COTTON
RESEARCH-EXTENSION REPORT – 2010

The University of Georgia
College of Agricultural and Environmental Sciences
Edited by A. Smith, G. Collins, and C. Li

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J. Scott Angle
Dean and Director
University of Georgia College of Agricultural and Environmental Sciences
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2010 GEORGIA COTTON
RESEARCH AND EXTENSION REPORT

Edited by Amanda Smith, Associate editors: Guy Collins and Changying Li
Compiled by Amanda Smith

Georgia Agricultural Experiment Stations
Georgia Cooperative Extension
University of Georgia College of Agricultural and Environmental Sciences

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THE 2010 CROP YEAR IN REVIEW

Guy D. Collins
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The 2010 production season was certainly unique and quite different from 2009. Cotton acreage increased approximately 33 % from 2009, with an estimated 1,320,000 acres harvested in Georgia during 2010. The majority of the cotton crop this year was planted on time or slightly early in some areas, with approximately 22% of the acreage planted in June 2010 (2005-2009 average = 25%) as opposed to 40% planted in June 2009.

Early season rains were frequent and timely, allowing for superior crop stands in most places, and vigorous early season growth leading into the bloom period. However, these rains ceased to continue into July when a large majority of the crop was blooming. Additionally, both day and nighttime temperatures were elevated for most of July, compounding the effects of the drought. As a result, the crop encountered severe stress throughout most of Georgia (including irrigated fields), which consequently shortened the bloom period and reduced yield potential in many fields.

Rainfall returned around the 1st of August which resulted in some hardlock and boll rot in some early planted fields. Yields in the severely stressed areas were estimated to be relatively low (300 – 500 lbs/A) and bolls were beginning to open. In many cases, growers decided to wait to see if the August rains would produce a top crop, which proved to be a successful strategy in many cases this year. The weather from September and forward produced many warm, clear days providing adequate heat units to develop a top crop.

Harvest conditions were also better compared to recent years. According to the National Agricultural Statistics Service, cotton harvest, averaged over the previous 5-year period, has been 41% completed by November 1st (nearly 50% in years preceding 2009). This year, nearly 63% of our crop had been harvested by this date, further indicating that the 2010 crop was earlier than normal.

Although yields were highly variable depending upon rainfall, the average state yield was estimated at 811 lbs/A as of January 12, 2010, which isn't bad considering the summer weather. Despite the adverse summer weather and the widespread planting of newer varieties, cotton yields in Georgia continued to average over 800 lbs/A, which is a true testament to our growers, UGA research and extension personnel, and to the support of the Georgia Cotton Commission (http://www.nass.usda.gov/Publications).

The 2010 season was the first season in several years that DP 555 BR did not dominate the state's acreage, due to the transition to 2-gene Bt technologies and the limited remaining seed supply of DP 555 BR. Now that other factors tend to drive variety selection in particular situations, -and- since a single replacement for DP 555 BR was unlikely, growers began to plant a wider array of varieties in 2010.

The 2010 cotton acreage in Georgia was predominately comprised of remaining DP 555 BR (25%), other Deltapine varieties (34%), FiberMax varieties {15% (8% Liberty Link)}, and Phytogen varieties (24%) (http://www.ams.usda.gov/AMSv1.0/).

Herbicide resistant Palmer amaranth (pigweed) continued to be a serious production challenge across much of the state, and was the driving force behind variety selection in many areas, especially for dryland / conservation tillage growers.

Quality of the 2010 crop was similar to slightly better than previous years (Table 1). Of bales classed as of January 28, 2011, 16.3 percent were short staple (<34) and 26.5 percent were high mic (>4.9). Micronaire was higher than in years past, likely due to the widespread planting of slightly earlier maturing varieties and the abnormally severe drought stress. Fiber length uniformity improved substantially when compared to previous years, also a likely result of the changes in the predominant varieties planted (http://www.ams.usda.gov/AMSv1.0/).

Table 1. Fiber Quality of Bales Classed at Macon USDA Classing Office, 2007-2010

	Color Grade 31/41 or better (% of crop)	Bark/ Grass/ Prep (% of crop)	Staple (32nds)	Strength (g/tex)	Mic	Uniformity
2007	39 / 97	all < 1.0	34.3	28.6	47	80.0
2008	25 / 93	all < 1.0	34.4	28.7	46	80.2
2009	26 / 96	all < 1.0	35	28.8	45	80.3
2010	50 / 94	all < 1.0	34.9	29.7	47	81

Bales classed short staple (< 34) and high mic (>4.9)
2007: 20% and 21%   2008: 22% and 20%   2009: 4% and 9%   2010: 16% and 27%

Fiber quality data as of January 28, 2011. A total of 2,208,993 bales were classed. (Source: http://www.ams.usda.gov/AMSv1.0/)

EFFECT OF CLEANING TREATMENTS ON COTTON FIBER QUALITY

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Introduction

Cotton fiber quality can be affected by various factors, such as variety, environment, and cultural practices (Brown et al., 2004). Along with other factors, cleaning during the ginning process could have a significant impact on certain fiber quality parameters (Boykin et al., 2010; Li et al., 2010). Under-cleaning would not provide clean cotton fiber and could result in price penalization to cotton growers, while over-cleaning would create excessive short fibers and lower fiber quality as well (Anthony 1990). There must be a balance between the clean cotton and long fiber. Therefore, understanding what fiber quality parameters can be affected by different ginning practices is critical to enable cotton growers to achieve the maximum profit.

The microgin at The University of Georgia Tifton Campus uses the same equipment layout used in a typical commercial gin but all machine parts are one-foot wide versus 8-10 feet wide in commercial gins. The seed cotton cleaner and lint cleaners can be bypassed in the UGA microgin. There is an option to use one, two, or even no lint or seed cotton cleaners depending on how the researcher wants the cotton to be processed. Therefore, it provides an opportunity for researchers to study the effect of certain ginning components on fiber quality.

The overall goal of this study was to utilize the UGA microgin to study the ginning effect on Cotton fiber quality. Cotton fiber quality parameters measured by the HVI, AFIS Pro, as well as Shirley Trash Analyzer were compared.

Materials and Methods

Cotton was grown in Colquitt County in Georgia and harvested in October and November, 2009. Three cotton cultivars, i.e., DL555, FM1740, PHY370, were selected in this study due to their popularity and wide availability in Georgia. Cotton samples were stored in trailers and ginned at the UGA microgin later.

The University of Georgia microgin was manufactured by Lummus (Lummus Inc., Savannah, GA) and Cherokee (Cherokee Fabrication Inc., Salem, AL), using the same equipment layout as used in a typical commercial gin. The equipment layout of the microgin was arranged in a standard configuration for spindle picked cotton (Figure 1).

During the ginning process of the microgin, seed cotton was cleaned using a six cylinder incline cleaner and a stick machine (defined as seed cotton cleaner #1), followed by an additional six cylinder incline cleaner feeding into a Trashmaster® cleaner (defined as seed cotton cleaner #2). Upon exiting the cleaners, the cotton entered an extractor feeder and a 24-saw Lummus gin stand. After lint and seeds were separated in the gin stand, the lint was cleaned by one air jet lint cleaner and one saw type lint cleaner. Six cleaning treatments were created by various combinations of two seed cotton cleaners and the saw type lint cleaner as follows: 1) All used, 2) Bypass lint cleaner, 3) Bypass #2 seed cotton cleaner, 4) Bypass #1 seed cotton cleaner, 5) Bypass both #2 seed cotton cleaner and lint cleaner, and 6) Bypass both #1 seed cotton cleaner and lint cleaner.

When cotton samples were being ginned in the microgin, seed cotton samples from the trailer were continuously collected by the vacuum pipe and ginned by the microgin. The sample size was controlled by the ginning time: roughly 13-14 minutes were used to gin cotton samples before the vacuum pipe was shut off, which was equivalent to 80-100 pounds of lint for each sample. Three replicates were used for each treatment.

The fiber quality test was conducted in the USDA ARS Cotton Quality Research Station (CQRS) in South Carolina. Four fiber quality parameters from the HVI (Count, Leaf, Uniformity, and UHM) and five parameters from the AFIS PRO (VFM, Total count, L(w), SFC, and Neps) were measured and evaluated. The Shirley Trash Analyzer is an instrument to separate trash and foreign matter from lint by mechanical methods. It provides a more accurate trash measurement than the HVI and AFIS. Two parameters from the Shirley Analyzer were used: visible and invisible.

The one-way analysis of variance (ANOVA) was conducted to test equal means across six cleaning treatments in all quality parameters. Tukey's LSD (least significant difference) was chosen to determine the significant difference between treatments with a significance level of 0.05. Standard error was used to describe the variation of the mean. The SAS statistical software (SAS Institute, Cary, NC) was used for statistical tests and data analysis.

Results and Discussion

For HVI Trash Count (Figure 2), lint ginned by treatment 2, 5, and 6 which all bypassed the lint cleaner had higher Trash Count than the lint ginned by treatment 1, 3 and 4 which used the lint cleaner. No significant difference was observed among treatments 1, 3, and 4 which all used the lint cleaner, but used different seed cotton cleaners. This might suggest that the seed cotton cleaner may not be as efficient as lint cleaners in determining the final fiber trash content. This pattern was consistent in all three cotton cultivars. Although the Leaf grade reflected a similar pattern, the difference was not significant across six treatments. One reason is that the Leaf grade is a classer's subjective measure; the second reason is that the Leaf grade is categorical data, instead of numerical data, resulting in insignificance statistically.

For HVI Uniformity (Figure 3), lint ginned by treatments 2, 5, 6 had significant higher uniformity than that by treatments 1, 3, and 4. This pattern is consistent in FM1740 and PHY370, but not so in DP555. Among three cultivars, DP555 had lower uniformity than the other two cultivars regardless of treatments. PHY370 had the highest uniformity among three cultivars.

For HVI UHM length, no significant difference was observed across six treatments in all three cultivars. This indicates that seed cotton cleaning and lint cleaning had an effect in creating short fibers (for most cultivars) but the UHM length was not affected significantly.

For AFIS Visible Foreign Matter (VFM), there was no significant difference across six treatments in both DL555 and FM1740 with the exception of PHY370 which exhibited a higher VFM value in treatment 6 than in other treatments (Figure 4). For Total Trash Count/g, lint ginned by treatments 2, 5, and 6 always had higher trash count values than that ginned by treatments 1, 3, and 4. This was a similar pattern to that observed in HVI trash measurement.

For AFIS length measurement (Figure 5), both the Length by weight and Short Fiber Content did not exhibit significant differences across six treatments in almost all three cultivars except for PHY370 in which treatment 5 yielded lint with higher Length than treatment 3. Among three cultivars, FM1740 had slightly higher lint than the other two cultivars, and PHY370 had the lowest Short Fiber Content.

FM1740 and PHY370 did not show a significant difference in AFIS Neps across six treatments (Figure 6). In DL555, lint ginned by treatments 1, 3, and 4 had significantly higher Neps than that ginned by treatments 2, 5 and 6. This result suggests that more Neps are likely to be created when the lint cleaner is used.

For Shirley Trash Visible (Figure 7), a very clear and consistent pattern was observed that lint ginned by treatments 2, 5, and 6 had significantly higher visible trash than that ginned by treatments 1, 3, and 4 in all three cultivars. Treatment 1 always had the lowest visible trash because all cleaners were used in this treatment. For Shirley Trash Invisible, DP555 and PHY370 did not exhibit significant differences across the six treatments. In FM1740, lint ginned by treatments 2 and 5 had significantly higher invisible trash than that ginned by treatments 1, 3, and 4.

Conclusions

Results from this study showed that cleaning treatments had more significant effect on fiber trash content than on fiber length. Treatments 2, 5, and 6 (which all bypassed the lint cleaner), were more likely to create lint with higher trash content but less short fiber content. Results suggest that the lint cleaner was crucial to reducing trash and inducing short fibers. AFIS Neps results indicated that lint had less Neps when less cleaning equipment was used. Shirley trash Visible is a better indicator than the Invisible to characterize trash on the fiber. Among three cultivars, PHY370 had the least short fiber content in these cleaning treatments.

Acknowledgements

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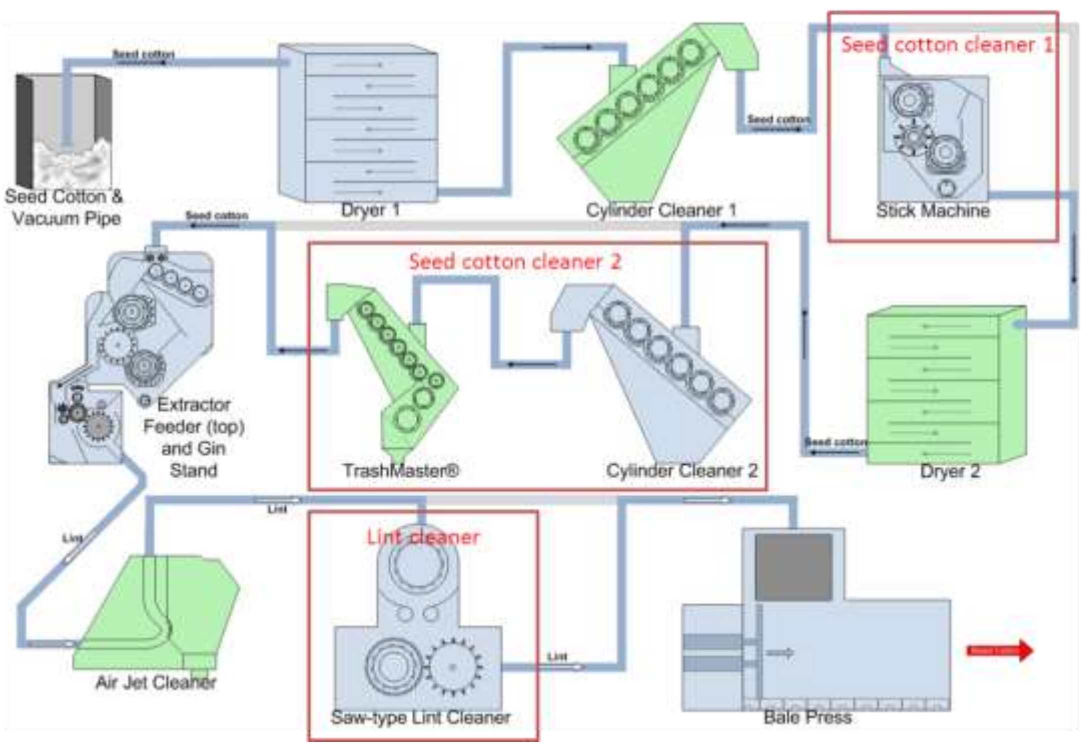


Figure 1. Diagram of the UGA microgin

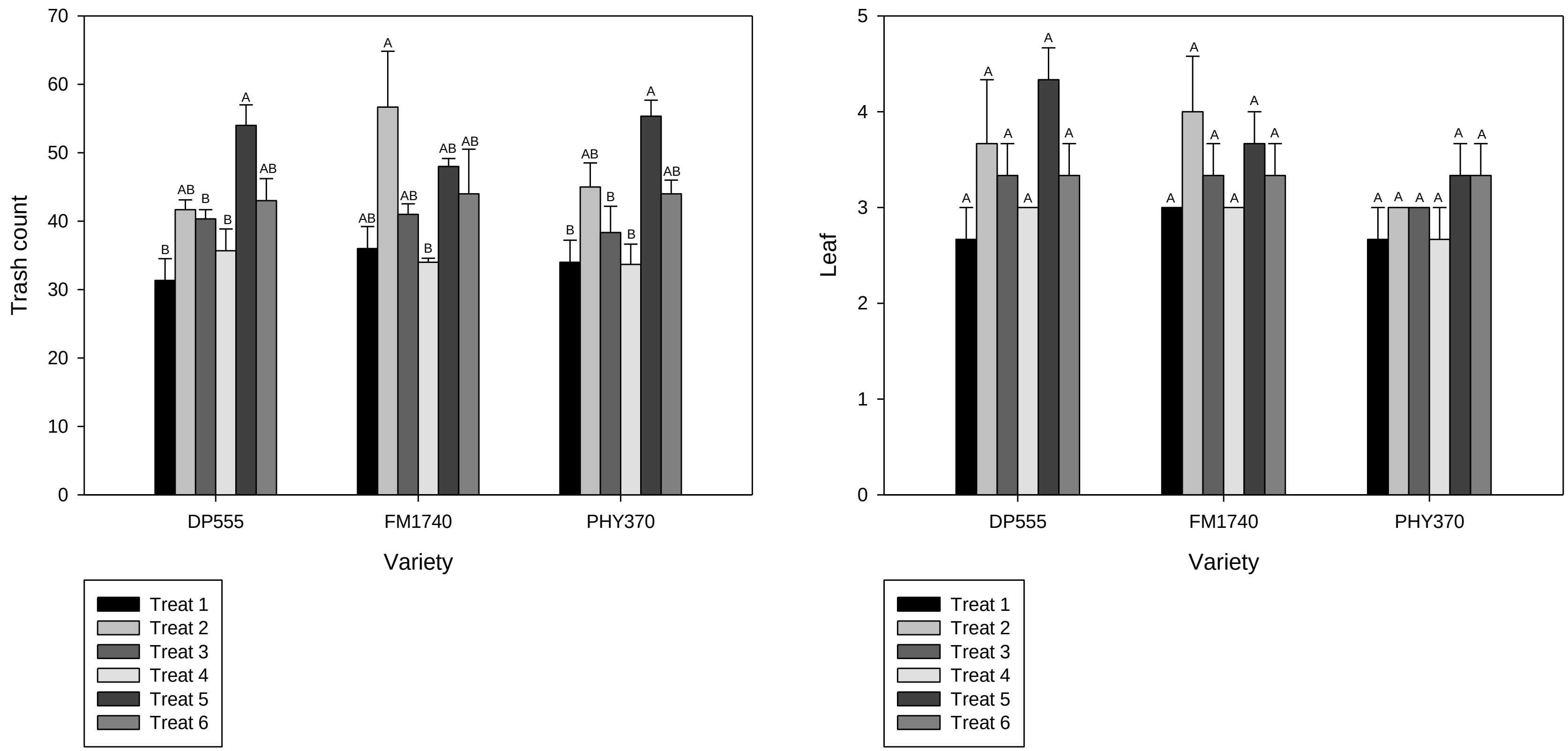


Figure 2. HVI trash measurements (Leaf and Trash Count)

