Cotton

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THE 2013 CROP YEAR IN REVIEW

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The 2013 production season was quite different from that of any recent season in Georgia. Cotton acreage planted increased 6.2 percent from 2012 with 1.37 million acres planted and 1.34 million acres harvested according to USDA-NASS. Georgia remains the second largest cotton producing state in the country with Texas as the first.

The predominant defining factor describing the 2013 season was the abnormally excessive season-long rainfall that we experienced. Wet and cool weather in early spring delayed planting slightly later than normal, pushing much of the initial planting into late May, when a short-lived slightly drier spell occurred. Rains quickly returned and significantly delayed planting of the later crop, especially cotton planted behind wheat. Cotton in many areas struggled to get a good start. Substantial water logging occurred in many fields, which significantly delayed or prevented timely application of side-dressing fertilizers and/or layby herbicides. Cotton in many of these fields remained short with a suboptimal boll load season-long, and many fields had significant portions that drowned. Other fields, if well-drained, were able to recover and develop high yield potential, although much of the crop was later maturing than normal. This recovery could likely be attributed to the warmer, sunnier, and drier weather that occurred during August and September, which allowed for accelerated boll development and reduced losses due to boll rot and hardlock.

Harvest weather throughout the fall, although cooler than normal, was fairly cooperative, reducing additional losses and allowing for timely harvest. Some areas experienced a mild frost around October 25, which is slightly earlier than normal; however, most areas did not receive a significant frost until November 10-12, which is the typical approximate average first frost date for many areas in South Georgia.

The most common challenges for growers in 2013 included nematodes, which expanded into several more fields than normal, emphasizing the need for cultivar tolerance to nematodes or other effective treatment options. The loss of aldicarb and the wet weather during 2013 are largely to blame for the increased incidence of nematodes. Target spot was also a concern in many fields, as it was in 2012. Glyphosate-resistant pigweed remains a significant challenge, especially in fields where excessive moisture prevented or delayed layby applications. Despite these and other challenges, many parts of Georgia were blessed with better than expected yields, resulting in a projected statewide average yield of 831 lbs/acre.

Georgia is expected to produce 2.32 million bales for 2013, sustaining our commitment to cotton. Although yields were variable depending upon drainage and the effects of excessive rains, average statewide yields continue to remain above 800 lbs/acre, despite the loss of DP 555 BR, which is a true testament to Georgia's growers, their commitment to cotton, and the release of superior varieties. As new(er) varieties are being released onto the market in a much more rapid manner (due to increased competition and advancements by industry), variety selection remains a very important issue. Many of the new varieties performed very well for Georgia growers in 2013. The 2013 cotton acreage in Georgia was predominately comprised of Deltapine varieties (61.28 percent), Phytogen varieties (27.31 percent), FiberMax varieties (4.56 percent), and Stoneville varieties (4.41 percent) (www.ams.usda.gov/AMSv1.0/).

The quality of the 2013 crop was comparable to previous years for some parameters (Table 1). Of 2.244 million bales classed as of January 23, 2014, 1 percent was short staple (<34) and 22.3 percent were high mic (>4.9). Average staple was similar to that of the previous two years, although the incidence of short staple was very low.

Average micronaire was slightly higher than in 2012, but the incidence of high mic was noticeably higher in 2013 than in many preceding years. High micronaire is usually attributed to drought stress, when only lower fully mature bolls are retained or in environments with very high yield potential where the upper bolls reach full maturity. Drought stress was not significant in any part of the state in 2013. Therefore, some incidences of high micronaire may have been due to either high yields or water logging that caused stress to plants and limited growth, similar to what may be typically expected from drought stress.

Fiber length uniformity remained high in 2013, a likely result of the constant changing in varieties planted. Most noticeably, bark was lower in 2013 compared to 2012, but was slightly higher than in years preceding 2011.

Table 1. Fiber Quality of Bales Classed at the Macon USDA Classing Office, 2008-2013

	Color Grade 31/41 or better (% of crop)	Bark/ Grass/ Prep (% of crop)	Average Staple (32nds)	Average Strength (g/tex)	Average Mic	Average Uniformity
2008	25 / 93	all < 1.0	34	28.7	4.6	80.2
2009	26 / 96	all < 1.0	35	28.8	4.5	80.3
2010	50 / 90	all < 1.0	35	29.9	4.8	81
2011	38 / 84	2.6 / <1 / 1	36	29.6	4.6	81.7
2012	48 / 91	11.9 / <1 / <1	36	29	4.6	81.7
2013	49 / 89	5.3 / <1 / <1	36	29.6	4.7	81.8

Bales classed short staple (< 34)
2008: 20%, 2009: 22%, 2010: 4%, 2011: 2.8%, 2012: 1.4%, 2013: 1%

Bales classed high micronaire (> 4.9)
2008: 21%, 2009: 20%, 2010: 9%, 2011: 8.8%, 2012: 15.4%, 2013: 22.3%

Fiber quality data as of January 23, 2014. SOURCE: http://www.ams.usda.gov/AMSv1.0/

Acknowledgement

The UGA Cotton Team would like to express their gratitude to the Georgia Cotton Commission for their continued support of our research and extension programs.

ECONOMIC ANALYSIS OF HEAVY RYE COVER CROP TO CONTROL GLYPHOSATE-RESISTANT PALMER AMARANTH IN COTTON

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Abstract

Glyphosate-resistant Palmer amaranth has caused many growers to abandon conservation tillage and revert back to tillage and cultivation along with herbicides. The objective of this study was to determine the agronomic feasibility and resulting profitability of utilizing a very heavy cover crop (heavy biomass) to control glyphosate resistant Palmer amaranth in a conservation tillage system planting a Roundup-Ready Flex® variety. This research was conducted at seven locations over a two-year period (2012 and 2013). Three heavy rye cover crop systems were compared to strip-till production with no cover crop. There was no difference in cotton yield between having no cover crop and the three rye cover crop treatments. The highest net return was achieved when not having a cover crop. This was due to much higher costs with the cover crop systems. The heavy rye cover did provide savings in herbicide expense, but these savings were more than offset by other costs. Future research could address methods to reduce the costs associated with cover crop systems such as various cotton herbicide programs, varying seeding rates on the cover crop, and various types of cover crop. Future research could also include any cotton fiber quality differences between no cover crop and having a cover crop.

Introduction

Effective weed management is one of many critical components of profitable cotton production. However, herbicide resistance, if present, represents a significant threat to successful weed control and profitability. Approximately 92 percent of Georgia cotton acreage is planted to Roundup-Ready varieties (Shurley). Since 2004, Palmer amaranth resistant to glyphosate has spread and now been confirmed in nearly every agronomic (row crop producing) county in the state. Glyphosate-resistant Palmer amaranth is the dominant issue in Georgia cotton production and row crop production in general.

University of Georgia Extension has developed herbicide programs for both Roundup-Ready® and LibertyLink® varieties in both conventional and conservation tillage systems (Culpepper). These programs (recommendations) are diverse in mode of action; they reduce the reliance on a single mode of action (glyphosate), and also integrate other cultural practices such as hand-weeding, tillage, cover crops, crop rotation, etc. Herbicide programs are improving and becoming more effective. Georgia cotton growers are becoming more successful at controlling the growth and spread of glyphosate-resistant Palmer amaranth.

One of the greatest challenges for cotton production when glyphosate resistance is present is making sure no Palmer amaranth is emerged at planting time. Beyond that, early season control is also critical. Glyphosate-resistant Palmer amaranth has caused many growers to abandon conservation tillage and revert back to tillage and cultivation along with herbicides.

Objectives and Methodology

The objective of this study was to determine the agronomic feasibility and resulting profitability of utilizing a very heavy cover crop (heavy biomass) to control glyphosate-resistant Palmer amaranth in a conservation tillage system planting a Roundup-Ready Flex® variety. A heavy cover crop reduces exposure to sunlight—both reducing amaranth germination and interfering with emergence and growth.

This research was conducted at seven locations over a two-year period (2012 and 2013). The research consisted of large on-farm plots—four treatments with each treatment replicated four times. The treatments were four cotton production systems defined as follows:

Solid seeded rye: Rye cover crop (planted with drill) with cotton planted into solid rye. All cotton herbicides were broadcast except for layby, which was directed.

Rye-free zone: Rye cover crop (planted with drill) but 12-inch strips left out where cotton was planted. All cotton herbicides were applied as with solid seeded rye.

Rye-free zone banded: Same as rye-free zone except cotton PPI herbicides were applied in an 8-inch band and PRE herbicides applied in a 12-inch band.

No cover crop: No rye cover crop. Strip-till cotton was planted into previous crop residue and fallow. All cotton herbicides were broadcast except for directed spray at layby.

These four treatments (production systems) were the same at all locations for both years. There were four locations in 2012 and three locations in 2013. The locations for 2012 were Macon County, Worth County, Colquitt County, and Berrien County. The 2013 locations were Macon County, the University of Georgia Ponder Farm (Tift County), and the Sunbelt Agricultural Exposition Farm (Colquitt County).

The following details the herbicides applied in each of the four treatments (Table 1). The programs were very similar except for the PPI application in the FZ banded treatment and the addition of 2,4-D in the no cover crop treatment. Otherwise, the materials used were the same in each treatment, but there were some slight differences in the rate (amount per acre) applied.

Table 1. Herbicides Applied in Each of Four Treatments, Four Locations 2012, Three Locations in 2013.

	Solid Rye	Rye w/ 12" FZ	FZ Banded[1]	No Cover
Burndown	Gramoxone + Valor	Gramoxone + Valor	Gramoxone + Valor	Gramoxone + Valor + 2,4-D
PPI			Prowl + Reflex	
PRE	Direx + Reflex + Gramoxone	Direx + Reflex + Gramoxone	Direx + Reflex	Direx + Reflex + Gramoxone
POST 1	Warrant + RUWM[2]	Warrant + RUWM[2]	Warrant + RUWM[2]	Warrant + RUWM[2]
POST 2	Dual + RUWM[2]	Dual + RUWM[2]	Dual + RUWM[2]	Dual + RUWM[2]
Layby Directed	Direx + MSMA	Direx + MSMA	Direx + MSMA	Direx + MSMA

1/ PPI applied in a 12-inch band, PRE applied in an 8-inch band
2/ Roundup Weather Max

Rye was planted at a rate of 90 pounds of seed per acre (for solid rye cover). The rye cover crop received 20 lbs/acre of nitrogen. Cotton following rye also received an additional 20 lbs/acre of nitrogen. Other than herbicides and associated application cost and nitrogen as prescribed, all other inputs and production practices were the same for each treatment.

The rye was allowed to grow very tall (7 to 8 feet in height). The rye was then sprayed (burndown) and "rolled"—using a roller pulled behind the tractor to lay/press the rye down to the ground. Planting was then done in the same direction as the rye was rolled.

Seedcotton yield per acre was determined by weighing the production from each replication of each treatment. Seedcotton was not ginned, so lint yield was estimated at 40 percent of seedcotton yield (a 40 percent gin turn-out). Lint was valued at the November 2012 and November 2013 average cash price for base grade (Color 41, Leaf 4, Staple 34) cotton for the 2012 and 2013 treatments respectively (USDA-AMS). Any fiber quality differences were not included in the analysis.

Results

Cotton Yields

In 2012, the study was conducted at four locations. At two of the four locations (Macon County and Berrien County), the cotton yield for all three cover crop treatments was higher and statistically significantly different than the no cover crop treatment (Figure 1). At the other two locations (Worth County and Colquitt County), yield was not significantly different among any of the treatments.

At all four locations in 2012, the rye cover crop treatments were equal to or higher than the no cover crop treatment. Although not statistically different, the solid rye treatment gave the highest yield at three locations and the no cover crop treatment had the highest yield at one location.

In 2013, the study was conducted at three locations (Figure 2). At Macon County, cotton yield for the solid rye cover crop treatment was lower and statistically different than the other three treatments. At both other locations, there was no statistical difference in yield among treatments. The no cover crop treatments had the highest yield at each location, but this difference was not statistically significant. Among the three cover crop treatments, the rye planted with the rye-free zone resulted in the highest cotton yield, but this difference in yield was not statistically significant.

Averaged over all seven locations over the two years, cotton yields were not statistically different across the four treatments (Figure 3). Numerically, the highest cotton yield was achieved with the rye-free zone (1,133 lbs/acre) and the lowest yield achieved with the rye-free zone banded (1,097 lbs/acre). But statistically, there was no difference in yield among the four treatments—the three cover crop treatments yielded just as well as no cover crop, and the three cover crop treatments yielded the same.

Herbicide Costs

Herbicide costs ranged from $60.22 per acre for the rye-free zone banded treatment to $79.75 per acre for the no cover crop treatment (Table 2). There was little difference in herbicide cost between the solid rye treatment and rye-free zone treatment. The free zone treatment with PPI and PRE herbicides banded, was approximately $12 per acre cheaper than the other two cover crop treatments. In the cost of herbicides, the three cover crop treatments ranged from roughly $7 to $19 per acre cheaper than having no cover crop.

Table 2. Average Herbicide Costs[1] per Acre for Each Treatment, 2012-2013

	Solid Rye	Rye w/ 12" FZ	FZ Banded	No Cover
Burndown	$11.43	$11.43	$10.05	$18.14
PPI			$3.57	
PRE	$17.48	$16.30	$2.73	$17.74
POST 1	$15.75	$15.75	$15.75	$15.75
POST 2	$16.37	$16.37	$16.37	$16.37
Layby Directed	$11.75	$11.75	$11.75	$11.75
Total Cost	**$72.78**	**$71.60**	**$60.22**	**$79.75**

1/ Includes crop oil in addition to herbicides shown in Table 1. Excludes costs of application.

Other Costs and Net Returns

In addition to the cost of herbicides, other costs that varied among the four treatments were seed cost for the rye cover crop, nitrogen on the cover crop and extra nitrogen on cotton following the cover crop, and the costs of application. Machinery and equipment costs were estimated and derived from UGA Extension estimates (Shurley and Smith). Application costs included the variable costs (fuel, repairs, and labor) of planting the rye cover crop, nitrogen application on rye, rolling the rye, and herbicide application unless herbicide was applied in tandem with another operation (like rolling or planting) already budgeted. Application cost also included the annual fixed costs (depreciation, interest, and insurance) on the roller since this is an additional investment required for the heavy rye cover crop system. All other machinery and equipment for both rye and cotton was assumed already owned and available, so annual fixed costs need not be considered.

Costs considered were only those that varied or would change as the result of having a cover versus not having a cover crop and that would change based on the three cover crop systems utilized. All other inputs and production practices were the same regardless of cover crop or no cover crop. Thus, those costs are irrelevant and need not be considered. Therefore, the Net Return is the net or residual above these variable treatment-related costs only.

Table 3. Average Per Acre Net Return for Each Treatment, 2012-2013

	Solid Rye	Rye w/ 12" FZ	FZ Banded	No Cover
Cotton Yield (lbs/acre)	1,103	1,133	1,097	1,101
Price ($/lb)	$0.721	$0.721	$0.721	$0.721
Income	**$795.06**	**$816.68**	**$790.73**	**$793.62**
Variable Costs				
-Rye Cover Crop (Seed)	$40.50	$27.00	$27.00	
-Additional Nitrogen	$26.51	$26.51	$26.51	
-Herbicides	$72.78	$71.60	$60.22	$79.75
-Application[1]	$38.92	$38.92	$43.47	$17.02
Total Variable Cost	**$178.71**	**$164.03**	**$157.20**	**$96.77**
Net Return	**$616.34**	**$652.65**	**$633.53**	**$696.85**

1/ Includes the variable costs (fuel, repairs, and labor) of planting the rye cover crop, nitrogen application on rye, rolling the rye, and herbicide applications. Also includes the annual fixed costs (depreciation, interest, and insurance) on the roller.

Total variable costs were lowest when having no cover crop (Table 3). Costs were highest for the solid rye cover crop. The rye-free zone (with herbicides broadcast) and rye-free zone with PPI and PRE banded, saved approximately $14 to $21 per acre compared to the solid rye cover crop system. Variable costs ranged from $96.77 per acre (no cover crop) to $178.71 per acre (solid rye cover crop). Compared to having no cover crop, the three cover crop treatments averaged approximately $70 per acre higher cost. Compared to having no cover crop, the least expensive of the three cover crop treatments was the rye-free zone with PPI and PRE banded—approximately $60 per acre higher than the no cover crop treatment.

Cotton yield was not statistically different among the four treatments although numerically, the rye-free zone treatment (with herbicides broadcast) had the highest yield. Fiber quality was not considered in this study, so the average price for cotton was the same for each treatment.

Net return was highest ($696.85 per acre) for cotton produced with no cover crop. This was due primarily to the difference in (lower) costs. Likewise, the lowest net return resulted from cotton produced with the solid (no rye-free zone) cover. Compared to having no cover crop, net return averaged approximately $63 per acre less for the three cover crop treatments. The rye-free zone with broadcast herbicides offered the highest net return among the three cover crop treatments—approximately $44 per acre less than having no cover crop.

Summary and Conclusions

Three heavy rye cover crop systems were compared to strip-till production with no cover crop. A heavy rye cover crop suppresses emergence and growth of weeds like Palmer amaranth. One objective of this research was to determine if a heavy rye cover crop could be a successful management practice for helping control glyphosate-resistant Palmer amaranth in conservation tillage.

Statistically, there was no difference in cotton yield between having no cover crop and the three rye cover crop treatments. The implication of this is that producing cotton behind a heavy rye cover crop can achieve yield consistent with having no cover crop—there was no yield loss due to having the heavy cover.

The highest net return was achieved when not having a cover crop. This was due to much higher costs with the cover crop systems. The three heavy rye cover crop treatments were less expensive in herbicide cost compared to strip-till production without a cover crop. The heavy rye cover did provide savings in herbicide expense, but these savings were more than offset by other costs such as application, cost of the cover crop, and additional nitrogen.

Assuming, on average, no difference in yield, the net return of a cover crop system compared to no cover crop will depend on cost. The herbicide programs for the three heavy rye cover crop treatments in this study and associated cost were very similar to strip-till cotton production with no cover crop. Even with the heavy cover crop and large amount of biomass to suppress emergence and growth of glyphosate-resistant Palmer amaranth, the use of herbicides and amounts applied were similar.

Future research could address methods to reduce the costs associated with cover crop systems such as various cotton herbicide programs, varying seeding rates on the cover crop, and various types of cover crop. Future research could also include any cotton fiber quality differences between no cover crop and having a cover crop.

Variable costs were approximately $70 per acre higher for the three rye cover crop treatments compared to having no cover crop. The least difference in cost was approximately $60 per acre. Compared to having no cover crop, net return averaged approximately $63 per acre less for the three cover crop treatments.

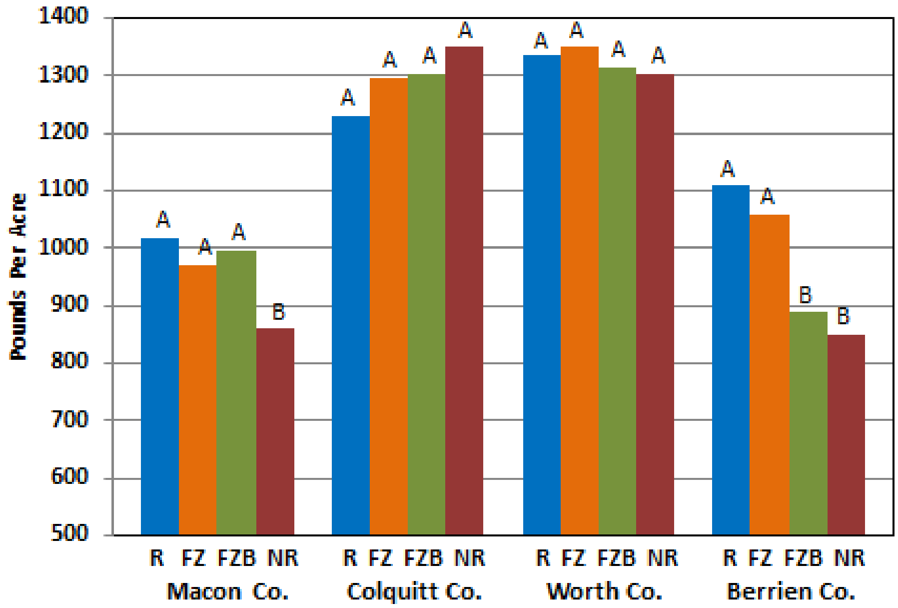

Figure 1. Cotton Yield For Each Treatment, by Location, 2012

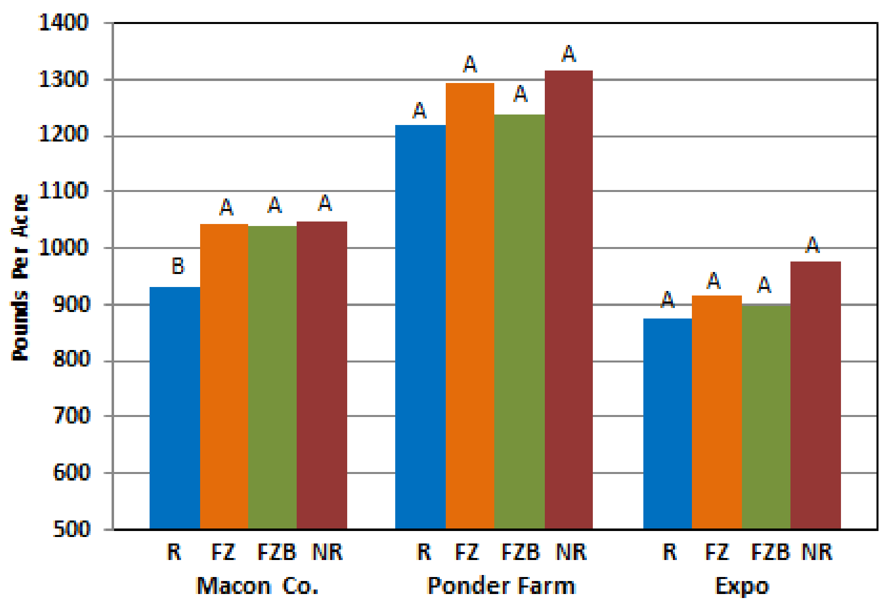

Figure 2. Cotton Yield For Each Treatment, by Location, 2013

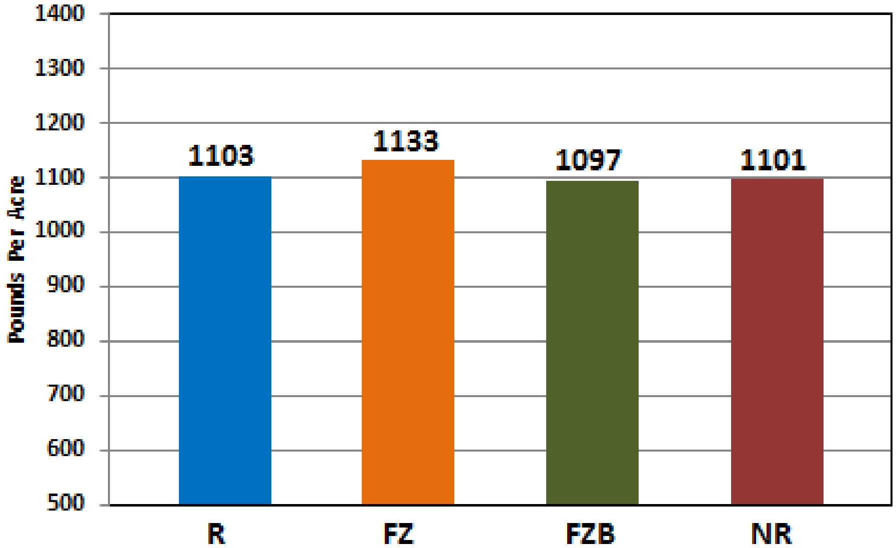

Figure 3. Average Cotton Yield By Treatment, 2012-2013

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ECONOMICS OF COVER CROP AND SUPPLEMENTAL FERTILIZER IN STRIP-TILLAGE COTTON

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Abstract

Cover crop selection plays an important role in strip-tillage cotton production in Georgia. Some benefits of growing a cover crop in row crop systems include reduced soil erosion and the possibility for reduced fertilizer inputs. An economic analysis was conducted using a partial budget approach to determine how cover crops and supplemental nitrogen application impact profitability. Field research was conducted in Tifton, GA, in 2012 where cotton was grown under strip-tillage management following a crimson clover, vetch, rye, or wheat cover crop, or with no cover control, and fertilizer applications of zero, 30, 60, or 90 pounds of nitrogen per acre on cotton. There were a total of 80 plots (five cover crop treatments × four fertilizer treatments × four replications) in a randomized complete block design. Yield data were collected to determine gross revenue. Revenue was based on the Southeast average base price for November 2012. Gross revenue was highest when cotton followed the leguminous cover crops crimson clover and vetch. Gross revenue was also higher at 60 and 90 pounds of nitrogen per acre. Systems costs were calculated for cover crop and nitrogen fertilizer. Adjusted revenue, defined as revenue adjusted for yield, cover crop cost, and nitrogen fertilizer cost was calculated to determine the most profitable combination of cover crop and nitrogen fertilizer. Results indicate that plots following hairy vetch appeared to be the most profitable. Cotton following hairy vetch had higher average adjusted revenues ($80 per acre higher) when averaged across all supplemental nitrogen rates. Additionally, supplemental nitrogen appeared to boost profitability of strip-tillage cotton compared to zero supplemental nitrogen when averaged across all cover crops. Average adjusted revenues were $53 per acre higher at 30 lbs/acre of nitrogen, $69 per acre higher at 60 lbs/acre of nitrogen, and $103 per acre higher at 90 lbs/acre of nitrogen than the adjusted revenue for zero nitrogen. Results by cover and fertilizer treatment indicate that cotton following rye, wheat and no cover appeared more profitable with supplemental nitrogen fertilizer. Adjusted revenue from using a traditional wheat or rye cover crop and higher amounts (60 or 90 pounds) of nitrogen on cotton was similar but slightly lower than the hairy vetch cover crop. Having no cover crop resulted in the lowest adjusted revenue of any of the systems in the study. Reduced soil and wind erosion and improved soil quality are considered benefits of a cover crop but were not considered in this study.

