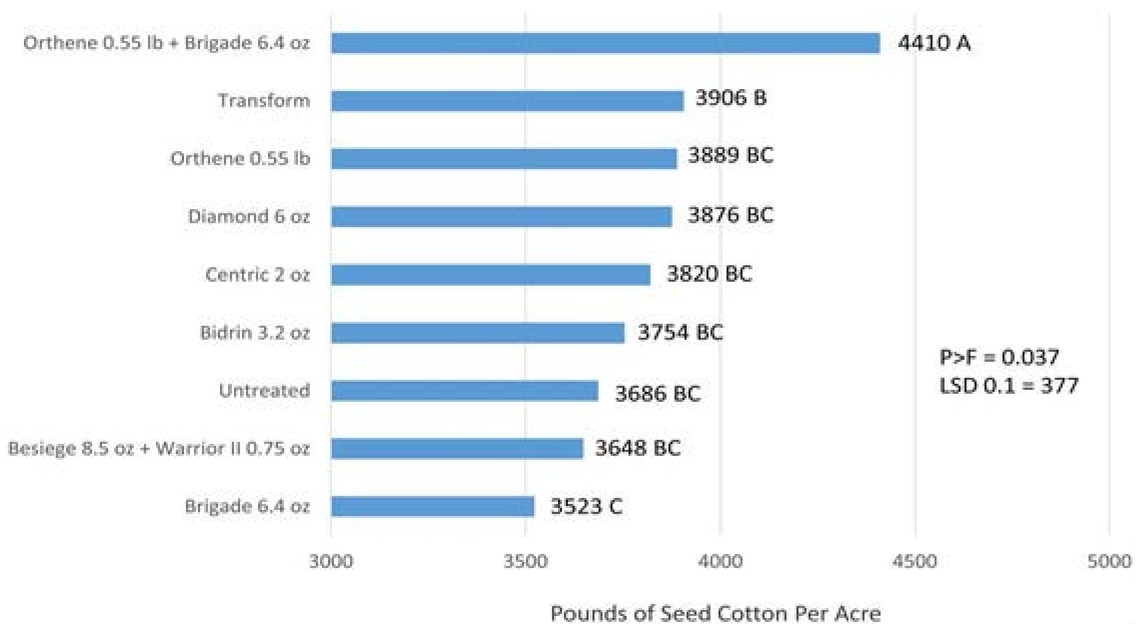
Figure 1. Plant Bug Counts 4 and 11 Days After Insecticide Applications on August 9, 2018 at Belle Mina, AL



There was a significant treatment effect with respect to the total number of plant bugs sampled at 4DAA (P>F=0.0001) but not at 11 DAA (P>F = 0.7). The Orthene + Brigade, Transform and Orthene treatments had the fewest number of TPB's at 4DAA and the counts in these 3 treatments were significantly less than in Brigade, Besiege + Warrior II, untreated and Centric Treatments

(LSD 0.1 = 5.7). The untreated plots and the Centric Treatment were not significantly different at 4 DAA. Brigade had significantly more TPB's at 4 DAA than the untreated plots. The Diamond and Bidrin treatments had TPB numbers that were not significantly different from the Orthene alone and Transform treatments. There was not a significant treatment effect with respect to the total number of plant bugs sampled at 11 DAA (P>F = 0.7). Counts made 11 days after applications were applied showed numerical means that ranged from 5.5 plant bugs per 12 feet in the Orthene alone treatment to 13 plant bugs in the Brigade Treatment.

Figure 2. Yield Response of Cotton to Different Insecticide Treatments for Plant Bugs at Belle Mina, AL 2018



There was a significant treatment effect with respect to yield (P>F=0.037). Yield in the Orthene + Brigade Treatment (4410 lbs. seed cotton /acre) was significantly greater than that in all the other treatments (LSD 0.1 =337 lbs.) Yield in the Brigade treatment was significantly lower than that in all the other treatments. Yields in the remaining treatments were not significantly different from each other at the 90% level of confidence. Since there was little difference in the number of plant bugs in the top 3 yielding treatments and boll worm damage was negligible in the dual gene cotton variety, it is not known why the yield difference was significantly greater in the Orthene + Brigade Treatment.

Controlling Escape Bollworms in Two Gene Cotton

R. Smith, T. Reed, and A. Jacobson

Objective 1. Evaluation of 2 Versus 3 Gene Cotton Traits; Pyrethroid Versus Prevathon Against Bollworms with and without Fire Ants Present.

Materials and methods: This study was conducted at the Prattville Agricultural Research Unit (PARU) and the Tennessee Valley Research and Extension Center (TVREC) at Belle Mina. Plots were planted at Prattville on 5/1 and at Belle Mina on 5/10. The 10 treatments in the study at Prattville and Belle Mina are presented in Tables 1 and 2, respectively. There was not a test to evaluate the 10 treatments without fire ants at Belle Mina. Plots at Prattville and Belle mina were planted using a 36 inch and 38 inch row spacing respectively. Plots were 4 rows wide and 30 feet long at Prattville and 8 rows wide and 25 feet long at Belle Mina. Treatments at Prattville were arranged in a split plot experimental design with 4 reps per treatment. The main plot treatments were fire ants present and fire ants absent. The 10 subplot treatments in the study at Prattville are shown in Table 1. Warrior II was the pyrethroid insecticide applied. Thirty squares per plot were examined for damage and BW larvae on 7/26,7/30 and 8/2 and 30 bolls were inspected for damage and larvae on 8/8 and 8/12. Also BW damaged bolls were counted on 120 row feet in each plot after plants were defoliated. Treatments at Belle Mina were arranged in a RCB design. BW damaged bolls were counted on 25 row feet at Belle Minain each plot after defoliation. Yields were taken from the center two rows of each plot on 10/08 at Prattville and at Belle Mina on 10/22.

Results: The total number of damaged squares plus bolls damaged before August 10, damaged bolls observed after defoliation and seed cotton yields at Prattville are presented in Table 1.

Table 1. Evaluation of 2 Versus 3 Gene Cotton Traits for Bollworm Control With and Without Fire Ants Present; Prevathon Versus Pyrethroid Foliar Overspray. Prattville, AL 2018.

Trt	Variety	Worm Traits	Foliar Insecticide and Date		Damaged Fruit/600		Damaged Bolls per 120 ft. at Harvest		Seed Cotton Yield per Acre		
#					Ants	No Ants	Ants	No Ants	Ants	No Ants	Avg.
1	PHY 444	WS II	None	-----	1	0	3	10	3642	3751	3697 A
2	PHY 480	WS III	None	-----	0	0	0	0	4005	3981	4014 BC
3	DP 1822	None	None	-----	10	82	21	36	3806	3509	3657 D
4	DP 1646	BG II	None	-----	0	2	0	3	4713	4822	4767 A
5	DP 1835	BG III	None	-----	0	0	0	0	4271	4053	4162 B
6	ST 5471	Twin Link Plus (3)	None	-----	0	0	0	0	3969	4277	4123 B
7	PHY 444	WS II	Prevathon 16oz	23-Jul	0	0	0	0	3799	3908	3854 CD
8	PHY 444	WS II	Pyrethroid 2.6oz	7/23,7/30	0	0	0	0	3618	3830	3724 D
9	DP 1646	BG II	Prevathon 16oz	23-Jul	0	0	0	0	4725	4592	4659 A
10	DP 1646	BG III	Pyrethroid 2.6oz	7/23,7/30	0	0	0	0	4556	4665	4610 A

A total of 600 fruit were examined at Prattville in each of 80 plots during the last week of July through August 10. No damaged fruit were found in any Bt variety treatments except in the PHY 444/no insecticide Treatment with ants (1 damaged fruit) and the DP 1646/no insecticide Treatment with no ants (2 damaged fruit). The DP 1822 non-Bt treatment had much higher fruit damage in the no ant plots (82) in comparison to plots with ants (10). No fruit damage was observed in any treatment with 3-genes or 2 gene treatments that included insecticide oversprays. Boll damage noted after defoliation per row ft. was also higher in the Non-Bt-no ants treatment (36) than in the similar treatment with ants (21). Some post-defoliation BW-damaged bolls were also found in the PHY 444-with ants (3) and without ants (10). The DP 1646- no ants treatment had 2 damaged bolls. No post-defoliation damaged bolls were found in any 3-gene Bt variety treatment nor in any 2-gene Bt variety treatment with an insecticide overspray. There was no significant main plot treatment effect on yield with respect to the presence or absence of fire ants (P>F = 0.84). Nor was there a significant main plot treatment by subplot treatment interaction (P>F=0.26). Though the difference was not significant at the 90% level of confidence the numerical difference of 296 lbs of seed cotton in the DP 1822 (non-Bt) –with fire ants and the DP 1822 -no fire ants treatments was possibly due in part to a yield reduction in the non-Bt plots without fire ants due to the higher level of damage observed in this treatment. There was a highly significant effect on yield with respect to subplot treatment (P>F =0.0000). The 3 DP 1646 treatments had a significantly higher yield than the other treatments (LSD 0.1 = 201 lbs. seed cotton). There was no significant difference between the PHY 444 Treatment that did not receive an insecticide overspray and the two PHY 444 Treatments that did receive an overspray at the 90% level of confidence.

Results of the trial at Belle Mina are presented in Table 2.

Table 2. Evaluation of 2 versus 3 Gene Cotton Traits for Bollworm Control Prevathon Versus Pyrethroid Foliar Overspray, Belle Mina, AL 2018

Trt #	Variety	Worm Traits	Foliar Insecticide Applied 7/25	Damaged Bolls Per 25 ft at Harvest	Seed Cotton Yield Per Acre
1	PHY 444	WS II	None	4.5 B	Data not presented
2	PHY 330	WS III	None	0.25 C	3499
3	DP 1822	None	None	12.25 A	3222
4	DP 1725	BG II	None	1.75 C	3957
5	DP 1820	BG III	None	1.5 C	3524
6	ST 5471	Twin Link Plus (3)	None	0.25 C	4152
7	PHY 444	WS II	Prevathon	2.0 C	Data not presented
8	PHY 444	WS II	Pyrethroid	1.25 C	Data not presented

9	DP 1646	BG II	Prevathon	0.0 C	4214
10	DP 1646	BG II	Pyrethroid	0.25 C	3699
			P>F =	0	0.26
			LSD 0.1 =	2.47	---

There was a significant treatment effect with respect to the number of damaged bolls per 25 row feet (P>F = 0.0000). The number of post-defoliation damaged bolls in the DP 1822 (non-Bt) Treatment (12.25) was significantly greater (LSD 0.1 =2.47) than that in all the other treatments. Inspection of the non-Bt plots on August 1 revealed that there were nine 2-7 day old larvae in 60 terminals, two 5–7 day old larvae in 60 blooms and two 7 day old larvae in 60 bloom tags. The number of damaged bolls in the PHY 444-no insecticide test (4.5) was significantly less than that in the DP 1822 Treatment but significantly more than that in all the other treatments which ranged from 0 to 1.75. Yields for the 3 PHY 444 Treatments are not presented in the table because there was an unexplained erratic stand in most of the PHY 444 plots and the yields were not representative of this variety's normal production. There was no significant difference in yield among the remaining 7 treatments at the 90% level of confidence (P>F = 0.26)

Objective 2. Evaluation of Timing of Application and Choice of Chemistry for Bollworm Control on 2-Gene Cotton

Materials and Methods: This study was conducted at the Prattville Agricultural Research Unit. The 8 treatments evaluated in the study are presented in Table 3. Warrior II was the pyrethroid insecticide applied. The variety Phytogen 444 W**F** was planted 5/1 using a 36 inch row spacing. Plots were 4 rows wide and 30 feet long with treatments arranged in a RCB design. Insecticides were applied either on 7/20 to coincide with the historical egg lay time at Prattville or 7/25 to control small larvae. A second Warrior II application was applied in Treatments 1 and 2 on 7/30.. Plots were inspected for damaged squares and/or damaged bolls on 7/26 , 7/30 , 8/2 and 8/10. The number of damaged bolls present after-defoliation on 10/4 was counted on 120 row feet. Plots were harvested on 10/8.

Results: The study results are presented in Table 3**.**

Table 3. Evaluation of Timing of Application and Choice of Chemistry for Bollworm Control on 2 Gene Cotton (PHY 444)

Trt #	Insecticide and Rate per Acre	Timing	Date	Total Seasonal Damage per 650 Fruit	Seasonal Percent Damaged Fruit	Damaged Bolls per 120 ft at Harvest	Seed Cotton Yield per Acre
1	Pyrethroid 2.6 oz	Small Larvae	7/25, 7/30	1	0.15	1 B	3527
2	Pyrethroid 2.6 oz	Eggs	7/20, 7/30	2	0.3	4 B	3787
3	Beseige 8.0 oz	Small Larvae	7/25	2	0.3	1 C	3594
4	Beseige 8.0 oz	Eggs	7/20	4	0.6	0 C	3636
5	Prevathon 16 oz	Small Larvae	7/25	1	0.15	0 C	3612
6	Prevathon 16 oz	Eggs	7/20	2	0.3	0 C	3793
7	Prevathon 16 oz	Eggs	7/20	1	0.15	0 C	3709
8	Untreated	---	---	15	2.3	14 A	3539
					P>F =	0	0.72
					LSD 0.1 =	2.96	---

The bollworm population was very low in this study. The percentage of damaged fruit found in the 4 inspections made prior to defoliation was 2.3% in the unsprayed PHY 444 and was less than 1% in all the insecticide treatments. The number of damaged bolls per 120 row feet that were counted after defoliation was 14 in the unsprayed plots and ranged from 0 to 4 in the insecticide treatments. There was no significant treatment effect with respect to yield (P>F = 0.72).

Objective 3: Document the Geographical Distribution of the Escape Bollworm Problem in Alabama Using Sentinel Plots.