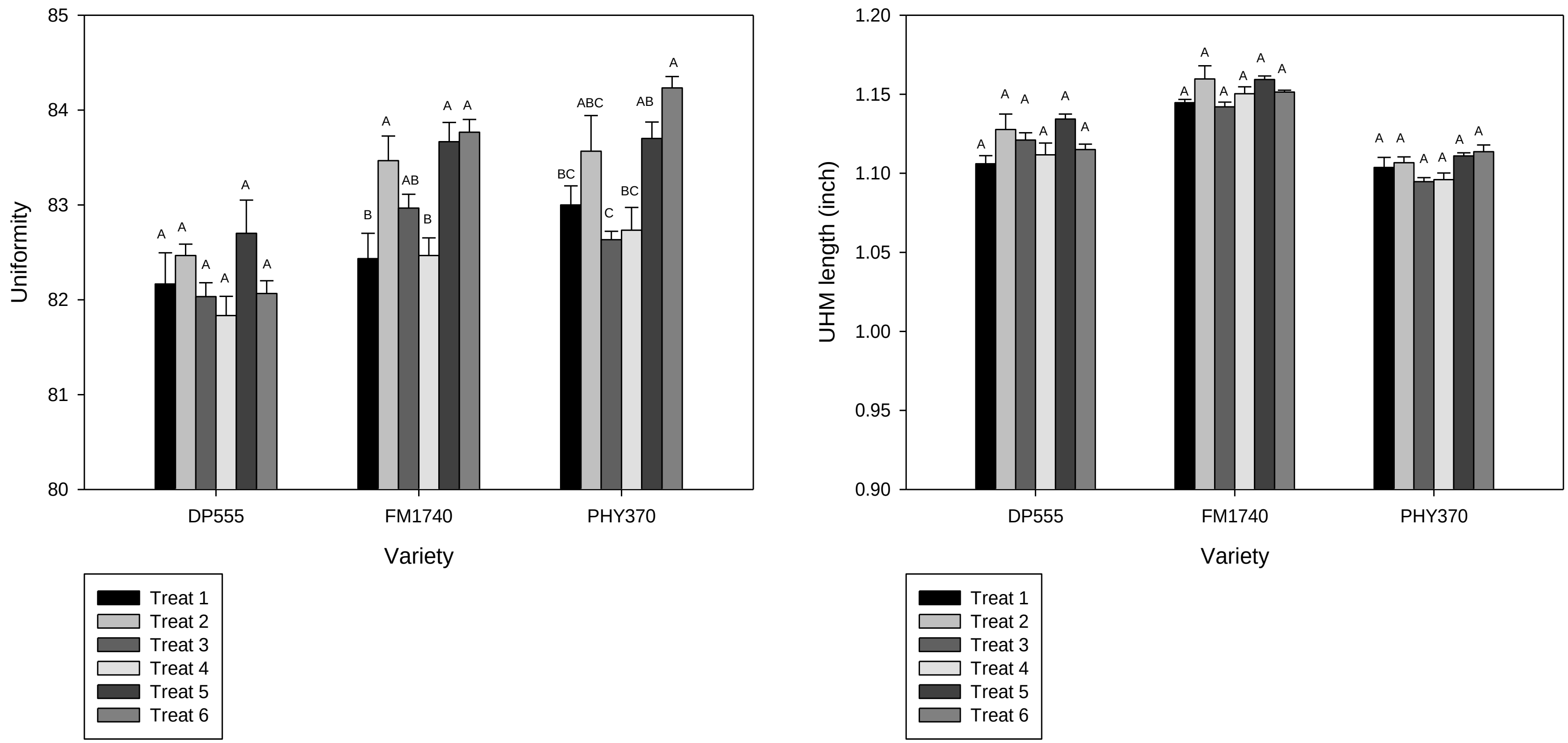
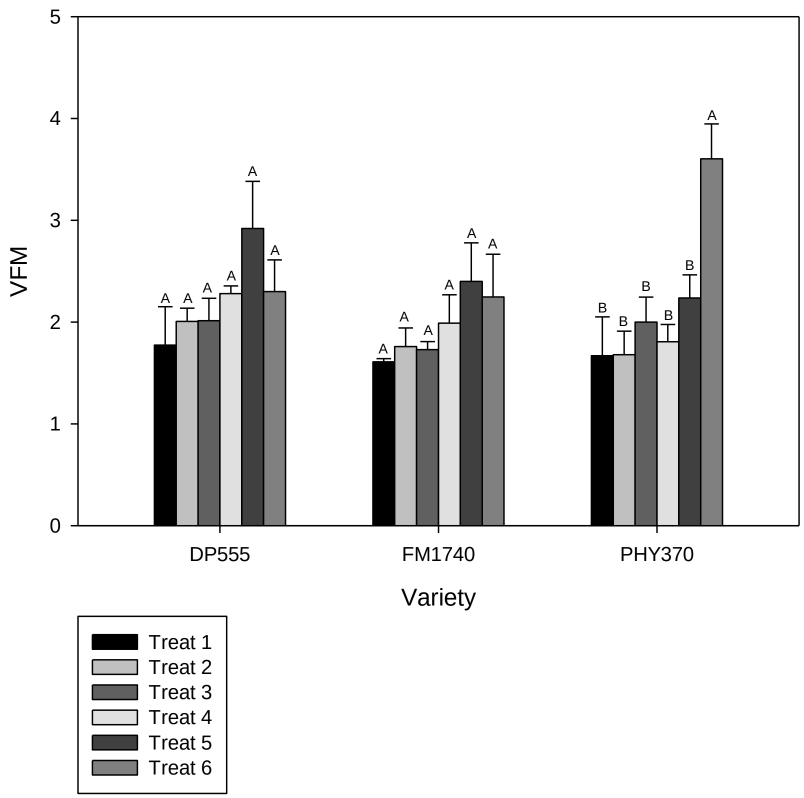


Figure 3. HVI length measurements (Uniformity and UHM length)



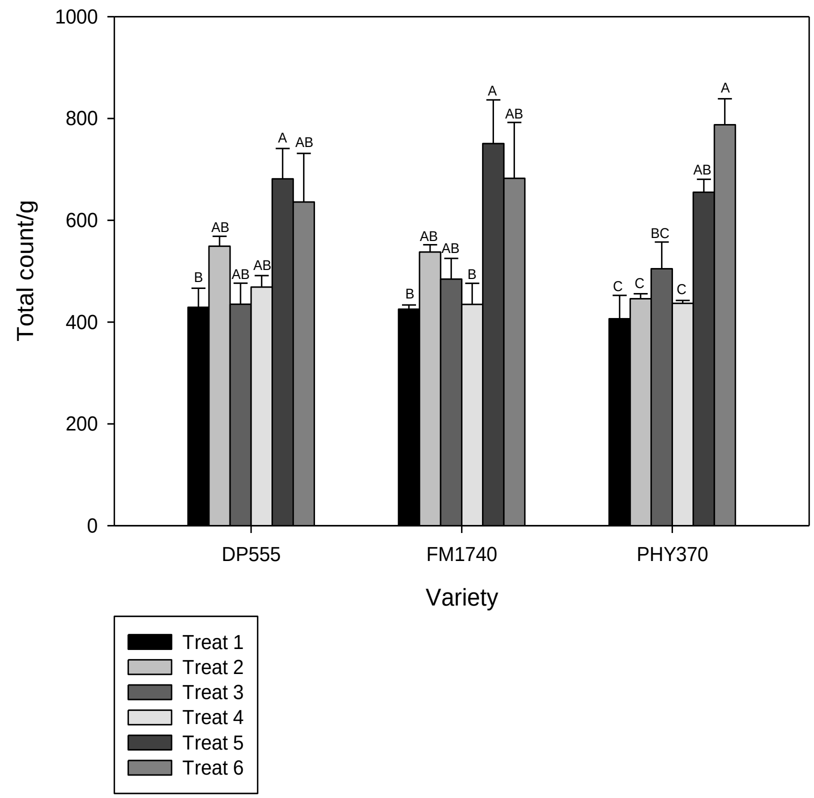


Figure 4. AFIS trash measurements (VFM and Total Count/g)

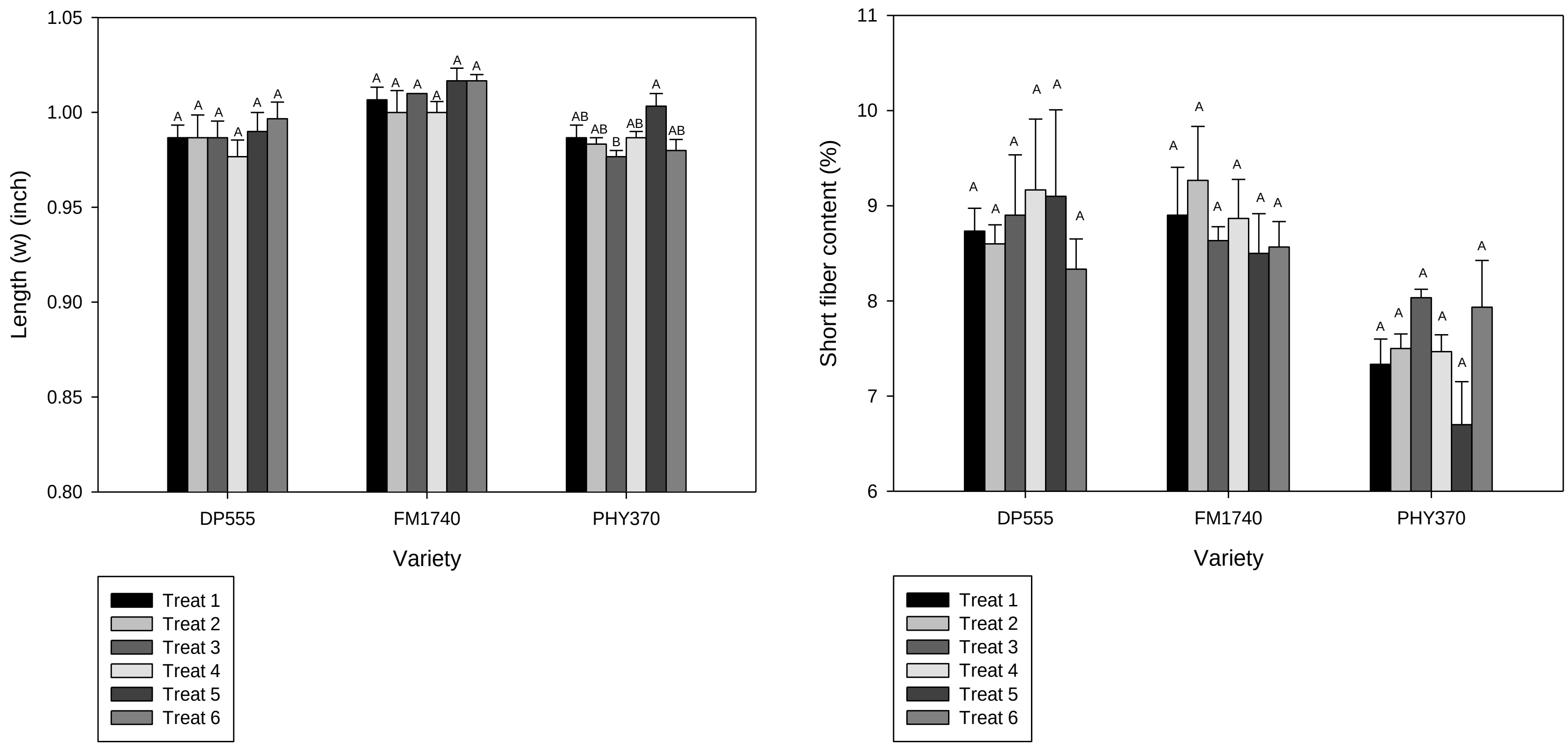


Figure 5. AFIS length measurements (L(w) and SFC)

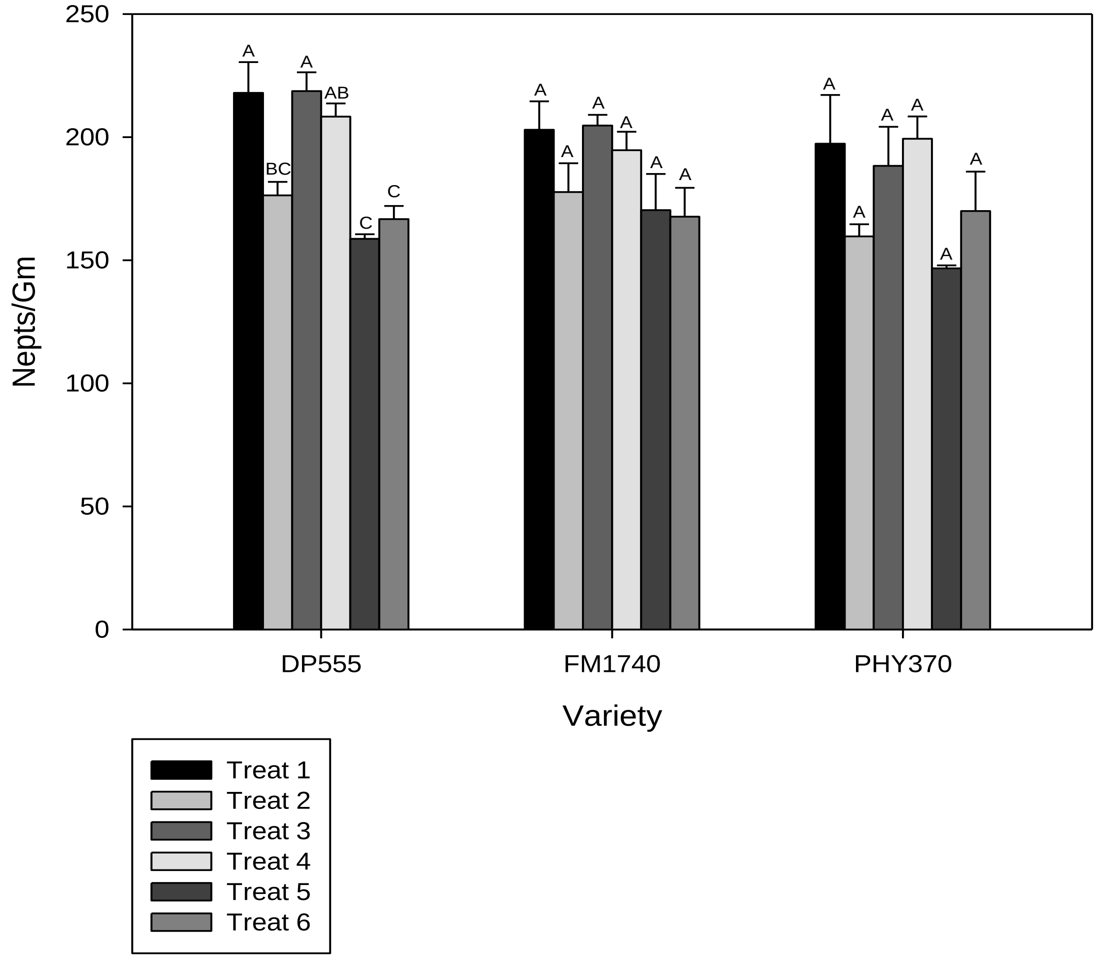


Figure 6. AFIS Neps measurements (Neps/Gm)

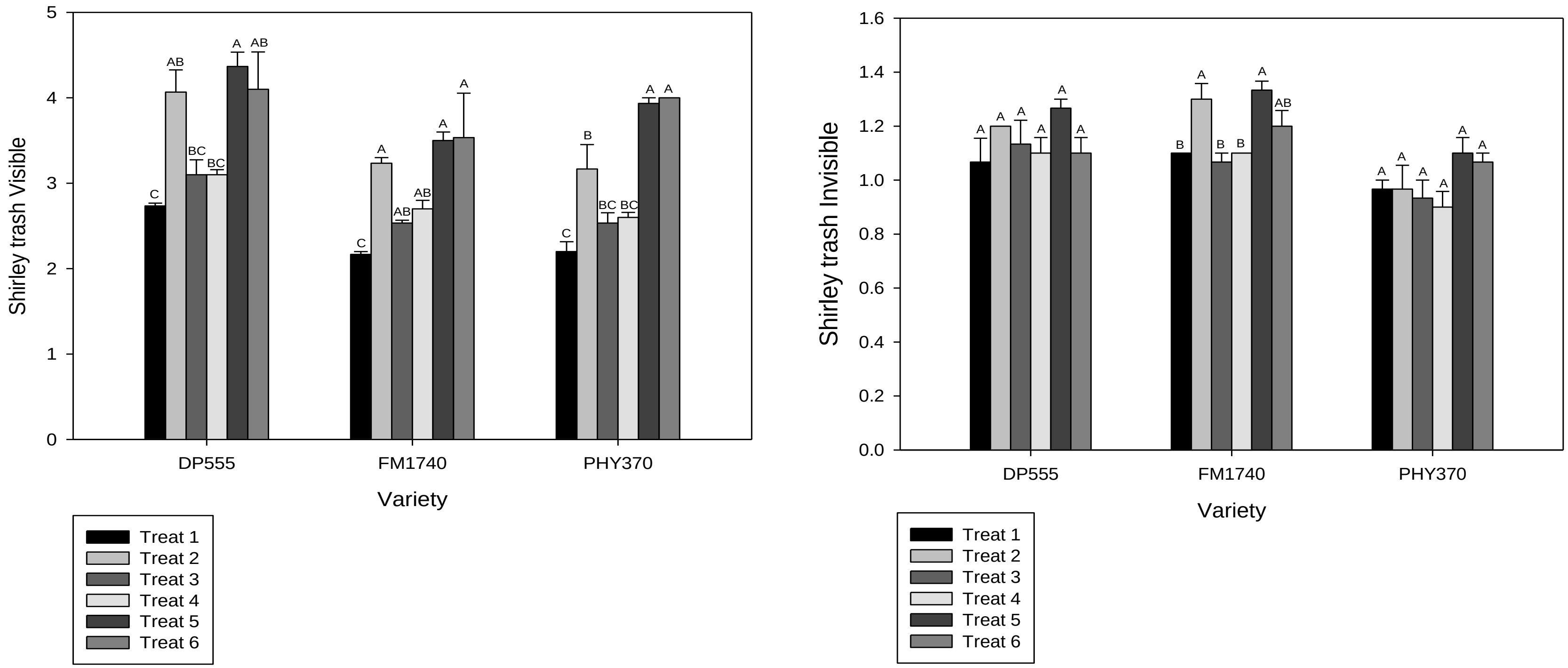


Figure 7. Shirley trash measurements (Visible and Invisible)

DEFINING OPTIMAL PGR MANAGEMENT STRATEGIES & PLANT POPULATIONS FOR NEW COTTON VARIETIES IN GEORGIA

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Introduction

Prior to 2010, approximately 85 percent of the Georgia cotton acreage was planted to DP 555 BR. Due to the expiration of the EPA registration for the Bollgard™ technology, only an approximate 25 percent of the Georgia cotton acreage was planted to DP 555 BR in 2010, with the remaining 75 percent planted to relatively new varieties. In 2011, 100 percent of the Georgia cotton acreage will be planted to varieties other than DP 555 BR. The 2011 acreage, and beyond, will likely be comprised of a diverse group of varieties, as a single predominate replacement for DP 555 BR is unlikely in the near future.

Some of the most popular new varieties often exhibit vastly different fruiting characteristics than that of DP 555 BR (Figure 1). Most of these varieties tend to set more fruit on lower nodes and less fruit on upper nodes compared to DP 555 BR, and many do not appear to exhibit the excessive vegetative growth characteristics exhibited by DP 555 BR. Therefore, many of the newer varieties may require less aggressive plant growth regulator (PGR) management in order to maximize boll set and lint yields. Additionally, some of the newer varieties appear to have “columnar-type” fruiting and branching characteristics, thereby raising the question of whether or not plant populations for these varieties need to be adjusted in order to maximize yield potential.