Introduction and Objective

Cover crop selection plays an important role in strip-tillage cotton production in Georgia. Some benefits of growing a cover crop in row crop systems include reduced soil erosion and the possibility for reduced fertilizer inputs. These cover crop benefits come at a cost to growers via the seed, its planting, and consequent burn down prior to planting the cotton. The question is whether these costs are outweighed by the benefits. Supplemental fertilizer application can increase cotton yield, but that supplemental fertilizer application is only economically rational when the value of the yield is greater than the cost of the supplemental fertilizer and its application. The objective of this research was to determine how cover crops and supplemental nitrogen application on cotton impact profitability.

Data and Methods

Field research was conducted in Tifton, GA, in 2012 where cotton was grown under strip-tillage management following a crimson clover, vetch, rye, or wheat cover crop, or no cover crop (the control treatment), and supplemental applications of zero, 30, 60 or 90 pounds of nitrogen per acre on cotton. The cover crops were planted at recommended seeding rates as follows: crimson clover at 18 lbs/acre, hairy vetch at 20 lbs/acre, rye at 90 lbs/acre, and wheat at 90 lbs/acre. There were a total of 80 plots (five cover crop treatments × four fertilizer treatments × four replications) in a randomized complete block design.

An economic analysis was conducted using a partial budget approach. Yield data were collected to determine gross revenue. Revenue was based on the Southeast average price for base quality cotton (Color 41, Leaf 4, Staple 34) for November 2012 (USDA-AMS). Fiber quality differences were not considered in this study. Costs were calculated for cover crop and fertilizer expenses. Adjusted revenue, defined as gross revenue minus cover crop and fertilizer costs, was calculated for each treatment to determine the most profitable combination of cover crop and supplemental nitrogen fertilizer.

Results

Gross revenue was calculated by multiplying yield per acre by the November 2012 Southeast average base price of cotton ($0.6942 per pound). Yields for the plots planted to hairy vetch and crimson clover cover crops were higher than those planted to rye and wheat as well as the no cover control (Table 1). As a result, gross revenue was highest when cotton followed the leguminous cover crops: crimson clover and vetch.

Table 1. Average Yield and Gross Revenue by Cover Crop

Cover Crop	Yield (lbs/acre)	Gross Revenue ($/acre)
Crimson Clover	1,450	$1,007
Hairy Vetch	1,566	$1,087
Rye	1,396	$ 969
Wheat	1,414	$ 982
No Cover	1,294	$ 898

A similar result occurred in the plots receiving supplemental nitrogen (Table 2). Yields were higher for plots that received supplemental nitrogen than the plots that received zero nitrogen. As a result, gross revenues were higher for the plots that received supplemental nitrogen.

Table 2. Average Yield and Gross Revenue by Supplemental Fertilizer

Supplemental Nitrogen Rate (lbs N/acre)	Yield (lbs/acre)	Gross Revenue ($/acre)
Zero	1,285	$ 892
30	1,406	$ 976
60	1,469	$1,020
90	1,536	$1,066

Yield and gross revenue also varied as a result of the interaction of cover crop and level of fertilizer applied on cotton (Table 3). Cotton planted after leguminous cover crops (hairy vetch and crimson clover), showed relatively high yield and gross revenue across all levels of nitrogen. With a crimson clover cover crop, the highest cotton yield was achieved with 90 lbs/acre of nitrogen but yield was only 112 lbs/acre more than with no nitrogen. With the hairy vetch cover crop, cotton yield was highest with 30 lbs/acre of nitrogen, but yield was less than 100 lbs/acre higher than with no nitrogen.

Cotton planted after non-leguminous cover crops (rye and wheat) generally showed higher yields and gross revenues as the amount of nitrogen increased. With a rye cover crop, the highest cotton yield and gross revenue was achieved with 60 lbs/acre of nitrogen. With a wheat cover crop, highest cotton yield and gross revenue was achieved with 90 lbs/acre of nitrogen.

Cotton planted with no cover crop achieved the highest yield with 90 lbs/acre of nitrogen. Cotton with no nitrogen applied and planted after crimson clover or hairy vetch resulted in the same yield as cotton with no cover crop and 90 lbs/acre of nitrogen. The highest yields and gross returns were achieved with hairy vetch and 30 lbs/acre of nitrogen (1,640 lbs/acre) and wheat and 90 lbs/acre of nitrogen (1,604 lbs/acre).

Table 3. Average Yield and Gross Revenue by Cover Crop and Supplemental Fertilizer

Supplemental Fertilizer / Cover Crop	Zero N		30 lbs N		60 lbs N		90 lbs N	
	Yield (lbs/acre)	Gross Revenue ($/acre)	Yield (lbs/acre)	Gross Revenue ($/acre)	Yield (lbs/acre)	Gross Revenue ($/acre)	Yield (lbs/acre)	Gross Revenue ($/acre)
Crimson Clover	1,438	$ 998	1,358	$ 943	1,454	$1,009	1,550	$1,076
Hairy Vetch	1,564	$1,086	1,640	$1,138	1,468	$1,019	1,590	$1,104
Rye	1,122	$ 779	1,318	$ 915	1,613	$1,120	1,531	$1,063
Wheat	1,122	$ 779	1,426	$ 990	1,506	$1,045	1,604	$1,113
No Cover	1,181	$ 820	1,287	$ 893	1,303	$ 905	1,405	$ 975

Table 3 presents yield and gross revenue for each cover crop and nitrogen combination; costs are not yet considered. Costs considered in the study were the costs associated with the cover crop and the cost of supplemental fertilizer (nitrogen). All other inputs and costs were the same for each treatment and thus need not be considered for comparison. Costs associated with the cover crop include seed, planting (fuel, labor, and repairs and maintenance of tractor and equipment), and the cost of herbicide and spraying for terminating the cover crop. Costs associated with nitrogen fertilizer include the cost of the fertilizer and the application of the fertilizer (fuel, labor, and repairs and maintenance of tractor and equipment). No fertilizer, herbicides, fungicides, or other inputs and costs were applied to the cover crops. Table 4 shows the estimated cost of each cover crop and nitrogen combination.

Table 4. Average Systems Costs per Acre by Cover Crop and Supplemental Fertilizer

Fertilizer / Cover Crop	Zero N	30 lbs N	60 lbs N	90 lbs N
Crimson Clover	$58.26	$88.50	$108.90	$129.30
Hairy Vetch	$68.06	$98.30	$118.70	$139.10
Rye	$65.37	$95.61	$116.01	$136.41
Wheat	$52.86	$83.10	$103.50	$123.90
No Cover	$ 8.47*	$38.71	$ 59.11	$ 79.51

* The No Cover, Zero N plots had a cost (herbicide and application) to terminate winter weeds.

Profitability of the cover crop and supplemental fertilizer systems was determined by calculating and comparing adjusted revenue. Adjusted revenue was calculated by subtracting the costs associated with the various cover crops and supplemental fertilizer systems (Table 4) from gross revenue (Table 3).

When averaged across all fertilizer levels (Figure 1), cotton planted after hairy vetch appeared to be the most profitable followed by crimson clover and wheat. Cotton planted after no cover crop and after rye gave the lowest adjusted revenue.

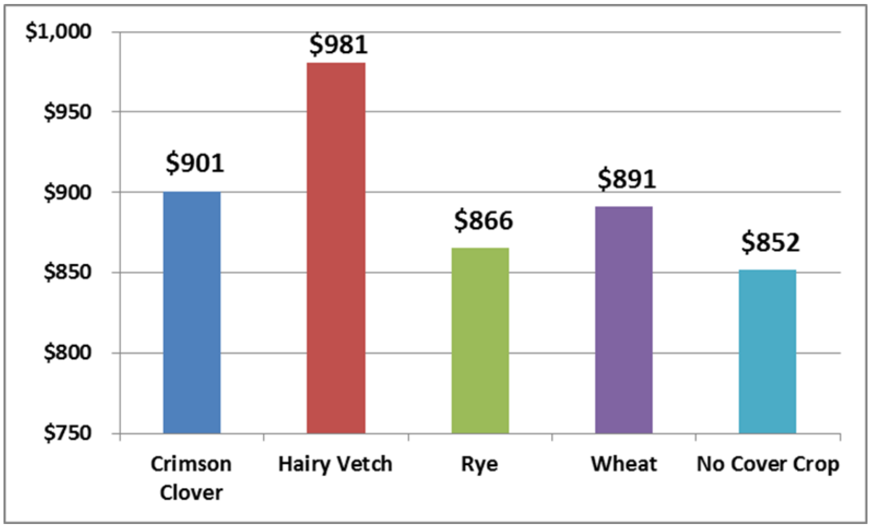

Figure 1. Average Adjusted Revenue by Cover Crop ($/acre)

When averaged across all cover crops (Figure 2), plots that received the most supplemental fertilizer (nitrogen) resulted in the highest average adjusted revenue. Adjusted revenue increased as the amount of nitrogen increased. Rates of 30, 60, and 90 lpounds of nitrogen per acre resulted in an increase in adjusted revenue of $53, $69, and $103 per acre, respectively, compared to zero nitrogen.

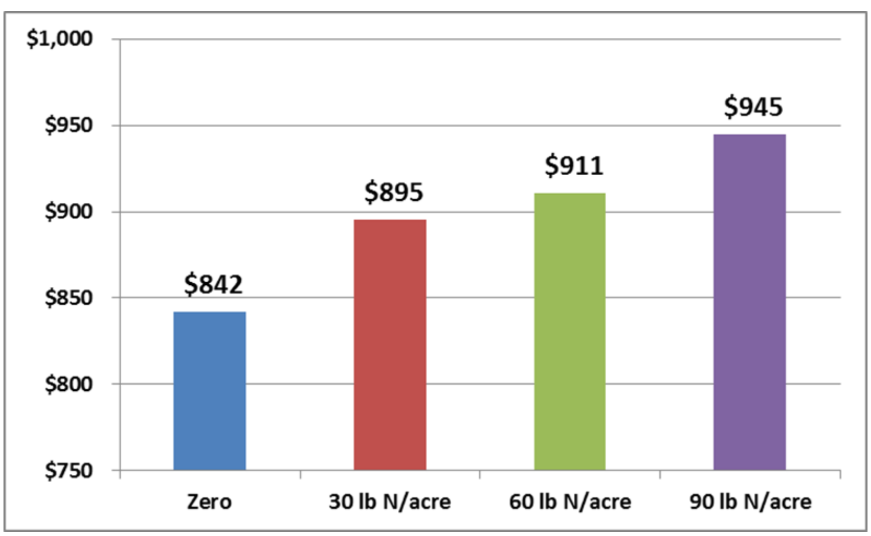

Figure 2. Average Adjusted Revenue by Supplemental Nitrogen Rate ($/acre)

Figure 3 shows the adjusted revenue by cover crop and supplemental fertilizer (nitrogen) combination. The highest adjusted revenue was achieved with cotton produced with 30 lbs/acre of nitrogen after a hairy vetch cover crop. This was followed by hairy vetch and zero nitrogen then by a rye cover crop and 60 lbs/acre of nitrogen. Cotton following traditional grass/small grain cover crops (rye and wheat) resulted in lower but similar adjusted revenue—with rye and 60 lbs/acre of nitrogen and wheat and 90 lbs/acre of nitrogen. On average, cotton produced with no cover crop resulted in lower adjusted revenue.

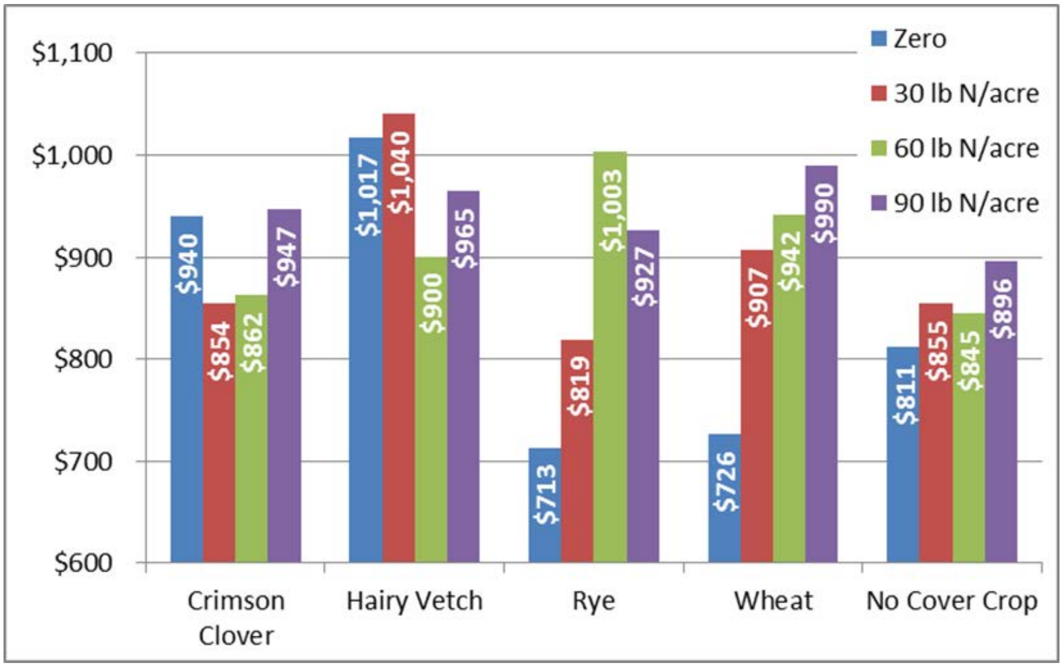

Figure 3. Average Adjusted Revenue by Cover Crop and Supplemental Fertilizer ($/acre)

Conclusions

Adjusted revenues were calculated to determine the impact of cover crop and the application of supplemental nitrogen fertilizer on cotton yield. Cotton following hairy vetch appeared to have the most profit potential. Averaged over all levels of N, it had the highest average adjusted revenue by $80 per acre. A hairy vetch cover crop with zero or 30 lbs of N applied to cotton offered the highest adjusted revenue. Adjusted revenue from using a traditional wheat or rye cover crop and higher amounts (60 or 90 lbs) of N on cotton was similar but slightly lower than the hairy vetch cover crop. Having no cover crop resulted in the lowest adjusted revenue of any of the systems in the study. Compared to having no cover crop, having a cover crop resulted in higher adjusted revenue when averaged across all N levels considered. Cotton following leguminous cover crops (crimson clover or hairy vetch) may allow for reduced side dress nitrogen applications. Hairy vetch resulted in higher adjusted revenue than crimson clover.

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2013 COTTON OVT VARIETY TRIALS

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Introduction

The University of Georgia's 2013 Cotton Variety Trials (OVT) were conducted at five locations across Georgia, spanning the cotton belt from southwest to northeast Georgia. Irrigated trials were conducted on-farm in Decatur County and at UGA research and education centers in Midville, Plains, and Tifton. Dryland trials were conducted on university research and education centers in Athens, Midville, Plains, and Tifton. Performance data in these tables, combined with data from previous years should assist growers with variety selection, one of the most important if not most important decisions in an economically viable cotton production plan. Data collected from the University of Georgia Variety Testing Cotton Program can be found at the Statewide Variety Testing website: www.swvt.uga.edu. Also, the data is published in the UGA Agricultural Experiment Station Annual Publication 104-5, January 2014.

Materials and Methods

The University of Georgia conducts Official Cotton Variety (OVT) and Strain (OST) trials across Georgia to provide growers, private industry, Extension specialists, and county agents with performance data to help in selecting high-yielding adapted varieties. Data from the OVT assists the private seed companies in assessing the fit of their products in Georgia. The University of Georgia cotton OVT is conducted by John D. Gassett, program director, Cotton OVT, Griffin, GA, along with J. LaDon Day, Department of Crop and Soil Sciences, Griffin, GA, and Anton Coy, senior agricultural specialist, Tifton, GA. The OVT is split into released variety and strain trials with placement of varieties or strains into the particular trial chosen by its owner. Trials are separated by maturity. Irrigated OVT trials are conducted at Bainbridge, Midville, Plains, and Tifton, while dryland OVTs are conducted at Athens, Midville, Plains, and Tifton, Thus varieties placed into the OVT are included in eight trials per year, giving a fair size data set with which to evaluate variety performance. The strain trials are irrigated and conducted at Midville, Plains, and Tifton. Trials consist of four replicated, randomized complete block designs. An accepted, common, management system is employed at each location for agronomic and pest management, but transgenic cultivars are not produced according to their intended pest management system(s) due to their placement alongside conventional varieties. A random fiber quality sample was taken on the picker during harvest and ginned to measure lint fraction on all plots including the irrigated early and late maturing trial at Tifton. But the remaining portion of the seed cotton from the early and later maturity plots was bagged and sent to the Micro Gin at Tifton for processing. All fiber samples were submitted to the USDA Classing Office in Macon, GA, for HVI analyses. Trials were picked with a state-of-the-art harvest system composed of an International IH 1822 picker fitted with weigh baskets and suspended from load cells. This system allows one person to harvest yield trials where the established bag-and-weigh approach required eight people or more. The electronic weigh system allowed for timely harvest of yield trials. Data from all trials and combined analyses over locations and years are reported as soon as fiber data are available from the test lab in Adobe pdf and Excel formats on the UGA Cotton Team website maintained at www.ugacotton.com. Also, the data is available at the Statewide Variety Testing website: www.swvt.uga.edu.

Results and Discussion

For the first time since 2009, Georgia producers in 2013 were fortunate to have adequate soil moisture for planting combined with an abundance of rainfall. Prolonged and periodic precipitation events lead to spring plantings being delayed for many farmers in Georgia. Cooler than normal temperatures early in the planting season resulted in low soil temperatures and slowed germination for many crops. Irrigation was not a concern for most of the growing season. Rainfall throughout the season presented problems for ground applications of fungicides, insecticides, and supplemental nutrients. Extremely wet conditions in some areas of the state were detrimental to crops resulting in leaching of nutrients and crop losses due to water logging.

Seasonal rainfall totals received were normal to above normal amounts for much of Georgia during 2013. Areas in southwest Georgia received less than the normal amount of rainfall but were within an inch of achieving so. This was a drastic improvement for the area around Plains over the past four years. Much of the Piedmont and the rest of the Coastal Plain received 14-26 percent more rainfall than normal.

Crop maturity progressed below the five-year average and harvest conditions were hampered due to wet weather conditions in 2013. Cotton producers seeded 1.37 million acres in Georgia, a 6 percent increase from last year and the largest acreage since 2006.

Cotton yield of 831lbs/acre for 2013 was a 24 percent decrease from the 2012 record yield of 1,091 lbs/acre, a total production of 2.32 million bales or 20 percent less than the previous year.

Among varieties in the Dryland Earlier Maturity Trials, PHY 333 WRF, PHY 499 WRF, PX 444413 WRF, PX 444414 WRF, PX 300310 WRF, MON 12R224B2R2, ST 4946GLB2, DG CT13125F, PHY 339 WRF, SSG HQ 210 CT, and NG 1511 B2RF stand out as varieties with high yield and relative yield stability over four locations (Table 1). When summarized over two years and four locations, PHY 499 WRF was the top performer while four other varieties were above average (Table 2).

Among the best performing earlier maturing varieties produced under irrigation, PX 444413 WRF and PHY 499 WRF were the top two highest in yield when averaged over locations (Table 3). Eleven other varieties performed well and were above average in yield (Table 3). PHY 499 WRF was the top yielding variety when averaged over two years and locations in the Irrigated Early Maturity Trials conducted at Bainbridge, Midville, Plains, and Tifton (Table 4). Four other varieties were above average in yield (Table 4).