Materials and Methods: Sentinel plots containing a conventional variety with Roundup traits only, WSII and III varieties and BGII and III varieties were planted in rows 50 to 100 feet long (non-replicated) with 4 rows per variety at the following experiment station locations: Fairhope, Brewton, Headland, Shorter, and Crossville (Sand Mountain). Plots used in Objective 1 at Prattville, and Belle Mina served as sentinel plots. There were also 6 on-farm strip plantings (3 in Lawrence county and 3 in Colbert county) of non-Bt, DP 1822 RR inserted into farmers' fields of BG II varieties that were regularly inspected for bollworms during July and August. A damaged boll count was made at the experiment station plantings following defoliation to document the varying levels of worm damaged bolls in the various genetics.

Results: Numbers of bollworm-damaged bolls found after defoliation in sentinel plots are shown in Table 4.

Table 4. Number of bollworm-damaged bolls after defoliation in sentinel plots, 2018

Variety	Bollworm Genes	Prattville Ants	Prattville No Ants	Headland	Belle Mina	Shorter	Brewton	Fairhope	Crossville
[1]DP1646 B2F	2	0	0	0	9	0	0	0	0
PHY444 WRF	2	2	5	2	22	0	0	0	0
ST5471 GLTP	3	NA	NA	0	1	0	0	0	0
[2]PHY480 W3FE	3	0	0	0	1	0	0	0	0
[3]DP1840 B3XF	3	0	0	0	1	0	0	0	0
DP1822 XF	0	16	18	11	60	0	0	0	0

Belle Mina varieties were [1] DP 1725 B2XF, [2] PHY 330 W3F3 and [3] DP 1820 B3XF.

The highest number of bollworm- damaged bolls observed after defoliation occurred at Belle Mina with 60 damaged bolls per 120 row feet in the DP 1822 non-Bt variety. The 2 gene varieties also had more boll worm- damaged bolls at Belle Mina than the other locations. The 3-gene varieties at Belle Mina did have one damaged boll each per 120 row feet. There were 11 and 18 damaged bolls in the non-Bt variety in the Headland and Prattville sentinel plots. No damaged bolls were observed in any variety at Shorter, Brewton, Fairhope or Crossville. The 6 on-farm sentinel strips also had either zero or negligible numbers of larvae present. A very low number of cotton acres were sprayed for bollworms in Alabama in 2018 and the population level of bollworms in the sentinel plots was representative of the numbers found across the state.

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

T. Reed

Study Protocol: This study was conducted at the Belle Mina Research station and the Prattville Research Unit . Plots were planted at Belle Mina on May 7 and were arranged in a RCB design with 4 reps/treatment. There were two treatments that had untreated seed and no insecticides that were planted into wheat stubble. The variety used was ST 4949 GLT. Plots were 4 rows wide (38 inch row spacing) and 25 feet long. Treatments are provided in Table 1. All treatments except 9, 10 and 14 were planted into a wheat cover-crop residue. Treatments 9, 10 and 14 were tilled prior to planting. Velum Total, Admire Pro and Orthene were applied in-furrow on top of the seed using 6502 flat fan nozzles that applied 12 gallons of water per acre. Nozzles were turned to line up parallel with the furrow and all the water went into the furrow. Treatments that included foliar over-sprays of insecticides which were applied at the very early 2nd true leaf stage (Treatments 3, 4, 6, 16,and 17) were applied on May 21. No rain fell for at least 12 hours after the application. However rainfall did occur the following evening after night fall.. Treatment 5 was a foliar Orthene spray that was applied when the 4th true leaf was small on May 25. All foliar sprays were applied using 8002 flat fan nozzles, 40 psi and 15 gallons water/acre..Leaves 1, 2, 3 and 4 were rated individually at Belle Mina. Thrips damage ratings for the first and second true leaves were made on May 22. Thrips damage ratings for the third and fourth true leaves were made on May 28. Damage ratings were made on a scale of 0 to 5 with 0 being no damage and 5 being severe damage. The middle two rows of each plot were harvested October 8.

Plots were planted at Prattville on April 25. The variety planted was ST 4949 GLT. Seed were planted no-till into the soybean residue left from the previous crop. Experimental design was similar to that at Belle Mina with 4 reps of all treatments. Treatments are provided in Table 2. There were two treatments with untreated seed and no insecticides. Plots were 4 rows wide and 30 feet long with a 36 inch row spacing. In-furrow sprays applied in Treatments 7 (Velum Total), 8 and 12 (Orthene), and 11 (Admire Pro) were delivered in 16.5 gallons of water per acre using 25 psi and TX6 Conejet nozzles that had the insert removed and which sprayed a narrow band directly into the furrow middle. Foliar sprays for Treatments 4, 6,and 10 were applied May 15th. The foliar Orthene spray applied when the 4th true leaf was very small (Treatment 5) was sprayed on May

22. Foliar insecticides were applied using 7.7 gallons of water/acre, 60 psi and TX6 Conejet nozzles. Damage ratings were made for leaves 1 and 2 on 5/14 and were averaged. This was repeated for leaves 3 and 4 on 5/23. The middle 2 rows of each plot were harvested October 3.

Results: Thrips damage ratings , stand counts and yields at Belle Mina are presented in Table 1.

Table 1. Thrips Damage Ratings, Stand Counts and Cotton Yields with Different Seed, In-Furrow and Seedling Foliar Sprays at Belle Mina, AL. 2018

	Treatment	Mean Damage Rating				Plants/6 Row Ft	Lbs Seed Cotton/Acre
		L11	L22	L33	L44		
1	Avicta Elite	1.1	1.1	1.5	1.5	15.4	3189
2	Aeris	1.3	1.3	1.6	1.6	13.9	3330
3	Aeris + Foliar Orthene 97 – 3 oz -L2	1	1	1.3	1.4	15	3190
4	Untrted seed + Foliar Orthene 97 – 3 oz – L2	1.8	1.8	1.6	1.6	14.4	3124
5	Untrted seed + Foliar Orthene 97 – 3 oz – L4	1.9	1.6	3	2.9	13.8	3180
6	Untrted seed + Foliar Radiant – 1.5 oz – L2	1.8	1.6	1.8	1.6	13.9	3129
7	Untrted seed + Velum Total – 1.4 oz – IFS5	1.1	1.1	1.4	1.3	15	3219
8	Aeris + Orthene 97 – 8 oz – IFS	0.7	0.6	1	1	14	3444
9	Avicta Elite – No crop residue	2.3	2.1	2.5	2.4	11.8	2713
10	Untrted seed – No crop residue	2.6	2.6	4	3.9	12.4	2759
11	Untrted seed + Admire Pro – 7.4 oz –IFS	0.6	0.6	1.1	1	15.3	3225
12	Untrted seed + Orthene 97 – 16 oz – IFS	1.6	1.4	1.4	1.3	17	2829
13	Untrted Seed with crop residue	1.8	1.6	2.9	2.8	13.6	3107
14	Aeris with no crop residue	1.7	1.5	2.6	2.5	12.6	2359
15	Untrted seed with crop residue	1.7	1.6	2.9	2.8	13.8	3224
16	Untrted Seed + Brigade – 6.4 oz – L2	1.6	1.6	2.4	2.3	13.6	3472
17	Untrted seed + Bidrin – 3.2 oz – L2	1.6	1.4	1.6	1.5	13.1	3286
	P>F	0	0	0	0	0.12	0.0188

	LSD 0.1	0.46	0.42	0.3	0.32	---	457

[1] L1 = leaf 1, [2] L2= leaf 2, [3] L3 = leaf 3, [4] L4 = leaf 4.

There was a significant treatment effect with respect to the thrips damage rating for each of the 4 true leaves rated (P>F=0.0000). The no insecticide with no crop residue treatment (Trt 10) had a significantly higher damage rating for each leaf rated than all the other treatments for true leaves 2-4. Treatment 9 (Avicta Elite with No Crop Residue)was the only treatment that did not incur damage that was significantly less than Treatment 10 with respect to leaf 1. Damage levels did not reach the economic threshold of 3 for any treatment with respect to leaves 1 and 2. With respect to untreated seed that were sprayed at the early leaf 2 stage only Brigade failed to prevent damage above the rating of two for leaves 3 and 4. Treatment 5 had a damage level of 3 for leaf 3 because the foliar Orthene application on May 25 was not soon enough to prevent leaf 3 from showing this level of damage. Orthene applied on May 21 when the 2nd true leaf was very small did keep the damage rating for leaves 3 and 4 below 2. The untreated seed planted into a tilled plot (Trt 10) had a damage rating of 4 for leaf 3 and 3.9 for leaf 4. The untreated seed planted into wheat stubble (Trts 13 and 15) had a damage rating just below 3 for both leaf 3 and leaf 4.indicating that the presence of stubble resulted in less thrips damage.

Thrips pressure was moderate in this study and under test conditions all the insecticide treatments provided satisfactory thrips control except Trt 5. There was no significant treatment effect with respect to stand count (P>F=0.12) at the 90% level of confidence. Plants in tilled plots did not emerge as uniformly as plots with wheat stubble. Some plants in all tilled plots did not have a true leaf when plots were first rated for damage on May 22. The final stand counts revealed that plant density was numerically lowest in the tilled treatments. There was a significant treatment effect with respect to yield (P>F = 0.0188). As a consequence of the prolonged emergence in all three tilled treatments the yields in these treatments were reduced and were the lowest yielding treatments in the study. Yields for the two treatments with untreated seed planted into crop residue were 3107 and 3224 lbs/acre, a difference of 117 lbs. of seed cotton. The 13 treatments with the highest numerical yields were not significantly different from each other.

Thrips damage ratings, stand counts and yields at Prattville are presented in Table 2.

Table 2. Thrips Damage Ratings, Stand Counts, and Cotton Yields with Different Seed Treatments, In-Furrow and Seedling Foliar Insecticide Treatments at Prattville, AL 2018

	Treatment	Mean Damage Rating		Plants/6 Row Ft	Lbs Seed Cotton/Acre
		L1+L21	L3+L42		
1	Avicta Elite	2.5	2.1	11.2	3255
2	Aeris	1.8	1.9	10.2	3298
3	Aeris + Foliar Orthene 97 – 3 oz -L2	1.8	1.3	11	3170
4	Untrted seed + Foliar Orthene 97 – 3 oz – L2	3	1.5	10.5	3128
5	Untrted seed + Foliar Orthene 97 – 3 oz – L4	3.3	3.8	9.8	3068
6	Untrted seed + Foliar Radiant – 1.5 oz – L2	3.5	2	10.1	3285
7	Untrted seed + Velum Total – 1.4 oz – IFS	3.3	2.4	9.4	3249
8	Aeris + Orthene 97 – 8 oz – IFS	2.5	2.1	9.6	3092
9	Untrted seed	3.3	3.8	8.8	3043
10	Untrted seed + Bidrin –3.2 oz-L2	3	2.1	10.5	3140
11	Untrted seed + Admire Pro – 7.4 oz –IFS	2	2.8	11.1	3176
12	Untrted seed + Orthene 97 – 16 oz – IFS	3.3	3.1	8.7	3140
13	Untrted seed	3.1	4	9	3177
	P>F	0.0014	0	0.218	0.91
	LSD 0.1	0.77	0.37		

There was a significant treatment effect with respect to thrips damage rating for both dates that ratings were made (P>F= 0.0014 and 0.0000). Five of the 13 treatments had damage ratings for leaf 1/leaf 2 on May 14 (19 DAP) that were less than 3. These treatments were Trt 1 = Avicta Elite seed treatment, Trt 2 = Aeris seed treatment, Trt 3= Aeris Seed treatment + Foliar Orthene (Orthene in this treatment was applied the next day), Trt 8 = Aeris seed treatment + Orthene applied in furrow at planting and Trt 11 = Untreated seed + Admire Pro applied in-furrow. Plots were first rated on May 14 prior to the application of foliar insecticides utilized in 4 different treatments that had untreated seed and thus the benefit of the foliar insecticides did not have an opportunity to be expressed until leaf 3/leaf 4 were inspected May 23. The May 23 inspection revealed that the only treatments with a damage rating of 3 or more were the 2 untreated seed /no insecticide treatments and the Untreated seed + Orthene IFS. There was no significant treatment effect with respect to yield at Prattville at the 90% level of confidence. Mean numerical yields ranged from 3298 lbs. seed cotton in the Aeris treatment to 3043 lbs. in one of the 2 untreated seed /no insecticide treatments; a difference of 255 lbs. There was a numerical difference of 134 lbs. between the 2 control treatments.