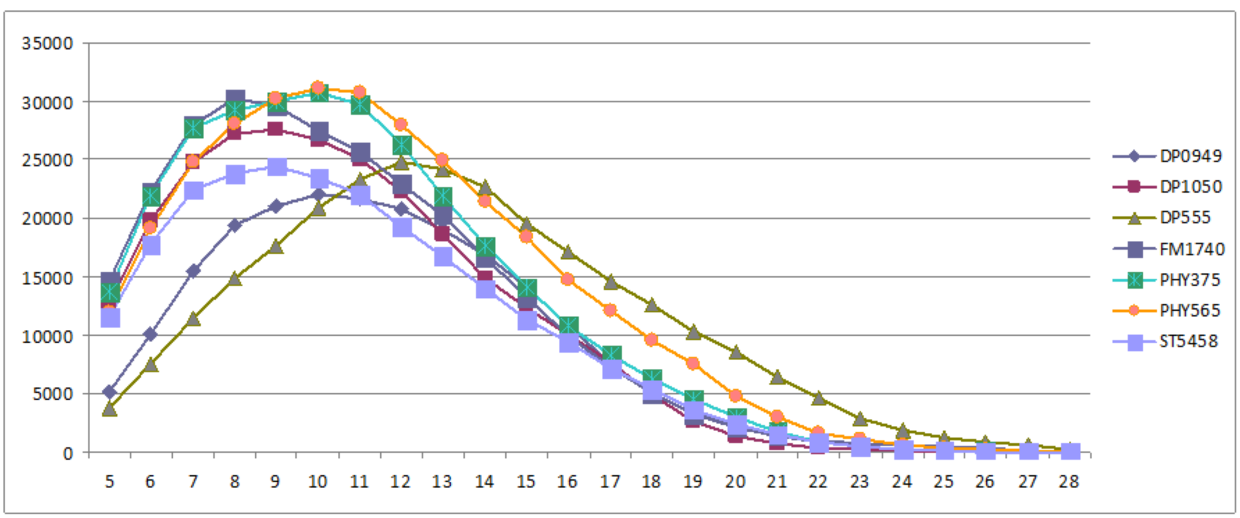

Figure 1. Distribution of total bolls per acre by node for several new varieties

Methods

A series of experiments was conducted in 2010 in Tifton, GA and in Midville, GA, to investigate the response of several of the newer varieties to various PGR management strategies and plant populations. These trials were conducted using a randomized complete block design containing four replications. All PGR treatments were applied using a CO_2-pressurized backpack sprayer calibrated to deliver 15 GPA using regular flat-fan nozzles.

The objective of Experiment #1 was to quantify the response of 10 new varieties to an aggressive PGR treatment consisting of Mepiquat Chloride (MC) applied at a rate of 12 oz/A to 9-10 leaf(lf) cotton, followed by (fb) 16 oz/A MC at early bloom (EB), fb 16 oz/A MC at EB+2weeks (wk), fb 16 oz/A MC at EB+4wk. This PGR treatment was representative of a commonly used approach to adequately suppress plant height for DP 555 BR, especially in well-watered environments. The varieties included in Experiment #1 included DP 555 BR, DP 1050 B2RF, DP 1048 B2RF, DP 0949 B2RF, PHY 565 WRF, PHY 375 WRF, PHY 485 WRF, ST 4288 B2F, ST 5458 B2F, and FM 1740 B2F, evaluated in both irrigated and dryland conditions.

The objective of Experiment #2 was to determine if a pre-bloom MC application was necessary to adequately suppress plant height for some of the new varieties, which included DP 555 BR, DP 0949 B2RF, DP 0912 B2RF, and FM 1740 B2F. PGR treatments used in Experiment #2 included a non-treated control; an aggressive treatment consisting of 12 oz/A MC applied to 9-10 lf cotton fb 12 oz/A MC at EB fb 16 oz/a MC at EB+2wk; a mild treatment consisting of 12 oz/A MC at EB fb 16 oz/a MC at EB+2wk; and a non-aggressive treatment consisting of a single application of 16 oz/A MC at EB+2wk.

The objective of Experiment #3 was to determine if Stance™ (ST) (usually resulting in milder, or more forgiving, plant height suppression) is a more appropriately used PGR if a pre-bloom application is justified for an earlier maturing variety. Varieties included in Experiment #3 included DP 1050 B2RF and FM 1740 B2F and PGR treatments included a non-treated control; 2 oz/A ST applied to 9-10 lf cotton fb 3 oz/A ST at EB; 2 oz/A ST applied to 9-10 lf cotton fb 16 oz/A MC at EB; 3 oz/A ST applied to 9-10 lf cotton fb 16 oz/A MC at EB; 8 oz/A MC applied to 9-10 lf cotton fb 16 oz/A MC at EB; and 12 oz/A MC applied to 9-10 lf cotton fb 16 oz/A MC at EB.

The objective of Experiment #4 was to determine if ST should be used to manage growth throughout the season for some of the earlier maturing varieties. Varieties included in Experiment #4 were DP 555 BR and FM 1740 B2F and PGR treatments included a non-treated control; 2 oz/A ST applied to 9-10 lf cotton fb 2 oz/A ST at EB fb 2 oz/A ST at EB+2wk; 3 oz/A ST applied to 9-10 lf cotton fb 3 oz/A ST at EB fb 3 oz/A ST at EB+2wk; 4 oz/A ST applied to 9-10 lf cotton fb 4 oz/A ST at EB fb 4 oz/A ST at EB+2wk; 8 oz/A MC applied to 9-10 lf cotton fb 8 oz/A MC at EB fb 8 oz/A MC at EB+2wk; and 12 oz/A MC applied to 9-10 lf cotton fb 12 oz/A MC at EB fb 12 oz/A MC at EB+2wk.

The objective of Experiment #5 was to determine if higher plant populations are required for some of the columnar-type varieties to reach maximum yield potential. Varieties included in Experiment #5 were DP 555 BR, DP 0949 B2RF, PHY 375 WRF, and FM 1740 B2F, and plant populations included 0.5 plants foot^{-1}, 1 plant foot^{-1}, 2.5 plants foot^{-1}, and 4.5 plants foot^{-1}.

Results and Discussion

Results from Experiment #1 indicated that newer varieties differ in their responses to an aggressive PGR treatment which was previously required to manage growth of DP 555 BR, and thus differed with regard to growth potential. The greatest reduction when comparing the relative rank of varieties of non-treated cotton versus the sum of treated and non-treated cotton in the dryland trial occurred with PHY 565 (Figure 2). PHY 485 WRF appeared to exhibit greater growth potential in dryland environments than some of the other varieties. The greatest reduction when comparing the relative rank of varieties of non-treated cotton versus the sum of treated and non-treated cotton in the irrigated trial occurred with PHY 565 WRF (Figure 3). Most of the other varieties ranked according to their maturity as predicted. DP 1050 B2RF and DP 1048 B2RF held a lower rank on overall growth potential in the irrigated trial than they did in the dryland trial, indicating that some of the other varieties are likely less drought tolerant.

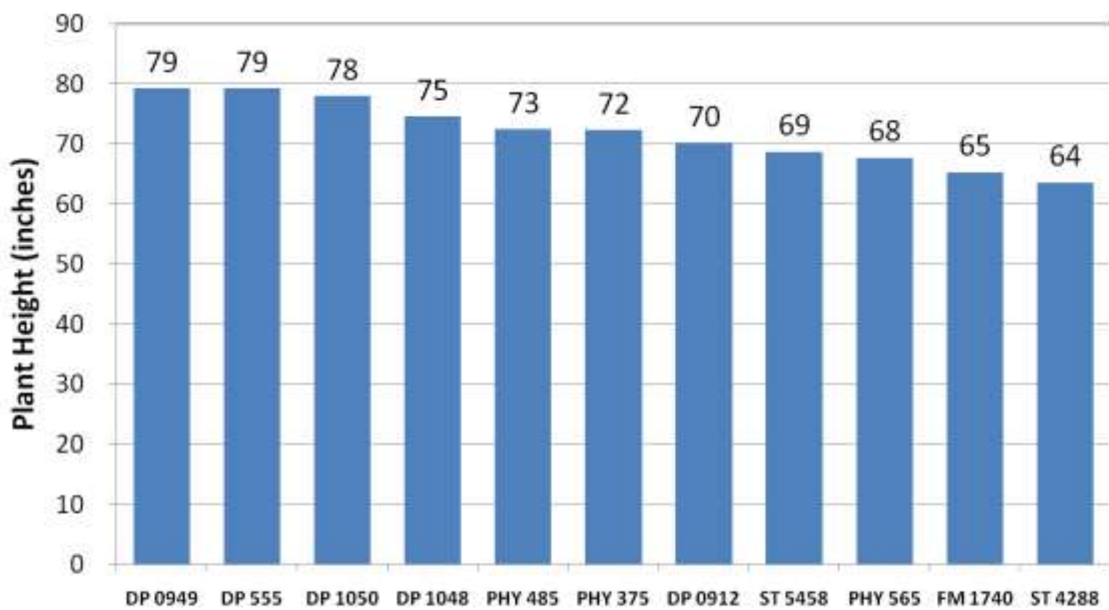

Figure 2. Sum of MC-treated and non-treated plant height as a measurement of growth potential for new varieties in dryland environments.

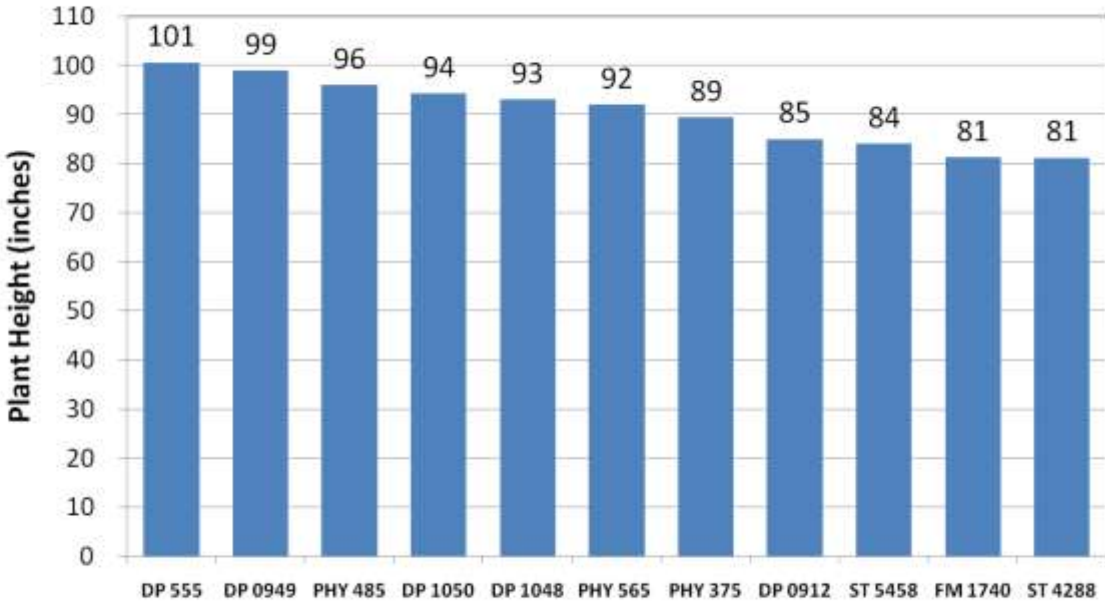

Figure 3. Sum of MC-treated and non-treated plant height as a measurement of growth potential for new varieties in irrigated environments.

Results from Experiment #2 indicated that a pre-bloom PGR application was necessary to achieve optimal plant height (38 to 45 inches) for DP 555 BR and DP 0949 B2RF in these irrigated conditions, however the pre-bloom application resulted in less-than-optimal final plant height for the two early maturing varieties; DP 0912 B2RF and FM 1740 B2F. Especially in the case of FM 1740 B2F, optimal plant height was achieved when PGRs were applied at EB or thereafter.

Results from Experiment #3 suggest that 2 oz/A ST applied to 9-10 lf cotton fb 3 oz/A ST at EB resulted in taller plants compared to 12 oz/A MC applied to 9-10 lf fb 16 oz/A MC at EB for DP 1050 B2RF, however plant height was similar between these two PGR treatments when applied to FM 1740 B2F, suggesting that Stance™ may adequately suppress plant height for FM 1740 B2F whereas MC may be more appropriate for DP 1050 B2RF, when used during the prebloom period.

Results from Experiment #4 indicated that 12 oz/A MC applied thrice resulted in significantly different plant height between DP 555 BR and FM 1740 B2F, however these two varieties responded similarly to all other PGR treatments. These results also indicated that 8 oz/A MC applied thrice to DP 555 BR resulted in similar plant height to that of 2 oz/A ST applied thrice to FM 1740 B2F, indicating that Stance™ may be more appropriate for PGR management of varieties exhibiting less growth potential.

Lastly, the results from Experiment #5 indicated that the three new varieties are somewhat earlier maturing than DP 555 BR at all plant populations. Additionally, there was a reduction in nodes above white flower noticed for DP 555 BR when plant populations increased from 2.5 to 4.5 plants $foot^{-1}$ (Figure 4). This effect was not observed in other varieties. Yield responses to increasing plant populations varied among the varieties tested (Figure 5). DP 555 BR achieved maximum yield at 1 plant $foot^{-1}$, although yields were similar at 2.5 plants $foot^{-1}$. Maximum yields for FM 1740 B2F and DP 0949 B2RF were achieved at 2.5 plants $foot^{-1}$. Maximum yields for PHY 375 WRF were achieved at 4.5 plants $foot^{-1}$.

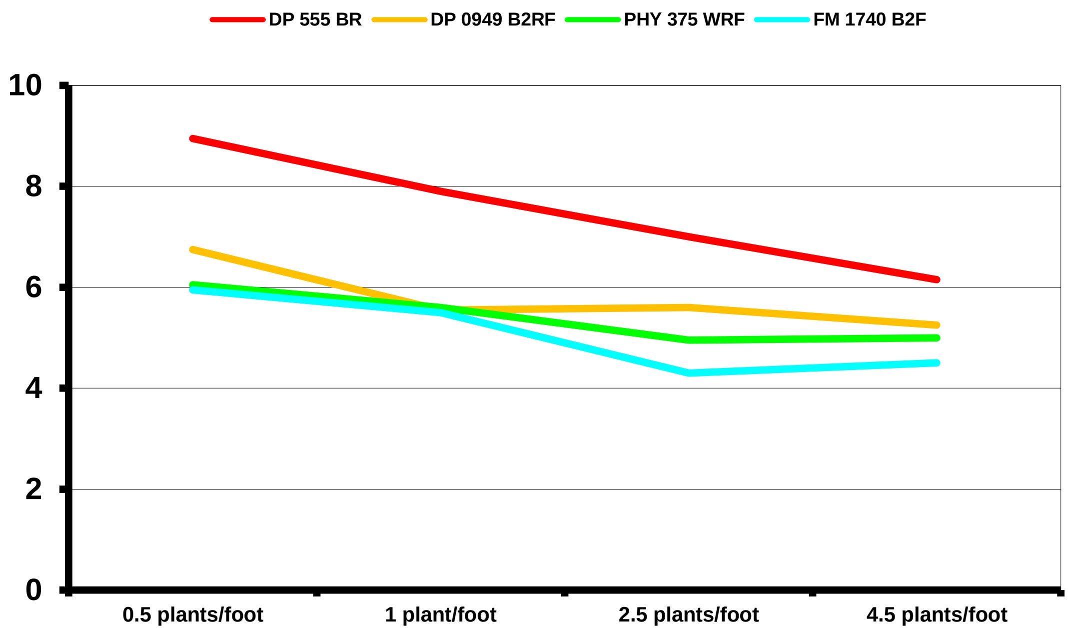

Figure 4. Plant population effects on nodes above white bloom of four varieties.

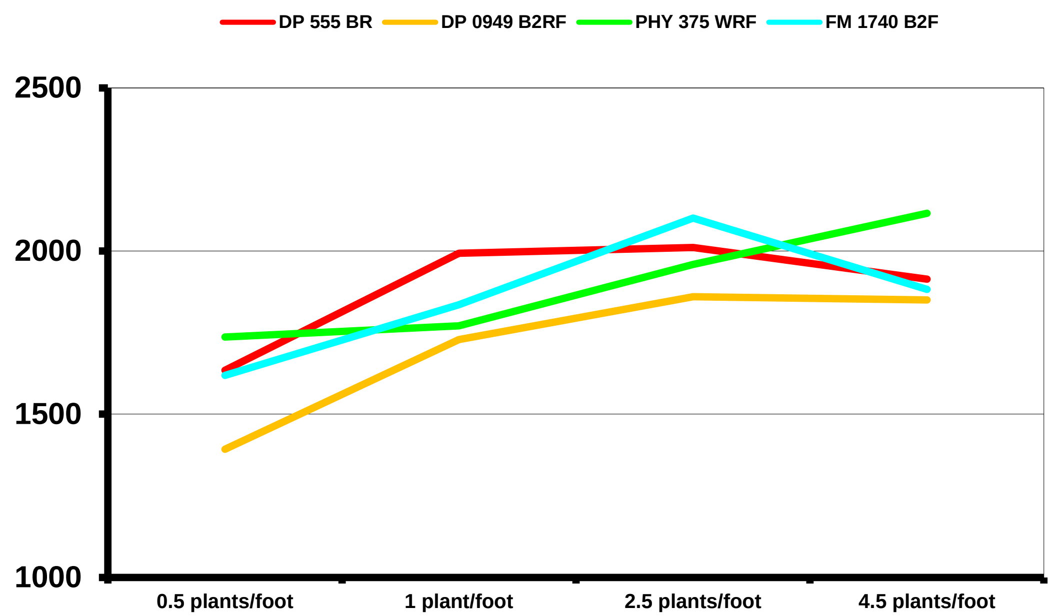

Figure 5. Plant population effects on lint yield (Lbs/A) of four varieties.

Summary and Conclusions

In summary, results from these trials suggest that responses to PGR treatments vary among the varieties tested, and that an aggressive PGR strategy may result in suboptimal plant height for some varieties. For some of the earlier maturing varieties, a pre-bloom PGR application may not be necessary to adequately suppress plant height. Additionally, the use of Stance™ may be more appropriate than standard mepiquat-containing products for earlier maturing varieties in some environments. Lastly, the currently recommended 2.5 plants foot^{-1} plant population appears to be appropriate for some of the newer columnar-type varieties to achieve maximum yields.

Acknowledgement

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2010 COTTON OVT VARIETY TRIALS

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Introduction

The University of Georgia 2010 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 University research stations and/or education centers in Midville, Plains, and Tifton. Dryland trials were conducted on University research stations and/or education centers in Athens, Midville, Plains, and Tifton. Performance data in these tables, combined with data from previous years should assist growers in 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. Additionally, the data is published in the UGA Agricultural Experiment Station Annual Publication 104-2, January 2011.

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 varieties. Data from the OVT assists the private seed companies assess the fit of their products in Georgia. The University of Georgia cotton OVT is conducted by J. LaDon Day, Program Director, Cotton OVT, Griffin, GA. along with Mr. Larry Thompson, Research Professional I, Tifton, GA. The OVT is split into 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, providing a large data set with which to evaluate variety performance. The strains trials are irrigated and conducted at Midville, Plains, and Tifton. Trials consist of 4-replicate, 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). A random 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 Starlab, Knoxville, TN. 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 sells. 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

Much like 2009, the spring weather of 2010 was again wet and cold especially during March. Soggy soil conditions challenged land preparation due to the persistent and sometimes torrential rains received in Georgia over the winter, however, producers quickly caught up with sunny and warm weather in early April. Hot dry conditions returned in June and persisted throughout one of the hottest summers and falls on record. Seasonal rainfall totals were below normal across all of south Georgia, with extremely hot and dry growing conditions this summer and fall in Plains and surrounding counties. The average rainfall deficit was 25% in the area around Plains, the largest shortage in the state. However, northeast Georgia around Athens and surrounding counties received 18% above normal for the nine month reporting period.

Crop maturity progressed ahead of the 5-year average and harvest conditions for the year were excellent compared to last season. Cotton farmers seeded 1.33 million acres of cotton during 2010, 33% more than last year. State cotton per acre yields in 2010 of 779/lbs was 14% less than 2009 and the least per acre production in Georgia in six years. However, due to increase in cotton acreage (33%) in 2010, the number of bales produced was the most in four years.

Among varieties in the Dryland Earlier Maturity Trials, PHY 499WRF and DP 1028B2RF stand out as varieties with high yield and relative yield stability in the dryland trials averaged over four locations (Table 1). There were also 13 other varieties above average in yield (Table 1). When summarized over two years and four locations DP 0912B2RF, GA2006053, Dyna-Gro 2570B2RF, PHY 375WRF, FM1740B2RF, PHY367WRF, and DP0924B2RF, were the top performers (Table 2).