The top yielding later maturity varieties in the trial conducted without irrigation when averaged over four locations revealed the consistent performance of ST4747GLB2, PX 554010 WRF, PHY 499 WRF, NG 1511 B2RF, MON 13R352B2R2, PX 553840 WRF, ST6448GLB2, MON 12R242B2R2, and PHY 575 WRF (Table 5). Averaged over locations and years, PHY 499 WRF was the front runner along with three other varieties that produced above average lint yields (Table 6).

Under irrigation and averaged over four locations, the top five later maturing varieties were PX 554010 WRF, MON 13R352B2R2, DP 1252 B2RF, CG 3787 B2RF, and PHY 575 WRF (Table 7). Two other varieties, DP 1454NR B2RF and DP 1050 B2RF, were not statistically different from these top five. Averaged over locations and two years, DP 1252 B2RF and PHY 499 WRF were the two front runners, while three other varieties were above average in yield (Table 8).

The Earlier Maturity and Later Maturity Strains Trials (OST) portend improved varieties for crop seasons 2014 and beyond (Tables 9). Varieties from Dow, All-Tex, Georgia, and Monsanto were high-yielding performers among standard earlier and later maturing entries in the strains trial (Table 9).

For percent lint yield, the total seed cotton from replicated plots of the 2013 Early and Later Maturity irrigated experiments at Tifton were processed through the UGA Micro-Gin, located on the UGA Tifton Campus. Turn-out is presented in Tables 10 and Table 11. To obtain quality fractions, the Micro-ginned samples were sent to the USDA Classing Office in Macon, GA, for HVI analysis processing. Data can be found in Tables 10 and 11.

In summary, several new varieties described herein portend potentially higher yields and improved fiber quality packages available to Georgia growers.

Table 1. Yield Summary of Dryland Earlier Maturity Cotton Varieties, 2013

	Lint Yield[a]									
Variety	Athens	Midville	Plains	Tifton	4-Loc. Average	Lint	Unif. Index	Length	Strength	Mic.
	---------- lb/acre ----------					%	%	in	g/tex	units
PHY 333 WRF	**1626** [1]	**1994** [9]	2033 [4]	1659 [9T]	**1828** [1]	45.7	84.6	1.19	31.6	4.4
PHY 499 WRF	1194 [11]	**2066** [5]	**2113** [2]	**1826** [2]	**1800** [2]	45.6	83.9	1.15	32.6	4.8
PX 444413 WRF	1097 [14]	**2167** [1]	**2240** [1]	1657 [10]	**1790** [3]	44.9	84.2	1.26	31.9	3.7
PX 444414 WRF	**1450** [3]	**2104** [2]	1908 [10]	1651 [11]	**1778** [4]	45.2	83.6	1.18	31.6	4.2
PX 300310 WRF	**1512** [2]	**2024** [7]	**2078** [3]	1484 [24]	**1774** [5]	44.1	83.3	1.13	30.5	4.5
MON 12R224B2R2	1293 [6]	**2007** [8]	1922 [9]	1659 [9T]	**1720** [6]	43.4	83.4	1.17	30.3	4.2
ST 4946GLB2	1387 [4]	**2074** [4]	1746 [22]	1610 [14]	**1704** [7]	43.2	83.3	1.14	31.4	4.7
DG CT13125F	1234 [9]	1902 [15]	1896 [11]	**1692** [7]	**1681** [8]	44.8	84.0	1.17	30.3	4.3
PHY339 WRF	1091 [15]	**2037** [6]	1958 [5]	1600 [15]	**1671** [9]	43.5	84.1	1.19	31.1	4.4
SSG HQ 210 CT	1214 [10]	1827 [22]	1867 [13]	**1757** [4]	**1666** [10]	41.9	82.6	1.11	30.7	4.6
NG 1511 B2RF	939 [21]	1900 [16]	1891 [12]	**1891** [1]	**1655** [11]	45.1	84.1	1.14	31.2	4.8
SSG AU 222	1278 [7]	1850 [19]	1807 [16T]	1593 [16]	1632 [12]	43.4	83.9	1.19	30.7	4.4
GA2009037	928 [22]	1937 [12]	1923 [8]	**1701** [6]	1622 [13]	42.7	82.5	1.19	31.4	4.6
PHY 427 WRF	1247 [8]	1857 [17]	1806 [17]	1561 [20]	1618 [14]	42.0	83.5	1.16	31.6	4.2
GA2010098	1152 [12]	**1990** [10]	1807 [16T]	1506 [22]	1614 [15]	43.2	83.6	1.20	32.4	4.2
DP 1034 B2RF	927 [23]	1853 [18]	1941 [6]	**1732** [5]	1613 [16]	44.6	84.5	1.19	29.4	4.5
DP 0912 B2RF	1304 [5]	1831 [21]	1787 [19]	1483 [25]	1601 [17]	42.2	83.3	1.12	30.8	4.7
CG 3428 B2RF	573 [27]	**2091** [3]	1936 [7]	**1770** [3]	1593 [18]	44.5	84.4	1.19	30.1	4.6
DP 1321 B2RF	926 [24]	1942 [11]	1796 [18]	1584 [18]	1562 [19]	44.4	83.9	1.13	30.9	4.9
AM 1550 B2RF	1027 [18]	1692 [26]	1845 [14]	**1679** [8]	1561 [20]	43.4	82.5	1.12	28.2	4.5
GA2008016	976 [19]	1763 [24]	1823 [15]	1612 [13]	1543 [21]	39.9	83.8	1.18	33.0	4.8
DG2285 B2RF	1067 [16]	1907 [13]	1659 [23]	1501 [23]	1533 [22]	42.6	83.6	1.15	29.9	4.4
SSG CT Linwood	1051 [17]	1719 [25]	1757 [21]	1519 [21]	1511 [23]	43.5	84.1	1.15	33.9	4.9
GA2004143	958 [20]	1904 [14]	1580 [25]	1587 [17]	1507 [24T]	44.8	83.6	1.21	34.1	4.4
GA2009100	834 [25]	1839 [20]	1777 [20]	1578 [19]	1507 [24T]	44.0	84.5	1.20	33.5	4.3
PHY 417 WRF	1132 [13]	1793 [23]	1564 [26]	1191 [26]	1420 [25]	44.1	83.3	1.15	31.3	4.1
DG CT12353	724 [26]	1689 [27]	1617 [24]	1617 [12]	1412 [26]	43.1	83.9	1.15	31.8	4.8
Average	1116	1917	1855	1619	1627	43.7	83.7	1.17	31.3	4.5
LSD 0.10	209	218	197	215	174	1.4	0.8	0.02	1.1	0.2
CV %	15.9	9.7	9.0	11.3	10.9	2.4	1.0	2.17	4.2	5.0

[a] Superscripts indicate ranking at that location.
Bolding indicates entries not significantly different from highest yielding entry based on Fisher's protected LSD (P = 0.10).

Table 2. Two-Year Summary of Dryland Earlier Maturity Cotton Varieties at Four Locations[a], 2012-2013

Variety	Lint Yield	Lint	Uniformity Index	Length	Strength	Micronaire
	lb/acre	%	%	inches	g/tex	units
PHY 499 WRF	**1593**	46.0	84.1	1.15	31.5	5.0
DP 1034 B2RF	1436	45.3	84.4	1.18	28.8	4.6
DP 1321 B2RF	1412	44.8	83.7	1.13	30.0	5.0
NG 1511 B2RF	1398	45.8	83.8	1.13	30.4	4.9
GA2009100	1397	44.8	83.9	1.18	32.4	4.6
DP 0912 B2RF	1390	42.9	83.4	1.12	30.0	5.0
SSG HQ 210 CT	1357	42.1	82.8	1.12	30.6	4.7
GA2004143	1341	44.7	84.3	1.20	33.3	4.6
SSG AU 222	1335	43.2	83.4	1.17	29.6	4.6
SSG CT Linwood	1324	43.4	84.0	1.13	32.3	4.9
AM 1550 B2RF	1312	43.3	82.8	1.12	28.1	4.6
Average	1391	44.2	83.7	1.15	30.6	4.8
LSD 0.10	60	0.5	0.5	0.02	0.7	0.1
CV %	10.5	2.7	1.1	2.37	4.1	4.7

[a] Athens, Midville, Plains, and Tifton.

Bolding indicates entries not significantly different from highest yielding entry based on Fisher's protected LSD (P = 0.10).

Table 3. Yield Summary of Earlier Maturity Cotton Varieties, 2013, Irrigated

	Lint Yield[a]									
Variety	Bainbridge	Midville	Plains	Tifton	4-Loc. Average	Lint	Unif. Index	Length	Strength	Mic.
	---------------------------- lb/acre ----------------------------					%	%	in	g/tex	units
PX 444413 WRF	1532 [2]	**2097** [2]	**2146** [1]	**1802** [5]	**1894** [1]	43.2	83.9	1.25	31.4	3.9
PHY 499 WRF	**1741** [1]	**1988** [5]	**2015** [5]	**1829** [3]	**1893** [2]	43.9	83.5	1.17	31.3	4.9
PX 300310 WRF	1428 [6]	**2142** [1]	**2079** [3]	**1870** [2]	**1880** [3]	42.1	82.6	1.14	29.7	4.6
PX 444414 WRF	1466 [3]	**2005** [4]	1982 [7]	**1903** [1]	**1839** [4]	42.2	83.8	1.19	31.3	4.3
PHY 333 WRF	1390 [7]	**2006** [3]	**2131** [2]	1650 [15]	**1794** [5]	42.8	84.0	1.20	31.0	4.5
NG 1511 B2RF	1453 [5]	1894 [10]	1883 [13]	**1769** [7]	1750 [6]	45.0	84.3	1.17	31.9	5.0
DP 1034 B2RF	1289 [15]	1741 [20]	**2062** [4]	**1799** [6]	1723 [7]	43.0	83.9	1.20	29.8	4.6
SSG HQ 210 CT	1383 [8]	1875 [12]	1800 [19]	**1811** [4]	1717 [8]	41.0	82.6	1.13	31.0	4.9
GA2009037	1245 [20]	1879 [11T]	1980 [8]	1679 [12]	1696 [9]	40.8	82.8	1.20	31.1	4.6
DP 1321 B2RF	1363 [10]	1937 [7]	1824 [17]	1655 [13T]	1695 [10]	41.9	83.7	1.17	30.3	4.8
SSG AU 222	1345 [12]	1802 [17T]	1903 [11]	1701 [9]	1688 [11T]	41.8	83.9	1.21	30.7	4.6
PHY339 WRF	1366 [9T]	1922 [8]	1836 [15]	1629 [18]	1688 [11T]	41.7	83.7	1.20	30.2	4.3
DP 0912 B2RF	1455 [4]	1866 [13]	1829 [16]	1565 [21]	1679 [12]	40.7	83.6	1.14	30.4	5.1
GA2009100	1234 [21]	1856 [15]	1914 [10]	1705 [8]	1677 [13]	41.9	84.0	1.22	33.5	4.3
AM 1550 B2RF	1366 [9T]	1620 [24]	**2004** [6]	1694 [10]	1671 [14]	41.2	83.0	1.14	28.5	4.6
GA2004143	1270 [17]	1938 [6]	1789 [20]	1651 [14]	1662 [15]	42.5	84.4	1.24	33.2	4.5
MON 12R224B2R2	1352 [11]	1902 [9]	1725 [23]	1612 [19]	1648 [16]	40.2	84.2	1.20	30.5	4.3
DG2285 B2RF	1313 [13]	1727 [22T]	1742 [22]	1632 [17]	1603 [17]	41.3	83.0	1.17	28.7	4.6
ST 4946GLB2	1308 [14]	1807 [16]	1599 [26]	1689 [11]	1601 [18]	41.1	83.6	1.16	31.2	4.9
DG CT13125F	1051 [26]	1879 [11T]	1975 [9]	1491 [24]	1599 [19]	41.9	83.7	1.21	30.5	4.2
PHY 427 WRF	1272 [16]	1747 [19]	1714 [24]	1655 [13T]	1597 [20]	40.7	83.0	1.15	30.3	4.3
GA2008016	1268 [19]	1771 [18]	1756 [21]	1506 [23]	1575 [21]	38.4	84.0	1.19	32.7	4.8
DG CT12353	1170 [23]	1802 [17T]	1666 [25]	1640 [16]	1570 [22]	41.8	83.4	1.16	31.4	5.0
CG 3428 B2RF	1126 [24]	1727 [22T]	1816 [18]	1607 [20]	1569 [23]	42.8	83.8	1.21	29.9	4.8
GA2010098	1211 [22]	1730 [21]	1896 [12]	1408 [25]	1561 [24]	41.5	83.9	1.23	32.7	4.4
SSG CT Linwood	1066 [25]	1859 [14]	1850 [14]	1181 [26]	1489 [25]	41.1	83.4	1.15	32.4	5.0
PHY 417 WRF	1269 [18]	1692 [23]	1467 [37]	1523 [22]	1488 [26]	41.7	82.8	1.16	30.2	4.2
Average	1323	1860	1866	1654	1676	41.8	83.6	1.18	31.0	4.6
LSD 0.10	180	156	148	168	126	1.2	0.6	0.02	1.1	0.2
CV %	11.5	7.1	6.8	8.6	8.3	2.7	1.2	2.28	3.7	4.3

[a] Superscripts indicate ranking at that location.
Bolding indicates entries not significantly different from highest yielding entry based on Fisher's protected LSD (P = 0.10).

Table 4. Two-Year Summary of Earlier Maturity Cotton Varieties at Four Locations[a], 2012-2013, Irrigated

Variety	Lint Yield	Lint	Uniformity Index	Length	Strength	Micronaire
	lb/acre	%	%	inches	g/tex	units
PHY 499 WRF	**2020**	43.7	84.1	1.17	30.4	4.7
DP 1034 B2RF	1883	43.4	84.3	1.19	28.3	4.4
NG 1511 B2RF	1816	44.0	84.2	1.15	29.6	4.6
GA2009100	1809	42.2	84.3	1.21	31.8	4.1
GA2004143	1798	42.8	84.4	1.23	32.3	4.4
SSG AU 222	1764	41.6	84	1.21	29.2	4.4
DP 0912 B2RF	1758	40.6	83.5	1.13	29.4	4.8
DP 1321 B2RF	1727	41.9	83.8	1.16	29.1	4.5
AM 1550 B2RF	1685	40.7	83.1	1.14	27.7	4.3
SSG HQ 210 CT	1659	40.6	83.2	1.15	30.2	4.6
SSG CT Linwood	1628	41.5	83.8	1.13	31.0	4.9
Average	1777	42.1	83.9	1.17	29.9	4.5
LSD 0.10	61	0.5	0.6	0.01	0.8	0.1
CV %	8.3	2.9	1.1	2.09	4.4	4.5

[a] Bainbridge, Midville, Plains, and Tifton.

Bolding indicates entries not significantly different from highest yielding entry based on Fisher's protected LSD (P = 0.10).

Table 5. Yield Summary of Dryland Later Maturity Cotton Varieties, 2013

	Lint Yield[a]									
Variety	Athens	Midville	Plains	Tifton	4-Loc. Average	Lint	Unif. Index	Length	Strength	Mic.
	---------------------------- lb/acre				----------------------------	%	%	in	g/tex	units
ST4747GLB2	**1534** [1]	1832 [14]	**1872** [2]	**1807** [3]	**1761** [1]	44.6	83.3	1.21	31.3	4.5
PX 554010 WRF	**1491** [2]	**2035** [3]	**1683** [10]	**1628** [10]	**1709** [2]	46.0	84.4	1.16	31.0	4.3
PHY 499 WRF	1358 [4]	1850 [11]	1652 [12]	**1811** [2]	**1668** [3]	45.5	84.4	1.15	32.1	4.8
NG 1511 B2RF	1237 [6]	**2091** [1]	1500 [18]	**1827** [1]	**1664** [4]	45.4	83.9	1.16	31.0	4.8
MON 13R352B2R2	903 [14]	**2077** [2]	**1875** [1]	**1777** [5]	**1658** [5]	45.8	84.3	1.21	32.4	4.5
PX 553840 WRF	**1434** [3]	1835 [13]	1519 [17]	**1724** [7]	**1628** [6]	43.2	84.4	1.18	32.5	4.3
ST 6448GLB2	966 [10]	1863 [8]	**1868** [3]	**1744** [6]	**1610** [7]	43.2	83.6	1.21	31.2	4.5
MON 12R242B2R2	1130 [9]	1843 [12]	**1775** [5]	**1660** [8]	**1602** [8]	44.4	83.9	1.16	29.0	4.9
PHY575 WRF	1179 [7]	1888 [7]	**1773** [6]	1525 [17]	**1591** [9]	43.6	83.9	1.22	30.3	4.2
CG 3787 B2RF	868 [16]	1851 [10]	**1747** [8]	**1804** [4]	1567 [10]	45.7	84.8	1.18	30.3	4.7
DP 1137 B2RF	893 [15]	1856 [9]	**1689** [9]	**1654** [9]	1523 [11]	45.1	84.0	1.15	29.6	4.7
DP 1050 B2RF	909 [13]	**2020** [4]	1637 [13]	1518 [18]	1521 [12]	45.8	83.8	1.18	29.7	4.7
FM1944 GLB2	1277 [5]	1710 [16]	1522 [16]	1553 [14]	1516 [13]	41.2	83.5	1.21	33.3	4.7
DP 1252 B2RF	736 [20]	**1979** [5]	**1760** [7]	1578 [12]	1513 [14]	44.8	83.5	1.15	28.9	4.9
DP 1454NR B2RF	927 [12]	1913 [6]	1477 [20]	1598 [11]	1479 [15]	45.0	83.2	1.15	31.3	4.9
GA2007095	1156 [8]	1674 [19]	1498 [19]	1544 [15]	1468 [16]	43.0	83.4	1.15	31.6	4.8
NG 5315 B2RF	757 [19]	1800 [15]	**1666** [11]	1539 [16]	1440 [17]	45.4	84.3	1.17	29.2	4.7
PHY 599 WRF	827 [17]	1643 [20]	**1794** [4]	1403 [19]	1417 [18]	44.6	83.6	1.19	32.1	4.4
GA 230	963 [11]	1708 [17]	1569 [14]	1339 [20]	1395 [19]	43.0	83.6	1.23	31.9	4.4
DG2610 B2RF	769 [18]	1699 [18]	1539 [15]	1554 [13]	1390 [20]	44.3	84.0	1.18	29.9	4.5
Average	1066	1858	1671	1629	1556	44.5	83.9	1.18	30.9	4.6
LSD 0.10	145	152	216	219	185	1.3	0.7	0.02	0.9	0.2
CV %	11.5	6.9	10.9	11.4	10.1	2.2	0.9	1.82	4.1	4.5

[a] Superscripts indicate ranking at that location.

Bolding indicates entries not significantly different from highest yielding entry based on Fisher's protected LSD (P = 0.10).

Table 6. Two-Year Summary of Dryland Later Maturity Cotton Varieties at Four Locations[a], 2012-2013

Variety	Lint Yield	Lint	Uniformity Index	Length	Strength	Micronaire
	lb/acre	%	%	inches	g/tex	units
PHY 499 WRF	**1502**	45.5	84.0	1.15	31.1	4.9
CG 3787 B2RF	1402	46.1	84.5	1.17	29.2	4.8
DP 1050 B2RF	1363	45.8	83.6	1.16	29.2	4.8
DP 1252 B2RF	1362	45.9	84.0	1.16	28.2	4.9
DP 1137 B2RF	1343	45.8	83.7	1.15	28.7	4.9
NG 1511 B2RF	1336	45.4	83.7	1.15	30.6	4.8
DG2610 B2RF	1297	45.1	83.9	1.17	29.4	4.6
GA2007095	1281	43.2	83.4	1.17	30.7	4.7
GA 230	1267	43.2	83.9	1.22	31.3	4.6
Average	1350	45.1	83.8	1.17	29.8	4.8
LSD 0.10	63	0.5	0.5	0.01	0.7	0.1
CV %	11.3	2.6	1.0	1.88	4.1	5.2

[a] Athens, Midville, Plains, and Tifton.

Bolding indicates entries not significantly different from highest yielding entry based on Fisher's protected LSD (P = 0.10).

Table 7. Yield Summary of Later Maturity Cotton Varieties, 2013, Irrigated

	Lint Yield[a]									
Variety	Bainbridge	Midville	Plains	Tifton	4-Loc. Average	Lint	Unif. Index	Length	Strength	Mic.
	lb/acre					%	%	in	g/tex	units
PX 554010 WRF	**1452** [6]	**2152** [1]	**2014** [5T]	**1827** [2]	**1861** [1]	45.0	84.0	1.16	30.7	4.3
MON 13R352B2R2	1310 [12]	**2112** [2]	**2139** [1]	**1871** [1]	**1858** [2]	43.5	83.9	1.22	32.4	4.4
DP 1252 B2RF	**1613** [1]	1924 [12]	**2045** [3]	1668 [5]	**1813** [3]	44.4	84.4	1.16	29.1	5.0
CG 3787 B2RF	**1523** [3]	1994 [7]	1939 [8]	**1784** [3]	**1810** [4]	44.2	84.1	1.17	29.7	4.8
PHY575 WRF	1435 [8]	1870 [17]	**2014** [5T]	**1690** [4]	**1752** [5]	40.3	84.3	1.25	30.9	4.3
DP 1454*NR* B2RF	1439 [7]	1879 [15]	**2030** [4]	1638 [7]	**1746** [6]	42.4	83.3	1.16	30.7	4.9
DP 1050 B2RF	**1461** [5]	1933 [11T]	**1984** [6]	1599 [10]	**1744** [7]	44.3	84.4	1.19	28.3	4.7
PHY 499 WRF	**1529** [22]	1951 [10]	1890 [9]	1565 [12]	1734 [8]	43.3	84.7	1.17	31.9	4.9
ST4747GLB2	1290 [16]	**2070** [4]	**2049** [2]	1518 [14]	1732 [9]	42.0	83.4	1.22	30.7	4.5
DP 1137 B2RF	1345 [11]	1933 [11T]	1976 [7]	1659 [6]	1728 [10]	43.0	83.9	1.17	29.9	4.7
NG 1511 B2RF	1425 [9]	**2106** [3]	1855 [13]	1506 [15]	1723 [11]	44.0	83.7	1.16	30.9	4.9
ST 6448GLB2	1292 [15]	1997 [6]	1867 [12]	1610 [9]	1692 [12]	40.3	84.1	1.23	30.8	4.6
PX 553840 WRF	**1502** [4]	**2013** [5]	1763 [16T]	1354 [17]	1658 [13]	41.2	84.5	1.17	31.6	4.5
MON 12R242B2R2	1174 [20]	1921 [13]	1878 [10]	1627 [8]	1650 [14]	42.4	84.1	1.18	29.1	4.9
NG 5315 B2RF	1307 [13]	1975 [9]	1769 [15T]	1532 [13]	1646 [15]	43.7	84.5	1.19	29.5	4.7
DG2610 B2RF	1223 [19]	1907 [14]	1769 [15T]	1571 [11]	1617 [16]	43.7	84.4	1.19	29.7	4.7
FM1944 GLB2	1248 [18]	1990 [8]	1876 [11]	1255 [20]	1592 [17]	39.6	83.6	1.21	33.0	4.6
GA 230	1295 [14]	1765 [18]	1763 [16T]	1459 [16]	1570 [18]	39.8	83.5	1.25	30.9	4.3
GA2007095	1266 [17]	1871 [16]	1784 [14]	1336 [19]	1564 [19]	40.5	83.6	1.16	31.9	4.6
PHY 599 WRF	1353 [10]	1729 [19]	1636 [17]	1345 [18]	1515 [20]	42.3	84.5	1.23	31.9	4.5
Average	1374	1955	1902	1571	1700	42.5	84.0	1.19	30.7	4.6
LSD 0.10	164	151	157	200	121	1.2	0.7	0.02	0.9	0.2
CV %	10.1	6.5	7.0	10.8	8.4	2.8	0.9	1.98	4.0	4.1

[a] Superscripts indicate ranking at that location.
Bolding indicates entries not significantly different from highest yielding entry based on Fisher's protected LSD (P = 0.10).