VI. Nematode Management

Cotton Nematicide Combinations for Root-Knot Nematode Management in Central Alabama, 2018

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

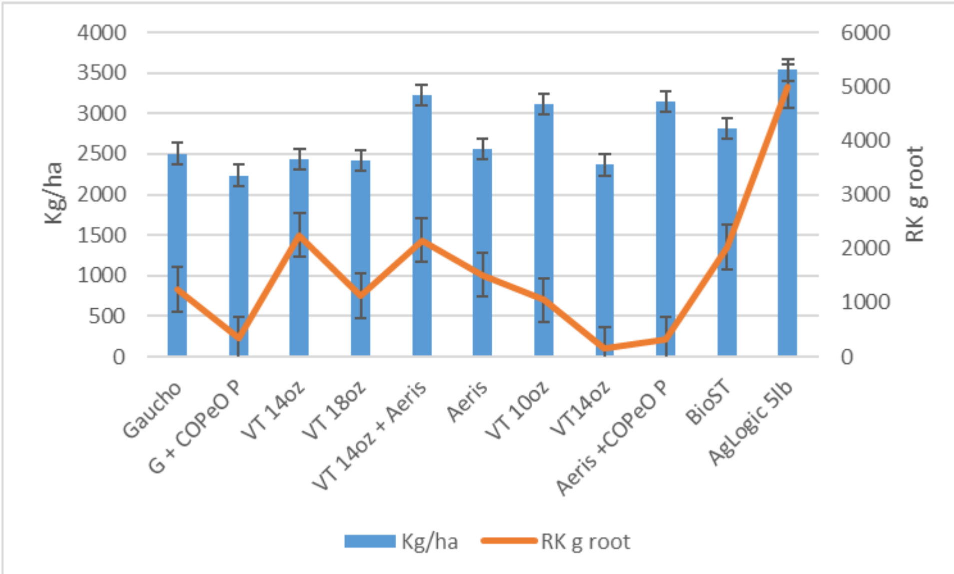
Nematicide combinations were evaluated for root-knot nematode management on ST 4949 GBL2 and ST 4946 GBL2 cotton. The field site is located on the E. V. Smith Plant Breeding Unit near Tallassee, AL. This field has been cultivated in cotton for over 18 years and is naturally infested with the root-knot nematode. The soil is a Kalmia loamy sand (80% sand, 10% silt, 10% clay). The cotton seed were treated with nematicide seed treatments by Bayer CropScience. Ag Logic was applied at planting with granular hoppers attached to the planter. Velum Total was applied as an in-furrow spray with 8002 flat fan nozzles angled diagonally across the seed furrow immediately in front of the seed. Plots were planted on 2 May with a soil temperature of 18°C at a 10 cm depth and adequate soil moisture. Plots consisted of 2 rows, 7.6 m long with 0.91 m row spacing and were arranged in a randomized complete block design with five replications. Blocks were separated by a 4.5 m wide alley. All plots were maintained throughout the season with standard herbicide, insecticide, and fertility production practices as recommended by the Alabama Cooperative Extension System. Plots were irrigated with a center pivot irrigation system as needed. Seedling survival was determined by dividing the number of live plants by the number of seeds planted per row at 26 days after planting (DAP) on 23 May. Samples were collected for nematode analysis by digging up 4 random plants per plot on 13 June. Nematodes were extracted from the root systems using 6% NaOCl and by collecting the nematodes on a 25 µm sieve. Plots were harvested on 9 Oct. Data were statistically analyzed using SAS 9.4 and means compared using Tukey's HSD test at the $P \leq 0.10$ level. Monthly average maximum temperatures from planting in May through harvest in October were 34, 36, 36, 37, 36, and 34°C with average minimum temperatures of 10, 16, 19, 18, 20, and 5°C, respectively. Rainfall accumulation for each month was 10.3, 9.1, 11.7, 7.6, 4.0, and 10.3 cm with a total of 53.0 cm over the entire 2018 season.

Root-knot nematode disease pressure was high for irrigated cotton in 2018. Plant stand at 26 DAP was similar for all nematicides with an average survival rate of 57% of the plants per row. Root-knot nematode population density was high at 35 DAP. All the nematicide combinations supported similar ($P \leq 0.10$) numbers of root-knot nematodes eggs per 4 plants and per gram of root compared to the Gaucho control for both cotton cultivars. Velum Total in furrow spray at 14 oz/A over the seed treatments of Gaucho and COPeO on ST 4949 GBL2 (8) supported similar numbers of root knot nematodes as Velum Total in furrow spray at 14 oz/A over the seed treatment of Gaucho on ST 4946 GBL2 (14). Thus, these in-furrow spray nematicides over the seed treatments provided similar reductions in root-knot reproduction under high root knot nematode population density. Seed cotton yields were average in 2018. Yields varied by 1517 kg/ha over all nematicides. The combination Gaucho + COPeO seed treatments on ST 4946 GBL2 (13) produced the greatest yield which interestingly was significantly greater ($P \leq 0.10$) than Gaucho + COPeO seed treatments on ST 4949 GBL2 (2). All other nematode combinations produced similar ($P \leq 0.10$) yields.

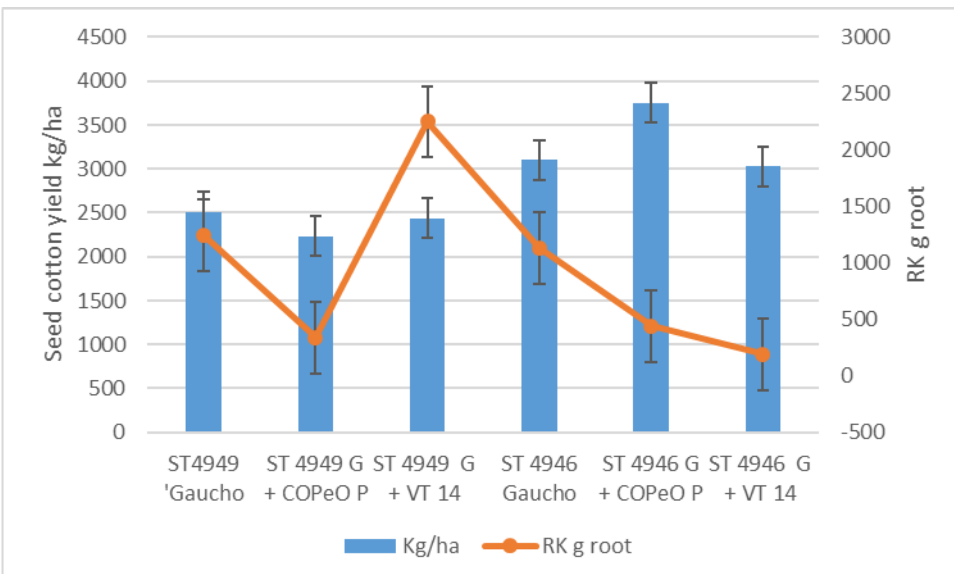
Nematicide treatment and rate		Survival* 26 DAP	*Meloidogyne incognita* Eggs 35 DAP		Seed cotton yield
		Percent	per 4 plants**	g/root	(kg/ha)
	ST 4949				
1	Gaucho 600 (0.5 mg ai/seed)	57.5	2816 ab	844 abc	2505 ab
2	Gaucho 600 (0.5 mg ai/seed) + COPeO Prime (0.2 mg ai/seed)	58.3	545 b	196 abc	2236 b
3	Velum Total (14 oz/A) + Gaucho 600 (0.5 mg ai/seed)	57.0	3138 ab	1070 abc	2439 ab
4	Velum Total (18 oz/A) + Gaucho 600 (0.5 mg ai/seed)	53.5	2840 ab	916 abc	2418 ab
5	Velum Total (14 oz/A) + Aeris (0.75 mg ai/seed)	55.8	6675 a	1998 a	3223 ab
6	Aeris (0.75 mg ai/seed)	51.8	3438 ab	1118 abc	2563 ab
7	Velum Total (10 oz/A) + Gaucho (0.375 mg ai/seed) + COPeO (0.25 mg ai/seed)	60.5	2038 ab	617 abc	3115 ab
8	Velum Total (14 oz/A) + Gaucho (0.375 mg ai/seed) + COPeO (0.25 mg ai/seed)	59.8	474 b	148 bc	2367 ab
9	Aeris (0.75 mg ai/seed) + COPeO (0.25 mg ai/seed)	58.5	1076 ab	299 abc	3151 ab
10	Bio ST Nematicide	57.3	4496 ab	1477 ab	2817 ab
11	AgLogic 5 lb/A	56.0	3774 ab	1144 abc	3536 ab
	ST 4946				
12	Gaucho 600 (0.5 mg ai/seed)	58.8	3251 ab	896 abc	3100 ab
13	Gaucho 600 (0.5 mg ai/seed) + COPeO Prime (0.2 mg ai/seed)	61.8	985 ab	303 abc	3753 a
14	Velum Total (14 oz/A) + Gaucho 600 (0.5 mg ai/seed)	57.0	542 b	128 c	3027 ab
	Tukey's HSD ($P \leq 0.10$)	13.69	4487.2	1311.7	905.8

* Survival was the number of seedlings in 7.6 meter of row 26 days after planting (DAP) divided by the number of seeds planted presented as a percent.

**Data were analyzed by ANOVA using PROC GLIMMIX with SAS 9.4 (SAS Institute, Inc., Cary, NC) and means compared with Tukey's HSD ($P \leq 0.10$) level.



Kg/ha
RK g root
Gaucho
G + COPeO P
VT 14oz
VT 18oz
VT 14oz + Aeris
Aeris
VT 10oz
VT14oz
Aeris +COPeO P
BioST
AgLogic 5lb
Kg/ha
RK g root



Seed cotton yield kg/ha
RK g root
ST4949 'Gaucho
ST 4949 G + COPeO P
ST 4949 G + VT 14
ST 4946 Gaucho
ST 4946 G + COPeO P
ST 4946 G + VT 14
Kg/ha
RK g root

Cotton Variety Evaluation with and without Velum Total for Root-Knot and Fusarium Wilt Management in Alabama, 2018

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

Ten cotton varieties were evaluated with and without the addition of Velum Total 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 2 May, with seeds planted at a depth of 2.5 centimeters. Test plots consisted of 4 rows (two treated with Velum Total and two untreated), that were 7.6 meters long with a 0.9-meter row spacing and a 1.8-meter alley between replications. Velum Total was applied as an in-furrow spray at a rate of 1.02 L/ha 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 as recommended by the Alabama Cooperative Extension System, and watered as needed with an overhead irrigation system. Monthly rain accumulation from planting in May until harvest in October were 6.25, 8.71, 10.92, 14.38, 4.47, 0.25 cm respectively for a total of 44.98 cm over the whole growing season. Nematode population density (eggs/gram of root) and plant biomass measurements were taken 33 days after planting 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 the 9 Oct. Plants were counted for vascular discoloration indicating Fusarium infection immediately after harvest. Data were analyzed with SAS 9.4 using PROC GLIMMIX and LS-means were compared using Tukey-Kramer's method ($P \leq 0.1$).

In this test, treatments with Velum Total could not be assoicated with an siginficant increase in early season plant biomass or lint cotton yield. However, in both cases a nurmerical advantage (0.86 grams and 85 kg/ha respectively) on average across all varieties was oservered in treated plots. A numerical decrease was also observed in root-knot eggs per gram of root and Fusarium wilt when Velum Total was added (174 fewer eggs/g of root and 2 less plants with FOV). The percentage of plants with FOV were Yields, root-knot nematode population density and FOV incidence were significantly different among the cotton varieties. Cropland Genetics 3885 B2XF had the higheset cotton yield with an increase of 834 kg of lint cotton per hectare over the lowest yielding variety. Phytogen 487 WRF had the second highest yield in the test. This may be atribuited in part to its nematode resistance which was reflected by the lowest number of root-knot eggs/gram of root; a 99% reduction compaired to the variety with the highest population density. Deltapine 1522 B2XF was rainked third in yield and also had the lowest FOV infection.

Source of Variation (F-value)	Biomass (g)	Lint Cotton Yield (kg/ha)	Root-knot eggs/g of root	Fusarium wilt
Cotton Variety	5.22****y	2.81***	2.49**	3.12***
Nematicide	0.25	0.52	1.48	0.30
Variety x Nematicide	0.37	0.26	1.61	0.46
Nematicide LS-means				
Untreated	23.54x a	805 a	650 a	26.2 a
Velum Totalw	24.40 a	890 a	476 a	24.0 a
Cotton Variety LS-means				
Deltapine 1646 B2XF	19.38 bc	897 ab	331 ab	19.0 abc
Deltapine 1522 B2XF	29.28 ab	1148 ab	725 ab	6.0 c
PhytoGen 333 WRF	26.37 abc	1020 ab	13448 a	33.7 ab
PhytoGen 487 WRF	25.21 abc	1183 ab	125 b	28.0 abc
PhytoGen 444 WRF	25.81 abc	730 ab	680 ab	26.0 abc
NexGen 3729 B2XF	18.70 bc	515 b	538 ab	17.3 abc
NexGen 5007 B2XF	15.45 c	495 b	239 ab	32.7 abc
Stoneville 6182 GLT	18.42 bc	566 ab	560 ab	42.1 a
Stoneville 5517 GLTP	24.58 bc	577 ab	808 ab	34.0 ab
Croplan Genetics 3885 B2XF	36.51 a	1338 a	278 ab	11.9 bc

y Significance at the 0.1, 0.05, 0.01, and 0.001 level is indicated by *, **, ***, and **** respectively.
x values present are LS-means separated using the Tukey-Kramer method at $P \leq 0.1$. Values in the same column followed by the same letter do not differ significantly.
w Velum total was applied at the time of planting as an in-furrow spray at a rate of 1.02 L/ha.

Evaluation of Nematicide Products for Increasing Cotton Plant Growth and Yield and Decreasing Reniform Nematode Population Density on Cotton in North Alabama, 2018

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

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 four replications. The plots were planted on 8 May using DeltaPine 1522 B2XF variety 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. The nematicides were applied as either seed treatments, in-furrow sprays, or foliar sprays at labeled rates. Velum Total, Propulse, and Admire Pro were applied as an in-furrow sprays at the time of planting at rates of 1.02 L/ha, 0.99 L/ha and 0.62 L/ha respectively. COPeO Prime, BioST Nematicide 100, and Avicta were applied as seed treatments at rates of 0.3 mg ai/seed, 8 oz/Cwt, and 0.15 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 pin head 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 May through harvest in October were 30, 33, 33, 33, 32, and 25°C with average minimum temperatures of 18, 20, 21, 21, 21, and 13°C, respectively. Rainfall accumulation for each month was 8.64, 11.35, 5.59, 11.23, 7.85, and 6.19 cm with a total of 50.85 cm over the entire growing season. Plant stand counts were taken 29 May which corresponded to 21 DAP. Nematode population density (eggs per gram of root), plant height, and biomass (root fresh weight + shoot fresh weight) were determined at 37 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. Data were analyzed with SAS 9.4 using PROC GLIMMIX and LS-means were compared using Dunnett's method ($P \leq 0.1$).