Among the best performing earlier maturing varieties produced under irrigation, PHY 499WRF, DP 0912B2RF, and DP 1028B2RF were the top three highest in yield when averaged over locations (Table 3). Twelve other varieties performed well and were above average in yield (Table 3). FM1740B2RF, DP 0912 B2RF, DP 0920B2RF, and Dyna-Gro 2570B2RF when averaged over two years and locations in the Irrigated Early Maturity Trials conducted at Bainbridge, Midville, Plains, and Tifton; were the top yielding group (Table 4).

The top yielding later maturity variety in the trial conducted without irrigation and averaged over four locations revealed the consistent performance of PHY499WRF

(Table 5). An additional sixteen varieties were above average in yield (Table 5). Averaged over locations and years, DP 0949B2RF, DP 0935B2RF, PHY 375WRF and ST 5458B2F were the front runners (Table 6).

Under irrigation DP1034B2RF, was the highest yielder among 16 other varieties in the top significant group of the standard later maturing trials averaged over locations (Table 7). Four other varieties were above average in lint yield (Table7). Averaged over locations and years, DP 0940B2RF, and PHY375WRF were the two front runners (Table 8).

The Earlier Maturity and Later Maturity Strains Trials (OST) portend improved varieties for crop seasons 2011 and beyond (Tables 9). Varieties from All-Tex, Dyna-Gro, Georgia, and Monsanto DP were high yielding performers among standard earlier and later maturing entries in the strains trial.

In order to compare ‘small gin’ seed/lint with samples processed through the Micro-gin (MG) on the Tifton Campus, data from the Tifton, Georgia, 2010, Early and Later Maturity cotton variety performance, irrigated, respectively, is presented in Table 10 and Table 11. The seed cotton from the 2010 Early and Later Maturity experiments were sub-sampled during picking, the seed separated using a small gin and for HVI analysis processed by Star Lab in Knoxville, Tennessee. The remaining seed cotton was processed through the Micro-gin, Tifton Campus and also for HVI analysis sent to Star Lab in Knoxville, TN.

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

Table 1. Yield Summary for Dryland Earlier Maturity Cotton Varieties, 2010

Variety	Lint Yield[a] Athens	Midville	Plains	Tifton	4-Loc. Average	Lint	Unif. Index	Length	Strength	Mic.
	lb/acre	lb/acre	lb/acre	lb/acre	lb/acre	%	%	in	g/tex	units
PHY 499 WRF	**1685** [1]	**1580** [1]	**551** [1]	977 [5]	**1198** [1]	46.1	83.2	1.08	31.2	4.9
DP 1028 B2RF	**1594** [2]	1362 [4]	**542** [2]	816 [10T]	**1079** [2]	47.1	82.6	1.09	28.2	5.0
DP 0912 B2RF	1238 [12]	1390 [3]	424 [11]	1135 [1]	1047 [3]	44.0	81.9	1.04	28.6	5.1
CG3035RF	1403 [4]	1213 [9]	**449** [7]	937 [7]	1000 [4]	43.9	82.3	1.08	29.3	5.0
PHY 375 WRF	1380 [6]	1161 [13]	**450** [6]	985 [4]	994 [5]	44.9	82.5	1.08	27.5	4.5
All-Tex LA122	1292 [9]	1151 [15]	435 [9]	997 [3]	969 [6]	44.2	82.9	1.12	28.1	4.7
PHY 367 WRF	1384 [5]	1125 [16]	**504** [3]	800 [12]	953 [7]	43.4	81.8	1.10	28.7	4.3
GA2007095	1165 [20]	1355 [5]	392 [17]	856 [9T]	942 [8]	42.6	82.4	1.12	29.9	4.8
DP 1032 B2RF	1230 [15]	**1415** [2]	408 [14]	704 [20]	939 [9]	45.4	82.0	1.10	28.7	4.6
GA2006053	1449 [3]	1123 [17]	374 [20]	781 [15]	932 [10]	40.8	82.5	1.11	27.9	5.0
GA2006106	1296 [8]	1042 [20]	348 [24]	1013 [2]	925 [11]	41.8	82.0	1.15	31.3	4.7
FM1740B2RF	1146 [23]	1237 [7]	372 [21]	919 [8]	919 [12]	43.5	82.0	1.07	28.5	4.8
DP 0920 B2RF	1234 [13]	1163 [12]	**501** [4]	765 [17]	916 [13]	44.6	81.9	1.08	26.5	4.7
Dyna-Gro 2570B2RF	1271 [11]	1174 [10]	418 [12]	791 [13]	914 [14]	43.3	82.5	1.08	29.1	4.8
NG 3331 B2RF	1280 [10]	1251 [6]	347 [25]	764 [18]	910 [15]	43.1	82.3	1.05	30.7	4.8
All-Tex A102	1229 [16]	1074 [18T]	340 [27]	945 [6]	897 [19]	42.1	82.1	1.12	29.4	4.6
DP 0924 B2RF	1212 [17]	1218 [8]	364 [22]	745 [19]	885 [17]	43.9	81.7	1.04	27.8	4.8
AM 1550 B2RF	1194 [18]	1159 [14]	**463** [5]	632 [26]	862 [18]	43.3	82.2	1.05	26.5	4.6
CG3220B2RF	1141 [24]	1028 [22]	**447** [8]	816 [10T]	858 [19]	42.8	82.4	1.07	27.9	4.6
All-Tex 7A21	1339 [7]	1030 [21]	405 [15]	644 [25]	855 [20]	44.5	82.8	1.13	29.8	4.9
SSG CT Linwood	1152 [21]	1165 [11]	415 [13]	671 [22]	850 [21]	42.7	81.8	1.06	30.8	5.1
NG 8015 B2RF	1106 [26]	1074 [18T]	342 [26]	812 [11]	833 [22]	40.7	82.8	1.11	31.1	4.6
ST 4288B2F	1151 [22]	1027 [23]	381 [19]	767 [16]	832 [23]	40.7	81.3	1.07	26.9	4.6
CG3520B2RF	1189 [19]	1068 [19]	385 [18]	657 [23]	825 [24T]	41.3	81.9	1.08	25.5	4.3
CG4020B2RF	1233 [14]	1023 [24]	393 [16]	652 [24]	825 [24T]	42.3	82.4	1.10	25.7	4.2
NG 4010 B2RF	845 [28]	952 [26]	434 [10]	856 [9T]	772 [25]	42.5	82.2	1.08	30.4	4.6
CG3020B2RF	1129 [25]	931 [27]	305 [28]	675 [21]	760 [26]	41.0	82.1	1.03	26.5	4.2
NG 4012 B2RF	900 [27]	984 [25]	355 [23]	789 [14]	757 [27]	44.2	81.7	1.08	29.9	4.5
Average	1245	1160	412	818	909	43.2	82.2	1.08	28.6	4.7
LSD 0.10	182	183	106	218	128	1.1	0.8	0.02	1.2	0.3
CV %	12.4	13.4	21.8	22.6	16.6	2.2	0.9	2.98	4.6	5.3

[a] Superscripts indicate ranking at that location.

Bolding indicates entries not significantly different from highest yielding entry based on Fisher's protected LSD

Table 2. Two-Year Summary for Dryland Earlier Maturity Cotton Varieties at Four Locations[a], 2009-2010

Variety	Lint Yield	Lint	Uniformity Index	Length	Strength	Micronaire
	lb/acre	%	%	inches	g/tex	units
DP 0912 B2RF	**1214**	44.3	82.6	1.07	28.8	5.1
GA2006053	**1202**	41.6	83.5	1.15	28.8	4.9
Dyna-Gro 2570B2RF	**1199**	44.5	83.0	1.11	28.7	4.9
PHY 375 WRF	**1196**	45.4	82.8	1.11	27.9	4.6
FM1740B2RF	**1190**	44.4	82.5	1.10	28.5	4.8
PHY 367 WRF	**1178**	44.2	82.4	1.12	28.5	4.4
DP 0924 B2RF	**1172**	44.3	82.5	1.07	28.2	4.9
DP 0920 B2RF	1139	44.6	82.8	1.12	26.8	4.9
NG 3331 B2RF	1129	43.4	82.8	1.08	30.4	5.0
AM 1550 B2RF	1115	44.2	82.6	1.09	26.4	4.7
CG3220B2RF	1107	43.2	83.0	1.11	27.4	4.7
All-Tex A102	1057	42.9	83.2	1.15	28.9	4.5
CG3035RF	1046	44.7	82.8	1.10	29.0	4.9
CG4020B2RF	1046	42.8	83.3	1.14	26.5	4.3
ST 4288B2F	1043	41.9	82.3	1.11	27.9	4.8
SSG CT Linwood	1038	43.6	82.8	1.09	31.6	5.2
CG3520B2RF	1022	42.7	82.7	1.12	25.7	4.5
CG3020B2RF	977	41.4	82.7	1.08	26.3	4.3
Average	1115	43.6	82.8	1.11	28.1	4.7
LSD 0.10	66	0.4	0.8	0.02	0.7	0.1
CV %	14.5	2.1	2.5	5.06	4.3	5.1

[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 for Earlier Maturity Cotton Varieties, 2010, Irrigated

	Lint Yield[a]									
					4-Loc.		Unif.			
Variety	Bainbridg	Midville	Plains	Tifton	Average	Lint	Index	Length	Strength	Mic.
	------------------------- lb/acre -------------------------					%	%	in	g/tex	units
PHY 499 WRF	**1830** [1]	**2222** [1]	**1453** [2]	**1792** [4]	**1824** [1]	45.8	84.9	1.14	32.5	4.8
DP 0912 B2RF	**1714** [3]	**2097** [2]	**1428** [3T]	**1804** [1]	**1761** [2]	42.5	83.5	1.11	30.4	4.9
DP 1028 B2RF	**1742** [2]	1998 [6]	1346 [11]	**1693** [8]	**1695** [3]	46.0	84.3	1.16	30.1	4.8
DP 0924 B2RF	**1662** [5]	**2054** [4]	1320 [13]	**1657** [11]	1673 [4]	43.1	83.1	1.12	30.5	4.9
FM1740B2RF	1544 [9]	1943 [9]	**1396** [6]	**1736** [7]	1655 [5T]	43.3	83.6	1.14	30.3	4.7
DP 1032 B2RF	**1672** [4]	**2048** [5]	**1397** [5T]	1503 [18]	1655 [5T]	45.3	83.7	1.17	30.9	4.7
Dyna-Gro 2570B2RF	**1645** [6]	1828 [14]	1262 [17]	**1778** [5]	1628 [6]	42.4	84.0	1.15	30.3	4.7
AM 1550 B2RF	1516 [12]	1939 [10]	**1418** [4]	**1610** [14]	1621 [7]	43.1	83.3	1.12	28.5	4.6
GA2007095	1487 [15]	1863 [13]	**1382** [8]	**1740** [6]	1618 [8]	41.9	84.7	1.20	31.6	4.4
DP 0920 B2RF	1468 [17]	**2086** [3]	1341 [12]	1541 [17]	1609 [9]	43.5	84.0	1.15	28.5	4.6
NG 3331 B2RF	1597 [7]	1867 [12]	**1428** [3T]	1497 [20]	1597 [10]	43.0	83.9	1.12	31.8	5.0
PHY 375 WRF	1472 [16]	1992 [7]	1231 [20]	**1675** [10]	1592 [11]	44.0	83.9	1.15	30.4	4.4
PHY 367 WRF	1413 [22]	1737 [18]	**1561** [1]	**1626** [13]	1584 [12]	42.6	83.5	1.17	31.1	4.1
CG3220B2RF	1461 [18]	1885 [11]	1255 [18]	**1692** [9]	1573 [13]	41.3	84.5	1.17	31.2	4.7
CG3035RF	1509 [14]	1758 [16]	**1397** [5T]	**1570** [16]	1559 [14]	43.7	84.5	1.14	31.2	4.6
ST 4288B2F	1366 [24]	1665 [23]	**1373** [9]	**1798** [2]	1550 [15]	40.3	83.1	1.15	29.0	4.6
GA2006053	1437 [21]	1977 [8]	1291 [15]	1460 [23]	1541 [16]	40.0	83.6	1.19	29.3	4.6
All-Tex 7A21	1513 [13]	1713 [20]	**1386** [7]	1500 [19]	1528 [17]	43.8	84.5	1.19	31.8	4.3
All-Tex LA122	1444 [19]	1807 [15]	1269 [16]	**1576** [15]	1524 [18]	43.8	84.6	1.18	29.7	4.4
SSG CT Linwood	1441 [20]	1542 [28]	1188 [23]	**1797** [3]	1492 [19]	43.0	83.8	1.12	33.3	5.0
NG 4012 B2RF	1538 [10]	1651 [25]	1214 [21]	1455 [24]	1465 [20]	42.0	83.4	1.18	33.0	4.3
All-Tex A102	1260 [28]	1658 [24]	1238 [19]	**1637** [12]	1448 [21]	41.4	83.9	1.18	30.3	4.4
NG 4010 B2RF	1333 [26]	1736 [19]	1354 [10]	1310 [28]	1433 [22]	42.0	83.6	1.17	31.7	4.5
CG4020B2RF	1405 [23]	1699 [21]	1195 [22]	1395 [26]	1424 [23]	41.4	84.2	1.19	29.3	4.2
CG3020B2RF	1364 [25]	1670 [22]	1145 [25]	1494 [22]	1418 [24]	40.5	84.1	1.12	28.2	4.1
GA2006106	1192 [29]	1757 [17]	1122 [26]	1496 [21]	1392 [25]	41.3	84.4	1.22	33.6	4.5
CG3520B2RF	1177 [30]	1589 [27]	1313 [14]	1429 [25]	1377 [26]	41.1	83.9	1.16	27.7	4.4
NG 8015 B2RF	1268 [27]	1633 [26]	1146 [24]	1338 [27]	1346 [27]	41.0	83.6	1.17	33.6	4.7
DG10612 B2RF	1555 [8]	.	.	.	.	.	.	.	.	.
DG10624 B2RF	1523 [11]	.	.	.	.	.	.	.	.	.
Average	1485	1836	1316	1593	1557	42.6	83.9	1.16	30.7	4.6
LSD 0.10	220	211	190	259	140	1.3	0.7	0.02	1.0	0.2
CV %	12.6	9.8	12.2	13.8	12.1	2.2	0.9	1.80	4.0	5.4

[a] Superscripts indicate ranking at that location.

Bolding indicates entries not significantly different from highest yielding entry based on Fisher's protected LSD

Table 4. Two-Year Summary for Earlier Maturity Cotton Varieties at Four Locations[a], 2009-2010, Irrigated

Variety	Lint Yield	Lint	Uniformity Index	Length	Strength	Micronaire
	lb/acre	%	%	inches	g/tex	units
FM1740B2RF	**1844**	43.8	83.6	1.16	28.8	4.4
DP 0912 B2RF	**1839**	42.8	83.8	1.13	29.8	4.8
DP 0920 B2RF	**1818**	44.2	84.0	1.17	27.5	4.5
Dyna-Gro 2570B2RF	**1815**	43.5	83.8	1.16	28.9	4.6
DP 0924 B2RF	1760	43.3	83.6	1.14	29.3	4.7
PHY 367 WRF	1726	43.2	83.9	1.19	29.7	4.1
GA2006053	1725	41.2	83.9	1.19	28.6	4.5
AM 1550 B2RF	1711	43.5	83.6	1.14	26.9	4.4
CG3220B2RF	1707	42.2	84.3	1.18	28.9	4.6
SSG CT Linwood	1683	43.5	84.0	1.14	31.7	4.9
ST 4288B2F	1672	40.8	83.6	1.18	28.2	4.7
PHY 375 WRF	1667	44.0	83.8	1.16	28.9	4.2
NG 3331 B2RF	1649	43.1	84.0	1.13	30.4	4.8
CG3035RF	1631	44.1	84.2	1.16	29.3	4.3
All-Tex A102	1605	41.9	83.9	1.18	29.0	4.2
CG4020B2RF	1555	41.8	84.2	1.20	27.5	4.1
CG3520B2RF	1552	41.6	84.1	1.18	26.7	4.3
CG3020B2RF	1549	40.8	84.2	1.15	27.5	4.0
Average	1695	42.7	83.9	1.16	28.8	4.4
LSD 0.10	81	0.4	0.4	0.01	N.S.[1]	0.2
CV %	11.5	2.1	0.9	1.69	4.4	5.7

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

1. The F-test indicated no statistical differences at the alpha = .10 probability level; therefore a LSD value was not calculated.

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

Table 5. Yield Summary for Dryland Later Maturity Cotton Varieties, 2010

	Lint Yield[a]									
Variety	Athens	Midville	Plains	Tifton	4-Loc. Averag	Lint	Unif. Index	Length	Strength	Mic.
	------------------------ lb/acre			------------------------		%	%	in	g/tex	units
PHY 499 WRF	**1537** [1]	**1361** [2]	**551** [1]	**1160** [1]	**1152** [1]	46.5	83.1	1.07	31.2	4.8
DP 1050 B2RF	1341 [5]	**1372** [1]	**509** [3T]	953 [10]	1044 [2]	46.7	83.2	1.10	27.7	4.8
DP 1137 B2RF	**1474** [2]	**1181** [9]	**496** [4]	959 [7]	1028 [3]	45.9	82.8	1.08	27.3	4.9
DP 1048 B2RF	1256 [10]	**1261** [4]	**509** [3T]	**976** [5]	1000 [4]	46.3	82.7	1.10	27.4	4.9
PHY 519 WRF	1245 [12]	**1326** [3]	381 [17]	**1006** [4]	990 [5]	43.8	82.2	1.09	30.0	4.9
DP 1034 B2RF	1339 [6]	**1207** [7]	**476** [6]	878 [20]	975 [6]	45.9	82.9	1.10	27.9	4.9
DP 0935 B2RF	1213 [13]	1144 [12]	**483** [5]	**1049** [3]	972 [7]	44.4	81.2	1.05	27.2	5.0
DP 0949B2RF	1132 [21]	**1167** [10]	424 [10]	**1129** [2]	963 [8]	45.5	82.2	1.09	29.6	4.9
10R052B2R2	**1466** [3]	1099 [19]	**528** [2]	731 [30]	956 [9]	47.4	82.9	1.09	28.7	5.1
DP 1133 B2RF	1271 [8]	1131 [14]	**457** [7]	943 [12]	950 [10]	46.1	82.4	1.08	31.3	4.9
ST 5458B2RF	1272 [7]	1120 [18]	417 [12]	894 [19]	926 [11]	43.0	81.7	1.08	28.9	5.0
AM 1550 B2RF	1115 [23]	**1192** [8]	406 [14]	957 [9]	917 [12]	43.8	82.0	1.02	25.6	4.9
PHY 375 WRF	**1389** [4]	1129 [15]	374 [20]	772 [28]	916 [13]	44.6	82.1	1.07	28.3	4.6
DP 1032 B2RF	1251 [11]	**1156** [11]	342 [25]	911 [18]	915 [14]	44.0	82.8	1.11	29.3	4.8
GA2004303	1163 [19]	1139 [13]	420 [11]	935 [13]	914 [15]	43.2	81.9	1.09	30.1	5.0
GA2004143	1175 [18]	1121 [17]	431 [9]	925 [16]	913 [16]	45.9	82.3	1.12	31.2	4.9
BCSX 1010B2F	1259 [9]	1040 [21]	344 [24]	933 [14]	894 [17]	43.2	81.7	1.08	27.8	4.5
ST 5288B2F	1061 [29]	**1253** [5]	442 [8]	817 [24]	893 [18]	43.1	82.1	1.08	27.4	4.9
NG 3331 B2RF	1188 [15]	**1249** [6]	318 [29]	784 [26]	885 [19]	43.5	82.7	1.06	29.2	5.0
FM1740B2RF	1042 [30]	1126 [16]	392 [16]	958 [8]	879 [20]	44.9	81.9	1.06	27.6	4.8
PHY 565 WRF	1185 [16]	1039 [22]	302 [31]	927 [15]	863 [21]	42.2	82.5	1.09	30.9	4.7
PHY 569 WRF	1145 [20]	1020 [24]	363 [22T]	918 [17]	862 [22]	42.2	83.3	1.08	30.4	4.7
ST 4288B2F	1084 [26]	969 [28]	373 [21]	970 [6]	849 [23]	41.2	82.2	1.08	27.5	4.8
PHY 440 W	1181 [17]	936 [32]	397 [15T]	827 [23]	835 [24]	44.5	82.2	1.04	29.6	4.5
PHY 525 RF	1131 [22]	1012 [25]	397 [15T]	781 [27]	830 [25]	42.6	82.7	1.15	30.3	4.5
BCSX1040B2F	1015 [32]	966 [29]	375 [19]	952 [11]	827 [26]	39.8	83.6	1.17	30.3	4.3
PHY 485 WRF	1197 [14]	994 [27]	363 [22T]	730 [31]	821 [27]	43.1	82.7	1.07	29.9	4.7
FM 1845LLB2	1082 [27]	1001 [26]	306 [30]	872 [21]	815 [28]	41.5	82.8	1.14	30.8	4.8
FM1773LLB2	1094 [25]	1043 [20]	324 [28]	735 [29]	799 [29]	41.6	82.0	1.11	31.0	4.9
BCSX1030B2F	1069 [28]	963 [30]	409 [13]	701 [32]	786 [30]	43.7	81.9	1.07	26.4	4.4
SSG CT 310HQ	1029 [31]	887 [33]	376 [18]	836 [22]	782 [31]	40.8	82.6	1.11	33.7	5.0
NG 4010 B2RF	912 [33]	1036 [23]	336 [26]	796 [25]	770 [32]	42.1	82.3	1.09	30.5	4.7
NG 4012 B2RF	1107 [24]	948 [31]	349 [23]	649 [34]	763 [33]	43.3	81.6	1.08	28.8	4.4
NG 8015 B2RF	893 [34]	866 [34]	333 [27]	689 [33]	695 [34]	41.3	81.7	1.07	30.5	4.9
Average	1186	1102	403	884	894	43.8	82.4	1.09	29.2	4.8
LSD 0.10	149	220	99	186	103	1.3	0.8	0.03	1.4	0.3
CV %	10.7	17.1	21.1	17.9	16.2	2.3	1.0	2.92	4.2	5.6