Table 8. Two-Year Summary of Later Maturity Cotton Varieties at Four Locations[a], 2012-2013, Irrigated

Variety	Lint Yield	Lint	Uniformity Index	Length	Strength	Micronaire
	lb/acre	%	%	inches	g/tex	units
DP 1252 B2RF	**1948**	44.9	84.4	1.16	27.8	4.6
PHY 499 WRF	**1909**	43.4	84.8	1.18	30.3	4.6
CG 3787 B2RF	**1906**	44.2	84.3	1.17	28.2	4.5
DP 1050 B2RF	**1889**	44.1	84.2	1.18	27.5	4.4
DP 1137 B2RF	1878	43.5	84.1	1.16	28.3	4.4
DG2610 B2RF	1818	43.8	84.4	1.19	28.4	4.4
NG 1511 B2RF	1740	43.5	83.9	1.15	29.6	4.5
GA 230	1679	40.1	84.3	1.26	30.2	4.0
GA2007095	1645	40.7	84.1	1.18	30.4	4.3
Average	1824	43.1	84.3	1.18	28.9	4.4
LSD 0.10	66	0.3	0.5	0.02	0.7	0.1
CV %	8.8	1.6	1.0	2.22	4.2	4.5

[a] Bainbridge, Midville, Plains, and Tifton.

Bolding indicates entries not significantly different from highest yielding entry based on Fisher's protected LSD (P = 0.10).

Table 9. Yield Summary of Cotton Strains, 2013, Irrigated

Variety	Lint Yield[a] Midville	Plains	Tifton	3-Loc. Average	Lint	Unif. Index	Length	Strength	Mic.
	---------- lb/acre ----------				%	%	inches	g/tex	units
DGX 11W351 B2RF	**2119** [2]	**2359** [1]	**2225** [3]	**2234** [1]	45.7	83.2	1.17	30.9	4.5
GA 2010102	**2066** [5]	2167 [2]	**2144** [6]	**2126** [2]	44.6	84.6	1.20	31.6	4.9
DP 1050 B2RF	**2071** [3]	1894 [9]	**2248** [1]	**2071** [3]	45.4	84.2	1.18	27.6	4.5
PHY 499 WRF	1979 [6]	1915 [8]	**2232** [2]	**2042** [4]	45.3	84.3	1.16	31.0	4.8
GA 2010074	**2068** [4]	1970 [7]	**2065** [7]	**2034** [5]	44.0	83.9	1.21	31.6	4.5
DP 1454*NR* B2RF	1820 [19]	1870 [10T]	**2203** [4]	1964 [6]	44.2	83.4	1.15	32.4	5.0
MON 13R341B2R2	1929 [10]	1870 [10T]	**2047** [8]	1949 [7]	45.2	84.4	1.19	33.0	4.9
NB502-55T	1836 [16]	2081 [3]	1877 [14]	1931 [8]	43.2	84.5	1.19	31.7	4.6
GA 2011004	**2194** [1]	2057 [4]	1487 [19]	1912 [9]	45.9	84.1	1.18	29.6	4.8
NB502-18R	1824 [18]	1744 [15]	**2150** [5]	1906 [10]	44.2	83.7	1.18	30.0	4.2
CT13414	1964 [8]	1766 [14]	1964 [13]	1898 [11]	45.5	84.4	1.15	28.1	4.8
DP 0912 B2RF	1880 [13]	1794 [12]	**2004** [11]	1893 [12]	41.7	82.8	1.11	28.9	4.8
NB502-47T	1965 [7]	1684 [17]	**2024** [10]	1891 [13]	43.4	82.9	1.19	28.9	4.2
GA 2011191	1945 [9]	1828 [11]	1860 [15]	1878 [14]	43.6	84.0	1.17	30.3	4.6
PHY339 WRF	1915 [11]	1651 [18]	**2043** [9]	1870 [15]	42.6	83.5	1.18	29.4	4.1
GA 2010019	1874 [14]	2002 [9]	1640 [18]	1839 [16]	42.4	83.9	1.21	33.4	4.6
GA 2010076	1841 [15]	2007 [8]	1652 [17]	1833 [17]	43.0	83.5	1.23	32.5	4.2
NB502-68R	1890 [12]	1784 [13]	1801 [16]	1825 [18]	43.9	84.8	1.21	31.2	4.3
DG CT13324 B2RF	1835 [17]	1623 [19]	1969 [12]	1809 [19]	43.4	84.1	1.19	30.5	4.6
NB502-54T	1803 [20]	1730 [16]	1475 [20]	1669 [20]	43.7	83.3	1.19	29.4	4.4
Average	1941	1890	1956	1929	44.1	83.9	1.18	30.6	4.6
LSD 0.10	175	178	246	232	1.5	0.8	0.03	1.6	0.2
CV %	7.6	8.0	10.6	8.9	2.2	0.8	1.83	3.7	4.4

[a] Superscripts indicate ranking at that location.

Bolding indicates entries not significantly different from highest yielding entry based on Fisher's protected LSD (P = 0.10).

Table 10. Earlier Maturity Cotton Variety Performance, 2013, Irrigated, Tifton, Georgia

Variety	Lint Yield	Lint*	Uniformity Index*	Length*	Strength*	Micronaire*
	lb/acre	%	%	inches	g/tex	units
PX 444414 WRF	**1903**	40.1	83.5	1.15	29.5	4.3
PX 300310 WRF	**1870**	39.4	81.9	1.14	28.7	4.6
PHY 499 WRF	**1829**	41.9	81.6	1.13	29.7	5.0
SSG HQ 210 CT	**1811**	39.9	82.2	1.11	28.2	5.0
PX 444413 WRF	**1802**	41.7	83.1	1.25	32.3	3.8
DP 1034 B2RF	**1799**	41.4	83.1	1.18	28.2	4.6
NG 1511 B2RF	**1769**	40.1	83.6	1.13	29.8	4.8
GA2009100	1705	39.8	83.6	1.23	30.9	4.1
SSG AU 222	1701	39.9	83.0	1.19	29.8	4.7
AM 1550 B2RF	1694	40.0	82.0	1.13	27.8	4.7
ST 4946GLB2	1689	40.7	82.4	1.10	29.8	5.0
GA2009037	1679	39.5	82.1	1.22	31.7	4.6
DP 1321 B2RF	1655	39.5	83.4	1.15	29.2	5.0
PHY 427 WRF	1655	39.6	81.7	1.12	28.9	4.4
GA2004143	1651	40.8	83.9	1.24	32.7	4.5
PHY 333 WRF	1650	41.4	83.4	1.17	30.4	4.5
DG CT12353	1640	40.8	82.7	1.14	30.1	5.0
DG2285 B2RF	1632	39.7	82.7	1.13	26.5	4.8
PHY339 WRF	1629	39.4	82.8	1.20	29.1	4.3
MON 12R224B2R2	1612	38.8	83.1	1.19	29.8	4.2
CG 3428 B2RF	1607	41.4	83.4	1.21	29.3	4.9
DP 0912 B2RF	1565	38.5	82.7	1.10	28.9	5.0
PHY 417 WRF	1523	40.2	82.4	1.14	28.5	4.1
GA2008016	1506	37.5	83.6	1.18	31.8	4.9
DG CT13125F	1491	40.7	82.4	1.18	29	4.4
GA2010098	1408	38.6	83.5	1.23	32.7	4.4
SSG CT Linwood	1181	39.1	82.8	1.12	31.6	5.1
Average	1654	40	82.8	1.16	29.8	4.6
LSD 0.10	168	0.7	N.S.[1]	0.04	1.6	0.2
CV %	8.6	1.5	0.9	2.06	3.2	2.7

* To determine percent lint fractions and quality parameters plot seed cotton was processed through the MicroGin located on the UGA Tifton Campus.

1. The F-test indicated no statistical differences at the alpha = 0.10 probability level; therefore an LSD value was not calculated.

Bolding indicates entries not significantly different from highest yielding entry based on Fisher's protected LSD (P = 0.10).

Planted: April 30, 2013.
Harvested: October 10, 2013.
Seeding Rate: 4 seeds/foot in 36" rows.
Soil Type: Tifton sandy loam.
Soil Test: P = Medium, K = Medium, and pH = 6.8.
Fertilization: 25 lb N, 88 lb P_2O_5, and 100 lb K_2O/acre. Sidedress: 70 lb N and 25 lb K_2O/acre.
Previous Crop: Peanuts.
Management: Disked, subsoiled and bedded; Reflex, Cotoran, and Prowl used for weed control; Orthene and Bidrin used for insect control; Pix used for PGR.

	May	June	July	Aug.	Sept.	Oct.
Irrigation (in):	0	1.75	0	1.00	0.75	0
Rainfall (in):	2.26	6.86	8.67	7.41	0	0

Trials conducted by A. Coy, S. Willis, R. Brooke, D. Dunn, and B. McCranie.

Table 11. Later Maturity Cotton Variety Performance, 2013, Irrigated, Tifton, Georgia

Variety	Lint Yield	Lint*	Uniformity Index*	Length*	Strength*	Micronaire*
	lb/acre	%	%	inches	g/tex	units
MON 13R352B2R2	**1871**	42.2	82.7	1.18	31.6	4.7
PX 554010 WRF	**1827**	46.5	83.2	1.13	29.9	4.4
CG 3787 B2RF	**1784**	42.3	83.6	1.12	28.9	4.8
PHY575 WRF	**1690**	38.6	83.3	1.21	29.7	4.2
DP 1252 B2RF	1668	43.3	83.0	1.11	27.8	5.2
DP 1137 B2RF	1659	41.5	83.5	1.13	28.6	4.9
DP 1454*NR* B2RF	1638	39.4	82.9	1.14	30.1	5.1
MON 12R242B2R2	1627	40.5	83.3	1.15	27.5	5.0
ST 6448GLB2	1610	37.8	82.8	1.19	30.8	4.6
DP 1050 B2RF	1599	42.6	82.4	1.13	28.0	4.9
DG2610 B2RF	1571	41.4	83.6	1.14	29.2	4.8
PHY 499 WRF	1565	41.7	84.0	1.14	30.7	5.0
NG 5315 B2RF	1532	42.1	83.4	1.17	28.6	4.9
ST4747GLB2	1518	39.0	82.4	1.19	30.4	4.6
NG 1511 B2RF	1506	41.0	82.8	1.12	29.5	5.0
GA 230	1459	39.2	83.4	1.22	30.7	4.4
PX 553840 WRF	1354	38.7	83.8	1.15	32.0	4.5
PHY 599 WRF	1345	39.8	83.3	1.20	30.4	4.5
GA2007095	1336	38.2	82.5	1.12	29.7	4.7
FM1944 GLB2	1255	38.3	82.1	1.17	32.6	4.7
Average	1571	40.7	83.1	1.15	29.8	4.7
LSD 0.10	200	2.3	0.8	0.04	1.8	0.3
CV %	10.8	4.6	0.5	2.04	3.6	3.4

* To determine percent lint fractions and quality parameters plot seed cotton was processed through the MicroGin located on the UGA Tifton Campus.

Bolding indicates entries not significantly different from highest yielding entry based on Fisher's protected LSD (P = 0.10).

Planted: April 30, 2013.
Harvested: October 10, 2013.
Seeding Rate: 4 seeds/foot in 36" rows.
Soil Type: Tifton sandy loam.
Soil Test: P = Medium, K = Medium, and pH = 6.8.
Fertilization: 25 lb N, 88 lb P_2O_5, and 100 lb K_2O/acre. Sidedress: 70 lb N and 25 lb K_2O/acre.
Previous Crop: Peanuts.
Management: Disked, subsoiled and bedded; Reflex, Cotoran, and Prowl used for weed control; Orthene and Bidrin used for insect control; Pix used for PGR.

	May	June	July	Aug.	Sept.	Oct.
Irrigation (in):	0	1.75	0	1.00	0.75	0
Rainfall (in):	2.26	6.86	8.67	7.41	0	0

Trials conducted by A. Coy, S. Willis, R. Brooke, D. Dunn, and B. McCranie.

EVALUATION OF PERFORMANCE, GROWTH, AND FRUITING CHARACTERISTICS OF NEW COTTON VARIETIES AND QUANTIFYING POTENTIAL PRODUCTION RISKS OF UP-AND-COMING TECHNOLOGIES

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Introduction

Georgia is the second largest cotton-producing state in the US, with an acreage of 1.37 million in 2013, which leads all other commodities in the state, generating approximately $1 billion in farm income for 2013. Prior to 2010, approximately 85 to 90 percent of Georgia's cotton acreage was planted to a single variety, DP 555 BR, due to its adaptability to a broad range of environments, ease of management, and its unmatched yield performance and stability. The sudden transition away from DP 555 BR left growers with few known suitable replacements to plant and no information about variety adaptability to certain environments, as there was no apparent one-size-fits-all variety to replace DP 555 BR. Since that time, the release and removal of varieties on the marketplace has become much more rapid and competitive, forcing growers to plant untested varieties (with little knowledge of how these varieties might perform) and with little to no information with regard to how they should be positioned into environments or managed with irrigation.

On-Farm Cotton Variety Evaluations

The UGA On-Farm Cotton Variety Performance Evaluation Program, which has been conducted annually since 2010, has had an incalculable impact on the Georgia cotton industry with regard to variety selection. The broad range of environments captured in this program allowed for very quick assessment of variety performance and stability across these environments and has provided a first-hand testimony for county agents and cooperating and local growers to observe how these varieties perform in their local environments. This program is considered by the major seed companies as the primary source of variety performance information for growers.

It is estimated that improper variety selection can cost growers as much as $77 to $234 per acre depending on the error in variety selection (data based on 2013 variety performance at $0.80 per pound). For the 2013 cotton acreage of 1.37 million acres planted, improper variety selection may collectively have cost Georgia growers $105 million to $321 million. Proudly, the UGA On-Farm Cotton Variety Performance Evaluation Program helps to drastically reduce these losses, which returns this money to producers and ultimately into Georgia's economy.

Due to the rapid release of modern varieties onto the marketplace, this program is equipped to quickly identify the top varieties and the types of environments these varieties need to be produced in (seven brand new untested varieties were evaluated in this program in 2013 alone). This program continues to address one of the most important agronomic issues facing growers. Overall results from 17 trials in the 2013 program are illustrated in Figure 1.

2013 UGA On-Farm Cotton Variety Performance Evaluation Program *Stability*

Collins & Whitaker, 2013

Variety	Combined Average	% Top 1	% Top 2	% Top 3
DP 1050 B2RF	1,222	18	18	47
DP 1137 B2RF	1,219	29	47	53
DP 1252 B2RF	1,215	24	35	47
CG 3787 B2RF	1,215	18	41	53
NG 5315 B2RF	1,166	0	12	24
PHY 499 WRF	1,144	6	12	24
PHY 339 WRF	1,133	0	6	12
DG 2610 B2RF	1,129	0	6	6
ST 6448 GLB2	1,115	6	12	12
PHY 575 WRF	1,099	0	12	12
ST 4946 GLB2	1,097	0	0	6
FM 1944 GLB2	1,064	0	0	6

Figure 1. Lint Yield (lbs/acre) for the 17 trials in the 2013 UGA On-Farm Cotton Variety Performance Evaluation Program

Agronomic Irrigation Research

Additional yield optimization irrigation research was conducted in 2013 to investigate: 1) the utility of heavy rye residue (currently used as a cover crop for pigweed management) with regard to potential water savings, and 2) to re-evaluate and modify water needs for cotton varieties that differ in boll distribution, maturity, and sensitivity to water stress with emphasis on the impact of irrigation during squaring.

Figures 2 and 3 illustrate the effects of the heavy rye residue on water retention and yield. Data collected and other observations during 2013 suggested that the heavy rye residue retained applied irrigation water for a longer period of time following application and to a greater extent. However, the excessive rains observed throughout most of 2013 resulted in suboptimal yields, necessitating further investigation into this tillage system in drier seasons. The 2013 yield results indicated that the later maturing PHY 499 was penalized from excessive moisture when irrigating in excess of 50 percent of the UGA Checkbook in a conventionally tilled system, and all irrigation regimes when the heavy rye residue system was used. When irrigating at 75 to 100 percent there was no effect of tillage on yield, suggesting that excessive soil moisture prevailed due to excessive season-long rainfall. However there was no effect on yield for the earlier maturing and more drought-sensitive FM 1944, suggesting that excessive moisture may not affect varieties that exhibit these growth characteristics.

Other irrigation research has investigated the value and impact of irrigation during squaring. Current UGA recommendations call for 1 inch to be applied every week during squaring followed by varying amounts during the bloom period. Due to variety differences with regard to sensitivity to drought stress, UGA agronomists wanted to determine if later maturing varieties might not need irrigation during squaring, as later varieties tend to recover from dry spells well.

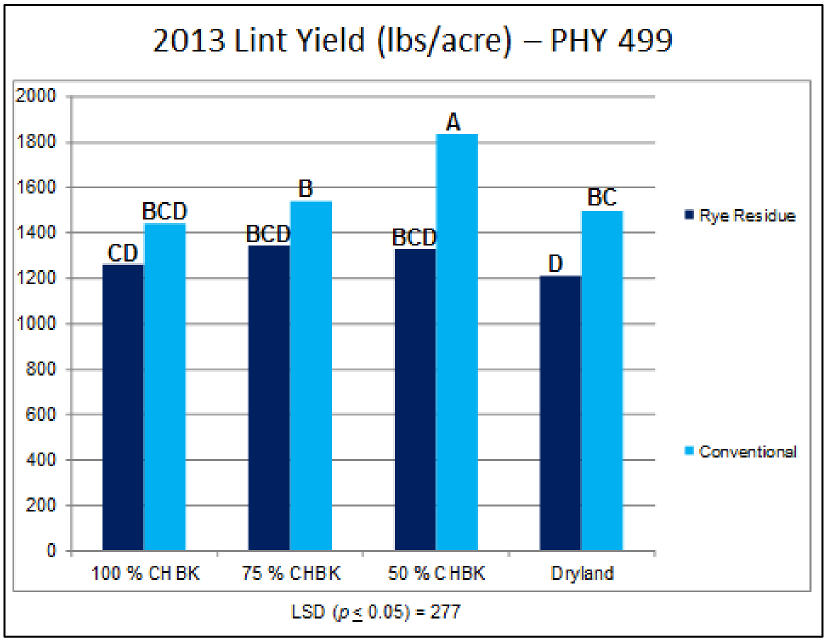

Figure 2. Lint Yield Response of PHY 499 to Various Irrigation Regimes in Conventional and Heavy Rye Residue Tillage Systems

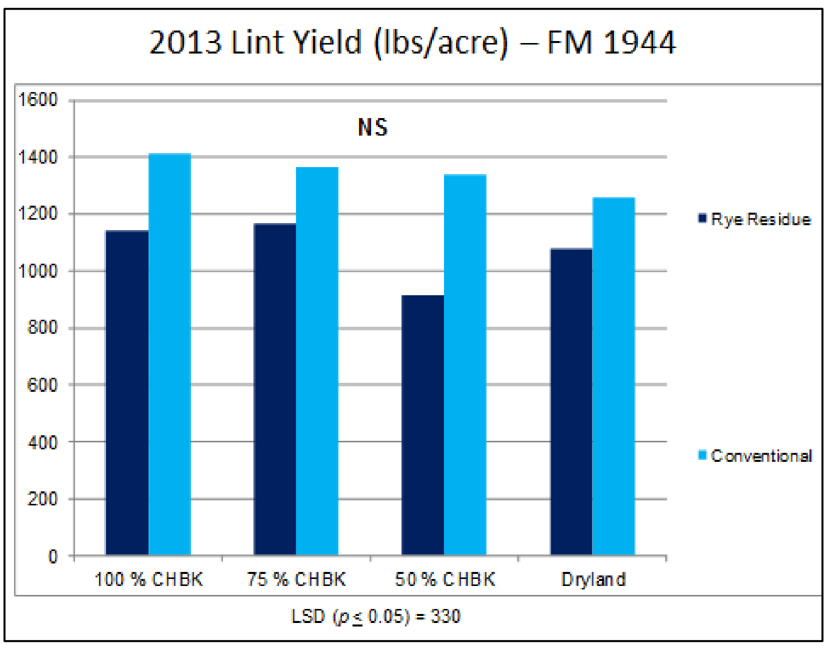

Figure 3. Lint Yield Response of FM 1944 to Various Irrigation Regimes in Conventional and Heavy Rye Residue Tillage Systems

Secondly, UGA agronomists wanted to determine if earlier maturing varieties that tend to be more drought sensitive could utilize more irrigation during squaring; the goal being to develop a higher number of fruiting sites and nodes above white flower, so that these varieties would not reach cutout as quickly. That way these varieties could potentially continue to set more upper bolls during the bloom period, whereas cutout would normally have been reached

The effects of irrigating during squaring are illustrated in Figures 4 and 5. During 2012, no rainfall occurred during the second week of squaring. Therefore, the normal UGA recommendations called for 1 inch to be applied during that week. When compared to initiating normal irrigation beginning at first bloom, the 1 inch applied during the second week of squaring resulted in 478 to 601 lbs/acre additional yield, indicating that drought during squaring (when potential fruiting sites are developing) could negatively affect all varieties, regardless of maturity. This also suggests that cotton cannot recover from stress during squaring, despite normal irrigation throughout the bloom period. The cost of applying 1 inch of irrigation water is relatively miniscule, therefore, timely irrigation by growers could result in significant yield gains. A similar effect was observed in 2013; however, the effect of irrigating during squaring was non-significant, likely due to the excessive rainfall that occurred during the last week of squaring and throughout the bloom period. Additional irrigation during squaring did not result in positive yield responses for either variety or year.