The largest increase in plant height compared to the control (3.18 cm) was recorded with treatment of AgLogic 15G. This treatment also recorded the largest plant biomass (root fresh weight + shoot fresh weight) though no significance was observed. Treatments of Aglogic 15G, Propulse + Admire Pro and, BioST Nematicide 100 all reduced reniform population density; reductions amounted to 95%, 75%, and 56% respectively. Seed cotton yields were increased by 4 nematicides in this test. Aglogic 15G, COPeO Prime + Vydate C-LV, COPeO Prime, and Propulse + Admire Pro increased yields by 1,781, 1,427, 1,193, 1,193 kg/ha of seed cotton yield compared to the control plots. No nematode reduction or early season plant growth increases were observed in association to the yield increase with treatment of COPeO Prime + Vydate C-LV. However, early season plant growth data and nematode samples were taken 37 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, a yield increase of 1,042 kg/ha of seed cotton was observed in association with the nematicide treatments in this test.

Treatments	Stand[z]	Plant Height (cm)	Biomass[y] (g)	Reniform eggs/g of root	Seed Cotton Yield (kg/ha)
Control	37 [x]	20.63	39.88	496	2372
Velum Total 1.02 L/ha	42	21.19	45.87	314	2774
COPeO Prime 0.3 mg ai/seed	43	20.88	42.92	226	3565 **
AgLogic 15G 5.6 Kg/ha	39	23.81 *	46.30	27 ***	4153 ***
BioST Nematicide 100 8 oz/Cwt	43	21.81	43.95	218 *	2943
Avicta 0.15 mg ai/seed	44	22.00	42.06	500	3096
COPeO Prime Vydate C-LV 1.24 L/ha	44	20.75	44.37	430	3799 **
Propulse 0.99 L/ha Admire Pro 0.62 L/ha	38	20.25	37.17	126 **	3565 **

[z] Plant stands per 7.6-meter row.
[y] Biomass is the sum of shoot fresh weight and root fresh weights collected 37 DAP.
[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.

Cotton Variety Evaluation with and without Velum Total for Root-Knot Nematode Management in Alabama, 2018

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

Ten cotton varieties were evaluated with and without the addition of Velum Total for management of the root-knot nematode 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 2 May, with seeds planted at a depth of 2.5 centimeters. Test plots consisted of 4 rows (two treated with Velum Total and two untreated), that were 7.6 meters long with a 0.9-meter row spacing and a 1.8-meter alley between replications. Velum Total was applied as an in-furrow spray at a rate of 1.02 L/ha 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 as recommended by the Alabama Cooperative Extension System, and watered as needed with an overhead irrigation system. Monthly rain accumulation from planting in May until harvest in October were 6.25, 8.71, 10.92, 14.38, 4.47, 0.25 cm respectively for a total of 44.98 cm over the whole growing season. Nematode population density (eggs/gram of root) and plant biomass measurements were taken 33 days after planting 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 the 9 Oct. Data were analyzed with SAS 9.4 using PROC GLIMMIX and LS-means were compared using Tukey-Kramer's method ($P \leq 0.1$).

In this test treatments with Velum Total could not be asoicated with an siginficant increase in early season plant biomass or lint cotton yield. However, in both cases a nurmerical advantage (0.86 grams and 85 kg/ha respectively) on average across all varieties was oservered in treated plots. A numerical decrease was also observed in root-knot eggs per gram of root when Velum Total was added (174 eggs/g of root). Yields and root-knot nematode population density were significantly different among the cotton varieties. Cropland Genetics 3885 B2XF had the higheset cotton yield with an increase of 834 kg of lint cotton per hectare over the lowest yielding variety. Phytogen 487 WRF had the second highest yield in the test. This may be atribuited in part to its nematode resistance which was reflected by the lowest number of root-knot eggs/gram of root; a 99% reduction compaired to the variety with the highest population density.

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Nematicide	0.25	0.52	1.48
Variety x Nematicide	0.37	0.26	1.61
Nematicide LS-means			
Untreated	23.54[x] a	805 a	650 A
Velum Total[w]	24.40 a	890 a	476 A
Cotton Variety LS-means			
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PhytoGen 333 WRF	26.37 abc	1020 ab	13448 a
PhytoGen 487 WRF	25.21 abc	1183 ab	125 b
PhytoGen 444 WRF	25.81 abc	730 ab	680 ab
NexGen 3729 B2XF	18.70 bc	515 b	538 ab
NexGen 5007 B2XF	15.45 c	495 b	239 ab
Stoneville 6182 GLT	18.42 bc	566 ab	560 ab
Stoneville 5517 GLTP	24.58 bc	577 ab	808 ab
Croplan Genetics 3885 B2XF	36.51 a	1338 a	278 ab

[y] Significance at the 0.1, 0.05, 0.01, and 0.001 level is indicated by *, **, ***, and **** respectively.
[x] values present are LS-means separated using the Tukey-Kramer method at $P \leq 0.1$. Values in the same column followed by the same letter do not differ significantly.
[w] Velum total was applied at the time of planting as an in-furrow spray at a rate of 1.02 L/ha.

Cotton Variety Evaluation with and without Velum Total for Reniform Nematode Management in North, Alabama, 2018

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

Ten cotton varieties were evaluated with and without the addition of Velum Total for management of the reniform nematode at Auburn University's Tennessee Valley Research and Extension Center, Belle Mina, AL. A control field that was not infested with the reniform nematode had the same ten varieties planted with and without the addition of Velum Total. Both fields were a Decatur silt loam soil type (24% sand, 49% silt, and 28% clay). The field trials were arranged in a randomized complete block design with five replications. The plots were planted on 8 May, and seeds planted at a depth of 2.5 centimeters. Test plots consisted of 4 rows (two treated with Velum Total and two untreated), that were 7.6 meters long with a 1-meter row spacing and a 1.8-meter alley between replications. Velum Total was applied at planting as an in-furrow spray at a rate of 1.02 L/ha 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 as recommended by the Alabama Cooperative Extension System, and watered as needed with an overhead irrigation system. Nematode population density (eggs/gram of root) and plant biomass were taken 37 days after planting by digging four plants at random for 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 the 5 Oct. for the non-nematode infested field. Due to rain and field conditions, the reniform nematode-infested field was harvested on 24 Oct. Data were analyzed with SAS 9.4 using PROC GLIMMIX and LS-means were compared using Tukey-Kramer's method ($P \leq 0.05$).

The presence of the reniform nematode in the field resulted in significant reduction in both early season plant biomass (recorded 37 days after planting) and seed cotton yield that amounted to 25.33g and 2169 kg/ha respectively on average across the varieties. The application of Velum Total increased both plant biomass and seed cotton yield. On average between all varieties, treatment with Velum Total increased yield by 260 kg/ha of seed cotton in this field. In the nematode-infested field this increase can be attributed at least in part to a 69% reduction in reniform nematode population density as measured by nematode eggs per gram of cotton root. All cotton varieties supported similar population density of the reniform nematode eggs but the presence of the reniform nematode had a heightened impact on the yield performance of some cotton varieties included in this test. The lead producing variety in the non-infested field were DP 1646 B2XF and DP 1522 B2XF respectively. However, in the nematode infested field a 50% reduction in yield was recorded for DP 1646 B2XF resulting in a significantly lower yield compared to the top variety in the field DP 1522 B2XF. DP 1522 B2XF recorded the slightest yield reduction in the nematode infested field with only a 32% loss when compared to the non-infested field.

Source of Variation (F-value)	Biomass (g)	Seed Cotton Yield (kg/ha)		Reniform eggs/g of root[z]
Cotton Variety	3.91****[y]	8.07****		1.63
Nematicide	5.49**	15.45****		15.41****
Nematode	145.16****	153.56****		-
Variety x Nematicide	1.21	0.84		1.06
Variety x Nematode	0.91	3.61****		-
Nematicide x Nematode	0.17	1.64		-
Variety x Nematicide x Nematode	0.32	0.53		-
Nematicide LS-means				
Untreated	55.24[x] b	3753 b		357 a
Velum Total[w]	60.17 a	4015 a		112 b
Nematode LS-means				
Nematode infested field	45.04 b	2800 b		--
Non-infested field	70.37 a	4969 a		--
Cotton Variety LS-means		**Nematode**	**No Nematode**	
Deltapine 1646 B2XF	48.72 b	2738 b	5423 a	125 a
Deltapine 1522 B2XF	63.33 ab	3665 a	5390 a	109 a
PhytoGen 333 WRF	54.88 ab	2642 b	5218 ab	490 a
PhytoGen 487 WRF	60.82 ab	3036 ab	4919 abc	205 a
PhytoGen 444 WRF	61.46 ab	2447 b	5083 ab	376 a
NexGen 3729 B2XF	48.50 b	2368 b	4858 abc	211 a
NexGen 5007 B2XF	51.56 b	2428 b	4603 bc	288 a
Stoneville 6182 GLT	61.71 ab	2732 b	4421 c	88 a
Stoneville 5517 GLTP	58.12 ab	2988 ab	5077 ab	277 a
Croplan Genetics 3885 B2XF	67.97 a	2954 ab	4699 bc	177 a

[z] Data for reniform eggs/gram of root was only collected from the nematode infested field and not the control field.
[y] Significance at the 0.1, 0.05, 0.01, and 0.001 level is indicated by *, **, ***, and **** respectively.
[x] values present are LS-means separated using the Tukey-Kramer method at $P \leq 0.05$. Values in the same column followed by the same letter do not differ significantly.
[w] Velum Total was applied at the time of planting as an in-furrow spray at a rate of 1.02 L/ha.

Evaluation of Nematicide Products for Increasing Cotton Plant Growth and Yield and Decreasing Reniform Nematode Population Density on Cotton in North Alabama, 2018

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

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 four replications. The plots were planted on 8 May using DeltaPine 1522 B2XF variety 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. The nematicides were applied as either seed treatments, in-furrow sprays, or foliar sprays at labeled rates. Velum Total, Propulse, and Admire Pro were applied as in-furrow sprays at the time of planting at rates of 1.02 L/ha, 0.99 L/ha and 0.62 L/ha respectively. COPeO Prime, BioST Nematicide 100, and Avicta were applied as seed treatments at rates of 0.3 mg ai/seed, 4.66 ml/kg, and 0.15 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 pin head 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 May through harvest in October were 30, 33, 33, 33, 32, and 25°C with average minimum temperatures of 18, 20, 21, 21, 21, and 13°C, respectively. Rainfall accumulation for each month was 8.64, 11.35, 5.59, 11.23, 7.85, and 6.19 cm with a total of 50.85 cm over the entire growing season. Plant stand counts were taken 29 May, which corresponded to 21 DAP. Nematode population density (eggs per gram of root), plant height, and biomass (root fresh weight + shoot fresh weight) were determined at 37 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. Data were analyzed with SAS 9.4 using PROC GLIMMIX and LS-means were compared using Dunnett's method ($P \leq 0.1$).

The largest increase in plant height compared to the control (3.18 cm) was recorded with treatment of AgLogic 15G. This treatment also recorded the numerically largest plant biomass (root fresh weight + shoot fresh weight) though no significant treatment effects were observed. Treatments of Aglogic 15G, Propulse + Admire Pro, and BioST Nematicide 100 all reduced reniform population density; reductions amounted to 95%, 75%, and 56% respectively. Seed cotton yields were increased by 4 nematicides in this test. Aglogic 15G, COPeO Prime + Vydate C-LV, COPeO Prime, and Propulse + Admire Pro increased yields by 1781, 1427, 1193, and 1193 kg/ha of seed cotton yield compared to the control plots. No nematode reduction or early season plant growth increases were observed in association to the yield increase with treatment of COPeO Prime + Vydate C-LV. However, early season plant growth data and nematode samples were taken 37 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, a yield increase of 1,042 kg/ha of seed cotton was observed in association with the nematicide treatments in this test.

Treatments	Stand[z]	Plant Height (cm)	Biomass[y] (g)	Reniform eggs/g of root	Seed Cotton Yield (kg/ha)
Control	37 [x]	20.63	39.88	496	2372
Velum Total (1.02 L/ha)	42	21.19	45.87	314	2774
COPeO Prime (0.3 mg ai/seed)	43	20.88	42.92	226	3565 **
AgLogic 15G (5.6 Kg/ha)	39	23.81 *	46.30	27 ***	4153 ***
BioST Nematicide 100 (4.66 ml/kg)	43	21.81	43.95	218 *	2943
Avicta (0.15 mg ai/seed)	44	22.00	42.06	500	3096
COPeO Prime (0.3 mg ai/seed) Vydate C-LV (1.24 L/ha)	44	20.75	44.37	430	3799 **
Propulse (0.99 L/ha) Admire Pro (0.62 L/ha)	38	20.25	37.17	126 **	3565 **

[z] Plant stands per 7.6-meter row.
[y] Biomass is the sum of shoot fresh weight and root fresh weights collected 37 DAP.
[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.