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

Table 6. Two-Year Summary for Dryland Later Maturity Cotton Varieties at Four Locations[a], 2009-2010

Variety	Lint Yield	Lint	Uniformity Index	Length	Strength	Micronaire
	lb/acre	%	%	inches	g/tex	units
DP 0949B2RF	**1182**	45.8	83.0	1.12	29.5	5.0
DP 0935 B2RF	**1145**	44.9	82.1	1.08	27.9	5.0
PHY 375 WRF	**1135**	45.3	82.6	1.10	28.7	4.6
ST 5458B2RF	**1129**	44.0	82.1	1.11	29.6	5.0
ST 5288B2F	1093	44.2	82.5	1.11	27.7	5.0
FM 1845LLB2	1069	42.5	83.6	1.17	31.1	4.8
BCSX 1010B2F	1060	43.5	82.4	1.12	28.4	4.7
PHY 485 WRF	1038	43.5	83.0	1.11	29.9	4.8
PHY 440 W	1035	44.1	83.0	1.09	29.6	4.6
PHY 525 RF	948	43.7	83.3	1.16	29.6	4.4
SSG CT 310HQ	916	41.4	83.1	1.13	34.1	4.9
Average	1068	43.9	82.8	1.12	29.6	4.8
LSD 0.10	68	0.4	0.5	0.02	0.8	0.1
CV %	15.4	2.2	1.0	2.24	4.3	4.6

[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 for Later Maturity Cotton Varieties, 2010, Irrigated

	Lint Yield[a]									
Variety	Bainbridge	Midville	Plains	Tifton	4-Loc. Average	Lint	Unif. Index	Length	Strength	Mic.
	lb/acre					%	%	in	g/tex	units
DP 1034 B2RF	**1616** [4]	1721 [23]	**1401** [1]	**1746** [1]	**1621** [1]	46.0	84.2	1.17	28.5	4.7
PHY 499 WRF	**1583** [6]	1859 [15]	**1288** [2]	**1702** [3]	**1608** [2]	45.4	84.1	1.14	32.5	4.8
DP 1050 B2RF	1546 [10]	**2158** [1]	1061 [14T]	**1622** [7]	**1597** [3]	45.9	84.5	1.16	28.9	4.8
PHY 375 WRF	1504 [13]	**2066** [4]	1134 [9]	**1678** [4]	**1596** [4]	43.7	83.8	1.15	29.4	4.4
10R052B2R2	**1765** [1]	1858 [16]	1212 [4]	1509 [18]	**1586** [5]	46.1	84.3	1.17	29.4	4.8
PHY 565 WRF	1490 [17]	**2100** [3]	1024 [17]	**1723** [2]	**1584** [6]	43.5	84.0	1.17	32.6	4.2
DP 1048 B2RF	**1636** [2]	1916 [12]	1102 [11]	**1624** [6]	**1569** [7]	45.1	84.5	1.17	28.5	4.7
DP 1137 B2RF	1555 [9]	**2001** [7]	1122 [10]	**1591** [10]	**1567** [8]	45.5	84.0	1.14	29.4	4.9
DP 0949B2RF	1505 [12]	**2112** [2]	955 [23]	**1675** [5]	**1562** [9]	44.1	83.6	1.15	30.0	5.0
DP 1133 B2RF	1484 [18]	**1960** [10]	1166 [5]	**1576** [11]	**1546** [10]	45.2	85.0	1.18	32.3	4.8
GA2004143	1493 [15]	**2062** [5]	948 [24]	1545 [16T]	**1512** [11]	45.0	84.0	1.18	32.9	4.7
DP 1032 B2RF	1541 [11]	**1992** [8]	986 [19]	1507 [19]	**1507** [12]	44.0	84.0	1.19	31.6	4.5
PHY 569 WRF	1563 [8]	1834 [18]	1158 [7]	1467 [22]	**1506** [13]	42.2	84.3	1.13	31.7	4.7
AM 1550 B2RF	1222 [32]	1928 [11]	**1251** [3]	**1610** [8T]	**1503** [14T]	42.4	83.3	1.12	27.9	4.6
PHY 519 WRF	1565 [7]	1852 [17]	1037 [16]	**1559** [15]	**1503** [14T]	42.7	83.0	1.15	31.8	4.6
ST 5458B2RF	**1584** [5]	1680 [28]	1162 [6]	**1567** [14]	**1498** [15]	42.7	83.4	1.15	31.4	5.0
NG 3331 B2RF	**1618** [3]	1720 [24]	1061 [14T]	**1570** [13]	**1492** [16]	42.6	84.1	1.13	31.9	4.8
ST 5288B2F	1463 [19]	**2028** [6]	816 [31]	**1608** [9]	1479 [17]	43.2	82.7	1.14	29.1	4.7
ST 4288B2F	1493 [16]	1736 [22]	1069 [12]	1545 [16T]	1461 [18]	39.9	83.1	1.15	28.8	4.6
GA2004303	1442 [21]	1869 [13]	1040 [15]	1490 [21]	1460 [19]	43.4	83.8	1.14	31.6	5.0
DP 0935 B2RF	1328 [26]	1867 [14]	1065 [13]	**1575** [12]	1459 [20]	43.2	83.5	1.12	29.0	4.7
BCSX1030B2F	1499 [14]	1708 [25]	1136 [8]	1404 [25T]	1437 [21]	42.7	83.0	1.14	27.1	4.3
FM1740B2RF	1303 [28]	**1961** [9]	915 [27]	1526 [17]	1426 [22]	43.5	82.9	1.13	30.2	4.6
FM 1845LLB2	1391 [24T]	1706 [26]	980 [21]	**1610** [8T]	1422 [23]	39.9	84.0	1.19	32.8	4.7
FM1773LLB2	1462 [20]	1738 [21]	928 [25]	1503 [20]	1408 [24]	39.3	83.8	1.21	33.7	4.9
PHY 485 WRF	1403 [23]	1787 [20]	981 [20]	1322 [28]	1373 [25]	42.3	84.0	1.14	31.2	4.9
BCSX 1010B2F	1250 [30]	1801 [19]	907 [28]	1450 [23]	1352 [26]	41.1	83.1	1.15	29.4	4.4
BCSX1040B2F	1390 [25]	1568 [32]	919 [26]	1404 [25T]	1320 [27]	37.8	84.7	1.24	31.9	4.3
NG 4012 B2RF	1271 [29]	1658 [30]	904 [29]	1431 [24]	1316 [28]	41.9	83.4	1.18	31.9	4.5
PHY 440 W	1230 [31]	1659 [29]	990 [18]	1363 [27]	1311 [29]	42.1	83.5	1.15	30.5	4.5
PHY 525 RF	1391 [24T]	1608 [31]	815 [32]	1276 [30]	1272 [30]	42.8	83.8	1.18	30.6	4.2
NG 8015 B2RF	1311 [27]	1682 [27]	840 [30]	1253 [31]	1271 [31]	39.6	83.7	1.16	32.6	4.8
NG 4010 B2RF	1193 [33]	1503 [33]	977 [22]	1376 [26]	1262 [32]	40.7	83.6	1.18	31.7	4.6
SSG CT 310HQ	1421 [22]	1469 [34]	703 [33]	1310 [29]	1226 [33]	39.6	83.8	1.16	34.0	4.7
Average	1456	1828	1031	1521	1459	42.8	83.8	1.16	30.8	4.7
LSD 0.10	190	198	186	190	130	1.0	0.7	0.02	1.0	0.2
CV %	11.1	9.2	15.4	10.6	11.2	2.4	0.8	2.11	4.0	4.8

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

Table 8. Two-Year Summary for Later Maturity Cotton Varieties at Four Locations[a], 2009-2010, Irrigated

Variety	Lint Yield	Lint	Uniformity Index	Length	Strength	Micronaire
	lb/acre	%	%	inches	g/tex	units
DP 0949B2RF	**1753**	44.6	83.8	1.17	29.5	4.8
PHY 375 WRF	**1731**	43.6	83.5	1.15	28.7	4.2
ST 5458B2RF	1649	43.3	82.9	1.17	30.7	4.8
DP 0935 B2RF	1625	44.1	83.3	1.14	28.6	4.5
ST 5288B2F	1609	43.7	82.9	1.15	28.4	4.6
PHY 485 WRF	1597	43.2	84.2	1.16	30.9	4.7
FM 1845LLB2	1536	40.4	84.3	1.21	31.9	4.4
BCSX 1010B2F	1498	41.0	83.4	1.18	29.5	4.4
PHY 440 W	1495	42.1	83.6	1.17	30.4	4.4
SSG CT 310HQ	1265	40.7	83.6	1.16	33.4	4.4
PHY 525 RF	1259	42.9	83.8	1.20	29.8	4.0
Average	1547	42.7	83.6	1.17	30.2	4.5
LSD 0.10	68	0.3	0.4	0.02	0.7	0.2
CV %	10.7	1.9	0.8	2.16	4.2	6.3

[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 for Cotton Strains, 2010, Irrigated

Variety	Lint Yield[a] Midville	Plains	Tifton	3-Loc. Average	Lint	Unif. Index	Length	Strength	Mic.
	---------- lb/acre ----------				%	%	inches	g/tex	units
10R052B2R2	**2156** [1]	**1107** [1]	**1503** [2]	**1589** [1]	46.6	84.2	1.15	28.7	4.9
DP 1137 B2RF	**2018** [2]	**1052** [5]	**1490** [4]	**1520** [2]	45.7	83.7	1.13	28.4	4.9
Dyna-Gro 2570B2RF	1698 [7T]	**1102** [2]	**1497** [3]	**1432** [3]	42.3	83.7	1.13	30.3	4.7
GA2006046	1842 [4]	**1093** [3]	1273 [12]	1403 [4]	42.0	83.4	1.17	29.9	4.8
GA2008083	1707 [6]	**977** [9]	**1470** [6]	1385 [5]	44.9	82.9	1.14	32.0	4.6
GA2008001	1727 [5]	**982** [8]	**1418** [7]	1376 [6]	42.7	84.0	1.20	32.3	4.7
DP 1133 B2RF	1926 [3]	**994** [7]	1200 [14]	1373 [7]	45.5	84.6	1.14	31.9	5.0
GA2008016	1653 [9]	926 [11]	**1473** [5]	1351 [8]	42.6	84.2	1.18	35.3	4.9
All-Tex ATX91437-2	1698 [7T]	**1090** [4]	1222 [13]	1337 [9]	45.1	83.0	1.16	27.0	4.4
GA2008005	1655 [8]	930 [10]	**1408** [8]	1331 [10]	43.0	84.6	1.18	32.1	5.0
All-Tex ATX81144	1573 [11]	**1042** [6]	**1335** [10]	1317 [11]	42.0	83.3	1.19	32.0	4.1
GA2008057	1488 [13]	922 [12]	**1512** [1]	1307 [12]	43.3	85.0	1.22	34.7	4.7
All-Tex ATX8W318-20	1640 [10]	740 [14]	**1338** [9]	1239 [13]	41.3	83.3	1.15	29.0	4.5
GA2008052	1536 [12]	823 [13]	1277 [11]	1212 [14]	41.2	84.2	1.19	32.7	4.3
Average	1737	984	1387	1369	43.5	83.9	1.17	31.2	4.7
LSD 0.10	151	143	195	171	1.3	0.6	0.03	1.1	0.3
CV %	7.3	12.2	11.8	10.1	1.8	2.7	1.09	4.0	4.0

[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 10. Tifton, Georgia: Earlier Maturity Cotton Variety Performance including Micro-Gin Quality Data, 2010, Irrigated

Variety	Lint Yield	MG[1] Lint Yield	Lint	MG[1] Lint	Unif. Index[2]	MG[1] Unif. Index	Length[2]	MG[1] Length	Strength[2]	MG[1] Strength*	Mic.[2]	MG[1] Mic.
	lb/acre	lb/acre	%	%	%	%	inches	inches	g/tex	g/tex	units	units
All-Tex 7A21	1500	1318	44.9	39.4	84.0	81.9	1.14	1.16	31.1	28.1	4.5	4.7
All-Tex A102	**1637**	**1400**	42.1	36.0	84.2	81.6	1.16	1.14	29.6	27.3	4.9	4.4
All-Tex LA122	**1576**	**1419**	44.5	40.1	84.4	82.1	1.14	1.13	30.1	25.6	4.6	4.7
AM 1550 B2RF	**1610**	**1443**	43.3	38.7	82.7	81.3	1.12	1.07	27.3	24.0	4.7	4.8
CG3020B2RF	1494	1239	42.7	35.5	84.3	82.0	1.12	1.10	28.2	25.4	4.5	4.4
CG3035RF	**1570**	**1415**	44.1	39.8	84.6	82.0	1.11	1.10	31.6	27.3	4.8	4.9
CG3220B2RF	**1692**	**1552**	41.8	38.4	84.5	81.8	1.15	1.12	32.2	25.9	4.9	4.9
CG3520B2RF	1429	1263	40.8	36.1	83.3	82.3	1.14	1.11	27.4	25.2	4.6	4.6
CG4020B2RF	1395	1210	42.5	36.8	83.6	82.5	1.13	1.13	28.4	26.2	4.5	4.5
DP 0912 B2RF	**1804**	**1564**	42.5	36.9	83.4	81.9	1.10	1.06	30.4	26.2	4.9	5.0
DP 0920 B2RF	1541	**1378**	44.7	40.0	84.6	81.8	1.11	1.09	28.1	25.3	5.1	5.1
DP 0924 B2RF	**1657**	**1388**	44.7	37.5	83.4	80.6	1.08	1.09	29.5	25.9	5.3	5.1
DP 1028 B2RF	**1693**	**1566**	45.4	42.0	84.5	82.4	1.14	1.10	29.9	26.9	4.8	5.1
DP 1032 B2RF	1503	1320	46.3	40.6	84.3	81.6	1.17	1.13	30.9	26.7	4.8	4.9
Dyna-Gro 2570B2RF	**1778**	**1575**	44.1	39.0	83.7	82.2	1.13	1.12	29.7	26.3	4.7	4.9
FM1740B2RF	**1736**	**1522**	43.7	38.2	83.3	81.5	1.13	1.09	29.8	27.3	4.6	4.7
GA2006053	1460	1319	40.3	36.5	83.0	81.5	1.15	1.14	28.9	26.3	4.9	4.7
GA2006106	1496	1312	42.6	37.5	84.6	82.2	1.19	1.16	34.2	29.6	4.6	4.5
GA2007095	**1740**	**1543**	43.2	38.3	84.6	81.6	1.15	1.13	31.3	26.1	4.6	4.7
NG 3331 B2RF	1497	1267	44.2	37.4	83.6	81.7	1.11	1.07	30.5	27.8	5.2	5.3
NG 4010 B2RF	1310	1132	43.7	37.8	83.7	81.7	1.15	1.14	30.3	27.9	4.6	4.8
NG 4012 B2RF	1455	1304	43.4	39.0	82.7	81.1	1.16	1.13	32.0	27.4	4.5	4.6
NG 8015 B2RF	1338	1141	42.7	36.4	84.2	82.0	1.15	1.11	32.9	29.1	4.6	5.0
PHY 367 WRF	**1626**	**1453**	43.1	38.6	82.6	82.4	1.16	1.15	30.9	28.0	4.1	4.5
PHY 375 WRF	**1675**	**1435**	45.7	39.2	83.0	81.3	1.12	1.11	31.0	25.8	4.5	4.6
PHY 499 WRF	**1792**	**1511**	48.1	40.5	84.3	82.4	1.11	1.09	31.9	29.2	5.1	5.0
SSG CT Linwood	**1797**	**1510**	44.7	37.6	82.8	81.8	1.11	1.08	31.6	29.1	5.2	5.4
ST 4288B2F	**1798**	**1485**	43.0	35.6	82.6	80.7	1.14	1.12	28.6	24.9	4.8	4.9
Average	1593	1392	43.7	38.2	83.7	81.8	1.13	1.11	30.3	26.8	4.7	4.8
LSD 0.10	259	220	1.2	0.6	1.3	N.S.[3]	0.03	0.03	2.8	1.5	0.4	0.2
CV %	13.8	13.4	2.4	1.4	0.9	0.8	1.56	1.51	5.3	3.2	5.3	2.5

1. Micro-Gin quality samples are from total seed cotton harvested from each plot.
2. A random quality sample was taken on the picker during cotton harvest.
3. The F-test indicated no statistical differences at the alpha = .10 probability level; therefore a LSD value was not calculat

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

Planted:	April 27, 2010.
Harvested:	September 15, 2010.
Soil Type:	Tifton sandy loam.
Fertilization:	78 lb N, 54 lb P_2O_5, and 108 lb K_2O/acre.
Management:	Temik applied 5 lb/acre.

	May	June	July	Aug.	Sept.
Irrigation (in):	1.20	2.30	4.20	1.00	0.00

Trials conducted by Larry Thompson.