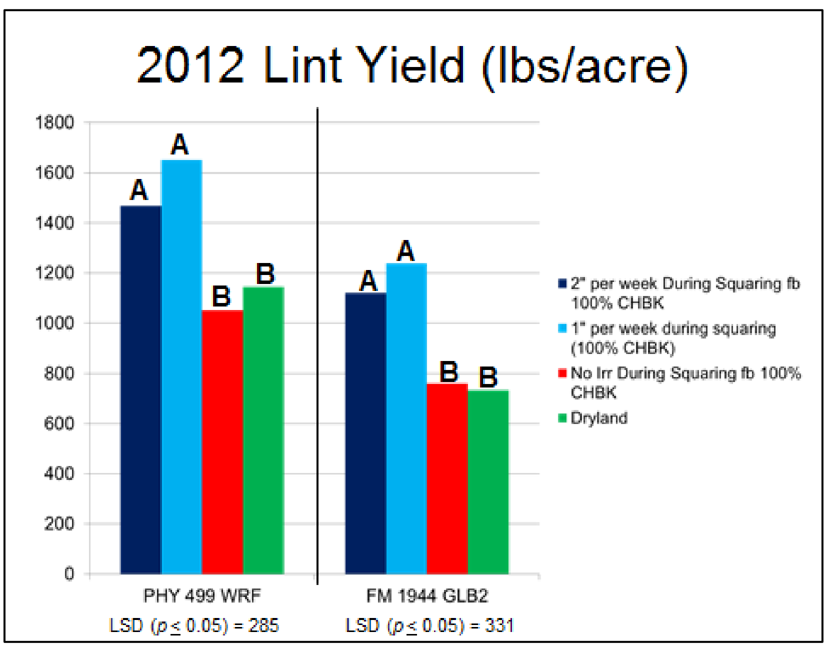

Figure 4. Lint Yield Response of FM 1944 and PHY 499 During 2012 to Normal Irrigation Season Long, No Irrigation During Squaring Followed by Normal Irrigation During Bloom, and Twice the Recommended Irrigation During Squaring.

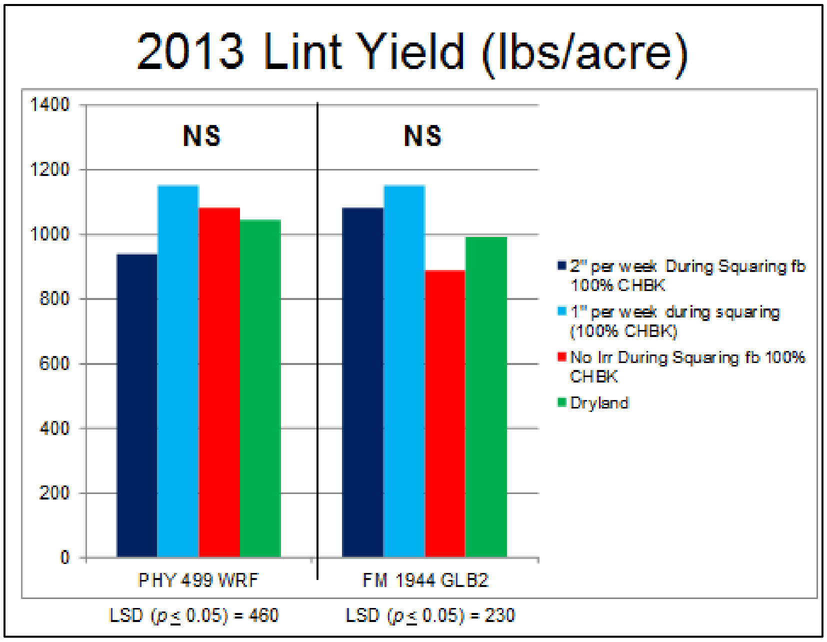

Figure 5. Lint Yield Response of FM 1944 and PHY 499 During 2013 to Normal Irrigation Season Long, No Irrigation During Squaring Followed by Normal Irrigation During Bloom, and Twice the Recommended Irrigation During Squaring.

Evaluation of Potential Risks of Herbicide Drift

The release of newer herbicide technologies within a few years could pose challenges for Georgia cotton growers. One example is the Enlist technology from Dow AgroSciences, which conveys tolerance to 2,4-D herbicide. Drift injury from 2,4-D is currently common, but yield loss due to drift is often difficult to predict or quantify. Most assessments of yield loss are subjective, and have little regard to growth stage, etc. This issue will most certainly become a much larger problem for Georgia cotton growers upon the release of these technologies, thus the increase in likelihood that drift will occur. The increased risks associated with these new technologies require extensive research to develop sound scientific techniques for quantifying yield loss due to 2,4-D drift. Research should account for growth stage and drift rate of the herbicide on both early and later maturing varieties. To date, the most sensitive growth stages to 2,4-D drift have been identified but the severity of such injury, and the resulting yield loss differs depending on the environment and other stresses. Continued research is needed to develop strategies for determining yield loss as it relates to visual injury from phenoxy herbicides at various growth stages.

Experiments were conducted in Tifton and Moultrie to quantify the effects of 2,4-D drift. PHY 499 WRF was subjected to two simulated drift rates (0.0357 and 0.00178 lbs/acre a.i.) of 2,4-D herbicide, applied every two to three weeks throughout the growing season, during the following growth stages: 4-leaf, 9-leaf, First Bloom (FB), and FB+2 weeks, FB+4 weeks, and FB+6 weeks. Data collection included percent injury, plant height weekly throughout the season, and mapping of boll distribution. Plots were harvested and subsequently ginned for lint yield, lint percentage, and HVI fiber quality. The impact of herbicide drift on yield was clearly quantified for all growth stages.

Results of the simulated 2,4-D drift experiment are illustrated below. Figures 6 and 7 illustrate the most important data in this experiment: yield responses to simulated 2,4-D drift at all growth stages. At Moultrie, the lower drift rate (that did not affect yields in previous years) caused mild yield loss but only between growth stages 9-leaf to FB+2wk. The higher drift rate reduced yields at all growth stages except FB+6wk (when all harvested bolls were set), but the greatest yield reductions occurred between 9-leaf to FB+2wk. In some cases, this effect nearly resulted in complete yield loss. At Tifton, the lower drift rate resulted in injury but did not affect yield compared to the non-treated control. However, the higher drift rate resulted in significant yield loss at all growth stages except at FB+6wk, with the greatest yield loss occurring at First Bloom and FB+2wk.

The results of this research clearly illustrate the growth stages in which phenoxy drift could cause the highest yield loss, however, continued research is needed to correlate visual injury to predictive yield loss at growth stages.

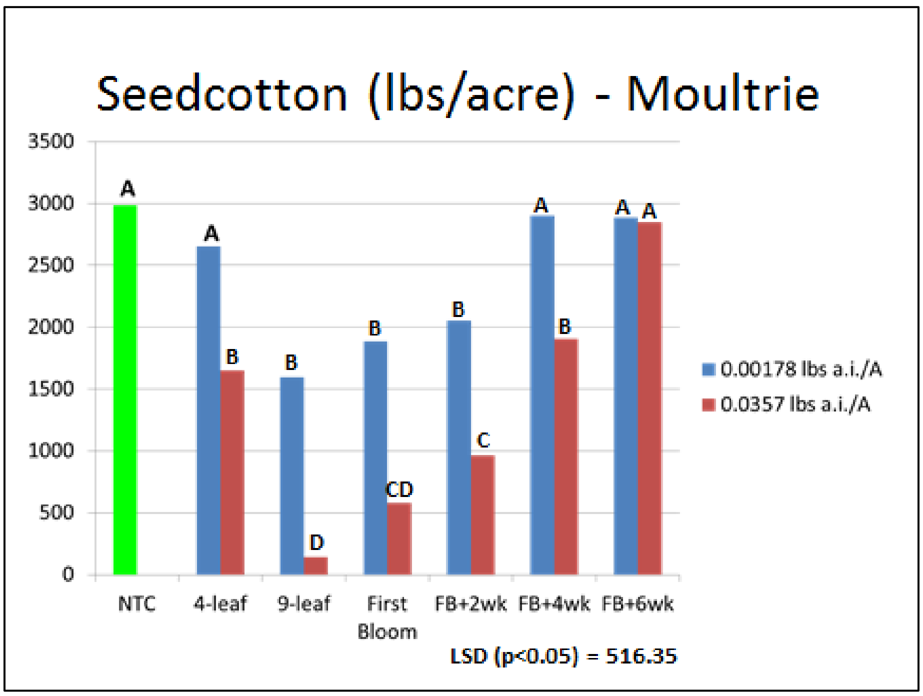

Figure 6. Lint Yield Response to Simulated 2,4-D Drift at Various Growth Stages During 2013 (Moultrie).

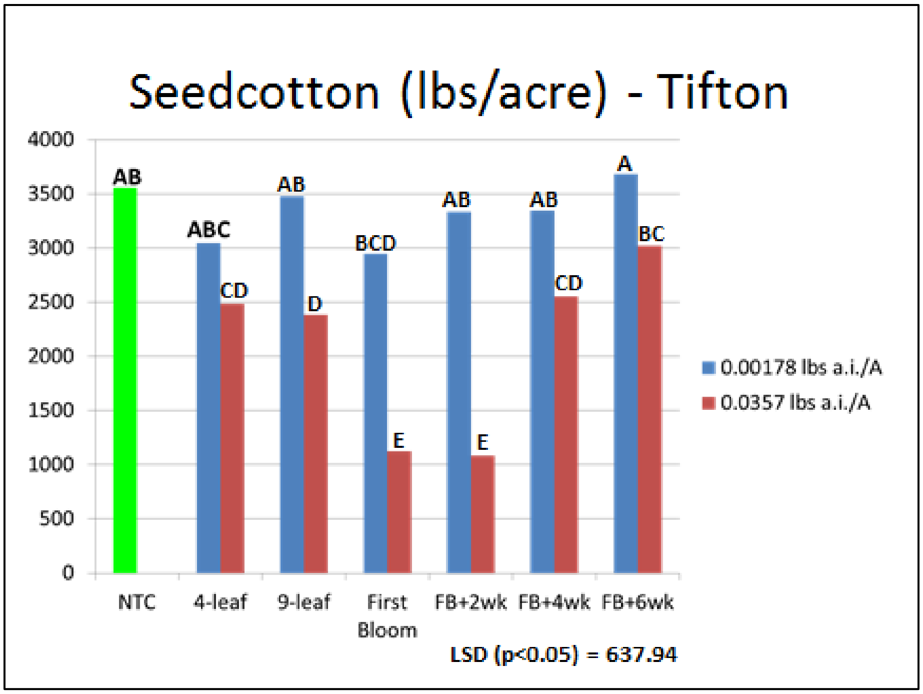

Figure 7. Lint Yield Response to Simulated 2,4-D Drift at Various Growth Stages During 2013 (Tifton).

Acknowledgements

The authors would like to express their gratitude to the Georgia Cotton Commission for their continued support of this and other research in the Cotton Extension Agronomics program.

THE UTILITY OF PLANT WATER STATUS MEASUREMENTS AS A MEANS TO IMPROVE WATER USE EFFICIENCY IN GEORGIA COTTON PRODUCTION

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Introduction

Current irrigation practices balance rainfall amounts and water loss due to crop evapotranspiration with supplemental irrigation (referred to as a "checkbook" approach). While this method has been successful at providing high crop yields, there is evidence that plant-based irrigation triggers could provide a means to conserve water resources, while maintaining profitable yields (Jones, 2004, 2007). Leaf water potential has been shown to integrate a plant's total environment such that differences in evaporative demand, rooting depth, soil moisture and growth-stage-specific water requirements will be accounted for (Grimes and Yamada, 1982). Pre-dawn water potential (Ψ_{PD}) has been considered the best available measurement of crop water status for trees (Ameglio et al., 1999); however, its use for irrigation scheduling in cotton is limited. Additionally, canopy temperature has been shown to provide an indirect indication of plant water status in arid regions (Ehrler et al., 1978; Idso, Jackson, Pinter, Reginato, and Hatfield, 1981); however, its usefulness has not been clearly demonstrated in the southeastern United States. Furthermore, data collected during the 2012 growing season indicated that Ψ_{PD} was clearly indicative of midday photosynthetic rates (Figure 1), allowing for the identification of a range of Ψ_{PD} thresholds for irrigation scheduling. In the current study, we evaluated whether Ψ_{PD} could be used to indicate the need for irrigation in cotton and if canopy temperature is a useful indicator of water stress in areas with humid growing seasons.

Materials and Methods

To determine if Ψ_{PD} (pre-dawn water potential) could be used to indicate the need for irrigation in cotton, two cotton cultivars PHY 499 WRF and FM1944 GLB2, were grown near Camilla, GA and were managed according to practices outlined by University of Georgia Extension except that five distinct irrigation treatments were established. These treatments included the following: 1) dryland, 2) well-watered conditions (100 percent Checkbook), and 3) three different Ψ_{PD} triggers (-0.50, -0.70, and -0.90 MPa). For irrigation scheduling, Ψ_{PD} was measured between 4:30 a.m. and 6:00 a.m. three days per week using a Scholander pressure chamber, and irrigation water was applied at 1/3 the weekly checkbook requirement. Plots were arranged in a randomized complete block design

Canopy temperature (T_C), air temperature (T_a), and relative humidity were recorded as afternoon averages from noon to 2 p.m., when photon flux density was above 600 W/m2, using SmartCrop sensors (Smartfield Inc., Lubbock, TX) and the weather data obtained from a weather station located at Stripling Irrigation Research Park. Canopy minus air temperatures for a non-water stressed ($T_{NWS} - T_a$) and a non-transpiring crop ($T_{dry} - T_a$) were estimated by regression analysis of $T_C - T_a$ versus VPD for a well-watered crop according to Idso et al. (1981). $T_C - T_a$ data of each plot were used along with estimates of $T_{NWS} - T_a$ and $T_{dry} - T_a$ to calculate a crop water stress index (CWSI) as described by Idso et al. (1981) using the equation: $CWSI = [(T_C - T_a) - (T_{NWS} - T_a)] / [(T_{dry} - T_a) - (T_{nws} - T_{air})]$, where positive values indicate water stress greater than the well watered control.

Seed cotton and lint yield were estimated from two 12 meter rows, and water use efficiency was determined for each plot by dividing lint yields by total water received from planting until defoliation. Season-long Ψ_{PD}, CWSI, seed cotton, lint yield, and WUE were analyzed via 2- way ANOVA with a random blocking factor. Post-hoc analysis was conducted using Fisher's LSD (α = 0.05). No cultivar-specific differences were observed for any measured parameter. Data presented represent means for each irrigation treatment after data had been combined from both cultivars.

Results and Discussion

Due to high rainfall during the 2013 growing season, when Ψ_{PD} was averaged for the entire growing season for each plot, there are no statistical differences in predawn water potential for any of the treatments examined, and the average for all treatments was well below the highest water potential threshold (Figure 2). Figure 3 illustrates a strong linear relationship (r^2 = 0.789) between vapor pressure deficit and $T_c - T_a$ for canopy temperature data collected between noon and 2:00 p.m., under solar radiation ≥ 600 W m^{-2}, and for a well-watered crop (100 percent Checkbook).

Using this relationship, the $T_c - T_a$ of a non-water-stressed crop ($T_{NWS} - T_a$) and a non-transpiring crop (T_{dry}) can be estimated under a given VPD and air temperature. Importantly, the relationship in Figure 3 allows for the calculation of the crop water stress index (CWSI). When the season-long CWSI is averaged for each plot, CWSI does not differ significantly from zero (no water stress) for any of the treatments examined (Figure 4). Figure 5 shows average lint yields, seed cotton yields, and water use efficiencies (WUE) for all five irrigation treatments. Importantly, seed cotton yields and lint yields were unaffected by irrigation treatment. However, due to the differences in irrigation water applied during the growing season, WUE was significantly affected by irrigation treatment, where the -0.7, -0.9, and dryland treatments had significantly higher water use efficiency than the checkbook method.

Our findings indicate that water use efficiency could be increased above current irrigation practices with plant-based methods and that remote sensing of canopy temperature may be a viable method for detecting the need for irrigation; however, care should be taken in the analysis of canopy temperature data so as not to include data points under heavy cloud cover.

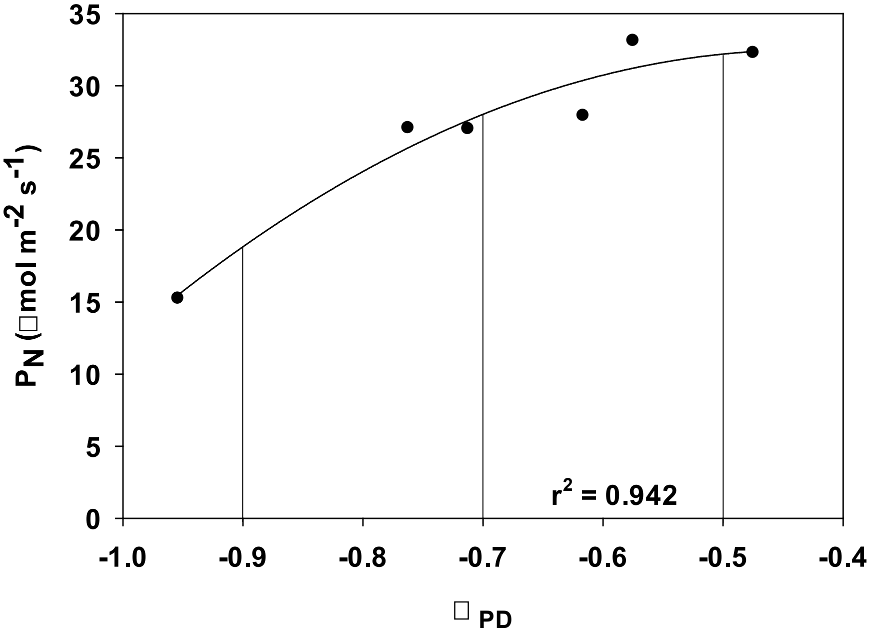

Figure 1. The Relationship Between Net Photosynthesis (P_N) and Predawn Water Potential (Ψ_{PD}). Each Data Point Represents the Average of 12 Replicate Plots Where Three Measurements Were Taken Per Plot. Data Were Obtained During the 2012 Growing Season. The Vertical Lines Indicate the -0.5, -0.7, and -0.9 MPa Ψ_{PD} Irrigation Thresholds Selected for the 2013 Growing Season.

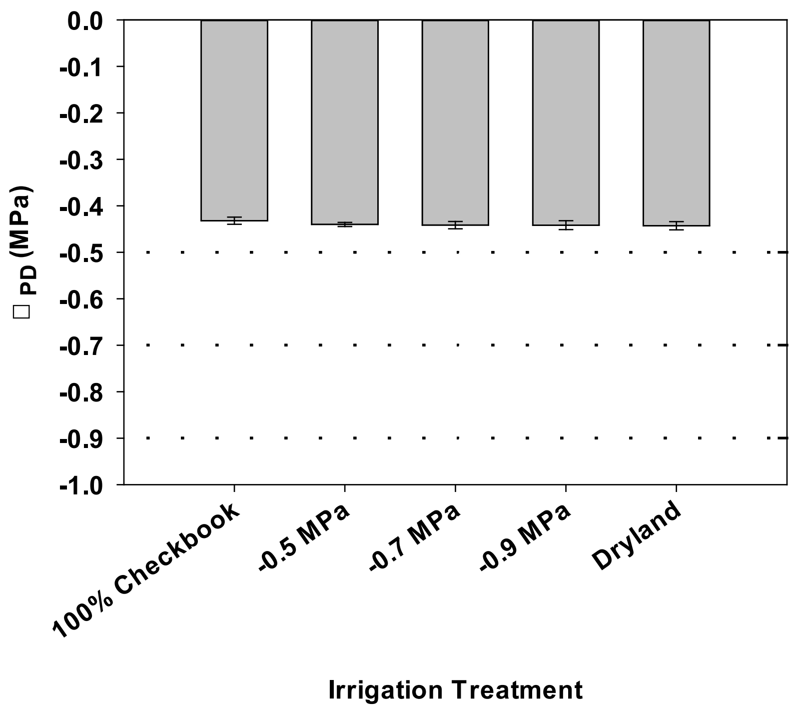

Figure 2. Seasonal Average Predawn Water Potential (ΨPD) for Cotton Grown in 2013. Significant Differences Due to Cultivar, Treatment, or Interaction Were Not Observed. Data Are Means ± SE (n = 8).

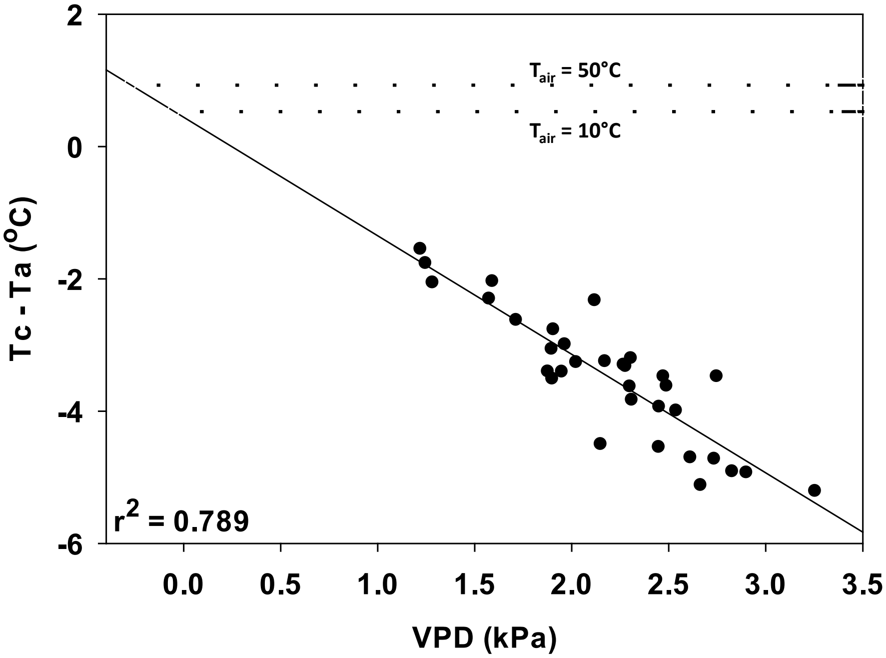

Figure 3. Canopy to Air Temperature Differential (T_c-T_a) vs. Vapor Pressure Deficit (VPD) for Well-Watered, Drip-Irrigated Cotton from Noon to 2:00 p.m. on Dates Where Solar Radiation Was ≥ 600 W m^{-2}. Horizontal Dashed Lines Represent Canopy Temperatures for Non-Transpiring Crop (T_{dry}) Under Two Different Air Temperature Scenarios. Data Are Means For a Given Sample Date (n = 8).