Evaluation of Nematicide Products for Increasing Cotton Plant Growth and Yield and Decreasing Root-Knot Nematode Population Density on Cotton in Central Alabama, 2018

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

Nematicide products were evaluated for their ability to increase cotton plant growth and yield, as well as manage the population density of root-knot nematode (*Meloidogyne incognita*). 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 four replications. The plots were planted on 2 May using Stoneville 4949 GLT variety 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. The nematicides were applied as either seed treatments, in-furrow sprays, or granular application. Velum Total was applied as an in-furrow spray at the time of planting at rates of 0.73 L/ha, 1.02 L/ha and 1.32 L/ha. COPeO Prime, BioST Nematicide 100, Aeris and Gaucho 600 were applied as seed treatments at rates of 0.2 mg ai/seed, 4.66 ml/kg, 0.75 mg ai/seed, and 0.47 ml/kg respectively. AgLogic was applied to the seed furrow at a rate of 5.6 kg/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 an overhead irrigation system. Rainfall accumulations for each month of the growing season were 6.25, 8.71, 10.92, 14.38, 4.47, 0.25 cm respectively for a total of 44.98 cm over the entire growing season. Plant stand counts were taken 23 May which corresponded to 21 DAP. Nematode population density (eggs per gram of root), plant height, and biomass (root fresh weight + shoot fresh weight) were determined at 33 DAP by digging four plants at random from each plot. 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 10 October. Data were analyzed with SAS 9.4 using PROC GLIMMIX and LS-means were compared using the Tukey-Kramer method ($P \leq 0.1$). The highest yields in this test were recorded on treatments of AgLogic, with yields increased by 1,300 kg/ha over the lowest yielding treatment. However, a decrease in root-knot eggs/gram of root was not observed in association with this yield increase as this treatment recorded the highest population density of nematodes. Two treatments, Gaucho 600 + COPeO Prime + Velum Total and Gaucho 600 + COPeO, recorded significantly lower nematode numbers by 97% and 93%, respectively. Both treatments also recorded reduced yield compared to the AgLogic treatment. The yield increases from the AgLogic treatment may have been associated with other pest protections provided by the chemical.

Treatments		Stand[z]	Plant Height (cm)	Biomass[y] (g)	Root-knot eggs/g of root	Seed Cotton Yield (kg/ha)
Gaucho 600[x]	0.47 ml/kg	58 ab[w]	22 a	38 a	1250 ab	2505 bcd
Gaucho 600 COPeO Prime	0.47 ml/kg 0.2 mg ai/seed	58 ab	17 b	29 b	339 dc	2236 d
Gaucho 600 Velum Total	0.47 ml/kg 1.02 L/ha	57 ab	19 ab	34 ab	2251 a	2439 bcd
Gaucho 600 Velum Total	0.47 ml/kg 1.32 L/ha	54 ab	20 ab	35 ab	1131 ab	2416 bcd
Aeris	0.75 mg ai/seed	52 b	20 ab	36 ab	1517 a	2563 bcd
Aeris Velum Total	0.75 mg ai/seed 1.02 L/ha	56 ab	22 a	40 a	2157 a	3223 ab
Goucho 600 COPeO Prime Velum Total	0.47 ml/kg 0.2 mg ai/seed 0.73 L/ha	61 a	22 a	38 a	1048 abc	3115 abc
Gaucho 600 COPeO Prime Velum Total	0.47 ml/kg 0.2 mg ai/seed 1.02 L/ha	60 a	21 a	37 ab	150 d	2367 cd
Aeris COPeO Prime	0.75 mg ai/seed 0.2 mg ai/seed	59 ab	22 a	40 a	326 bcd	3151 abc
BioST Nematicide 100	4.66 ml/kg	57 ab	19 ab	33 ab	2024 a	2817 abcd
AgLogic	5.6 kg/ha	56 ab	20 ab	37 ab	5002 a	3536 a

[z] Plant stands per 7.6-meter row.
[y] Biomass is the sum of shoot fresh weight and root fresh weights collected 33 DAP.
[x] All seeds were treated with the same premium fungicide seed treatment for protection against fungal pathogens.
[w] Values present are LS-means separated using the Tukey-Kramer method at $P \leq 0.1$. Values in the same column followed by the same letter do not differ significantly.

Cotton Variety Evaluation with and without Velum Total for Reniform Nematode Management in North Alabama, 2018

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

Ten cotton varieties were evaluated with and without the addition of Velum Total for management of the reniform nematode at Auburn University's Tennessee Valley Research and Extension Center, Belle Mina, AL. A control field that was not infested with the reniform nematode had the same ten varieties planted with and without the addition of Velum Total. Both fields were a Decatur silt loam soil type (24% sand, 49% silt, and 28% clay). The fields were arranged in a randomized complete block design with five replications. The plots were planted on 8 May, and seeds planted at a depth of 2.5 centimeters. Test plots consisted of 4 rows (two treated with Velum Total and two untreated), that were 7.6 meters long with a 1-meter row spacing and a 1.8-meter alley between replications. Velum Total was applied at planting as an in-furrow spray at a rate of 1.02 L/ha 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 as recommended by the Alabama Cooperative Extension System, and watered as needed with an overhead irrigation system. Nematode population density (eggs/gram of root) and plant biomass were taken 37 days after planting by digging four plants at random for 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 the 5 Oct. for the non-nematode infested field. Due to rain and field conditions, the reniform nematode-infested field was harvested on 24 Oct. Data were analyzed with SAS 9.4 using PROC GLIMMIX and LS-means were compared using Tukey-Kramer's method ($P \leq 0.05$).

The presence of the reniform nematode in the field resulted in significant reduction in both early season plant biomass (recorded 37 days after planting) and seed cotton yield that amounted to 25.33g and 2169 kg/ha respectively on average across the varieties. The application of Velum Total increased both plant biomass and seed cotton yield. On average between all varieties, treatment with Velum Total increased yield by 260 kg/ha of seed cotton in this field. In the nematode-infested field this increase can be attributed at least in part to a 69% reduction in reniform nematode population density as measured by nematode eggs per gram of cotton root. All cotton varieties supported similar population density of the reniform nematode eggs but the presence of the reniform nematode had a heightened impact on the yield performance of some cotton varieties included in this test. The lead producing variety in the non-infested field were DP 1646 B2XF and DP 1522 B2XF respectively. However, in the nematode infested field a 50% reduction in yield was recorded for DP 1646 B2XF resulting in a significantly lower yield compared to the top variety in the field DP 1522 B2XF. DP 1522 B2XF recorded the slightest yield reduction in the nematode infested field with only a 32% loss when compared to the non-infested field.

Source of Variation (F-value)	Biomass (g)	Seed Cotton Yield (kg/ha)		Reniform eggs/g of root[z]
Cotton Variety	3.91****[y]	8.07****		1.63
Nematicide	5.49**	15.45****		15.41****
Nematode	145.16****	153.56****		-
Variety x Nematicide	1.21	0.84		1.06
Variety x Nematode	0.91	3.61****		-
Nematicide x Nematode	0.17	1.64		-
Variety x Nematicide x Nematode	0.32	0.53		-
Nematicide LS-means				
Untreated	55.24[x] b	3753 b		357 a
Velum Total[w]	60.17 a	4015 a		112 b
Nematode LS-means				
Nematode infested field	45.04 b	2800 b		--
Non-infested field	70.37 a	4969 a		--
Cotton Variety LS-means		**Nematode**	**No Nematode**	
Deltapine 1646 B2XF	48.72 b	2738 b	5423 a	125 a
Deltapine 1522 B2XF	63.33 ab	3665 a	5390 a	109 a
PhytoGen 333 WRF	54.88 ab	2642 b	5218 ab	490 a
PhytoGen 487 WRF	60.82 ab	3036 ab	4919 abc	205 a
PhytoGen 444 WRF	61.46 ab	2447 b	5083 ab	376 a
NexGen 3729 B2XF	48.50 b	2368 b	4858 abc	211 a
NexGen 5007 B2XF	51.56 b	2428 b	4603 bc	288 a
Stoneville 6182 GLT	61.71 ab	2732 b	4421 c	88 a
Stoneville 5517 GLTP	58.12 ab	2988 ab	5077 ab	277 a
Croplan Genetics 3885 B2XF	67.97 a	2954 ab	4699 bc	177 a

[z] Data for reniform eggs/gram of root was only collected from the nematode infested field and not the control field.
[y] Significance at the 0.1, 0.05, 0.01, and 0.001 level is indicated by *, **, ***, and **** respectively.
[x] values present are LS-means separated using the Tukey-Kramer method at $P \leq 0.05$. Values in the same column followed by the same letter do not differ significantly.
[w] Velum Total was applied at the time of planting as an in-furrow spray at a rate of 1.02 L/ha.

Cotton Variety Evaluation with and without Velum Total for Root-Knot Nematode Management in Alabama, 2018

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

Ten cotton varieties were evaluated with and without the addition of Velum Total for management of the root-knot nematode 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 2 May, with seeds planted at a depth of 2.5 centimeters. Test plots consisted of 4 rows (two treated with Velum Total and two untreated), that were 7.6 meters long with a 0.9-meter row spacing and a 1.8-meter alley between replications. Velum Total was applied as an in-furrow spray at a rate of 1.02 L/ha 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 as recommended by the Alabama Cooperative Extension System, and watered as needed with an overhead irrigation system. Monthly rain accumulation from planting in May until harvest in October were 6.25, 8.71, 10.92, 14.38, 4.47, 0.25 cm respectively for a total of 44.98 cm over the whole growing season. Nematode population density (eggs/gram of root) and plant biomass measurements were taken 33 days after planting 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 the 9 Oct. Data were analyzed with SAS 9.4 using PROC GLIMMIX and LS-means were compared using Tukey-Kramer's method ($P \leq 0.1$).

In this test treatments with Velum Total could not be assoicated with an signficant increase in early season plant biomass or lint cotton yield. However, in both cases a nurmerical advantage (0.86 grams and 85 kg/ha respectively) on average across all varieties was oservered in treated plots. A numerical decrease was also observed in root-knot eggs per gram of root when Velum Total was added (174 eggs/g of root). Yields and root-knot nematode population density were significantly different among the cotton varieties. Cropland Genetics 3885 B2XF had the highest cotton yield with an increase of 834 kg of lint cotton per hectare over the lowest yielding variety. Phytogen 487 WRF had the second highest yield in the test. This may be atribuited in part to its nematode resistance which was reflected by the lowest number of root-knot eggs/gram of root; a 99% reduction compaired to the variety with the highest population density.

Source of Variation (F-value)		Biomass (g)	Lint Cotton Yield (kg/ha)	Root-knot eggs/g of root
Cotton Variety		5.22^{****y}	2.81***	2.49**
Nematicide		0.25	0.52	1.48
Variety x Nematicide		0.37	0.26	1.61
Nematicide LS-means				
Untreated		23.54^{x} a	805 a	650 a
Velum Total^{w}		24.40 a	890 a	476 a
Cotton Variety LS-means	**RKN Resistance**			
Deltapine 1646 B2XF	Not resistant	19.38 bc	897 ab	331 ab
Deltapine 1522 B2XF	Not resistant	29.28 ab	1148 ab	725 ab
PhytoGen 333 WRF	Not resistant	26.37 abc	1020 ab	13448 a
PhytoGen 487 WRF	2 resistant genes	25.21 abc	1183 ab	125 b
PhytoGen 444 WRF	Not resistant	25.81 abc	730 ab	680 ab
NexGen 3729 B2XF	Not resistant	18.70 bc	515 b	538 ab
NexGen 5007 B2XF	Not resistant	15.45 c	495 b	239 ab
Stoneville 6182 GLT	Not resistant	18.42 bc	566 ab	560 ab
Stoneville 5517 GLTP	Not resistant	24.58 bc	577 ab	808 ab
Croplan Genetics 3885 B2XF	Not resistant	36.51 a	1338 a	278 ab

^{y} Significance at the 0.1, 0.05, 0.01, and 0.001 level is indicated by *, **, ***, and **** respectively.
^{x} values present are LS-means separated using the Tukey-Kramer method at $P \leq 0.1$. Values in the same column followed by the same letter do not differ significantly.
^{w} Velum total was applied at the time of planting as an in-furrow spray at a rate of 1.02 L/ha.

Cotton Variety Evaluation with and without Velum Total for Root-Knot Nematode Management in South Alabama, 2018

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

Ten cotton varieties were evaluated with and without the addition of Velum Total for management of the root-knot nematode *Meloidogyne incognita* (race 3) at Auburn University's Gulf Coast Research and Extension Center, Fairhope, AL. A control field that was not infested with the root-knot nematode had the same ten varieties planted with and without the addition of Velum Total. Both fields were a Malbis sandy loam soil type (59% sand, 31% silt, and 10% clay). The fields were arranged in a randomized complete block design with five replications. The plots were planted on 9 Jun, and seeds planted at a depth of 2.5 centimeters. Test plots consisted of 4 rows, two treated with Velum Total and two untreated, that were 6.1 meters long with a 1-meter row spacing and a 1.8-meter alley between replications. Velum Total was applied at planting as an in-furrow spray at a rate of 1.02 L/ha 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 as recommended by the Alabama Cooperative Extension System, and watered as needed with an overhead irrigation system. Nematode population density (eggs/gram of root) and plant biomass were taken 40 days after planting by digging four plants at random for 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 the 30 Nov. Data were analyzed with SAS 9.4 using PROC GLIMMIX and LS-means were compared using Tukey-Kramer's method ($P \leq 0.05$).

Early season plant biomass was observed to be decreased by the presence of nematodes in the field. On average across the varieties 94 grams of biomass were lost when the root-knot nematode was present. The application of Velum total did effect both the biomass and yields of the varieties in this test. When Velum Total was not applied the largest plant biomass was recorded on Deltapine 1747NR B2XF; this was possibly influenced by the root-knot resistance of the variety. With the application of Velum Total the largest biomass was recorded in Stoneville 6182 GLT, a variety that is not resistant to root-knot nematode but has a good biomass response to the nematicide application. The largest seed cotton yield recorded when no Velum Total was applied was on Croplan Genetics 3885 B2XF variety. This variety did support one of the lowest nematode population densities which may have resulted in a high yield in the untreated plots. The highest yielding variety when Velum Total was applied was Stoneville 5818 GLT. This variety supported one of the highest nematode population densities, however, as it produced high yield in both treated and untreated plots.