Table 11. Tifton, Georgia: Later Maturity Cotton Variety Performance including Micro-Gin Quality Data, 2010, Irrigated

Variety	Lint Yield	MG[1] Lint Yield	Lint	MG[1] Lint	Unif. Index[2]	MG[1] Unif. Index	Length[2]	MG[1] Length	Strength[2]	MG[1] Strength*	Mic.[2]	MG[1] Mic.
	lb/acre	lb/acre	%	%	%	%	inches	inches	g/tex	g/tex	units	units
10R05B2R2	1509	**1386**	45.7	42.0	85.0	81.5	1.16	1.12	29.3	25.9	5.3	5.2
AM 1550 B2RF	**1610**	1369	44.7	38.0	83.3	81.0	1.11	1.09	26.4	26.1	4.7	4.8
BCSX 1010B2F	1450	1341	39.6	36.7	83.6	81.0	1.16	1.11	29.2	27.0	4.6	4.5
BCSX1030B2F	1404	1236	44.7	39.2	81.1	80.2	1.09	1.07	24.7	24.3	4.4	4.5
BCSX1040B2F	1404	1209	39.1	33.7	84.2	83.1	1.23	1.20	30.8	28.8	4.5	4.7
DP 0935 B2RF	**1575**	**1444**	44.1	40.4	82.1	80.6	1.06	1.05	26.5	25.6	4.9	4.9
DP 0949B2RF	**1675**	**1447**	45.8	39.6	83.4	81.7	1.11	1.10	29.8	28.3	5.3	5.1
DP 1032 B2RF	1507	1367	44.5	40.1	83.8	81.3	1.15	1.13	31.1	29.4	4.7	4.9
DP 1034 B2RF	**1746**	**1530**	47.1	41.2	83.6	81.7	1.15	1.12	27.3	25.2	4.9	4.9
DP 1048 B2RF	**1624**	**1440**	46.1	40.9	84.4	81.1	1.14	1.11	28.1	25.7	4.8	4.9
DP 1050 B2RF	**1622**	**1450**	47.2	42.2	84.6	81.7	1.13	1.13	26.8	25.5	5.2	5.0
DP 1133 B2RF	**1576**	**1375**	46.8	40.7	84.9	82.2	1.15	1.13	31.5	29.1	5.0	5.1
DP 1137 B2RF	**1591**	**1434**	45.8	41.3	84.7	81.3	1.13	1.07	29.7	25.2	4.9	5.1
FM 1845LLB2	**1610**	1371	41.9	35.7	83.8	81.8	1.14	1.16	30.6	29.9	4.9	4.8
FM1740B2RF	1526	1273	45.9	38.5	84.3	80.6	1.15	1.07	31.4	26.6	4.7	4.7
FM1773LLB2	1503	1322	40.0	35.2	83.2	80.9	1.18	1.14	34.1	30.3	4.8	4.8
GA2004143	1545	1350	46.2	40.4	83.9	81.8	1.17	1.15	31.2	28.7	5.0	4.9
GA2004303	1490	1347	44.3	40.1	82.6	80.7	1.13	1.03	30.8	27.8	5.2	5.4
NG 3331 B2RF	**1570**	1339	43.3	37.0	83.6	82.2	1.12	1.07	31.2	29.2	4.8	5.1
NG 4010 B2RF	1376	1252	41.3	37.6	83.3	81.4	1.16	1.14	30.7	27.5	4.6	4.6
NG 4012 B2RF	1431	1261	43.6	38.4	82.8	81.0	1.15	1.12	29.4	28.4	4.7	4.5
NG 8015 B2RF	1253	1122	40.6	36.4	83.1	82.2	1.14	1.12	31.8	28.7	4.9	5.0
PHY 375 WRF	**1678**	**1433**	45.1	38.5	83.3	81.3	1.13	1.11	27.9	27.8	4.4	4.6
PHY 440 W	1363	1176	43.2	37.3	83.2	82.0	1.11	1.10	29.4	27.8	4.6	4.8
PHY 485 WRF	1322	1115	43.9	37.0	83.7	82.0	1.10	1.09	31.0	28.5	5.0	5.0
PHY 499 WRF	**1702**	**1486**	46.5	40.6	84.1	81.9	1.11	1.10	31.2	28.9	4.9	5.2
PHY 519 WRF	**1559**	1358	43.1	37.7	82.1	81.7	1.11	1.12	31.3	29.3	4.6	4.7
PHY 525 RF	1276	1113	42.8	37.3	83.1	82.1	1.16	1.12	28.8	27.3	4.4	4.5
PHY 565 WRF	**1723**	**1475**	43.8	37.5	83.8	81.2	1.16	1.10	31.9	29.1	4.6	4.7
PHY 569 WRF	1467	1253	43.6	37.3	84.0	82.4	1.10	1.10	30.1	28.8	4.8	4.8
SSG CT 310HQ	1310	1138	41.9	36.4	83.3	81.3	1.13	1.09	32.6	30.3	5.1	5.0
ST 4288B2F	1545	1334	41.6	35.9	83.4	80.6	1.16	1.12	27.8	25.9	4.6	4.9
ST 5288B2F	**1608**	1365	44.0	37.4	82.0	81.0	1.10	1.08	27.2	24.9	4.8	4.9
ST 5458B2RF	**1567**	1336	45.4	38.7	82.0	80.2	1.10	1.07	29.8	27.0	4.8	5.3
Average	1521	1331	43.9	38.4	83.4	81.4	1.13	1.10	29.7	27.6	4.8	4.9
LSD 0.10	190	158	1.4	0.5	1.2	1.1	0.05	0.04	2.7	1.8	0.4	0.2
CV %	10.6	10.1	2.6	1.2	0.9	0.7	2.57	2.39	5.4	3.9	4.9	2.5

1. Micro-Gin quality samples are from total seed cotton harvested from each plot.
2. A random quality sample was taken on the picker during cotton harvest.

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

Planted:	April 27, 2010.
Harvested:	September 15, 2010.
Soil Type:	Tifton sandy loam.
Fertilization:	78 lb N, 54 lb P_2O_5, and 108 lb K_2O/acre.
Management:	Temik applied 5 lb/acre.

	May	June	July	Aug.	Sept.
Irrigation (in):	1.20	2.30	4.20	1.00	0.00

Trials conducted by Larry Thompson.

2010 RANDOLPH COUNTY NON-IRRIGATED COTTON VARIETY TEST PLOT

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Ted Milliron, Randolph County Cotton Producer

Introduction

For several years, DP 555 BR has been the cotton cultivar of choice in Randolph County and the state of Georgia. There were many years that DP 555 BR consisted of well over 90% of the acreage in the county. DP 555 BR was a tall growing, drought tolerant cotton variety with great fruiting potential and longevity. However, in 2008 DP 555 BR began to be phased out of production and this forced cotton producers in Georgia to seek new varieties to plant. Although DP 555 BR was considered superior in yield to all available cultivars, it did not produce the highest quality of fiber. Therefore, yield and fiber quality were the two most sought after characteristics when considering new varieties.

As the situation required an obvious transition to newer varieties, there was sufficient research on varieties in irrigated scenarios, but a considerable void for non-irrigated cotton variety research. Although most of southwest Georgia has ample water to irrigate crops, there are several areas where water is not available and many acres are non-irrigated. The lack of quality, replicated, non-irrigated cotton variety research prompted an effort by several county agents to conduct variety trials to assist producers in the coming years. As part of this desire to meet this need, the Randolph County Extension Office participated in the 2010 Uniform Cotton Variety Performance Evaluation Program, which was established by Dr. Guy Collins and Dr. Jared Whitaker. The objective of this program was to identify the best cultivars to plant in the absence of DP 555 BR and bolster the variety trial research effort across the state.

Materials and Methods

A suitable research plot location and grower, Ted Milliron, were identified for the program in Randolph County. Based on the research protocol provided by Dr. Guy Collins, the ten most likely replacement varieties were selected, acquired, and planting procedures were planned. The ten varieties tested in the non-irrigated cotton plots were: DP 555 BR, DP 0949 B2RF, DP 1048 B2RF, DP 1050 B2RF, FM 1740 B2RF, PHY 375 WRF, PHY 485 WRF, PHY 565 WRF, ST 4288 B2RF, and ST 5458 B2RF.

The test plots were prepared by disking, then trifluralin (1.25 pt/A) was applied and incorporated by disking. The plot area was stripped and planted with the seed being placed about 1” deep. Reflex and Diuron (1 pt/A each) were applied behind the drill with Temik placed in-furrow (4.5 lbs/A). Three replicated plots were designed and initiated in the same manner. Plots were 18’ wide x 1340’ long and approximately one-half acre each. Although DP 555 BR was not available to be planted beyond 2010, it was included in the test for a valid comparison.

Prior to emergence, paraquat was applied (10 oz/A) to kill any weeds left in the field. About three weeks after planting, Round-up (1qt/A) and Staple (2 oz/A) were applied to all plots. The final herbicide application occurred at layby with Diuron and MSMA (1qt/A each). Weed control in the plots was excellent. A few palmer amaranth survived and were hand pulled. Insect control consisted of Orthene 97 (1/4 lb/A applied @ 3-4 leaf stage for thrips control), Leverage (3 oz/A 2nd week of bloom) and one application of Bidrin (6oz/A for stink bug). One application of mepiquat chloride (12 oz/A) was applied to all plots after first bloom.

The plots received chicken litter (2 tons/A) prior to planting and 28-0-0-5 (60 lbs/A) after first bloom. Two applications of liquid boron (1 pt/A) were also applied after first bloom with herbicides and insecticides. The cotton plots were planted on April 23, 2010. On May 26, 2010 the first squares appeared. The cotton began blooming on June 12, 2010. It has also been assumed that the crop reached cut out around the end of the first week of July. Although we showed no measurable rain in the month of July, it is assumed that we received a small amount around July 4th, 2010. The lack of rain following first bloom was the primary factor in the low yields. Two of the three replications were harvested on September 4, 2010. Prior to harvest, the cotton was treated with Prep (1qt/A) and Dropp (6 oz/A) with a John Deere 6500 High-cycle sprayer because poor yield potential did not justify treating with an airplane. Due to harvesting issues and picker malfunctions, time did not allow for the third replication to be harvested on time and was thus removed from the final results.

Results and Discussion

The purpose of the study was to determine what the best cultivars were for non-irrigated cotton farming. Precipitation was certainly a big factor on the outcome of this research. Very little precipitation occurred and the day-to-day temperatures were the hottest on record (Table 1). As we switched from El Niño to La Niña, we experienced an extreme reduction in precipitation and an increase in temperature. Unfortunately the switch happened early in the growing season and the crop did not really benefit from the early season water as it became dry during the fruiting period. Extreme heat unit accumulation also forced the cotton plots into an early permanent wilt and cut out during the first part of July and thus limited yield. Another factor that created difficulty was the fact that rains were received in early and late August. As the plants were cutting out, new precipitation forced new growth on the plants creating unharvestable bolls that would ultimately never accumulate enough heat units to reach maturity. This resulted in difficulty defoliating and harvesting the plots, as well as, staining some lint.

Table 1 Average temperatures from period of first bloom to cut out (June 12-July 12) at the Georgia Automated Environmental Monitoring Network in Shellman, GA.

June 12-July 12 Period by Year	Average Daily Max Temperature	Average Daily Min Temperature	Average Daily Temperature
2010	95.36 °F	72.63 °F	83.99 °F
2009	94.19 °F	72.26 °F	83.22 °F
2008	91.91 °F	69.02 °F	80.46 °F
2007	92.27 °F	69.96 °F	81.11 °F

As mentioned above, the primary factor in the outcome of this research was the timing of the hydrologic events in relation to the growth stages of the cotton plots. Of the 9.64" of precipitation received and documented in the trial, only 2.00" of the total was received after first bloom. Of the 2" received in the trial following first bloom, the first rain received was two weeks following first bloom was .5". The rest of the remaining 1.5" came a full month following first bloom.

Given the climatic conditions this crop and the trial received, the results in some ways did not reflect some expectations, but promised to be an excellent study in the ability of the ten core varieties to tolerate extreme drought and heat.

Of the three replications we chose to measure the center plot assuming it would be the most uniform as far as conditions were concerned. There were some differences between the mic, strength and color grade of some of the varieties. The lint turnout from the UGA Micro-gin follows in Table 2.

Table 2. Gin results from the 2011 Randolph County non-irrigated cotton variety test plot located on Ted Milliron Farms courtesy of the UGA micro-gin.

Variety	Color Grade	Staple	Mic	Strength	Leaf Grade	% Gin Turnout	HVI Length	Uniformity
DP 555 BR	21	31	5.0	22.9	3	38.28	0.98	77.8
DP 0949 B2RF	21	34	4.2	28.3	3	36.71	1.05	80.5
DP 1048 B2RF	22	33	4.3	26.7	2	37.05	1.03	79.0
DP 1050 B2RF	21	33	4.2	26.7	2	39.74	1.04	80.0
FM 1740 B2RF	21	33	3.3	25.5	3	33.67	1.03	78.0
PHY 375 WRF	21	34	5.1	22.2	3	35.36	1.06	78.5
PHY 485 WRF	32	34	5	24.8	5	32.43	1.05	80.1
PHY 565 WRF	32	34	3.8	29.2	3	35.65	1.05	79.4
ST 4288 B2RF	21	35	3.4	27.6	3	32.92	1.08	80.3
ST 5458 B2RF	22	33	5.2	24.2	3	34.32	1.03	80.5

From the gin turnout, there was a spectrum of results. Compared to historical results, lint percentage was much lower than traditional levels. There is some speculation that during highly stressful growing conditions and drought, that seed size is typically larger and this could be the reason for this phenomenon.

Table 3 is the final yield for the varieties that were tested. This particular trial was one of 16 that included DP 555 BR as a comparison. It is extremely interesting to note that DP 555 BR did not perform well in this particular trial which alludes to the fact that good cotton yields cannot be expected in extreme conditions regardless of the variety or traits.

Table 3 Average yield, 2010 Randolph County non-irrigated cotton variety trial.

Variety	Yield (lbs/A)
ST 4288 B2RF	490
PHY 375 WRF	472
ST 5458 B2RF	452
DP 0949 B2RF	452
DP 1050 B2RF	421
FM 1740 B2RF	389
DP 1048 B2RF	383
DP 555 BR	369
PHY 485 WRF	357
PHY 565 WRF	352
Trial Average	414 lbs/A

The results from this particular trial were certainly subject to extreme growing conditions and we received some unexpected yields. However, we do believe that it will serve as a good example for expected yields for the varieties tested under similar conditions in the future.

BREEDING CULTIVARS AND GERMPLASM WITH ENHANCED YIELD AND QUALITY, 2010

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Introduction

The classical breeding component of the University of Georgia cotton improvement program works to develop germplasm with traits that can be used to meet the requirements of both producers and consumers. Higher and more stable yields combined with the fiber properties requested by the yarn and textile manufacturers are the goals for profitable production and processing to support the Georgia Cotton Industry. The objective of this report is to update progress made toward meeting these goals during the 2009 production season.

Materials and Methods

Our crosses mate elite University of Georgia breeding lines with promising germplasm and non-transgenic commercial cultivars to produce 10 sets of 5 half-sib families. These F_2-bulk populations from crosses made in the previous year and advanced at the counter-seasonal nursery in Tecoman, MX are evaluated for lint yield in 2-replicate, randomized complete block designs, with each set of half-sib F_2 families, the GA breeding line parent, and the check cultivar, GA 2004230, constituting a test. Of the F_2-bulk populations evaluated, the highest yielding populations are advanced in to F_3 for single plant selection. The first level of selection of the F_3 plants are decided by visual determination with more individuals selected from the best populations, fewer individuals from the better populations, and perhaps none from the poorer populations. If a segregation of a desirable and non-desirable class is evident in the poorer populations, individual desirable plants are selected from each of these populations. Of the approximately 1,000 selected F_3 plants, the plants with lint fractions less than 39% are discarded and then further selected on the basis of HVI fiber properties.

Seven hundred and forty F_3 plants selected in 2009 were advanced to F_4 progeny rows in Plains, GA, in 2010 (fields 25/26) for evaluation in an un-replicated grid design, with the middle row of each 9 row set of the trial assigned to the University of Georgia cultivar GA 2004230. The F_4 test is machine harvested and the seed-cotton yield of each F_4 progeny row is compared with the seed-cotton yield of the nearest row of GA 2004230 which is, in turn, modified depending on the distribution of the yield values across the test field. Further selections of the F_4 are based essentially on the fiber quality measures of length, strength, and fineness and on lint percentage to promote for testing in the F_5 preliminary yield trials (PTs). Separate, late-planted seed increase plots that are grown in isolation near Tifton, GA allow additional visual selection and hand harvest of seed-cotton to maintain genetic purity of the F_4, F_5, F_6, and elite generation experimental lines. Additional increases are planted at the University of Arizona's

Maricopa Agriculture Center in Maricopa, AZ to provide excellent quality seed for the field tests in the subsequent years. The six 2010 PTs were conducted at the William Gibbs Research Farm, UGA – Tifton Campus, Tifton, GA in fields 04232, 04231, 04212, 04210, 04264, and 04263. Each PT had 18 F_5 breeding lines and 2 commercial conventional checks (GA 2004230 and Deltapine DP 174RF) in a three replicate, randomized complete block designs for a total of 104 experimental entries. The F_6 Advanced Trials (ATs) were conducted at the University of Georgia – Tifton campus, Tifton, GA (AT1 at the William Gibbs Research Farm, fields 04234 and 04233) and Southwest Georgia Research and Education Center, Plains, GA (AT 1 in fields 25/26). The AT1 consisted of 24 experimental entries with three checks (GA 2004230, GA 2004303, and Monsanto Deltapine DP 174RF) that were planted in a three replicate, randomized complete block design. Prior to machine harvest of all trials except the F_2 and F_4 generations, 25 unweathered, open bolls from the middle of the fruiting zone were harvested from each plot, and subsequently ginned on a 10-saw laboratory model gin to determine lint percentage. Fiber samples of the PTs and ATs were submitted to Cotton Incorporated in Cary, NC for HVI fiber analysis. The elite (material > F_7) germplasm lines with high potential were tested in the 2010 Georgia Official Strains Trial (OST) and Official Variety Trials (OVTs) (Day and Thompson, 2011.

Results and Discussion

Five of our lines GA 2004143, GA 2004303, GA 2006053, GA 2006106, and GA 2007095 were tested in the 2010 GA OVTs (Day and Thompson, 2011). The following is a general synopsis of these lines with further details found in the Georgia 2010 Peanut, Cotton, and Tobacco Performance Tests (Day et al., 2011). GA 2004143 was ranked 11th over all of the locations for lint yield (not significantly different from the top yielder) with a very good fiber quality package. As in previous years, it did not yield as well in the dryland trial, ranking 16th, but it retained its fiber quality package. GA 2004303 did not perform as well as it has in previous years with only a 19th ranking in lint yield in the overall analysis in the irrigated trial and 15th in the dryland trial. In lint yield, both the irrigated and dryland yields of GA 2006053 compared poorly to the best yielding variety, and will not be retested in 2011. GA 2006106 also compared poorly to the best yielding variety, but its fiber quality package remained excellent and will be tested again. GA 2007095 ranked 8th in both the 2010 Irrigated, Earlier Maturity Cotton Varieties OVTs and the Dryland, Earlier Maturity Cotton Varieties OVTs. Furthermore, it had an excellent overall fiber package in the irrigated trials and maintained a very solid fiber package in the dryland trials unlike much of the competition.

Seven lines were promoted last year to the 2010 Georgia OSTs from the 2009 ATs: GA 2006046, GA 2008001, GA 2008005, GA 2008016, GA 2008052, GA 2008057, and GA 2008083 (Day et al., 2011). Of these lines, GA 2008057 is being further promoted to the 2011 OVTs based on the overall excellent fiber package particularly its length, strength, and uniformity. GA 2008083 was promoted because of its high yielding potential combined with a very good fiber package.