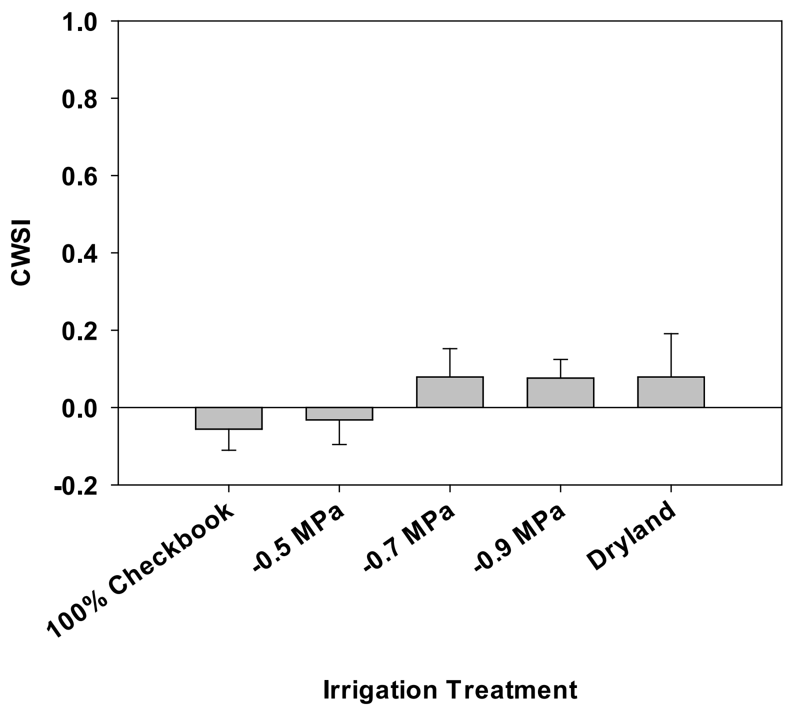

Figure 4. Seasonal Average Crop Water Stress Index (CWSI) for Cotton Grown in 2013. Significant Differences Due to Cultivar, Treatment, or Interaction Were Not Observed. Data Are Means ± SE (n = 8).

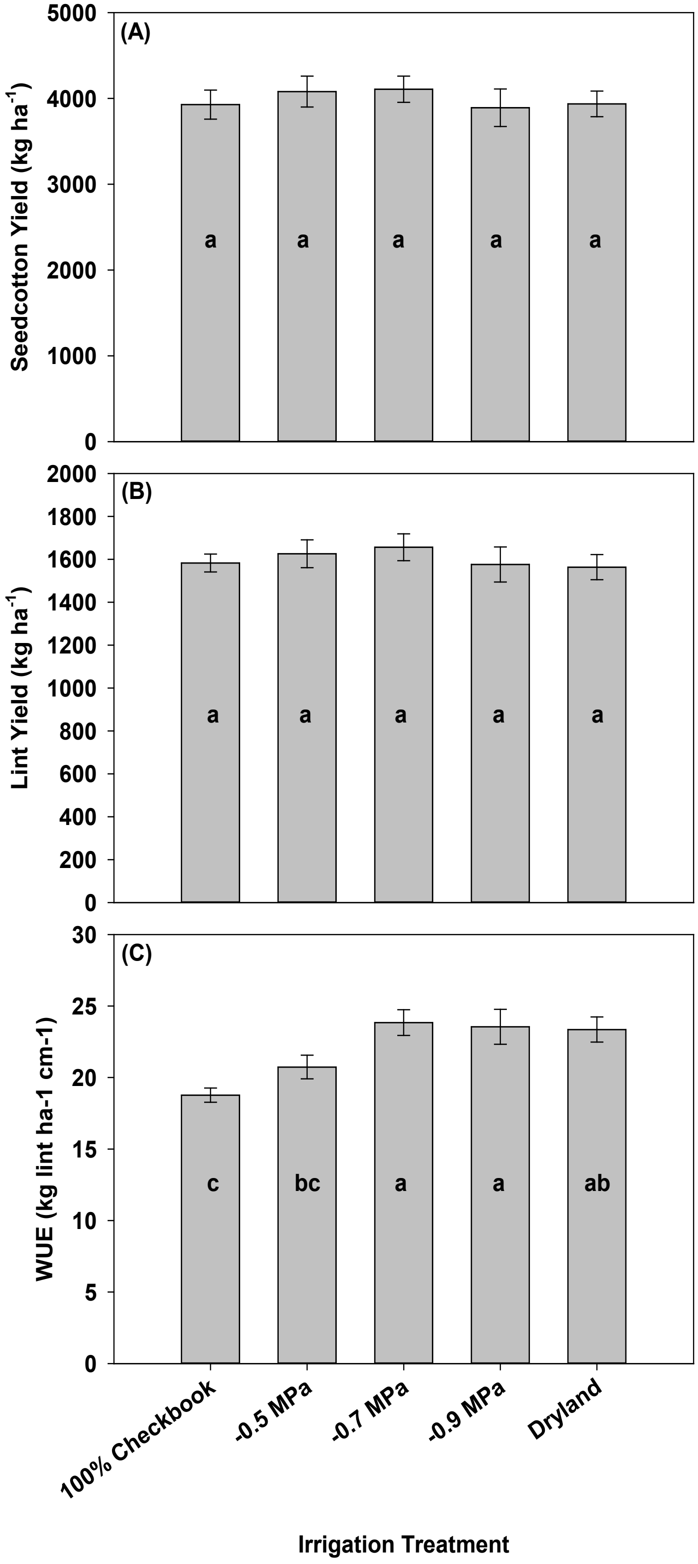

Figure 5. Seed Ccotton (A), Lint Yield (B), and Water Use Efficiency (C) for Cotton Grown Under Five Different Irrigation Regimes Near Camilla, GA, in 2013. Bars Sharing the Same Letter are Not Ssignificantly Different (P ≥ 0.05), and Data Represent Means ± SE (n = 8).

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FERTILIZATION AND COVER CROP INTERACTIONS FOR STRIP-TILL COTTON

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Introduction

Cover crop selection plays an important role in conservation tillage cropping systems, including strip-till cotton (*Gossypium hirsutum* L.) production in Georgia. Some benefits of growing a cover crop in row crop systems include reduced soil erosion in the winter. Reduced fertilizer input is also possible since the cover crop will scavenge nutrients that will then become available to the subsequent crop as the cover crop residue deteriorates during the growing season. Cover crops alone cannot supply the nutrient needs of a cotton crop; however, the balance between the recycling of nutrients from cover crops along with supplemental applications of fertilizer will be useful information to help inform growers about the potential for reducing fertilizer inputs while simultaneously conserving non-renewable resources such as soil and energy inputs required to make fertilizers.

There has been concern of cover crops tying up too much nitrogen and the timing of its release to the next crop (Vyn, Janovicek, Miller, and Beauchamp, 1999). However, cotton yields have been increased with the use of a cover crop compared to not using one (Raper, Reeves, Burmester, and Schwab, 2000). In addition, the type of cover crop selected can supply vastly different amounts of certain nutrients. For example, leguminous cover crops, which can biologically fix atmospheric nitrogen, can add nitrogen the system, while grass cover crops cannot offer this benefit. Yet, even different legumes have different biomass potential, which alters the amount of total nitrogen content that may be available for a following cotton crop. One study has shown higher dry matter and higher nitrogen availability from hairy vetch (*Vicia villosa* Roth) than from other leguminous cover crops as well as higher corn (*Zea mays* L.) yield after vetch than following rye (*Secale cereale* L.) (with no supplemental fertilizer) (Ebelhar, Frye, and Blevins, 1984).

Experiments on the potential yield and quality impact of cotton following certain cover crops have been conducted recently in Georgia. However, the full impacts and nutrient availability of cover crops can be masked by the addition of supplemental fertilizers. The information generated from this project is designed to gain a greater understanding of cover crop and fertilization management, along with their interactive effects, for producing the most economical cotton crop possible under strip-till management.

Materials and Methods

A split-plot experiment with four replications was established on the University of Georgia's Lang Farm on the Tifton Campus in a 1-acre field. Main plot treatment areas measuring 48 feet wide and 45 feet long were planted to one of five treatment effects as cover crop establishment. These included 1) no cover crop, 2) crimson clover (*Trifolium incarnatum* L.), 3) hairy vetch, 4) rye, and 5) winter wheat (*Triticum aestivum* L.). Sub-treatment effects of side-dress fertilization were randomly designated within each main plot treatment as 12 feet x 45 feet sub-plots, including zero, 30, 60, and 90 lbs/acre of nitrogen.

Cover crops were planted on 11/4/2011 as follows:
Crimson clover, 18 lb/acre; hairy vetch, 20 lb/acre; rye, 90 lb/acre; wheat, 90 lb/acre.

Rye and wheat cover crops were terminated on 3/12/2012 and crimson clover and vetch were terminated on 4/3/2012 with Roundup at 2 quarts/acre. Plots were strip-tilled on 5/9/2012. Cotton (DPL 1252) was planted at 3 seed/foot of row at approximately 0.75 inches deep on 5/11/2012. Pre-emergence herbicides were applied on 5/11/2012 including Prowl at 10 ounces/acre, Reflex at 10 ounces/acre, and Cotoran at 1 pint/acre. On 6/11/2012, an application of Roundup Powermax (1 quart/acre) + Staple LX (3 ounces/acre) + surfactant was applied for supplemental weed control. In addition, a directed spray of MSMA (2.5 pints/acre) + Direx (1 quart/acre) + crop oil (1 quart/acre) was applied on 7/13/2012.

Cover crop biomass measurements and soil sampling occurred around the time of cover crop termination on 4/2/2012, prior to the side-dress nitrogen application (7/3/2012) and at maximized vegetative growth (9/25/2012). The mid-season and final sample dates also included cotton whole-plant biomass sampling. Treatment-specific side-dress nitrogen rates were applied on 7/10/2012. Lint harvest occurred on 11/2/2012.

Results

By the time of cover crop termination, crimson clover had produced the most biomass, with three to five times the amount of biomass as the rye and wheat cover crops (Table 1). However, crimson clover decomposed fairly rapidly and was statistically equal to the residue levels of rye and wheat by early July. This is consistent with results from a previous iteration of this research in 2009. There was little remaining residue by late season. The growth of cotton was influenced by the cover crop being grown, as total plant biomass was greatest where the leguminous cover crops were decomposing. This was true prior to the application of side-dress nitrogen in early July, and still the case at the end of the season at peak vegetative biomass production in late September (Table 1). Likewise, nitrogen application affected vegetative biomass growth of cotton linearly, with around a 20 grams per plant difference in dry matter for every additional 30 lbs/acre of nitrogen that was applied (Table 2).

Table 1. Cover Crop Residue Decomposition and cotton vegetative Growth for Cover Crop Effects, Averaged Over N Rates, University of Georgia, Tifton, 2012

Cover Crop	4/2/12 CC^{x} Residue Biomass (kg DM^{y}/ha)		7/3/12 CC Residue Biomass (kg DM/ha)		9/25/12 CC Residue Biomass (kg DM/ha)		7/3/12 Cotton Biomass (g DM/plant)		9/25/12 Cotton Biomass (g DM/plant)	
Crimson Clover	6447	A	1876	AB	504	A	16.0	A	165.8	A
Vetch	2774	B	859	C	202	B	15.1	AB	154.1	AB
Rye	1404	B	1225	BC	112	B	11.9	CD	116.0	C
Wheat	1919	B	2502	A	410	A	9.7	D	129.4	BC
No Cover	-		-		-		12.8	BC	121.7	C
level p	0.0012		.0005		.0002		0.0001		0.004	
SE^{z}	890		383		90		1.4		14.6	

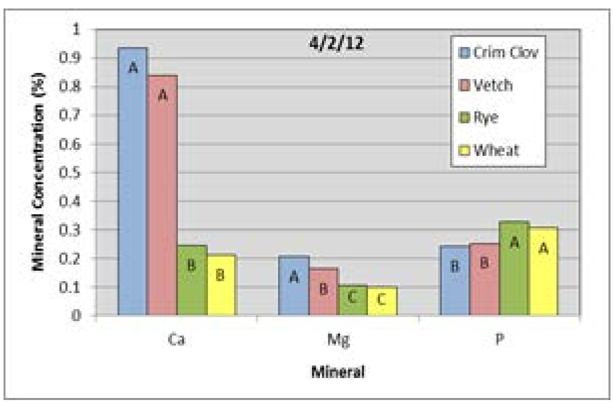
^{x} CC = Cover Crop
^{y} DM = Dry Matter
^{z} SE = Standard Error

Table 2. Cotton Vegetative Growth for Four N Rates, Averaged Over Cover Crops, University of Georgia, Tifton, 2012

N Rate (lb N/acre)	7/3/12 Cotton Biomass (g DM[y]/plant)		9/25/12 Cotton Biomass (g DM/plant)	
0	14.1	A	108.1	C
30	11.7	A	126.7	BC
60	13.6	A	145.8	AB
90	13.0	A	169.0	A
level p	0.231		.0002	
SE[z]	1.2		13.1	

[y] DM = Dry Matter
[z] SE = Standard Error

The mineral concentration in the cover crops varied at time of termination, and it was common for the two leguminous cover crops (crimson clover and vetch) to have similar values to each other and the two grass cover crops (rye and wheat) to have similar values to each other. But, the legume vs. grass comparisons were often different. The legume cover crops had greater mineral concentrations for calcium, magnesium, nitrogen, potassium, copper, zinc, and boron, while the grass cover crops had more phosphorus, and there was no difference among any of the species for manganese (Figures 1-3).



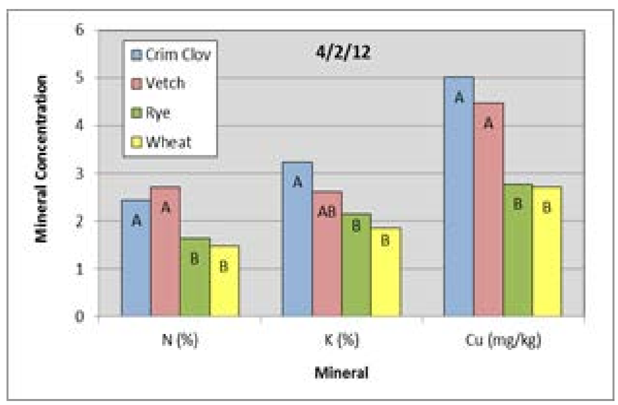


Figure 1 (left). Mineral Concentration of Ca, Mg, and P in Cover Crop Residue at Cover Termination, University of Georgia, Tifton, 2012

Figure 2 (right). Mineral Concentration of N, K, and Cu in Cover Crop Residue at Cover Termination, University of Georgia, Tifton, 2012

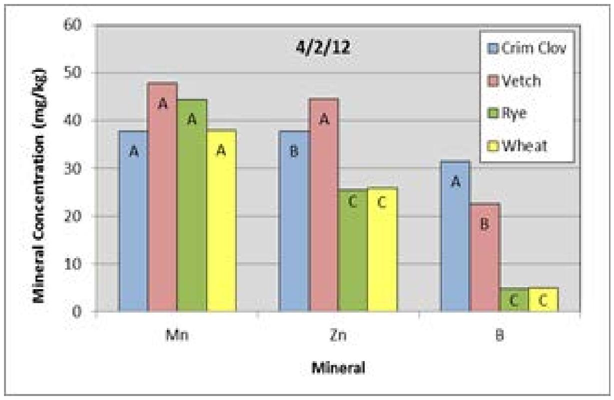
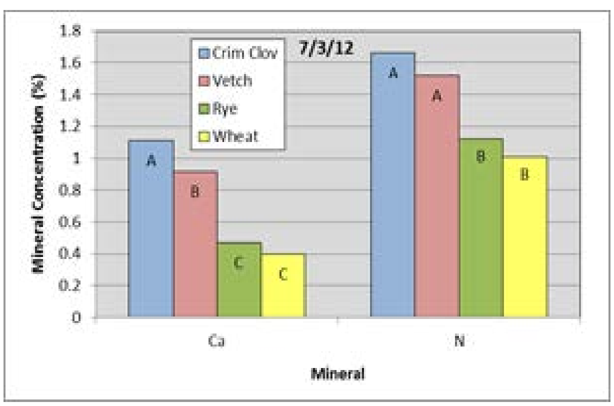


Figure 3. Mineral Concentration of Mn, Zn, and B in Cover Crop Residue at Cover Termination, University of Georgia, Tifton, 2012

By the time of side-dress nitrogen application in early July, after a period of decomposition had occurred (especially for the leguminous covers), the mineral concentration in the remaining cover crop residue still had some similar trends to the sampling in April for certain minerals. However, the separation was less pronounced, and crimson clover had a tendency to retain more nutrients than vetch (such as phosphorus, potassium, magnesium, and boron). There was still a much larger quantity of those nutrients released in crimson clover plots, since the total amount of biomass that decomposed was much greater, but it shows that the concentration of nutrients in vetch tissue was much more rapidly released (Figures 4-6). Concentration levels for the grasses were consistent in their level of release.



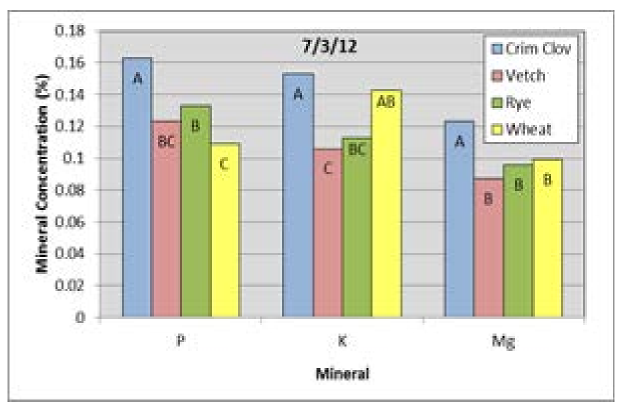
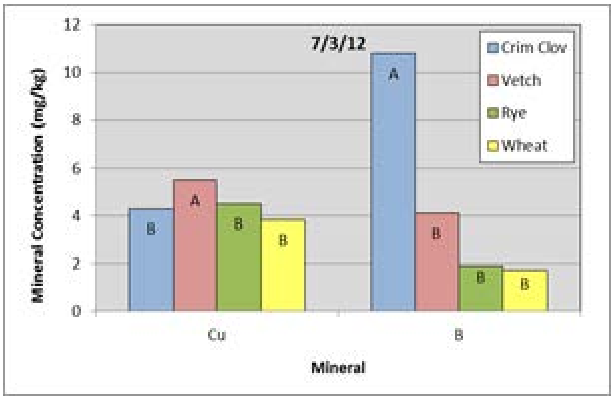


Figure 4 (left). Mineral Concentration of Ca and N in Cover Crop Residue Prior to Side-Dress N Application, University of Georgia, Tifton, 2012

Figure 5 (right). Mineral Concentration of P, K, and Mg in Cover Crop Residue Prior to Side-Dress N Application, University of Georgia, Tifton, 2012



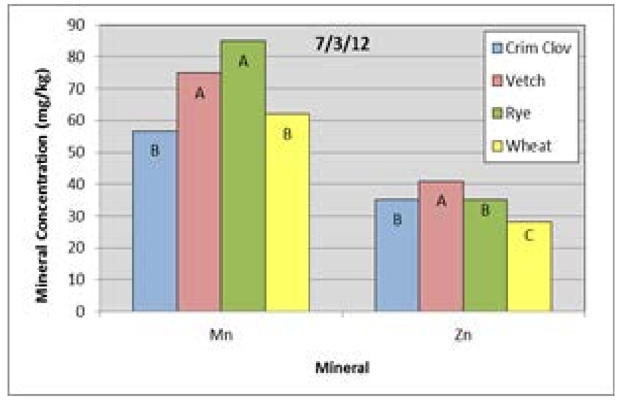
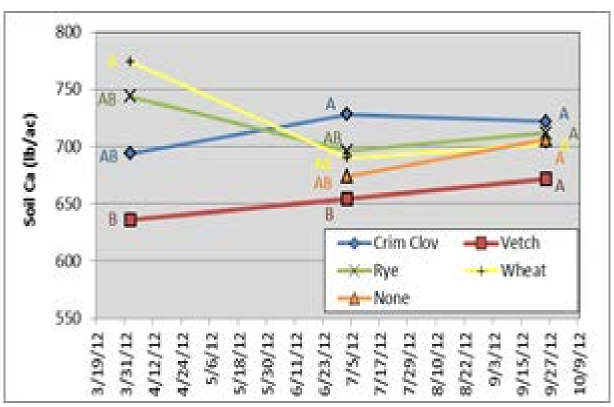


Figure 6 (left). Mineral Concentration of Cu and B in Cover Crop Residue Prior to Side-Dress N Application, University of Georgia, Tifton, 2012

Figure 7 (right). Mineral Concentration of Mn and Zn in Cover Crop Residue Prior to Side-Dress N Application, University of Georgia, Tifton, 2012

Soil test levels for calcium responded as expected. Calcium increased in plots where the leguminous cover crops were planted, as they had rapid decomposition and much higher calcium concentration than the grass covers (Figure 8). Soil calcium decreased during the first three months after cover crop termination where grass covers were grown, since there was very little decomposition of residues during this timeframe and the cotton plants were removing calcium from the soil at a more rapid rate than replenishment by the covers. By the end of the season, additional deterioration of cover residues and less need by the cotton plant (seen in the reduction in concentration within the cotton plant by late September, Figure 9) caused soil test calcium levels to remain the same or slightly increase.



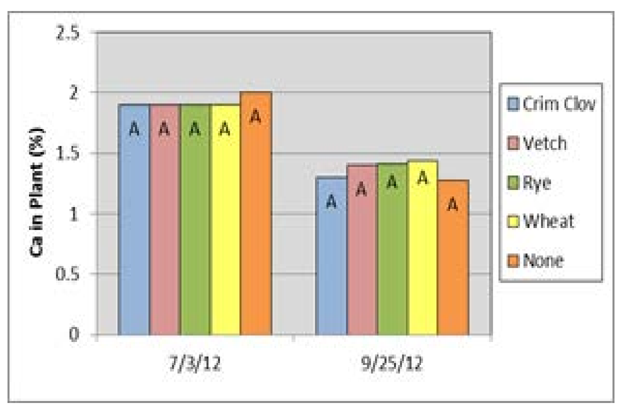
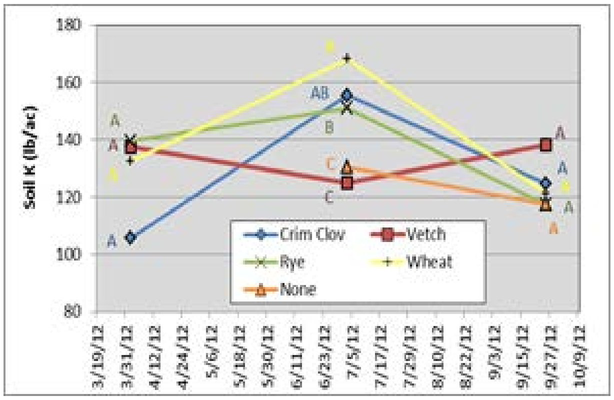


Figure 8 (left). Soil Ca During Growing Season, University of Georgia, Tifton, 2012

Figure 9 (right). Mineral Concentration of Ca in Cotton Plants Averaged Over Side-Dress N Treatments, Pre-Side-Dress (7/3/2012) and Pre-Defoliation (9/25/2012), University of Georgia, Tifton, 2012

Potassium concentration in residue decreased dramatically from April until July (Figures 2 and 5), meaning the majority of potassium left the residue since it is a mobile element. This may explain why soil potassium levels increased from April until July for most plots (Figure 10).