Source of Variation (F-value)	Biomass (g)		Seed Cotton Yield (kg/ha)		Root-knot eggs/g of root[z]
Cotton Variety	1.89[*y]		5.69[****]		5.10[****]
Nematicide	7.79[***]		1.40		0.62
Nematode	59.32[****]		0.28		-
Variety x Nematicide	2.57[***]		3.14[***]		0.21
Variety x Nematode	0.13		0.35		-
Nematicide x Nematode	0.02		0.91		-
Variety x Nematicide x Nematode	0.51		0.63		-
Nematicide LS-means					
Untreated	304.89[x] a		2468 a		37 a
Velum Total[w]	276.33 b		2413 a		34 a
Nematode LS-means					
Non-infested field	337.60 a		2488 a		--
Nematode infested field	243.62 b		2393 a		--
Cotton Variety LS-means	**Untreated**	**Nematicide**	**Untreated**	**Nematicide**	
Deltapine 1747NR B2XF	364 a	220 b	2399 ab	2299 bc	16 b
Deltapine 1558NR B2XF	313 ab	277 ab	2152 b	2599 ab	17 b
Deltapine 1646 B2XF	318 ab	244 ab	2484 ab	2329 bc	56 a
Deltapine 1851 B3XF	290 ab	312 a	2136 b	2075 c	57 a
PhytoGen 480 W3FE	335 ab	322 a	2322 ab	2507 abc	15 b
PhytoGen 430 W3FE	280 ab	278 ab	2715 a	2337 bc	30 ab
Stoneville 5818 GLT	314 ab	293 ab	2646 a	2851 a	62 a
Stoneville 6182 GLT	290 ab	329 a	2622 a	2198 bc	60 a
Croplan Genetics 9608 B3XF	258 b	246 ab	2445 ab	2353 abc	30 ab
Croplan Genetics 3885 B2XF	287 ab	242 ab	2761 a	2615 ab	17 b

[z] Data for root-knot eggs/gram of root was only collected from the nematode infested field and not the control field.
[y] Significance at the 0.1, 0.05, 0.01, and 0.001 level is indicated by *, **, ***, and **** respectively.
[x] Values present are LS-means separated using the Tukey-Kramer method at $P \leq 0.1$. Values in the same column followed by the same letter do not differ significantly.
[w] Velum Total was applied at the time of planting as an in-furrow spray at a rate of 1.02 L/ha.

Isolation of a Novel Fluorophore from *Rotylenchulus reniformis* (Reniform Nematode, RN)

S.W. Park and K.S. Lawrence

Objective:

A long-term goal of our team is to generate new GM cotton lines with enhanced resistance and/or tolerance against *R. reniformis* infections. One of present obstacles, however, is our lack of knowledge on the immunophysiology of cotton plants and plant roots against infections by *R. reniformis* and plant parasitic nema-todes (PPN). Hence, to elucidate the cellular modes of cotton root-PPN interactions, we have developed a novel microscopy imaging technique and started to monitor the 'real-time' responses of cotton root cells while *R. reniformis* attacks. These efforts uncovered serendipitously that *R. reni-formis* and PPN accumulate an intestinal autofluoescent compound (fluo-rophore, 425/525-nm) with enhanced stability (Fig. 1).

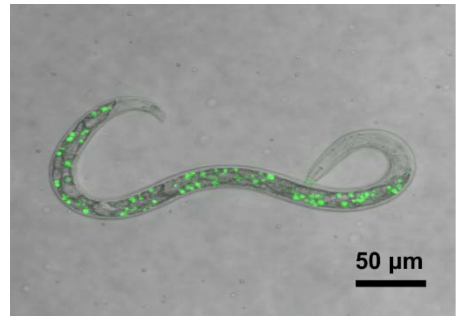

Figure 1. *R. reniformis*-derived auto-fluorophore. The live image merging the 2 different channels (DIC and FITC) of a confocal laser microscope.

Progress:

1. We have employed a series of instruments such as a high performance liquid chromatography (LC), LC-mass spectrometry (MS), and nuclear magnetic resonance, of which results indicate the compound is a sulfo-nium, [(17β)-3-ethoxyestra-1,3,5(10)-trien-17-yl]ethylmethyl-(9CI) (Fig. 2).

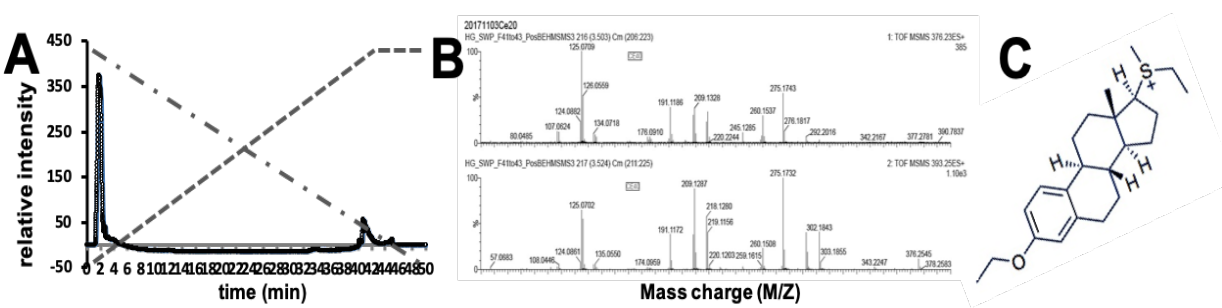

Figure 2. Identification of *R. reniformis*-derived autofluorophore. **A**. High performance liquid chromatography (HPLC) identifi-cation. Injection of the *R. reniformis*-derived autofluorescent solution was subjected directly into the C18 column and using a water to methanol (polar to non-polar) phase change (5%-100%). The peak of the compound was found between 40-45 minutes. **B**. MS/MS spectra of *R. reniformis*-derived autofluorophore. The data show mass-to-charge ratios to assist in determining identi-ty of the structure, sulfonium (**C**).

2. Root cells of cotton (Lonren-1, resistance germplasm) do not activate hypersensitive response in response to *R. reniformis* infections. For the past decades, a number of studies have speculated that cottons (e.g., Lonren-1 line) and plant roots could activate hypersensitive response upon PPN infections, which are in general considered as the most eminent and effective defense machinery of plants against microbial pathogens.

We have retrieved and stained cotton roots with propidium iodide (PI; red) and 2',7'-dichlorodihydrofluores-cein diacetate (reactive oxygen species-target dye; green) at 2-wk post *R. reniformis* infections (Fig. 3). Note that our preliminary studies determined that a majority of *R. reniformis* could penetrate cotton roots in ~13-16-day post inoculations. It was immediately noticeable that cotton roots produce and accumulate reactive oxygen species. However, hypersensitive response (localized cell death) was not detectable in cotton roots at and near *R. reniformis* infection sites. In particular, no localized cell death was observed even at and near the infection sites of pregnant female *R. reniformis* (e.g., see *R. reniformis*-infected Lonren-1). Considering that pregnancy takes a few days from the infection (J2) stage, the absence of developing localized cell death at the site of infections clearly concluded that cotton roots are incapable of developing hypersensitive response against PPN infections.

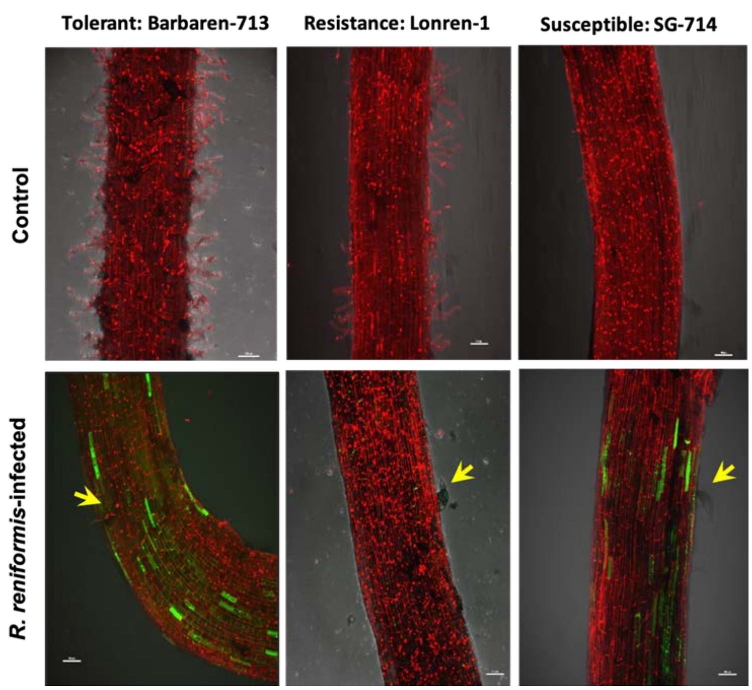

Figure 3. *R. reniformis* infections cause the production of reactive oxygen species but not develop localized cell death (e.g., hypersensitive response). Representative photographs of infected cotton roots were taken at 14 days post *R. reniformis* ino-culations, and yellow arrows indicate the infection sites of *R. reniformis*.

3. Roots of a tolerant cotton germplasm (Barbaren-713) pro-duce a larger number of root hair than those of Lonren-1 and a susceptible line (SureGrow-714) (Fig. 3). While monitoring H_2O_2 bursts and cell death in the roots of three cotton germplasms, it was apparent that a tolerant line Barbren-713 exhibited a thick mass of root hairs all along the secondary root. In contrast, Lonren-1 germplasms displayed a less amount of root hairs, whereas a susceptible cultivar SG-747 had few, perhaps, no root hair growth, suggesting potential importance or roles of root morphology or growth/development in cottons' tolerance against PPN infections.

4) Bioinformatics analysis: Moving forward, we have employed a systematic biology approach to discern **i**) the tolerance associated genes and **ii**) if those genes are involved in root morphology by analyzing differential transcriptomes between the tolerant and susceptible germplasms before and after nematode infections. As an initial step level differences of transcripts between tolerant (Barbren-713, Bar0) and susceptible (SG-747, DSO), and hypersensitive (Lonren-1, L10) germplasms were established via the National Center for Biotechnology Information (NCBI) database and Blast2GO software (please see an example in Fig. 4). Since most of genes found in the results of DSO v. L10 are likely irrelevant (or negative) to tolerance phenotype, we are now subtracting those genes from the results of DSO v. Bar0. In addition, we have been generating a comprehensive list of genes related to root growth and root hair development based on the *Arabidopsis* database and identifying their homologues in cotton plants and analyzing their expression levels in Bar0 compared to DSO and L10.

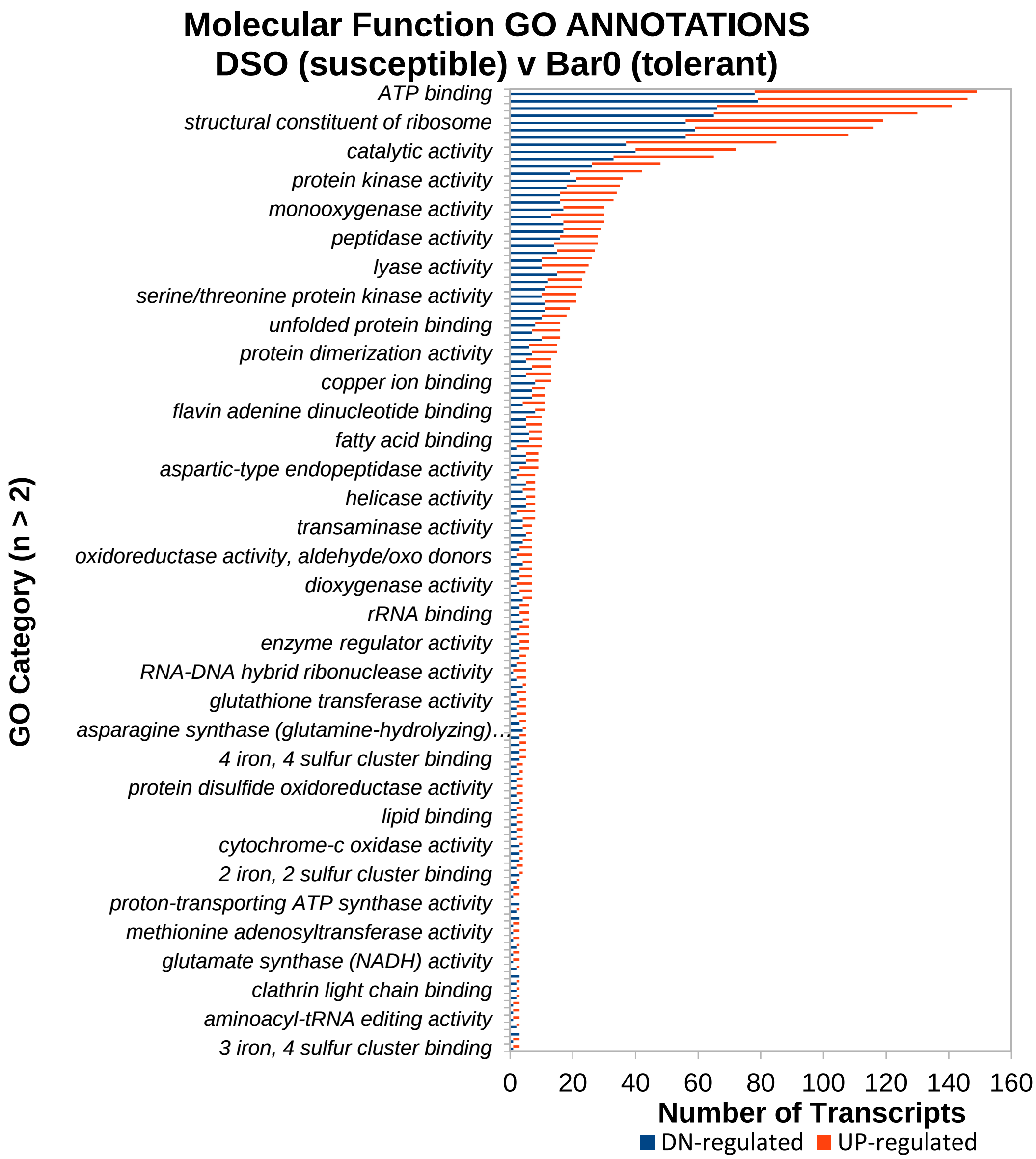

Figure 4. Gene ontology categories of differentially expressed transcripts from cotton root tissues comparing susceptible (SureGrow-747, DSO) to tolerance (Barbren-713, Bar0) genotype without R. reniformis infection. The percentage of differentially transcripts between genotypes in each biological pathway 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.