In the 2010 AT1 in Plains, half of the 2^{nd} replication and most of the 3^{rd} replication was affected by a pooling of irrigation water at the back edge of the field with a greater pooling to one side of the test. Furthermore, a field effect was visually seen from West to East and not from South to North which was the direction the blocks were positioned in this randomized complete block design. This reduced the variation between blocks that could have been and normally is removed in the randomized complete block ANOVA. There were large coefficients of variance (CV) of the entries in this test which helps explain the fact that there were no significant differences in yield. The overall CV was higher that desired, but at 18%, it wasn't extremely high. The Plains data also caused the pooled analysis of the trial to have no significant differences between cultivars in lint yield. The fiber quality measures and lint % values seemed unaffected (Table 2). Using lint yield and fiber quality measures, five lines were promoted to the 2011 GA OSTs (Tables 1 and 2). Two lines GA 2009100 and GA 2009147 were endorsed for their excellent fiber package (Table 2). GA 2009147 has superb fiber qualities across the board; it is in top tier of the longest, strongest, finest, and most uniform lint in this generation. The three others GA 2009037, GA 2009148, and GA 2009180 have great yield potential good to excellent fiber quality (Table 1 and 2). GA 2009180 was the top yielder in Tifton along with being in the top tier of length, strength, and uniformity (Table 1 and 2).

From the 2010 PTs (Tables 3, 4, and 5), twenty nine lines were selected for testing in the 2011 ATs based primarily on lint yield and fiber qualities as compared to checks. Based on lint yield comparisons, one hundred ninety-two F_4 progenies were selected for placement in the 2011 PTs with further selections to be made utilizing fiber quality measures. One thousand single plants were selected in the F_3 populations to be placed in the F_4 plant-to-row yield test, again, with further selections based on fiber quality. Forty-six F_1 crosses that were made in the summer of 2010 were sent to the USDA-ARS Cotton Winter Nursery in Tecoman, Mexico for selfing to the F_2 generation. These will be placed in replicated 2011 F_2 yield tests to determine the suitability of the germplasm populations to be further tested.

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Table 1. Results of 2010 Advanced (F_6) Trial 1.

2010 AT 1 Tifton							2010 AT 1 Plains						
ENTRY	**Lint Yield**	**Lint %**	**UHM in.**	**UI %**	**mic**	**Str g/tex**	**ENTRY**	**Lint Yield**	**Lint %**	**UHM in.**	**UI %**	**mic**	**Str g/tex**
GA 2009180	**1508**	41.19	**1.21**	84.85	5.10	**34.50**	GA 2009031	**1507**	**42.41**	1.13	**83.95**	**5.45**	30.3
GA 2004303	**1498**	41.20	1.11	83.20	**5.40**	32.70	GA 2009151	**1492**	**44.24**	1.09	**83.10**	**5.80**	**31.7**
DP 174RF	**1494**	**44.98**	**1.15**	82.85	4.95	29.55	GA 2009024	**1475**	**42.79**	1.10	**83.35**	**5.65**	**31.6**
GA 2009037	**1470**	40.16	**1.16**	83.30	**5.40**	30.90	GA 2009167	**1460**	40.55	1.09	82.40	5.30	30.0
GA 2004303	**1455**	41.82	1.12	82.60	5.30	30.75	GA 2009115	**1457**	**42.59**	1.10	**83.20**	5.15	30.1
GA 2009148	**1409**	39.94	**1.16**	84.25	5.05	**33.70**	GA 2009037	**1438**	40.94	1.14	**84.20**	**5.40**	29.3
GA 2009142	**1400**	41.69	**1.17**	82.75	**5.50**	**33.10**	GA 2009176	**1423**	**43.84**	1.09	82.25	**5.45**	**31.3**
GA 2009016	**1388**	41.35	1.12	82.05	5.15	29.90	GA 2004303	**1413**	**42.23**	1.07	**83.20**	5.35	28.8
GA 2009172	**1370**	40.81	**1.16**	83.60	**5.50**	**32.80**	GA 2009148	**1411**	41.35	1.08	81.55	**5.45**	**30.5**
GA 2009151	**1356**	**44.12**	1.08	83.05	**5.80**	**32.95**	GA 2009100	**1381**	41.33	**1.16**	**83.65**	4.75	**31.7**
GA 2009167	**1331**	41.75	1.11	83.25	5.05	31.35	GA 2009135	**1381**	40.08	1.14	**82.65**	5.30	**31.3**
GA 2009176	1310	**43.32**	1.13	83.90	**5.55**	**33.90**	GA 2009032	**1348**	42.14	1.11	82.35	**5.45**	28.4
GA 2009100	1306	**42.82**	**1.18**	83.70	4.55	31.75	GA 2009016	**1345**	**43.16**	1.09	81.40	5.20	28.5
GA 2009032	1294	41.86	1.14	82.70	**5.40**	31.35	DP 174RF	**1342**	**43.94**	1.11	**82.75**	5.20	27.8
GA 2009141	1258	40.86	1.14	83.75	**5.40**	32.10	GA 2009010	**1334**	41.18	1.02	81.95	5.10	26.9
GA 2009135	1239	40.87	**1.17**	82.95	5.15	31.75	GA 2009173	**1323**	38.91	1.07	**83.40**	**5.65**	29.7
GA 2009024	1220	**43.26**	1.11	82.25	**5.40**	32.55	GA 2009142	**1308**	41.25	1.11	81.10	5.35	**30.5**
GA 2009045	1207	41.12	1.14	83.10	**5.60**	32.40	GA 2009147	**1288**	36.68	**1.21**	**84.25**	4.40	**33.8**
GA 2009115	1202	42.35	1.12	83.50	5.10	32.15	GA 2009104	**1269**	41.29	1.09	**83.05**	5.35	29.4
GA 2009010	1187	40.96	1.06	81.25	5.25	29.50	GA 2009102	**1243**	41.28	1.13	**84.40**	5.20	**32.1**
GA 2009173	1185	38.34	1.13	84.20	5.30	31.25	GA 2004303	**1237**	40.35	1.09	**83.50**	5.20	**30.8**
GA 2009104	1162	41.30	1.12	83.80	5.25	32.70	GA 2009045	**1226**	41.94	1.12	82.35	**5.55**	**31.5**
GA 2009131	1161	**42.94**	1.14	83.20	5.25	28.45	GA 2009141	**1198**	**42.34**	1.14	**83.95**	**5.70**	**31.2**
GA 2009002	1124	40.20	1.13	83.70	5.15	**33.20**	GA 2009002	**1141**	40.66	1.11	**84.20**	5.10	**30.7**
GA 2009031	1123	41.35	**1.15**	83.40	5.10	31.65	GA 2009180	**1106**	40.29	**1.22**	**84.65**	4.90	**33.1**
GA 2009102	1090	42.01	**1.17**	83.35	4.95	**34.90**	GA 2009131	**1081**	42.04	1.09	**82.80**	**5.45**	28.3
GA 2009147	918	36.91	**1.21**	83.80	4.60	**35.70**	GA 2009172	**956**	38.47	**1.16**	**84.50**	5.30	**32.8**
$LSD_{0.10}$	**189**	**2.31**	**0.06**	**NS**	**0.38**	**2.91**	**$LSD_{0.10}$**	**NS**	**2.08**	**0.07**	**2.03**	**0.37**	**3.4**

The bold type indicates the lint yields that are not significantly different from the top yielder.
Exception: acceptable micronaire (mic) is a range; so the significant differences above 5.0 that are considered unacceptable are highlighted.
DP 174RF and GA 2004303 are check varieties for comparison purposes.

Table 2. Results of 2010 Advanced (F_6) Trial 1 over Tifton and Plains, GA

ENTRY	Lint Yield	Lint %	UHM in.	UI %	mic	Str g/tex
GA 2009180	1307	40.74	**1.21**	**84.75**	5.00	33.78
GA 2009147	1103	36.79	**1.21**	**84.03**	4.50	**34.73**
GA 2009100	1343	42.08	1.17	83.68	4.65	31.70
GA 2009172	1163	39.64	1.16	**84.05**	5.40	32.78
GA 2009037	1454	40.55	1.15	83.75	5.40	30.10
GA 2009135	1310	40.47	1.15	82.80	5.23	31.53
GA 2009102	1167	41.65	1.15	83.88	5.08	33.50
GA 2009142	1354	41.47	1.14	81.93	5.43	31.78
GA 2009031	1315	41.88	1.14	83.68	5.28	30.98
GA 2009141	1228	41.60	1.14	83.85	5.55	31.65
DP 174RF	1418	**44.46**	1.13	82.80	5.08	28.65
GA 2009045	1216	41.53	1.13	82.73	5.58	31.93
GA 2009148	1410	40.64	1.12	82.90	5.25	32.10
GA 2009032	1321	42.00	1.12	82.53	5.43	29.85
GA 2009002	1132	40.43	1.12	83.95	5.13	31.93
GA 2009176	1367	**43.58**	1.11	83.08	5.50	32.60
GA 2009115	1329	42.47	1.11	83.35	5.13	31.10
GA 2009104	1216	41.30	1.11	83.43	5.30	31.03
GA 2009131	1121	42.49	1.11	83.00	5.35	28.38
GA 2009167	1395	41.15	1.10	82.83	5.18	30.65
GA 2004303	1368	40.77	1.10	83.35	5.30	31.75
GA 2009016	1367	42.25	1.10	81.73	5.18	29.20
GA 2009024	1347	43.02	1.10	82.80	5.53	32.08
GA 2009173	1254	38.62	1.10	83.80	5.48	30.48
GA 2004303	1434	42.02	1.09	82.90	5.33	29.78
GA 2009151	1424	**44.18**	1.08	83.08	5.80	32.33
GA 2009010	1260	41.07	1.04	81.60	5.18	28.20
location by entry interaction	**NS**	**NS**	**NS**	**NS**	**†**	**NS**
$LSD_{0.10}$	**NS**	**1.15**	**0.02**	**0.79**	**-**	**1.18**

When location by entry interaction is significant, the locations cannot be combined to compare for significant differences; **NS (no significance), † (10%), * (5%), ** (1%), & *** (0.1%).**

The bold type indicates the measures that are not significantly different from the best when the location data is properly pooled.

DP 174RF and GA 2004303 are check varieties for comparison purposes.

Table 3. Results of 2010 Preliminary (F_5) Trials 1 and 2.

2010 PT1							2010 PT2						
ENTRY	Lint Yield	Lint %	UHM in.	UI %	Str g/tex	mic	ENTRY	Lint Yield	Lint %	UHM in.	UI %	Str g/tex	mic
DP174RF	1499	**43.61**	1.14	83.00	29.90	5.10	DP 174RF	**1588**	**43.46**	1.16	83.60	30.40	4.70
GA 2010016	1321	37.78	1.16	82.35	32.05	4.60	GA 2004303	**1583**	**42.06**	1.10	83.30	29.40	**5.25**
GA 2010015	1313	40.11	**1.22**	84.35	32.95	4.70	GA 2010032	**1513**	40.60	**1.22**	84.60	33.40	4.95
GA 2010002	1309	39.98	1.18	84.25	34.15	5.10	GA 2010026	**1474**	39.69	1.12	83.50	31.00	5.05
GA 2010014	1252	40.12	1.16	83.50	32.20	5.10	GA 2010019	**1412**	**41.61**	1.15	83.60	30.80	5.00
GA 2010011	1248	38.65	**1.21**	83.10	33.20	4.65	GA 2010021	**1406**	**41.14**	**1.19**	83.75	32.40	4.90
GA 2010017	1237	38.59	**1.20**	83.90	34.05	4.85	GA 2010030	**1403**	40.18	1.14	83.85	30.65	4.95
GA 2010003	1235	40.42	1.16	84.00	31.25	5.05	GA 2010024	**1386**	**41.95**	1.15	82.90	31.45	4.85
GA 2010010	1235	39.78	1.17	83.55	**35.60**	4.90	GA 2010023	1323	39.90	1.15	82.45	31.20	4.60
GA 2010013	1189	39.39	**1.19**	**84.55**	34.15	5.15	GA 2010020	1316	**41.68**	1.18	84.35	**33.90**	**5.20**
GA 2010005	1170	40.98	**1.22**	**84.70**	34.25	4.70	GA 2010022	1314	39.28	1.15	84.35	31.75	5.10
GA 2010006	1161	39.18	1.13	83.55	32.15	5.15	GA 2010036	1275	38.74	1.17	84.30	**35.05**	5.00
GA 2004303	1142	**41.14**	1.09	82.35	29.40	**5.40**	GA 2010033	1262	37.73	1.17	83.45	**34.90**	5.10
GA 2010004	1123	**41.98**	1.16	84.00	29.90	4.70	GA 2010034	1256	40.23	1.14	83.20	33.10	4.95
GA 2010018	1110	39.97	**1.21**	**85.35**	33.00	4.55	GA 2010025	1192	40.55	1.14	83.45	30.35	4.90
GA 2010001	1079	38.94	1.12	82.85	32.15	**5.40**	GA 2010028	1177	40.11	1.18	83.85	30.45	4.85
GA 2010012	1055	39.63	1.15	83.10	32.00	5.15	GA 2010035	1144	39.06	1.14	84.95	32.10	**5.25**
GA 2010008	974	37.43	1.11	83.15	30.55	4.80	GA 2010027	1141	40.65	1.17	83.70	32.00	4.95
GA 2010007	949	37.44	1.16	83.45	31.55	4.40	GA 2010029	1112	38.10	**1.20**	83.75	**33.90**	4.90
GA 2010009	850	38.70	1.12	83.60	31.20	4.55	GA 2010031	1062	38.42	1.17	83.30	32.75	4.80
$LSD_{0.10}$	**ns**	**2.60**	**0.03**	**0.92**	**1.31**	**0.25**	**$LSD_{0.10}$**	**216**	**2.66**	**0.03**	**ns**	**1.26**	**0.18**

The bold type indicates the lint yields that are not significantly different from the top.
Exception: acceptable micronaire (mic) is a range; so the significant differences above 5.0 that are considered unacceptable are highlighted.
'ns' signifies no significant differences from top to bottom of the list.
DP 174RF and GA 2004303 are check varieties for comparison purposes.

Table 4. Results of 2010 Preliminary (F_5) Trials 3 and 4.

2010 PT3							**2010 PT4**						
ENTRY	**Lint Yield**	**Lint %**	**UHM in.**	**UI %**	**Str g/tex**	**mic**	**ENTRY**	**Lint Yield**	**Lint %**	**UHM in.**	**UI %**	**Str g/tex**	**mic**
GA 2004303	**1737**	**41.91**	1.11	82.85	30.00	**5.55**	GA 2004303	1285	**42.14**	1.05	81.60	28.15	**5.55**
GA 2010052	**1694**	40.29	1.16	84.60	31.40	5.05	GA 2010062	1222	40.49	1.08	81.10	29.50	5.00
GA 2010038	**1560**	**42.63**	**1.19**	**84.70**	32.15	4.70	GA 2010070	1217	**43.72**	1.13	83.60	29.75	4.70
GA 2010050	**1474**	38.86	1.18	83.00	33.30	5.15	GA 2010067	1204	38.49	**1.17**	84.25	**31.75**	5.00
GA 2010049	**1467**	38.91	**1.20**	84.35	33.10	5.10	GA 2010058	1190	39.67	**1.15**	83.75	29.50	5.15
GA 2010047	**1461**	38.51	1.16	**84.70**	33.10	5.00	GA 2010059	1178	39.48	**1.15**	82.90	**33.35**	**5.50**
GA 2010054	**1451**	38.93	1.17	**85.10**	31.35	5.15	GA 2010061	1154	**41.91**	1.10	83.50	28.80	5.10
GA 2010046	**1440**	40.97	1.13	83.70	31.00	**5.20**	GA 2010060	1152	40.10	1.09	82.85	28.65	5.25
GA 2010041	**1431**	**41.94**	1.16	**85.30**	**34.55**	**5.25**	DP 174RF	1141	**44.38**	1.10	82.50	26.85	5.20
DP 174RF	**1417**	**43.60**	1.13	82.50	28.95	4.95	GA 2010064	1076	40.59	**1.14**	83.45	30.60	5.15
GA 2010051	**1413**	40.19	1.16	**84.90**	31.05	**5.20**	GA 2010068	1064	39.51	1.13	83.25	**32.05**	5.15
GA 2010040	**1408**	**41.87**	1.11	83.55	31.25	**5.45**	GA 2010063	1063	40.94	**1.16**	82.20	**31.65**	5.00
GA 2010042	1283	**41.58**	1.15	**84.65**	30.75	**5.40**	GA 2010069	1041	39.18	**1.15**	83.45	30.45	5.05
GA 2010037	1271	**41.75**	1.16	83.50	31.75	**5.20**	GA 2010056	1038	40.75	1.10	83.30	27.75	**5.30**
GA 2010045	1251	38.79	1.15	84.30	30.90	5.10	GA 2010065	1012	40.19	1.11	82.95	29.00	5.20
GA 2010048	1231	39.89	1.16	83.60	29.95	5.10	GA 2010072	985	**44.35**	1.02	82.40	27.80	**5.70**
GA 2010039	1137	**42.04**	1.14	83.25	29.00	5.15	GA 2010055	929	40.63	1.10	83.41	29.29	**5.40**
GA 2010053	1137	38.58	**1.21**	**84.90**	31.95	4.80	GA 2010057	874	39.56	1.11	82.60	27.55	**5.40**
GA 2010043	1107	39.19	1.16	83.35	31.50	**5.25**	GA 2010066	833	37.19	1.10	81.95	28.60	4.90
GA 2010044	1062	40.43	1.14	83.45	30.70	**5.40**	GA 2010071	824	**41.76**	1.13	82.80	31.10	4.70
$LSD_{0.10}$	**357**	**2.04**	**0.03**	**0.69**	**1.14**	**0.19**	**$LSD_{0.10}$**	**ns**	**3.03**	**0.04**	**ns**	**1.85**	**0.28**

The bold type indicates the lint yields that are not significantly different from the top.
Exception: acceptable micronaire (mic) is a range; so the significant differences above 5.0 that are considered unacceptable are highlighted.
'ns' signifies no significant differences from top to bottom of the list.
DP 174RF and GA 2004303 are check varieties for comparison purposes.

Table 5. Results of 2010 Preliminary (F_5) Trials 5 and 6.