Since cotton biomass increased ten-fold from July until September, while potassium concentration remained nearly the same during this timeframe (Figure 11), soil potassium levels decreased. In addition, there were relatively consistent rains during the latter half of the season, and with the relative mobility of potassium in the soil, it is possible that some leaching of the element occurred, pushing it below our sample depth.



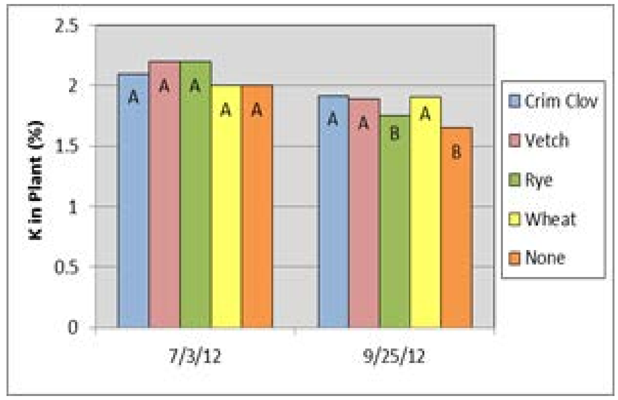
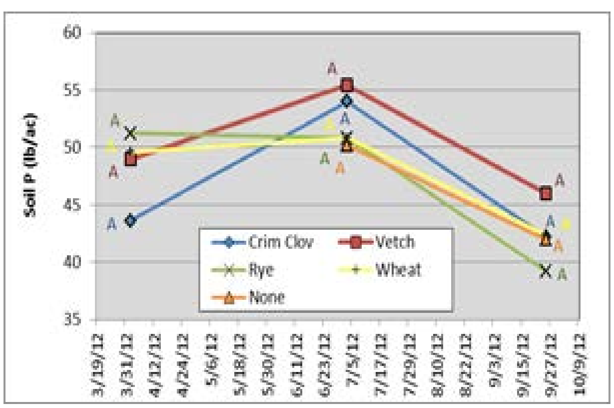


Figure 10 (left). Soil K During Growing Season, University of Georgia, Tifton, 2012

Figure 11 (right). Mineral Concentration of K in Cotton Plants Averaged Over Side-Dress N Treatments, Pre-Side-Dress (7/3/2012) and Pre-Defoliation (9/25/2012), University of Georgia, Tifton, 2012

There was a greater initial concentration of phosphorus in the grass cover crops (Figure 1), but the larger quantities of biomass decomposition by the legumes caused an increase in turnover of phosphorus to the soil for those crops before side-dress nitrogen, while the lack of decomposition of the grasses caused soil phosphorus to remain the same during the same timeframe (Figure 12). There was a decrease in late season soil phosphorus as the cotton plant grew. By end of the season, there was a higher concentration of phosphorus in cotton plants where the grass cover crops were grown (Figure 13).



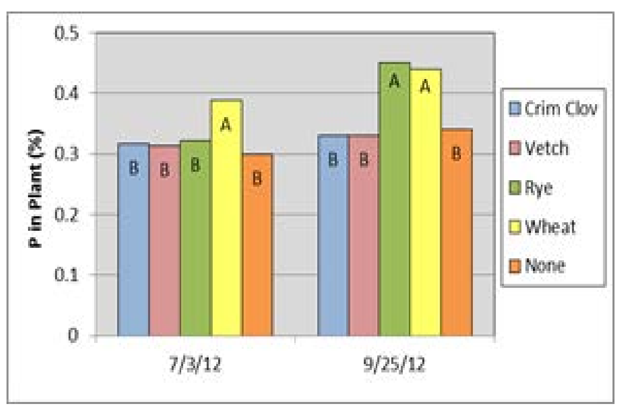
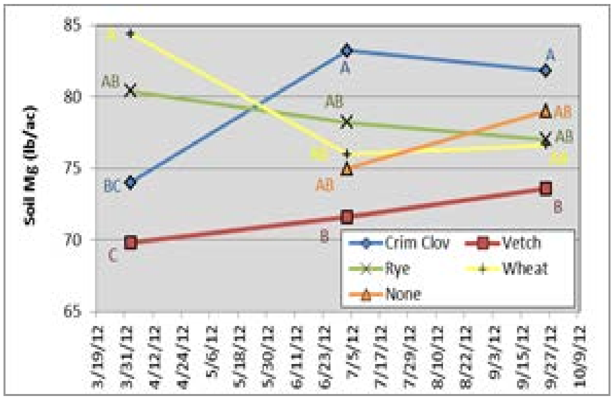


Figure 12 (left). Soil P During Growing Season, University of Georgia, Tifton, 2012

Figure 13 (right). Mineral Concentration of P in Cotton Plants Averaged Over Side-Dress N Treatments, Pre-Side-Dress (7/3/2012) and Pre-Defoliation (9/25/2012), University of Georgia, Tifton, 2012

Magnesium was in higher concentration in the leguminous cover crops than any other cover crop at the time of termination (Figure 1). Because of the decomposition of the leguminous cover crops over time, the soil concentration of magnesium increased (Figure 14), and provided more magnesium for cotton plants to uptake by mid-season (Figure 15). However, there was no difference in magnesium in cotton plant tissue by the end of the season, and only crimson clover plots had statistically more soil magnesium than vetch at the final sampling, partially because of the larger amount of residue that decomposed over the course of the season.



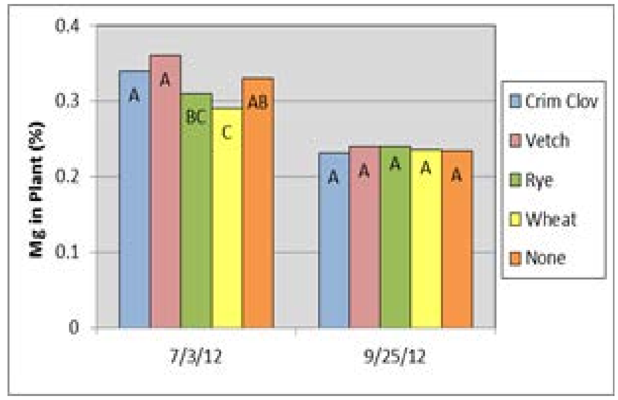
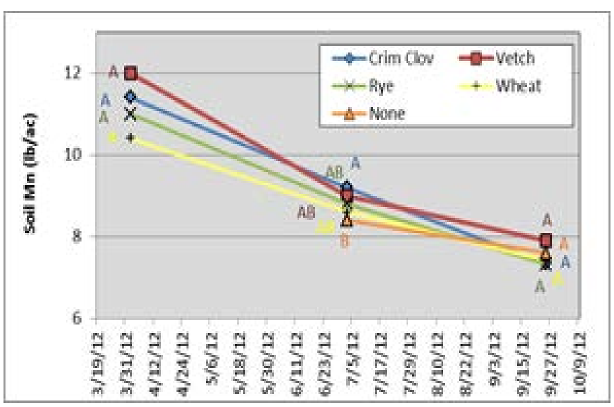


Figure 14 (left). Soil Mg During Growing Season, University of Georgia, Tifton, 2012

Figure 15 (right). Mineral Concentration of Mg in Cotton Plants Averaged Over Side-Dress N Treatments, Pre-Side-Dress (7/3/2012) and Pre-Defoliation (9/25/2012), University of Georgia, Tifton, 2012

There were few statistical differences in cover crop (Figures 3 and 7), soil (Figure 16), or cotton tissue (Figure 17) concentrations for manganese during the season. Consistent with a sister trial from 2007, concentrations of manganese in the cover crop tissue increased from termination until mid-season. Since manganese is considered an immobile element, it is not likely to rapidly decompose or leach from cover crop residue, and thus uptake by the cotton plant causes depletion of soil manganese.



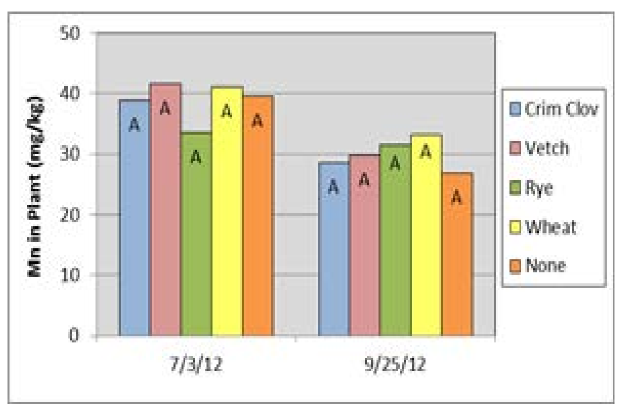
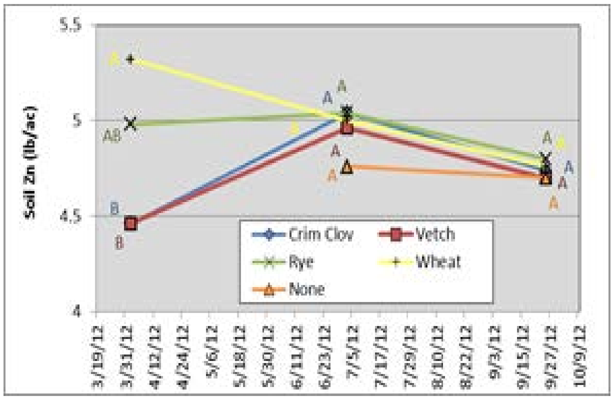


Figure 16 (left). Soil Mn During Growing Season, University of Georgia, Tifton, 2012

Figure 17 (right). Mineral Concentration of Mn in Cotton Plants Averaged Over Side-Dress N Treatments, Pre-Side-Dress (7/3/2012) and Pre-Defoliation (9/25/2012), University of Georgia, Tifton, 2012

Concentration of zinc in cover crop tissue was initially highest in leguminous cover crops (Figure 3), and remained higher than in wheat by mid-season (Figure 7). The greater quantities of legume decomposition in the first half of the season caused an increase in soil zinc levels initially (Figure 18). However, all plots resulted in depletion of soil zinc during the latter half of the season. At the end of the season, there were higher concentrations of zinc in plots where rye and wheat were grown. There were no direct indications why this occurred.



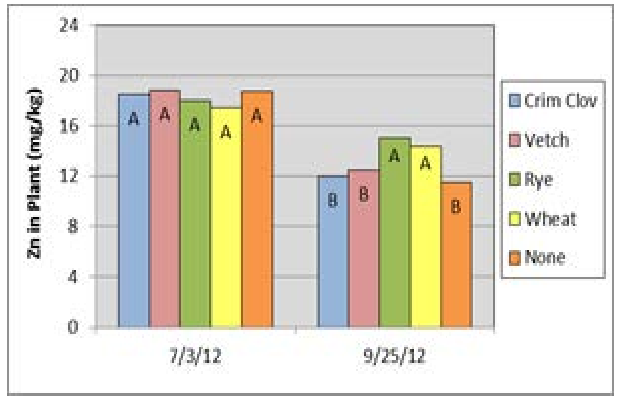


Figure 18 (left). Soil Zn During Growing Season, University of Georgia, Tifton, 2012

Figure 19 (right). Mineral Concentration of Zn in Cotton Plants Averaged over Side-Dress N Treatments, Pre-Side-Dress (7/3/2012) and Pre-Defoliation (9/25/2012), University of Georgia, Tifton, 2012

Concentration of nitrogen was highest in leguminous cover crops at burndown and mid-season, as expected (Figures 2 and 4). This translated to higher levels of nitrogen in cotton plants following the leguminous covers in most pairwise comparisons to other cover crop treatments (Figure 20). Soil nitrogen was not collected because of the extreme mobility in sandy soils and expense for conducting soil nitrogen tests for relatively inaccurate information. Results for copper in both cover crop (Figures 2 and 6) and cotton plant tissues (Figure 21) were similar to zinc over the course of the season. Boron had much higher concentrations in leguminous crops, especially in crimson clover (Figures 3 and 6), although this did not result in higher boron concentrations in the cotton plants (Figure 22).

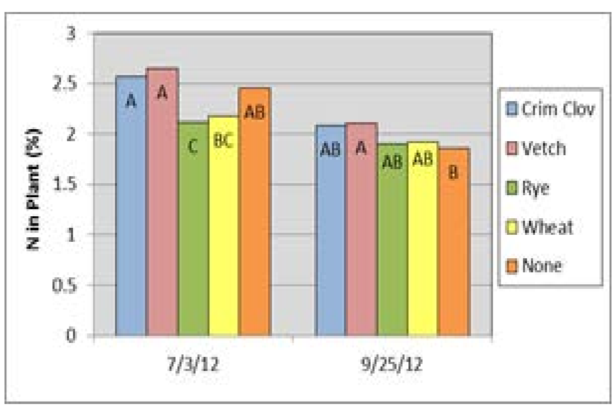
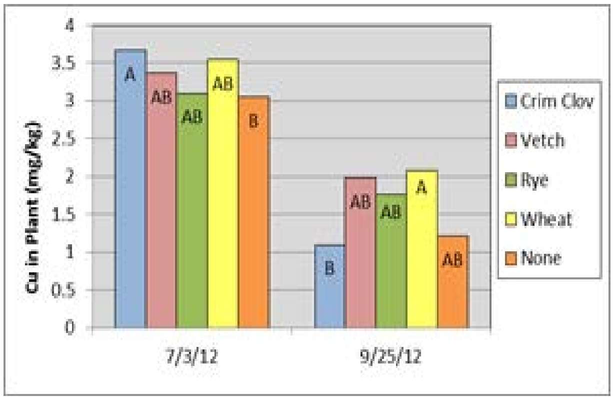


Figure 20. Mineral Concentration of N in Cotton Plants Averaged Over Side-Dress N Treatments, Pre-Side-Dress (7/3/2012) and Pre-Defoliation (9/25/2012), University of Georgia, Tifton, 2012



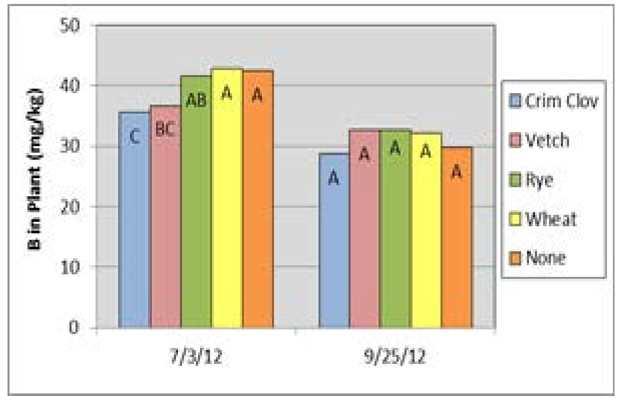
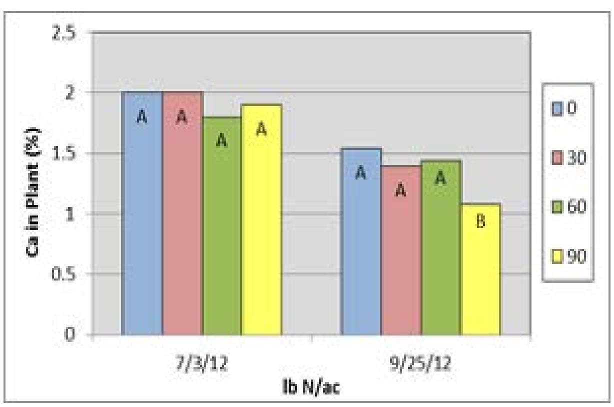


Figure 21 (left). Mineral Concentration of Cu in Cotton Plants Averaged Over Side-Dress N Treatments, Pre-Side-Dress (7/3/2012) and Pre-Defoliation (9/25/2012), University of Georgia, Tifton, 2012

Figure 22 (right). Mineral Concentration of B in Cotton Plants Averaged Over Side-Dress N Treatments, Pre-Sidedress (7/3/2012) and Pre-Defoliation (9/25/2012), University of Georgia, Tifton, 2012

General trends for application of side-dress nitrogen were similar for most minerals (Figures 23-31). In most cases, there was a decreasing trend in concentration of the various nutrients tested with increasing rate of nitrogen application. This was noted for calcium, phosphorus, magnesium, manganese, and zinc, especially at the end of the season. There was no evidence of nutrient differences for potassium, nitrogen, or boron at any of the side-dress nitrogen rates, especially at the end of the season. The only nutrient with a highly abnormal response at the various nitrogen rates was copper, where the zero, 30, and 90 lbs/acre of nitrogen rates followed a decreasing trend with increasing nitrogen rate, but the 60 lbs/acre of nitrogen rate resulted in the highest concentration of copper (Figure 28).



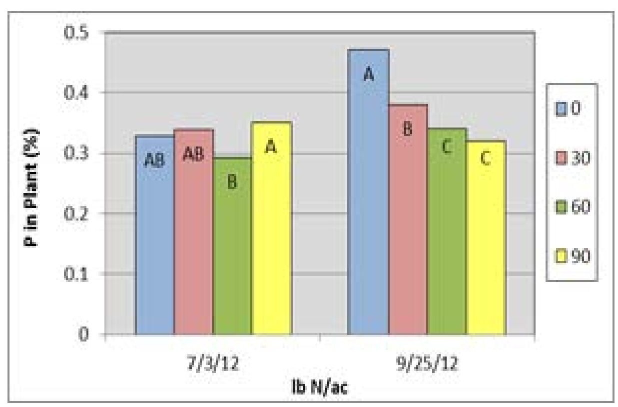
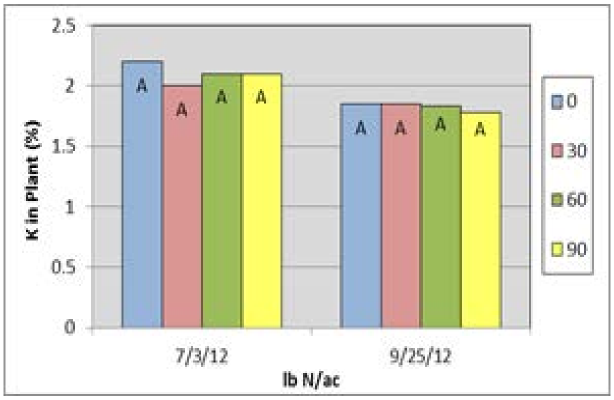


Figure 23 (left). Mineral Concentration of Ca in Cotton Plants Averaged Over Cover Crop Treatments, Pre-Side-Dress (7/3/2012) and Pre-Defoliation (9/25/2012), University of Georgia, Tifton, 2012

Figure 24 (right). Mineral Concentration of P in Cotton Plants Averaged Over Cover Crop Treatments, Pre-Side-Dress (7/3/2012) and Pre-Defoliation (9/25/2012), University of Georgia, Tifton, 2012



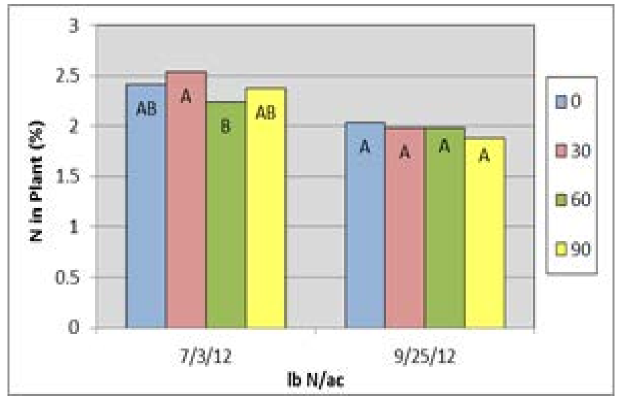
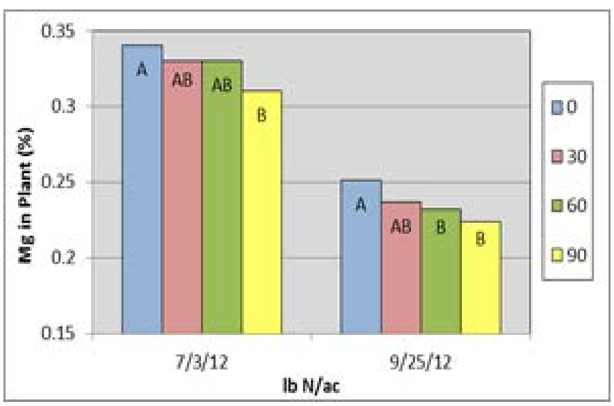


Figure 25 (left). Mineral Concentration of K in Cotton Plants Averaged Over Cover Crop Treatments, Pre-Side-Dress (7/3/2012) and Pre-Defoliation (9/25/2012), University of Georgia, Tifton, 2012

Figure 26 (right). Mineral Concentration of N in Cotton Plants Averaged Over Cover Crop Treatments, Pre-Side-Dress (7/3/2012) and Pre-Defoliation (9/25/2012), University of Georgia, Tifton, 2012



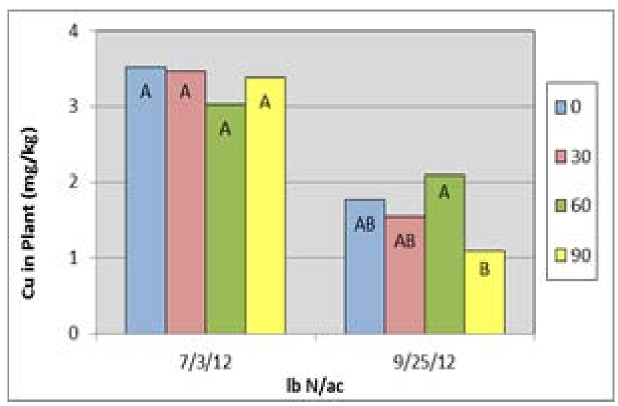
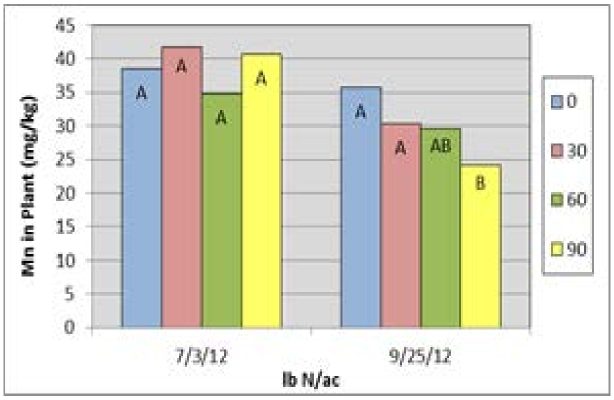