Future direction:

We will further employ **i**) computation analyses to search and **ii**) genetic mutagenesis to experimentally test a gene and genes which are responsible for the tolerance phenotype of cotton roots against PPN infections.

Isolation of a Root Signal Attracting a Semi-Endoparasite Nematode, *Rotylenchulus reniformis*

S. W. Park and K. Lawrence

Objective: A long-term goal of our labs is employing generic engineering and molecular breeding approaches to develop new transgenic lines of resistance or tolerance cottons against infections of *R. reniformis*. However, the main present obstacles to do so is our little understanding of interactions between plant and *R. reniformis*. In particular, it is mostly elusive how *R. reniformis* can recognize and move towards host plant roots. Hence, the proposed study has aimed at exploring if plant roots synthesize and produce specific (chemical) attractants for *R. reniformis*.

Rationale and Significance: Our earlier studies demonstrated - for the first time - that *R. reniformis* can selectively sense and move autonomously in a short distance towards the root extracts and exudates of host plants (cotton and soybean) but not nonhost plants (peanut) (Fig. 1). This suggests the presence of host-specific (chemical) attractants during plant root-*R. reniformis* interactions.

Thus the identification and characterization of the chemo-attractants will enable us to find and disrupt (mutate) their biosynthetic pathways, which engender GM cotton and other plant cultivars with no chemo-attractant productions. These GM cotton cultivars will then be resistance and/or likely 'im-mune' against the infection of *R. reniformis*.

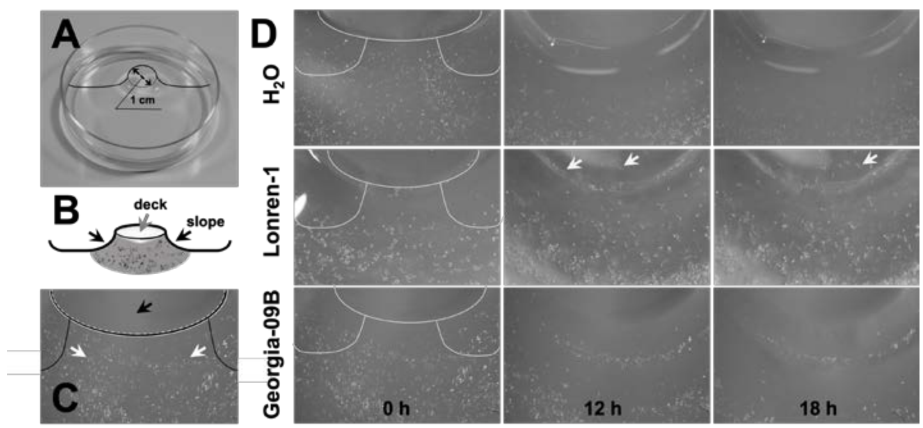

Figure 1. *R. reniformis* is attracted towards cotton root extracts but does not respond to peanut root extracts. (**A** to **C**) Development of a novel PPN motility assay. (***A, B***) Outline of an assay plate. A center of agar medium is uplifted to form a volcano-shaped, round deck (ø 1-cm). (***C***) Exemplary setup of a motility assay. *R. reniformis* (white arrows) suspended in water are placed around a slope of a volcano mountain, and carefully spread up to an edge of deck (white line), while a testing reagent (e.g., cotton root extracts, black arrow) dissolved also in water is loaded on a volcano deck and spread to a top side of edge (white dash line). Subsequently, the reaction and movement of *R. reniformis* are observed by a stereo microscope and photographed. A shape of the volcano mountain is outlined by solid black line. (**D**) The time-resolved responses of *R. reniformis* upon the exposure to water and root ex-tracts prepared from 2-wk grown cotton plants (Lonren-1) and 3-wk old commercial peanut variety (Georgia-09B). Representative photographs are taken at 0, 12 and 18 hr of assays. White lines draw the shapes of the volcano mountain, and white arrows indicate *R. reniformis* on the volcano deck.

Progresses: Our results demonstrated an intrinsic activity of root-exuded allelochemicals in the plant and plant parasitic nematode (PPN) interactions. Hence, we attempted to access whether root exudates convey a host specificity of PPN by cross-examining the responsive behaviors of the three most destructive PPNs (i.e., *R. reniformis*, *M. incognita* and *H. glycines*) towards the polar factions of root exudates prepared from their host and nonhost crops (i.e., cotton, soybean and peanut) (Table 1). As expected, *R. reniformis* and *M. incognita* were attracted to root exudates of cottons and soybeans (host plants), but not of nonhost peanuts. In parallel, *H. glycines* targeted mainly towards soybean (host plant) root exudates. These observations concurred with a conclusion that PPN could discern host plants through sensing selective chemoattractants in root exudates, in particular polar compounds such as organic and amino acids, and peptidic and nucleotide-containing metabolites (Plant Soil 256:67, Plant J 92:147).

Table 1. Chemotactic behaviours of PPN towards the root exudates of host and nonhost plants

Root Exudates / PPN	Numbers of PPN relocated onto the volcano deck			
	Cotton	Soybean	Peanut	Water
R. reniformis	13.5 ± 6.9*	10.0 ± 5.6*	0.5 ± 0.6	0
M. incognita	21.7 ± 6.2*	17.3 ± 3.5*	0	1.0 ± 1.4
H. glycines	3.0 ± 3.8	26.6 ± 9.8*	12.3 ± 6.2	0

Production (publications):

1) Liu W, Jones AL, Gosse HN, **Lawrence KS**, **Park SW** (2019) Root exudates convey host-specific messages that control the short-range underground orientation of plant parasitic nematodes. J Nematol, *Provisionally Accepted*.

2) Liu W, **Park SW** (2018) Underground mystery: Interactions between plant roots and parasitic nematodes. Curr Plant Biol, 15, 25-29.

3) Gosse HN, **Lawrence KS**, **Park SW** (2017) Underground mystery: The role of chemotactic attractant in plant roots and phytonematode interactions. Innovative Techniques in Agriculture, 1.2, 83-87.

Future direction: We will employ the high-performance liquid chromatography and the liquid chromatography mass spectrometer, and identify *R. reniformis* (and *M. incognita*) attractant(s) derived from cotton and soybean root exudates.

Evaluation of BioST Nematicide on Cotton in a Reniform Nematode Infested Field in Northern Alabama, 2018

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

The nematicide seed treatments BioST, systemic acquired resistance product (SAR EEF), and an experimental product (EXP B203) were evaluated for their performance in a reniform nematode infested cotton field. Albaugh, LLC treated the seeds prior to providing the seeds for our research. All the seeds contained base fungicide and insecticide (F&I) treatment. The experimental treatments included the base F&I plus the additional product. The seeds treated with base F&I, Fluopyram, and Avicta+Vibrance+IMD were used as control treatments. The field site was located on the Tennessee Valley Research and Education Center near Belle Mina, AL. This field has been a cotton monoculture for over 18 years and was artificially infested with the reniform nematode in 2007. The soil is a Decatur silt loam (23% sand, 49% silt, 28% clay). Plots consisted of 2 rows, 7.6 m long with 0.91 m row spacing and were arranged in a randomized complete block design with five replications. Blocks were separated by a 1.8 m wide alley between the plots. Plots were planted on 8 May. All plots were maintained throughout the season with standard herbicide, insecticide, and fertility production practices as recommended by the Alabama Cooperative Extension System. Plots were irrigated with a lateral irrigation system as needed. Plant stand was determined 16 days after planting (DAP) on 24 May by counting the number of seedlings in whole length of row in each plot. Samples were collected for nematode analysis and cotton growth assessment by digging 4 random plants per plot, 37 DAP on 14 June. Plant height, shoot and root fresh weight were measured prior to nematode egg extraction. Nematode eggs were extracted by shaking the roots in a 6% NaOCl solution for 4 minutes and collecting the eggs on a 25 µm sieve. The reniform nematode population density was measured as number of reniform nematode eggs per gram of root. Plots were harvested 175 DAP on 30 October. Data were analyzed with SAS 9.4 using PROC GLIMMIX and LS-means were compared using Tukey-Kramer's method ($P \leq 0.10$). Monthly average maximum temperatures from planting in May through harvest in October were 30, 33, 33, 33, 32, and 25°C with average minimum temperatures of 18, 20, 21, 21, 21, and 13°C, respectively. Rainfall accumulation for each month was 8.6, 11.4, 5.6, 11.2, 7.8, and 6.2 cm with a total of 50.8 cm over the entire growing season.

Average plant stand counts ranged from 36 to 48 plants per 7.6 m of row. The base fungicide & insecticide treatment had significantly higher stand count than BioST (1x), BioST (1.25x), BioST(1x)+EXP B203, and Avicta+Vibrance+IMD at $P \leq 0.1$. The average plant height, shoot, and root fresh weights were also significantly higher in base F&I treatment compared to most of the treatments. The reniform nematode population density measured as reniform nematode eggs per gram of root was relatively higher in all treatments compared to Fluopyram. Fluopyram treatment significantly reduced the nematode population density compared to BioST (1.25x), BioST(5x), and BioST (1x)+SAR EEF. The yield was significantly increased by Fluopyram compared to BioST(1x)+SAR EEF, but was not statistically significant in comparison to rest of the treatments ($P \leq 0.1$). Fluopyram treatment reduced the reniform population density by 56% and the yield was around 10% higher compared to the base F&I.

Treatment	16 DAP	37 DAP				175 DAP
	Plant stand[z]	Plant height[y] (cm)	Shoot fresh weight (g)	Root fresh weight (g)	*Rotylenchulus reniformis* [x] eggs/g root	Yield (kg/ha)
Fungicide & Insecticide[w]	48 A[v]	16.9 A	33.2 A	3.8 A	1075 AB	2490 AB
BioST (1x)	38 BC	14.6 B	22.2 B	2.5 B	1802 AB	2323 AB
BioST (1.25x)	36 C	16.8 A	27.8 AB	2.8 B	3118 A	2245 AB
BioST (5x)	45 AB	15.4 AB	23.4 B	2.7 B	3208 A	2401AB
BioST (1x) +SAR EEF	40 ABC	14.7 B	21.0 B	2.5 B	3163 A	1983 B
BioST (1x) + EXP B203	38 BC	14.6 B	22.3 B	2.4 B	1676 AB	2504 AB
Fluopyram	40 ABC	15.7 AB	28.1 AB	2.7 B	471 B	2747 A
Avicta + Vibrance +IMD	38 BC	16.2 AB	23.1 B	2.5 B	1552 AB	2362 AB

[z] Plant stand was the average number of seedlings per 7.6 m of row.
[y] Plant height was the average height of four random plants per plot measured in centimeters.
[x] *Rotylenchulus reniformis* eggs/g of root is the average number of reniform eggs per gram of root from four plant root systems.
[w] Fungicide & insecticide treatment included treatment with Vibrance and Cruiser. All other treatments included the fungicide and insecticide plus additional product (s).
[v] Values present are the LS-means separated by Tukey-Kramer method at $P \leq 0.1$. Values in the same column followed by the same letter do not differ significantly.

Evaluation of BioST Nematicide for Reniform Nematode Management on Cotton in Northern Alabama, 2018

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

Biological seed treatments were evaluated for reniform (*Rotylenchulus reniformis)* nematode management in a reniform nematode infested cotton field. The biological seed treatments included BioST alone, BioST in combination with SOILSET, ISR 2000, TANNIN, and ioFRESH. Albaugh, LLC treated the seeds with the formulations prior to providing them for our research. The seeds treated with base fungicide and insecticide (F&I) were used as control and all other experimental treatments contained base F&I plus the additional product. This test was planted at the Tennessee Valley Research and Extension Center near Belle Mina, Alabama. The field has been continuously cultivated with cotton for over 18 years and was infested with the reniform nematode in 2007. The soil type is Decatur silt loam (23% sand, 49% silt, and 18% clay). The trial was arranged in a RCBD with five replications. Plots consisted of 2 rows that were 7.6 meters long with 1-meter row spacing, and a 1.8 m alley between the plots. Planting occurred on 8 May. All plots were maintained throughout the season with standard herbicide, insecticide, and fertility production practices following recommendations by the Alabama Cooperative Extension System, and a lateral irrigation system was used for watering as needed. Plant stand data was collected 16 days after planting (DAP) by counting the seedlings in 7.6 m row of each plot. Other plant growth parameters including plant height, shoot fresh weight, root fresh weight, and nematode population density data were collected at 37 DAP from 4 randomly dug plants per plot. Nematode eggs were extracted by shaking the roots in a 6% NaOCl solution for 4 minutes and collecting the eggs on a 25-um sieve. The reniform nematode population density was measured as number of reniform nematode eggs per gram of root. Harvest occurred on 30 October at 175 DAP. Data were analyzed by ANOVA in SAS 9.4 (SAS Institute Inc.) and means were compared using Tukey-Kramer with $P \leq 0.10$. Monthly average maximum temperatures from planting in May through harvest in October were 30, 33, 33, 33, 32, and 25°C with average minimum temperatures of 18, 20, 21, 21, 21, and 13°C, respectively. Rainfall accumulation for each month was 8.6, 11.4, 5.6, 11.2, 7.8, and 6.2 cm respectively.