Figure 27 (left). Mineral Concentration of Mg in Cotton Plants Averaged Over Cover Crop Treatments, Pre-Side-Dress (7/3/2012) and Pre-Defoliation (9/25/2012), University of Georgia, Tifton, 2012

Figure 28 (right). Mineral Concentration of Cu in Cotton Plants Averaged Over Cover Crop Treatments, Pre-Side-Dress (7/3/2012) and Pre-Defoliation (9/25/2012), University of Georgia, Tifton, 2012



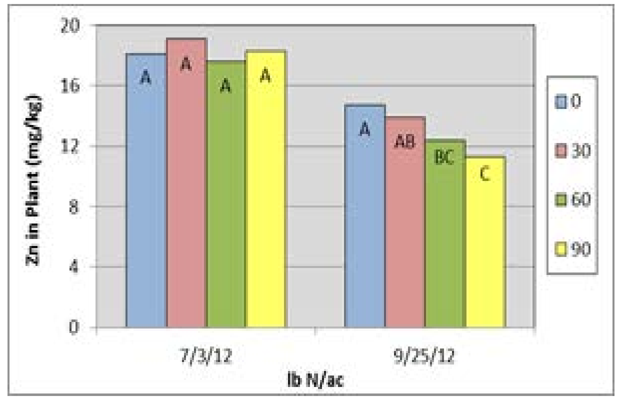


Figure 29 (left). Mineral Concentration of Mn in Cotton Plants Averaged Over Cover Crop Treatments, Pre-Side-Dress (7/3/2012) and Pre-Defoliation (9/25/2012), University of Georgia, Tifton, 2012

Figure 30 (right). Mineral Concentration of Zn in Cotton Plants Averaged Over Cover Crop Treatments, Pre-Side-Dress (7/3/2012) and Pre-Defoliation (9/25/2012), University of Georgia, Tifton, 2012

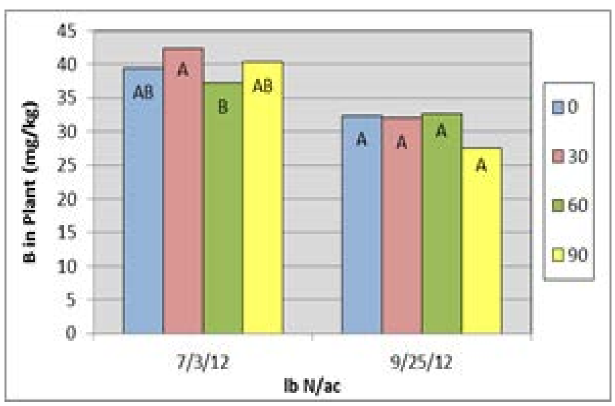


Figure 31. Mineral Concentration of B in Cotton Plants Averaged Over Cover Crop Treatments, Pre-Side-Dress (7/3/2012) and Pre-Defoliation (9/25/2012), University of Georgia, Tifton, 2012

Aside from all nutrient data, the most important take-home message to a grower is yield. There were significant differences in yield response to cover crop (Table 3) and to side-dress nitrogen rate (Table 4). There was an interaction of cover crop x side-dress nitrogen rate at the $0.10 > p > 0.05$ level of significance, although data for the interaction will not be shown in this report. When analyzed at the $\alpha=0.10$ level, the primary trend in the interaction effects were that there was no statistical difference in nitrogen rate at any level for crimson clover and vetch, while there was a difference for low input rates (zero and sometimes 30 lbs/acre of nitrogen) when compared to high input rates (60 and 90 lbs/acre of nitrogen) for the rye, wheat, and no cover crop treatments. This would indicate that the supplemental nutrients supplied by leguminous cover crops (crimson clover and vetch) may make it possible for reduced side-dress nitrogen applications for cotton, or less detrimental effect of untimely or lost fertilizer nitrogen due to volatilization or leaching, when following these cover crops.

When viewing the individual treatment factors alone and not in interaction, expected trends were observed. Lint yield was highest when cotton followed the leguminous cover crops (Table 3). There was no major advantage of having a grass cover crop over having no cover crop in terms of yield, and this would be an even narrower margin when the economics of additional seed and planting costs for the cover crop are incorporated. However, the benefits of grass cover crops are not typically observed in the short-term, but in the soil quality parameters built over time (such as soil organic matter). With respect to side-dress nitrogen application, yields increased with increasing nitrogen rate, although there was no statistical advantage from applying 90 lbs/acre of nitrogen over 60 lbs/acre of nitrogen (Table 4). This data would suggest that planting a leguminous cover crop provides the greatest opportunity for maximized yield, and a side-dress nitrogen application rate of approximately 60 lbs/acre of nitrogen is needed for optimized production. However, a closer look at the interaction values varies between cover crop and nitrogen rate applications.

Table 3. Lint Yield (lb/acre) for Cover Crop Effects, Averaged Over N Rates, University of Georgia, Tifton, 2012

Cover Crop	Lint Yield (lb/ac)	
Crimson Clover	1450	AB
Vetch	1566	A
Rye	1396	BC
Wheat	1414	BC
No Cover	1294	C
level p	0.0011	
SE[z]	60.4	

[z] SE = Standard Error

Table 4. Lint Yield (lb/acre) for Side-Dress N Rate Effects, Averaged Over Cover Crops, University of Georgia, Tifton, 2012

N Rate (lb N/ac)	Lint Yield (lb/ac)	
0	1285	C
30	1406	B
60	1469	AB
90	1536	A
level p	0.0002	
SE[z]	54.0	

[z] SE = Standard Error

Acknowledgments

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FLUORESCENCE IMAGING OF COTTON TRASH

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Introduction

Cotton lint is contaminated with trash particles from botanical and non-botanical sources during harvesting with cotton strippers and cotton pickers (Wakelyn et al., 2007). The presence of trash admixed with lint causes problems during processing and ultimately reduces its monetary value (Brashears, Baker, Bragg, and Simpson, 1992). Seed cotton undergoes cleaning at cotton gins where most trash is removed; however, ever smaller particles remain present. Ginned lint is baled and samples from individual bales are graded at the classing office. Grading is performed by human classers and instruments, with instruments providing more objective assessments (Xu and Fang, 1998).

Grading instruments include the High Volume Instrument (HVI), Shirley Analyzer (SA), and the Advanced Fiber Information System (AFIS). The HVI obtains fiber measurements using the geometric method by imaging the sample area to calculate the surface area covered with trash, while the SA and the AFIS are based on the gravimetric method to mechanically separate fibers. All of the systems lack the ability to differentiate trash categories. In this study, the feasibility of using fluorescent imaging for cotton trash detection and classification was tested.

The following objectives were addressed in the current study: 1) characterize different categories of cotton trash with fluorescence spectroscopy, 2) build a fluorescent imaging apparatus and select excitation sources based on the results from fluorescence spectroscopy, 3) extract features from fluorescent image and classify cotton trash.

Materials and Methods

Fluorescence Spectroscopy Analysis

Botanical trash (bark, green leaf) samples extracted from four cotton cultivars- (DP 0912, DP 1050, PhytoGen 499, FiberMax 1944) and non-botanical trash (paper, plastic bag) samples were dissolved in dimethyl sulfoxide (DMSO) for two hours. Extracts were filtered and analyzed with a fluorospectrometer. Excitation wavelength ranged from 300 nm to 500 nm, and emission was recorded from 320 nm to 700 nm.

Fluorescence Imaging of Cotton Trash

A total of 30 samples per trash category were placed on top of a lint layer and imaged under two types of excitation light. Under blue LED, light bark and green leaf were imaged, while under the UV LED, light paper and plastic bag were imaged (Figure 1). A camera was equipped with a longpass filter (400nm when blue LEDs were used, and 500nm when the UV LED was used) to remove any reflectance acquired in raw images, which were converted to the TIFF images with an open source software UFRaw (http://ufraw.sourceforge.net/). The resulting TIFF images were binned 4x4 and further denoising was applied with the median filter. Regions of interest were delineated and color features from the RGB (Red, Green, Blue) and HSV (Hue, Saturation, Value) images extracted and tested for significance with the MANOVA test (SAS 9.2, SAS Institute, Cary, NC).

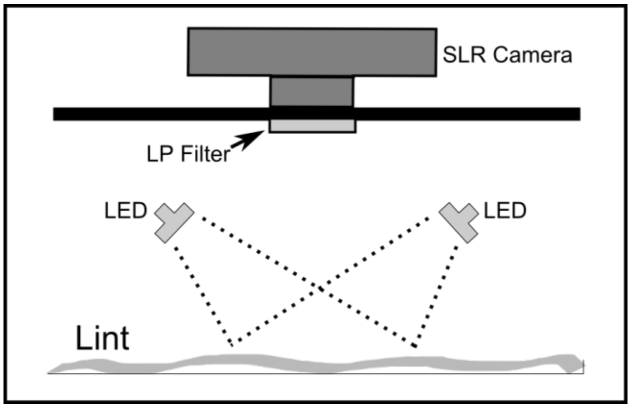

Figure 1. Fluorescence Imaging System Front View

Cotton Trash Classification

To classify cotton trash, the Linear Discriminant Analysis (LDA) algorithm (Matlab R2013a, Natick, MA) was used. Each trash category contained 30 observations, and 50 percent of the observations were used for training and 50 percent for testing. The order was then rotated, and those used for training were used for testing, and vice versa. Cross validation was performed with the leave-one-out and the 5-fold cross validation method.

Results and Discussion

Matrix 3D scan of bark (Figure 2) exhibits an emission peak in the red spectral range at 672 nm while excited at 430 nm. Green leaf was optimally excited at 410 nm and emitted at 675 nm. In contrast, paper and plastic bag exhibited optimal excitation in the UV spectral region (360 nm and 370 nm), with optimal emission at 412 nm and 417 nm, respectively. Both bark and green leaf fluoresce red because of a fluorophore-chlorophyll, while paper and plastic bag fluoresce blue because of presence of fluorescent whitening agents (in the case of paper), and coloring pigments (in the case of plastic bag).

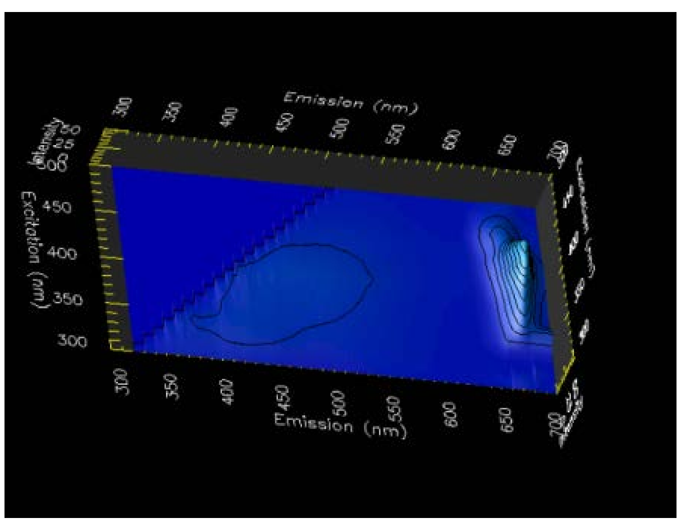

Figure 2. Fluorescence Spectroscopy Scan of Bark. Optimal Excitation/Emission Peaks Are at 430/672 nm

Based on the fluoroscopic analysis of botanical and non-botanical trash, it is possible to determine which excitation light sources can be used to induce optimal fluorescence emission in cotton trash. Fluorescent images of bark and green leaf were acquired under the blue LED excitation light and paper and plastic bag under UV LED excitation light (Figure 3).

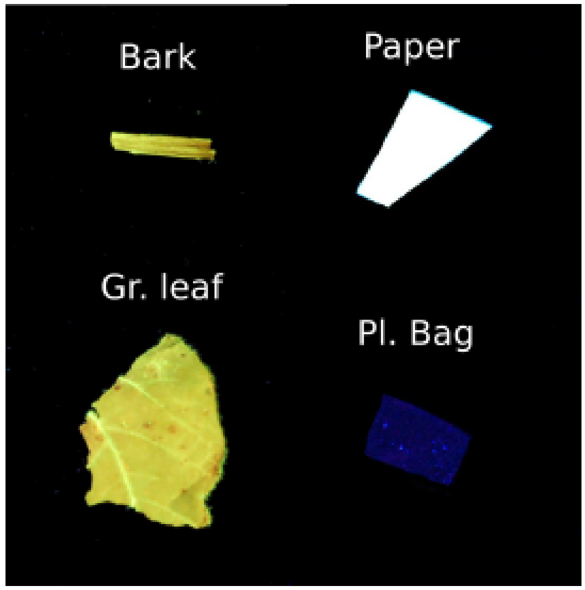

Figure 3. Fluorescent Images of Bark and Green Leaf (Excited With Blue LED Light) and Paper and Plastic Bag (Excited With UV LED Light)

To classify different categories of cotton trash, features from the RGB and HSV color model were extracted. Features from the RGB color model included red/green, red/blue, blue/green ratio, and features from the HSV images included H, S, and V. When images were acquired under the blue LED excitation light, features with the blue channel were not included because during imaging, the blue channel was effectively cut off to prevent any pseudo-fluorescence. To reduce the number of features, only the three features with the highest F-values based on the MANOVA test were used for classification. These features were red/green, H, and V (for images acquired under blue LED light), and B/G, S, and V (for images acquired under blue LED light). The LDA classification rates were highest for paper (100 percent), followed by green leaf (96.67 percent) and plastic bag (90 percent), and lowest for bark (76.67 percent).

Table 1. LDA Classification Results.

Trash Category	Classification Rate (%)
Bark	76.67
Gr. Leaf	96.67
Paper	100.00
Pl. Bag	90.00

Summary

The study demonstrated the capabilities of fluorescence imaging to detect and classify cotton trash. Fluoroscopic characterization findings of different types of cotton trash indicated their ability to be photoexcited and emit fluorescence in the UV and blue light spectral range. An imaging system was constructed with an SLR camera as the photo capturing device and blue and UV LEDs serving as excitation sources. Fluorescent images of cotton trash placed on top of lint were acquired and color features extracted from these images were used for classification. Classification rates of 90 percent and higher were achieved for plastic bag, green leaf, and paper. In comparison, the bark classification rate was noticeably lower at 76.67 percent. A potential explanation is that unlike other types of cotton trash, bark has a more heterogeneous appearance. Bark represents the outer layer of the stem and as such has a different appearance depending on which side is imaged, thus directly affecting its color appearance. This color variation affects the values of color features used in classification, and results in bark being misclassified as other trash types.

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THRIPS MANAGEMENT: USE OF FOLIAR INSECTICIDE SPRAYS TO SUPPLEMENT PREVENTIVE TREATMENTS BASED ON THRIPS RISK ASSESSMENT

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Introduction

Thrips are consistent and predictable insect pests of seedling cotton in Georgia and the southeastern US. Thrips infest cotton at emergence and initially feed on the lower surface of cotyledons prior to feeding in the terminal bud of developing seedlings. Excessive thrips feeding results in crinkled malformed true leaves, stunted plants, delayed maturity, reduced yield potential, and in severe cases loss of apical dominance and stand loss. Cotton seedlings are most susceptible to thrips during the early stages of development (cotyledon thru 2-leaf). Once seedlings reach the 4-leaf stage and are growing rapidly, thrips are rarely an economic concern.

Preventive insecticide treatments at planting are used by most growers for early season thrips control. The most common preventive treatments include the systemic insecticides imidacloprid or thiamethoxam applied as a commercial seed treatment. Both imidacloprid and thiamethoxam are neonicotinoid insecticides. Performance in Georgia has historically been similar when used as a seed treatment for thrips control; thus we will refer to these insecticides collectively as neonicotinoid seed treatments (NST).

Neonicotinoid seed treatments are active on thrips for about 21 days after planting (DAP); however, supplemental foliar sprays are needed in some environments (high thrips populations and/or extended infestations). There are two cultural practices that have a significant impact on thrips populations: 1) planting date and 2) tillage practice. Thrips infestations are typically higher on cotton planted during April and early May compared with late May and June plantings. Thrips infestations are also significantly greater in conventional tillage systems compared with reduced tillage systems. A risk index of thrips infestations may be predicted for cotton planted based on these two cultural practices, planting date and tillage practice. Cotton planted in April or early May in a conventional tillage system would be considered “high risk” for thrips. Whereas cotton planted after mid-May and/or in a reduced tillage system would be considered “low risk” for thrips. The objective of this study was to quantify the effect of a supplemental foliar insecticide spray when an NST is used in high- and low-risk thrips environments.

Materials and Methods

Data was summarized from small plot trials conducted by the University of Georgia, which included an NST with and without a foliar insecticide spray at the 1-leaf stage. In total 23 trials conducted from 2001 to 2013 were included in the data summary. Individual trials were assembled into “risk groups” based on planting date and tillage practice. Trials that were planted prior to May 10 in a conventional tillage system were placed in the high-thrips-risk group. Whereas trials planted after May 10 and/or in a reduced tillage system were placed in the low-thrips-risk group. Trial yields from the NST alone and the NST+foliar 1-leaf treatment were compared in each risk group using a paired t-test.

Results and Discussion

Sixteen trials were placed in the high-thrips-risk group and seven trials were placed in the low-thrips-risk group. The yield response associated with using an NST compared with no insecticide (NST minus no insecticide) is illustrated in Figure 1. Yields were numerically increased in 22 of 23 trials with an average yield increase of 251 pounds lint per acre when an NST was used compared with no insecticide plots. Yield responses tended to be greater in trials conducted in high-risk environments. On average yields were 308 and 121 pounds lint per acre higher when compared with no insecticide plots in high- and low-risk environments, respectively. This consistent yield response to NSTs is why most growers use preventive insecticides at planting for thrips control.

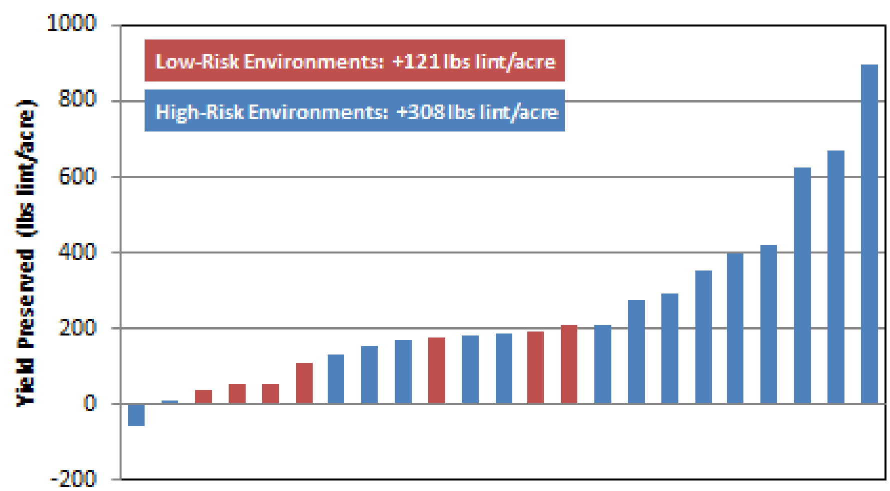

Figure 1. Yield Response to Thrips Control

Neonic Seed Treatments, 23 Trials (2001-2013)

Foliar insecticide (generally acephate at 0.18 lb ai/acre) was applied at the 1-leaf stage. On average the foliar insecticide was applied at 16 DAP with a range of 13-20 DAP. Figure 2 illustrates mean yield for no insecticide, NST, and NST+foliar 1-leaf in the low-risk and high-risk groups. Yields were not statistically different (prob (t) = 0.6043) for NSTs with and without a supplemental foliar spray in the low-risk environment, 1,335 pounds lint and 1,348 pounds lint per acre, respectively. Whereas, the NST+foliar 1-leaf treatment had significantly higher yields (prob (t) = 0.0122) compared with the NST alone in the high-risk environment, 1,526 pounds lint and 1,457 pounds lint per acre, respectively.

In summary, commercial seed treatments including imidacloprid or thiamethoxam provide similar levels of thrips control and are active on thrips for about three weeks after planting. Neonicotinoid seed treatments provide a consistent yield response in both low- and high-thrips-risk environments. However, research and observation have shown that a supplemental foliar insecticide spray is often needed in addition to an NST when thrips infestations are high, i.e. a high-thrips-risk environment. All cotton should be scouted on a regular basis for thrips and other insect pests, but we should expect higher thrips populations on cotton planted prior to May 10 in a conventionally tilled system compared with cotton planted after May 10 and/or in a reduced tillage system. Unless frequent and thorough scouting reveals thrips populations are below the threshold of two to three thrips per plant with immatures present, a foliar thrips systemic insecticide should be applied at the 1-leaf stage in conventional tilled fields planted prior to May 10 when an NST is used.

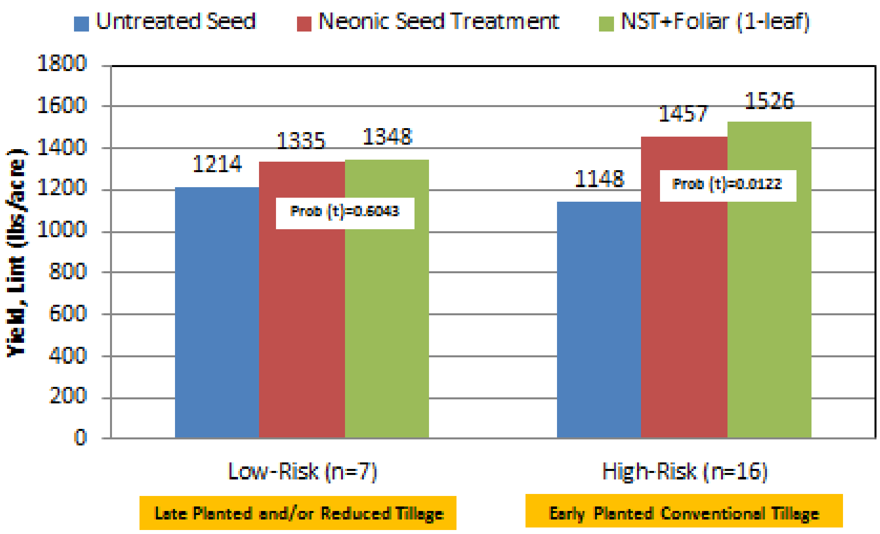

Figure 2. Yield Response to Thrips Management in Low Risk and High Risk Environments

In most situations an NST plus a foliar insecticide at the 1-leaf stage provides good thrips control, but fields should be scouted regularly for thrips and injury following the foliar spray until seedlings reach the 4-leaf stage and are growing rapidly. In fields planted after May 10 or where reduced tillage is used, the risk of damaging thrips infestations is lower, and an automatic foliar spray should not be applied when an NST is used. Fields in this low-thrips-risk environment should be scouted and treated in a timely manner when thresholds are exceeded.

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