Average plant stands ranged from 38 to 46 plants per 7.6 m row and were similar in all treatments. The average plant height ranged from 14.5 cm to 17.6 cm which were not significantly different at $P \leq 0.1$, but BioST, BioST+ISR 2000, and BioST+ioFRESH treated plants were taller than the F&I control. The shoot and root fresh weights were significantly higher in BioST+ISR compared to BioST+TANNIN but were not significantly different from the control. Reniform nematode eggs per gram of root ranged from 488 to 1721 eggs/g of root. BioST+TANNIN has significantly higher reniform eggs per gram of root compared to BioST+ISR2000 and BioST alone. These two treatments, BioST+ISR 2000 and BioST had 49% and 43% lower reniform nematode population density than the base F&I treatment. The yields at 175 DAP were statistically similar in all, but, numerically BioST+ioFRESH, BioST+ISR 2000, BioST+SOILSET, and BioST increased the yields by 15%, 15%, 13%, and 12% respectively.

Treatment	16 DAP	37 DAP				175 DAP
	Plant stand[z]	Plant height[y] (cm)	Shoot fresh weight (g)	Root fresh weight (g)	*Rotylenchulus reniformis*[x] eggs/g root	Yield (kg/ha)
Fungicide & Insecticide[w]	40 A[v]	15.7 A	33.0 AB	3.7 AB	950 AB	2168 A
BioST	43 A	16.0 A	32.6 AB	3.5 AB	546 B	2432 A
BioST + SOILSET	43 A	15.2 A	28.2 AB	2.6 B	1563 AB	2447 A
BioST + ISR 2000	44 A	17.6 A	36.4 A	4.2 A	488 B	2493 A
BioST + TANNIN	46 A	14.5 A	21.3 B	2.5 B	1721 A	2058 A
BioST + ioFRESH	38 A	17.4 A	33.0 AB	3.2 AB	1013 AB	2499 A

[z] Plant stand was the average number of seedlings per 7.6 m row.
[y] Plant height was the average height of four random plants per plot measured in centimeters.
[x] *Rotylenchulus reniformis* eggs/g of root was the average number of reniform nematode eggs per gram of root from four plant root systems.
[w]Fungicide & insecticide treatment included treatment with Vibrance and Cruiser. All other treatments included the fungicide and insecticide plus additional product (s).
[v] Values present are the LS-means separated by Tukey-Kramer method at $P \leq 0.1$. Values in the same column followed by the same letter do not differ significantly.

Evaluation of Cotton Nematicide Combinations for Reniform Nematode Management in Limestone County, Alabama, 2018

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

Gaucho, Copeo Prime, Aeris Seed Applied System, Velum Total and BioST Nematicide 100 were evaluated for reniform nematode management on cotton at the Tennessee Valley Research Center in Belle Mina, AL. The field was infested with the reniform nematode in 2007 and has been continuously cultivated in cotton. The soil is a Decatur silt loam soil consisting of 24% sand, 28% clay, and 49% silt. Seed treatments were supplied by Bayer Crop Science. Seeds were sown in plots that consisted of 2 rows, 7.3 m long with 1.0 m row spacing on 8 May. Plots were arranged in a randomized complete block design with five replications. Plots were maintained through the season with standard herbicide, insecticide and fertility production practices as recommended by the Alabama Cooperative Extension System, and a lateral overhead irrigation system was used as needed. Plant height, biomass, vigor and nematode population density data were collected at 37 DAP. Nematode population density was measured by extracting eggs from 4 root systems randomly selected per plot using 6% NaOCl while roots were on a shaker for 4 minutes collected on a 25-um sieve, and recorded as total eggs per gram of root. Plots were harvested on 10 Oct. Data was analyzed in SAS 9.4 (SAS Institute Inc.) using Glimmix procedure with $P \leq 0.1$. Monthly maximum temperatures from planting in May through October were 86.2, 90.8, 91.0, 90.8, 89.3, and 77.2 °F with average minimum temperatures 75.3, 79.8, 80.8, 80.0 , 79.4, and 66.1 °F, respectively. Rain fall accumulation for each month was 3.40, 4.47, 2.20, 4.42, 3.09, and 2.44 in. with a total of 20.02 in. over the growing season.

Plant height was increased ($P \leq 0.1$) by Aeris Seed Applied System (No. 3) compared to Gaucho (No. 1). Biomass was increased ($P \leq 0.1$) by Aeris Seed Applied System (No. 3) compared to Gaucho (No. 1).Vigor was decreased ($P \leq 0.1$) by Aeris Seed Applied Systems (No. 3) and Gaucho + BioST Nematicide 100 (No. 6) compared to Gaucho (No. 1). Reniform nematode eggs per gram of root were decreased ($P \leq 0.1$) by Aeris Seed Applied Systems + Copeo Prime (No. 4) compared to Gaucho (No. 1). The highest seed yield, numerically, was observed in Aeris Seed Applied Systems (No. 3) with Aeris Seed Applied Systems + Copeo Prime (No. 4) having the second highest yield and Gaucho (No. 1) had the lowest yield.

No	Treatment[z]	37 DAP				Seed Yield[v]
		Plant Height[y]	Biomass[x]	Vigor	RR eggs/g root[w]	
1	Gaucho 0.375 mg ai/seed	14.2 b[u]	27.3 b	3.0 ab	1748 a	1971
2	Gaucho 0.375 mg ai/seed Copeo Prime 0.2 mg ai/seed	14.3 b	33.4 ab	2.3 abc	1335 ab	2274
3	Aeris Seed Applied System 0.75 mg ai/seed	19.7 a	66.3 a	1.0 c	214 ab	2686
4	Aeris Seed Applied System 0.75 mg ai/seed Copeo Prime 0.2 mg ai/seed	18.0 ab	51.6 ab	1.5 bc	111 b	2611
5	Gaucho 0.375 mg ai/seed Velum Total 450 g ai/ha	17.6 ab	45.2 ab	2.0 abc	486 ab	2422
6	Gaucho 0.375 mg ai/seed BioST Nematicide 100 521 mL/100kg	18.5 ab	54.7 ab	1.3 c	960 ab	2566

[z]In all treatments seeds were treated with calcium carbonate 500 g/100kg, suspending agent 25 g/100kg, color coat white 130.4 mL/100kg, Spera 120.6 ml/100 kg, Pro-Ized blue colorant 62.5 m:/100kg, Secure Plus Seed Gloss 661 652mL/100kg Evergol Prime 5g ai/100 kg, Allegiance FL 28.9 mL/100kg, and Proline 480 SC 5 g ai/100kg

[y]Plant height was measured in centimeters

[x]Biomass is the shoot fresh weight plus the root fresh weight in grams.

[w]RR eggs/g root means number of reniform nematode eggs per gram of root from 4 root systems.

[v]Yield was measured in kg/ha

[u]Means followed by same letter do not significantly differ according to Tukey's method ($P \leq 0.10$).

Evaluation of Cotton Nematicide Combinations for Reniform Nematode Management in Northern Alabama, 2018

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

Gaucho, Copeo Prime, Aeris Seed Applied System, Velum Total and BioST Nematicide 100 were evaluated for reniform nematode management on cotton at the Tennessee Valley Research Center, in Belle Mina, AL. The field was infested with the reniform nematode in 2007 and has been a cotton monoculture since then. The soil is a Decatur silt loam consisting of 24% sand, 28% clay, and 49% silt. Seed treatments were applied by Bayer Crop Science. Seeds were sown in plots that consisted of 2 rows, 7.3 m long with 1.0 m row spacing on 8 May. Plots were arranged in a random complete block design with five replications. Plots were maintained through the season with standard herbicide, insecticide and fertility production practices as recommended by the Alabama Cooperative Extension System, and a lateral overhead irrigation system was used as needed. Plant height, biomass, vigor and nematode population density data were collected at 37 DAP. Nematode population density was measured by extracting eggs from 4 root systems using 6% NaOCl while roots were on a shaker for 4 minutes and the eggs were collected on a 25-um sieve, and recorded as total eggs per gram of root. Plots were harvested on 30 Oct. Data were analyzed in SAS 9.4 (SAS Institute Inc.) by using Glimmix procedure with $P \leq 0.1$. Monthly maximum temperatures from planting in May through October were 86.2, 90.8, 91.0, 90.8, 89.3, and 77.2 °F with average minimum temperatures 75.3, 79.8, 80.8, 80.0 , 79.4, and 66.1 °F, respectively. Rain fall accumulation for each month was 3.40, 4.47, 2.20, 4.42, 3.09, and 2.44 in. with a total of 20.02 in. over the growing season.

There were no statistically significant differences between the treatments. The stand counts, taken 16 days after planting, were numerically highest in Gaucho + COPeO Prime (No. 2) and lowest in Guacho + Velum Total (No. 5). The three highest plant heights, numerically, were in Aeris Seed Applied Systems (No. 3), Gaucho + BioST Nematicide 100 (No. 6), and Aeris Seed Applied Systems + COPeO Prime (No. 4). The highest biomass, numerically, was observed in Aeris Seed Applied Systems (No. 3) while the lowest, numerically, was observed in Gaucho + COPeO Prime (No. 2). The highest number of eggs per gram of root, numerically, was observed in Gaucho (No. 1), while the smallest number of eggs per gram of root was observed in Aeris Seed Applied System + COPeO Prime (No. 4) and Gaucho + BioST Nematicide 100 (No. 6). The highest seed yield, numerically, was observed in Aeris Seed Applied Systems + COPeO Prime (No. 4) with Gaucho + BioST Nematicide 100 (No. 6) having the second numerically highest yield and Gaucho + COPeO Prime (No. 2) had the numerically lowest yield.

No.	Treatment[z]	37 DAP			175 DAP	
		Count	Plant Height[y]	Biomass[x]	RR eggs/g root[w]	Seed Yield[v]
1	Gaucho 0.375 mg ai/seed	34.5	17.0	33.2	1596	2130
2	Gaucho 0.375 mg ai/seed COPeO Prime 0.2 mg ai/seed	38.5	15.4	28.9	849	1799
3	Aeris Seed Applied System 0.75 mg ai/seed	33.0	19.7	46.4	649	2206
4	Aeris Seed Applied System 0.75 mg ai/seed COPeO Prime 0.2 mg ai/seed	35.0	18.4	44.4	201	2611
5	Gaucho 0.375 mg ai/seed Velum Total 450 g ai/ha	31.8	16.4	24.5	780	2422
6	Gaucho 0.375 mg ai/seed BioST Nematicide 100 521 mL/100kg	35.5	18.7	40.3	381	2566

[z]In all treatments seeds were treated with calcium carbonate 500 g/100kg, suspending agent 25 g/100kg, color coat white 130.4 mL/100kg, Spera 120.6 ml/100 kg, Pro-Ized blue colorant 62.5 m:/100kg, Secure Plus Seed Gloss 661 652mL/100kg Evergol Prime 5g ai/100 kg, Allegiance FL 28.9 mL/100kg, and Proline 480 SC 5 g ai/100kg
[y]Plant height was measured in centimeters
[x]Biomass is the shoot fresh weight plus the root fresh weight in grams.
[w]RR eggs/g root means reniform nematode eggs per gram of root from 4 root systems.
[v]Yield was measured in kg/ha
[u]Means followed by same letter do not significantly differ according to Tukey's method ($P \leq 0.10$).

VII.Extras

2019 Alabama Cotton Commission Annual Report

W. Birdsong

49	Subsurface Drip Initiative	Birdsong,Dillard, Balkcom	6,000
50	Cotton Row Pattern and Seeding Rate/Placement Study	Birdsong, Dillard, Wells	5,000
51	South Alabama Cover Crops	Birdsong, Dillard, Gamble	4,000

2018 was a most difficult season for the Wiregrass and for the projects such as # 49, #50. The projects were located at the Wiregrass station and on October 10th, these projects sustained extensive hurricane damage rendering the data unusable and unreliable. As I have been taught by my mentor, Dallas Hartzog, there is only one thing worse than no data and that is reporting bad data. For these reasons, I do not have information on these projects for 2018. However, these projects are ongoing and they will be conducted in 2019. As a commitment to the Cotton Commission, I will report on these projects for 2019 results.

The South Alabama Cover Crops grant will be utilized to conduct a cover crop meeting this spring and funds will be utilized for a 2019 fall planting of additional cover crop work. Cover crops have been especially hard to get planted and established this past fall with a hurricane, and over 20 inches of rainfall recorded at the Wiregrass station since October 1st. However, I do believe that keeping the benefits of cover crops warrants a cover crop tour in late March or early April of 2019 in the Wiregrass. A date will be set soon and the Alabama Cotton Commission will be the lead sponsor.

Alabama Row Crops Short Course

T. Sandlin, B. Ortiz, A. V. Gamble, S. Li, D. P. Delaney, and k. Balkcom

Results:

The 2018 Alabama Row Crops Short Course at Auburn University was of great success and value. Approximately 240 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. Gary Adams-President of the National Cotton Council and Dr. Tyson Raper-2018 Cotton Specialist of the Year-University of Tennessee. 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

Justification and Procedures:

Thoughts on cotton variety selection can begin soon after harvest is complete. Timely data delivery of local variety results is critical to help aid these decisions. Prior to 2018, all seed cotton samples from on-farm, ovt, and replicated small plot tests are ginned at Auburn University on a table top gin. This is extremely time consuming and turnouts and grades are often not reflective of commercial gins.

Results:

All seed cotton samples from the 2018 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 early January 2019. Results were compiled and reported in our Cotton Agronomy On-Farm Variety Trial Results and disseminated in early January.