2010 PT5							2010 PT6						
ENTRY	**Lint Yield**	**Lint %**	**UHM in.**	**UI %**	**Str g/tex**	**mic**	**ENTRY**	**Lint Yield**	**Lint %**	**UHM in.**	**UI %**	**Str g/tex**	**mic**
GA 2004303	1306	41.13	1.07	81.25	27.90	**5.30**	DP 174RF	**1425**	**44.26**	1.11	82.60	27.50	4.90
DP 174RF	1254	**44.88**	1.09	82.45	28.20	**5.45**	GA 2010106	**1391**	41.42	**1.15**	82.00	**31.20**	5.05
GA 2010088	1241	41.70	1.07	82.15	29.30	**5.30**	GA 2010101	**1349**	41.53	1.10	82.60	29.80	4.90
GA 2010076	1186	37.92	**1.17**	82.25	**33.45**	5.20	GA 2010098	**1297**	40.77	**1.14**	82.40	30.20	5.00
GA 2010085	1169	**44.12**	1.14	82.65	31.10	**5.30**	GA 2010102	**1272**	40.92	**1.15**	82.55	**32.25**	5.15
GA 2010074	1128	**42.76**	1.11	81.65	30.45	**5.35**	GA 2010103	**1248**	41.60	1.08	83.60	30.40	**5.45**
GA 2010086	1107	41.13	1.12	83.35	29.25	**5.25**	DP 393	1236	40.13	1.12	82.85	**31.00**	5.00
GA 2010079	1102	39.09	**1.18**	83.65	**32.05**	5.15	GA 2004303	1216	**42.77**	1.07	82.30	27.75	5.10
GA 2010080	1092	**43.08**	1.14	82.95	30.70	5.15	GA 2010105	1196	40.17	1.12	82.05	30.05	4.90
GA 2010081	1077	40.63	1.14	82.55	29.55	**5.45**	GA 2010097	1189	41.45	1.12	82.35	30.85	**5.25**
GA 2010090	1053	**42.25**	1.09	82.38	28.35	**5.36**	GA 2010096	1168	40.38	1.04	83.20	27.95	**5.25**
GA 2010082	1052	40.90	1.12	82.85	30.30	**5.45**	GA 2010104	1152	38.16	1.11	82.90	**31.55**	**5.25**
GA 2010084	1051	41.27	**1.15**	82.90	31.30	4.95	GA 2004303	1140	41.43	1.09	82.10	28.85	5.05
GA 2010078	1038	39.70	1.11	81.15	29.35	5.05	GA 2010100	1125	40.35	**1.15**	83.10	**32.15**	**5.25**
GA 2010077	1017	39.54	**1.15**	82.20	**32.30**	5.05	GA 2010095	1073	39.58	1.09	82.30	29.65	5.05
GA 2010073	993	**45.32**	1.07	81.65	30.45	**5.80**	GA 2010094	1070	36.76	1.09	82.10	28.90	4.75
GA 2010075	948	40.79	**1.17**	82.95	**32.20**	**5.25**	GA 2010091	1042	41.71	1.07	82.65	28.75	**5.40**
GA 2010089	908	41.10	1.12	82.25	29.45	**5.35**	GA 2010092	947	41.63	1.09	82.45	28.15	5.05
GA 2010087	876	41.87	1.10	81.20	29.00	5.15	GA 2010099	896	39.60	1.10	82.35	30.45	5.20
GA 2010083	822	39.15	1.11	83.05	30.25	5.10	GA 2010093	856	36.55	1.10	81.37	30.06	4.89
$LSD_{0.10}$	**ns**	**3.35**	**0.03**	**NS**	**1.81**	**0.24**	**$LSD_{0.10}$**	**186**	**2.04**	**0.02**	**ns**	**1.29**	**0.21**

The bold type indicates the lint yields that are not significantly different from the top.
Exception: acceptable micronaire (mic) is a range; so the significant differences above 5.0 that are considered unacceptable are highlighted.
'ns' signifies no significant differences from top to bottom of the list.
DP 174RF, DP 393, and GA 2004303 are check varieties for comparison purposes.

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ADDING ROOT-KNOT NEMATODE RESISTANCE TO GEORGIA-ADAPTED COTTON GERMPLASM, 2010

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Introduction

State surveys of the densities of nematodes reveal that the major cotton-producing counties in Georgia have damaging levels of nematodes (state loss of 137,423 bales ... valued at $53,594,970 in 1998) and is increasing from previous years (National Cotton Council, 1998). From 1991 to 1998, almost 98 thousand bales per year valued at a total of $300 million were lost (National Cotton Council, 1998). It is estimated that Georgia producers specifically lose about 77,000 bales of cotton annually from root-knot nematodes (*Meloidogyne incognita,* RKN) damage (Blasingame and Petal, 2001). Crop rotation, while a recommended cultural practice to lessen soil populations of RKN, is not an option for most Georgia growers because of the lack of suitable non-host crops with which to rotate their cotton acreages. Therefore, inherent genetic resistance provides an attractive alternative to pesticides and crop rotation.

Poor profit potential of cotton production from yield stagnation and high pest management costs impels creation of cultivars with inherent genetic resistance to enhance economic returns for cotton producers. Insect, nematode, and weed pest management costs are among the highest expenditures growers face in cotton production (National Cotton Council, 2001), thus their reduction would enhance profitability of cotton production. Since Georgia is the second ranked cotton producing state in the US (NASS, 2006), cotton cultivars adapted for the unique aspects of the environment of Georgia, such as rainfall patterns, soils types and depth, and presence of root-knot nematodes, must be developed to give the best available genetics to the Georgia producer.

Despite the widespread occurrence of RKN in Georgia and most cotton production areas in the Southeast, and that genetic resistance to RKN has existed since 1974 (Shepherd, 1974), private cultivar developers have previously exhibited little interest in fulfilling this need. Commonly cited reasons for the slow progress in developing RKN resistant cultivars is that the current screening process is costly, tedious, time consuming and destructive for identifying resistance genotypes. Further, most breeding stations have neither the facilities nor personnel with expertise in nematology to carry out the screening process to identify resistant material. Of those RKN-resistant (CPCSD Acala NemX) or tolerant cultivars (ST LA887 or PM H1560) that have been distributed by commercial cotton seed companies, none are adapted to the Southeast.

Our objective, to develop Georgia-adapted, value-added cotton germplasm with RKN resistance, will benefit the state's producers by providing increased yield and decreased production costs whereas the increased availability of RKN-resistant germplasm will benefit the cotton industry across the belt.

Materials and Methods

We have developed advanced RKN parents from a backcross breeding population using M120-RNR and M155-RNR root-knot nematode resistant donor parent with the elite breeding line PD 94042. The best resistant BC3F3 lines were crossed with Georgia adapted, value added lines from our UGA Cotton Breeding program. A ten plant sample of the RKN resistant parental material was challenged twice with a very high rate of RKN in a pot-based greenhouse test following Shen et al. (2006). Further samples were then grown at the Gibbs Farm, University of Georgia-Tifton campus, in an RKN infested field following the procedure of Davis and May (2005). The resistant lines were verified in an additional pot-based greenhouse test. Resistant lines 103-7, 201-A, 506-5, and 506-11 were selected as parents to introgress the RKN resistance into the Georgia-adapted germplasm GA 98028 and GA 2001078. One intention of this project is to assist in further testing of these selections and use any improved material as parents to ultimately develop more elite germplasm.

DNA markers, developed in a companion project with the preliminary work described by Shen et al. (2006 and 2010), were intended to be used to select the resistant offspring using marker-assisted selection (MAS). The chromosomal region bearing the RKN resistance that is indicated by these molecular markers on chromosome 11 was verified independently (Ynturi et al., 2006), although the subsequent work in our lab appears to place some markers closer to the RKN resistance gene. The presence of this QTL results in decreased galling compared to susceptible plants when a plant's roots are challenged with RKNs. Another RKN resistance QTL was verified by He et al. (2011) on chromosome 14. It results in decreased numbers of nematode eggs as compared to susceptible plants when the roots are challenged with RKNs. These markers are polymorphic between the parental line and both original parents of the RKN resistance donors that led to the BC_3F_3 population. Any additional markers for RKN resistance will be utilized as they become available. Following **m**arker **a**ided **s**election (MAS) expectations, selecting for the closely linked markers will also select for the RKN resistance. Three rounds of crossing/backcrossing to the agronomic elite parents while ensuring the presence of the markers and the RKN resistance should give Georgia-adapted, value-added cotton germplasm with RKN resistance.

The following is our approach after using MAS to maintain the resistance and the marker up to the 2nd backcross. After single plant selections in the BC_2F_1 population of the backcrossing approach along with fiber quality testing, a non-replicated modified augmented design yield test (with every 5th row in the trial assigned to a conventional check cultivar) was to be planted to select for yield and to test/verify the homozygosity of the RKN resistance marker(s). This trial was to be machine harvested and the seed-cotton yield of each F4 progeny row compared with seed-cotton yield of the nearest check row. For the rows that significantly out-yield the nearest check plot, boll samples will be picked for lint %, fiber quality, and for seed in a parallel increase field. Next, the preliminary trial (PT) was to be conducted near Tifton or Plains, GA, depending upon land availability. Advanced generation germplasm lines promoted from the PT were to be tested in an advanced yield trial (AT) in both Plains and Tifton. Elite germplasm lines from a successful performance in the ATs will be tested in locations throughout the state in both dryland and irrigated fields in the University of Georgia Official Variety Trials.

Results & Discussion

Of the three RKN resistant lines 120-R1-B1, 120-R1-B3, and 155-R2-B1 mentioned in the previous section, they were tested in 2008 in our advanced trial AT1 (Lubbers and Chee, 2009). The two better lines 120-R1-B1 and 120-R1-B3 were retested in 2009 at the UGA-Tifton Campus Gibbs Farm in Tifton, GA and the UGA Southwest Georgia Research and Education Center in Plains, GA (Lubbers et al., 2010). The checks for this test were GA 2004230, DP 147RF, FM 966, and ST 4664RF along with PD 94042, the original elite breeding line. Line 120-R1-B3 performed very well and has been released as a germplasm line (Davis et al., 2011). "Registration of GA 120R1B3 Germplasm Line of Cotton" will be published in the Journal of Plant Registrations in early 2011.

The first of the three sets of crosses/backcrosses that we have made since 2007 used RKN-resistant parents derived from a M120-RNR by PD 94042 population that was crossed with transgenic (B2RF) lines derived from GA-adapted lines GA 98028 and GA 2001078. This set was challenged by RKN during the summer of 2010. Out of 633 plants of various crosses, 21 plants (3.3%) were selected as being at least very strongly tolerant with less than 10% root galling (Table 1). Further tests will be done to verify the RKN resistance response of these plants. These will be grown for seed increase in 2011 and then tested agronomically in 2012. The second set that used 155-R2-B1, 120-R1-B3, and 120-R1-B1 as RKN-resistant parents has been crossed over two seasons with a number of more elite lines including the new cultivars GA 2004230 and GA 2004303. Some of these are currently being grown to be phenotypically challenged with RKN in our greenhouse during the off-season of 2010/2011 with the rest being grown to produce BC_1 populations. The third set that are using M120-RNR for the RKN-resistant parents will be backcrossed in the greenhouse during the 2010/2011 off-season and tested using the DNA markers for the chromosome 11 and 14 RKN-resistance QTLs.

Currently, the DNA markers for the RKN resistance were found to not be polymorphic in any of the populations with any of the RKN-resistant markers in our possession. Furthermore, no polymorphisms showed between the immediate parents of these populations. The linkage between the markers and the RKN-resistance gene must have been broken in the development of the PD 94042 RKN-resistant population. Efforts to develop polymorphic markers are underway with funding from a companion project.

Table 1. Lines with < 10% root galling found in populations of Cotton States (CS) transgenic lines (include Bollgard II and Roundup-Ready flex traits from Monsanto) crossed with select Root-Knot nematode resistance lines developed from M120-RNR by PD 94042 populations.

Populations inoculated with Root-Knot nematodes[1,2]	Number of plants with < 10% root galling
201-A/CS02///CS02	2
506-5/CS11///CS11	4
506-5/CS11///CS12	3
506-5/CS13///CS13	2
506-11/CS02///CS02	2
506-11/CS11///CS11	3
506-11/CS12///CS12	3
506-11/CS13///CS13	2
Total number of plants out of 633 that were classified as at least strongly tolerant to RKN	21 (3.3% of total)

[1]CS02 is derived from GA 98028 and CS11, CS12, and CS13 are derived from GA 2001078
[2]F_4s from the original crosses were crossed with the recurrent parent (except in one of the populations) before being challenged with Root-Knot nematodes in a greenhouse planting.

In summary, we expect our backcrossing approach to provide a solid performing release of GA-adapted, RKN resistant germplasms/cultivars. Even though MAS is generally considered a reliable procedure, it is a relatively recent innovation and has not been extensively utilized, and there have been technical problems associated with it. Phenotypic analyses of the new populations are likely to present resource allocation difficulties that will decrease the size of the populations that can be tested.

Acknowledgements

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NUTRIENT CYCLING AND COVER CROP DECOMPOSITION IN STRIP-TILL AND CONVENTIONAL COTTON TILLAGE SYSTEMS

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Introduction

Cover crops and conservation tillage have important roles in agriculture because of their ability to reduce soil erosion, conserve soil moisture, potentially increase soil organic matter, and suppress numerous pests (Gallaher and Hawf, 1997; Siri-Prieto et al., 2007). However, there has been concern of cover crops tying up too much N and the timing of its release to the next crop (Vyn et al., 1999). A study in Ontario comparing legume and non-legume covers found improved N availability only following a legume (Vyn et al., 2000). However, Weinert et al. (2002) reported accumulation of 55-115 lb N/ac in overwintering rye on an irrigated sandy soil, which could be returned to the soil and a following crop.

In the hot and humid climate of the southeast, along with the sandy soils of the Coastal Plains, cover crops may deteriorate at different rates compared to more temperate environments and the heavy textured soils of the north, from where most decomposition data comes. Therefore, it is important to study the decomposition rates and nutrient cycling capabilities of various cover crops in southeastern crop production. These climates also alter activity of insect populations and feeding patterns. Since there is considerable acreage in both conventional and reduced tillage management in this region, and the incorporation of residues should drastically alter the rate of residue breakdown and thrips behavior, it is important to study decomposition effects and thrips populations in various cover crops common to the region under both tillage management scenarios. Therefore, the objectives of this experiment were to compare decomposition rates of cover crop residues and thrips activity in conventional and triptill cropping systems, including ‘AU Robin’ crimson clover (*Trifolium incarnatum* L.),‘Wrens Abruzzi’ rye (*Secale cereale* L.), and ‘AGS 2026’ wheat (*Triticum aestivum* L.) as winter cover crops.

Materials and Methods

Cover crops were planted 23 December 2009 in randomized complete block design at the University of Georgia Rigdon Farm in Tifton, GA. Treatments were organized as a 2 x 4 two-factor factorial with four replications. Independent variables consist of two tillage systems (conventional and strip-till) and four cover crop treatments (crimson clover (*Trifolium incarnatum* L.), rye (*Secale cereale* L.), wheat (*Triticum aestivum* L.), and bare soil). Individual plots were 0.01 ha (7.3 m x 13.7 m). Recommended seeding rates

(Sustainable Agriculture Network, 2007) were followed for planting crimson clover (17 kg ha^{-1}), rye (101 kg ha^{-1}), and wheat (134 kg ha^{-1}) with a Tye Pasture Pleaser no-till grain drill (AGCO Corp., Duluth, GA). Statistical analyses conducted with parametric statistical tests such as ANOVA and regression.

Due to the late planting of cover crops, which was a result of weather delays to harvesting the preceding cash crop in the assigned research plot location, cover crop establishment was poor. Crimson clover plots had to be abandoned for the strip-till treatment because of this unforeseen hardship. Crimson clover plots were salvaged in conventional tillage plots by bringing in residue from a neighboring field of reseeding crimson clover from another trial and spreading a prescribed amount of material (based on previous year's data) by hand and then incorporating via tillage.

A comprehensive sampling plan has been devised to monitor changes in soil nutrient mineralization and availability, nutrients in cover crops, and cotton biomass. Comparisons will be made across treatments and over time. Cover crops received a burn-down herbicide application of glyphosate (1.40 kg a.i. ha^{-1}) on 26 April 2010, and tillage treatments were established on 12 May 2010. All plots were planted with 'DP 161' (BGII/RF) cotton seed with Avicta Complete Pack seed treatment on 26 May 2010 at a 10 cm in-row seed spacing. Plots were fertilized with 22 kg N ha^{-1} + 4 kg S ha^{-1} in the form of 28-0-0-5 fertilizer on 26 July 2010. Other management practices were consistent with UGA Extension recommendations (Collins et al., 2010).

To evaluate the fate of cover crop residue and the movement of nutrients from cover crops to soil to cotton, biomass and soil samples were removed over the course of the season. The initial cover crop biomass sampling occurred on 13 April 2010 using a 0.5 m^2 quadrant for consistent sampling area among treatments. Another sampling was made on 27 May 2010, just prior to planting. Since cover crop tissue is buried in conventional tillage plots, a mesh litterbag made from fiberglass screen with 2.86 mm^2 holes (35 holes cm^{-2}) (Phifer, Inc., Tuscaloosa, AL) were constructed and filled with a prescribed residue amount (corresponding to 3.48 g dry matter [DM] of rye per bag, 2.7 g DM wheat per bag, 13.9 g DM crimson clover per bag) based on initial aboveground biomass residue. Dimensions of each bag cover 15 cm x 20 cm, or 300 cm^2 (Wang et al., 2004). Bags were buried in the conventional-till plots on 27 May 2010 at a depth of 15 cm so decomposition of incorporated residue could be simulated and retrieved over the course of time. Enough bags were buried so that one would be extruded on each sample date over the season to determine amount of original material remaining in the bag. Cover crop residue samples were then subsequently removed throughout the season on each field sampling date, which consisted of 6 July, 26 July, 17 August, 7 September, 23 September, and 20 October 2010. On each of these sample dates, aboveground biomass of the cotton plants residing within the 0.5 m^2 sample area were also removed. All plant tissue samples were dried and sieved to remove residual soil, rocks, and other contaminants. Dry matter was determined, then samples were ground and sent for plant nutrient analyses at the UGA Soil, Plant, and Water Laboratory. Soil samples at 0-5 cm and 5-20 cm depths were also taken on each sample date throughout the season. Soil samples at both depths were analyzed for soil macro and micro nutrients. Shallow soil samples were also analyzed for available nitrate and particulate organic matter at the beginning and end of the season. Due to the sheer volume of samples, not all plant tissue and soil samples have been processed and analyzed for nutrients at this time. Thus, the nutrient concentration results in cover crop tissue, soils, and cotton vegetation will be incorporated at a later time for submission to an appropriate scientific journal.

Results

Aside from a large discrepancy in initial quantity of cover crop biomass, due to the poor establishment conditions and bringing in residue for crimson clover plots at the previous year's biomass rate, decomposition in conventional tillage treatments followed relatively similar trends after planting (Fig. 1). Since there was very little wheat residue to begin with, the majority of it had decomposed between burndown and planting. Rye and crimson clover decomposed rapidly within the first six weeks after planting, with 70-78% of the residue being lost within the first six weeks, and only 15-20% loss from that point on. However, the total decomposition rate from initiation until late September when plants had reached maximum vegetative biomass, was similar among all three cover crops (crimson clover = 75%, rye = 83%, wheat = 76%). In strip-till management, rye residue did not break down as rapidly, with less than 25% decomposition in the first six weeks after planting (Fig. 2), and 45% decomposition from that point on. The total decomposition in strip-till was only 60% in rye, but was over 85% in wheat – that is primarily due to the fact that there was not a large quantity of wheat to begin with so total surface area being deteriorated by microorganisms caused rapid and near complete decomposition with wheat.

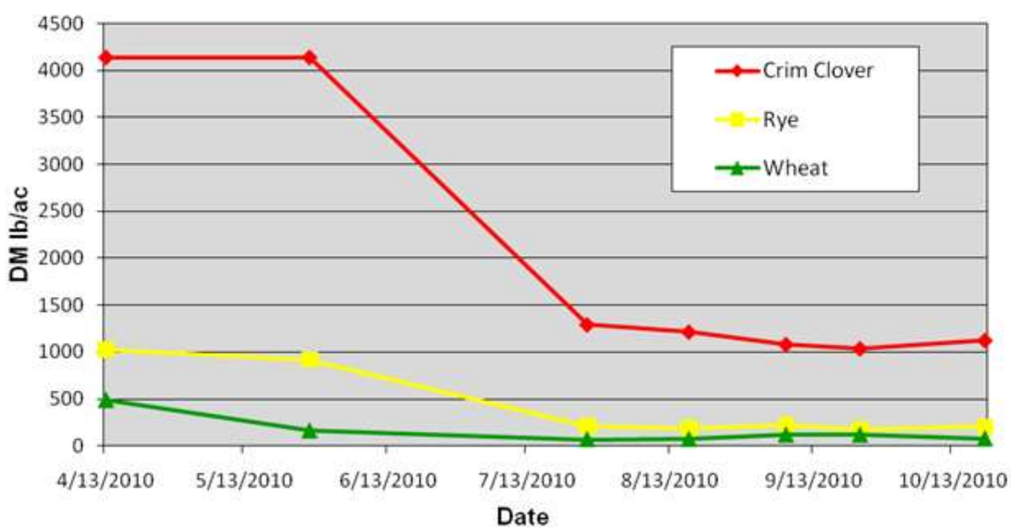

Figure 1.Cover Crop Biomass Breakdown Under Conventional Tillage

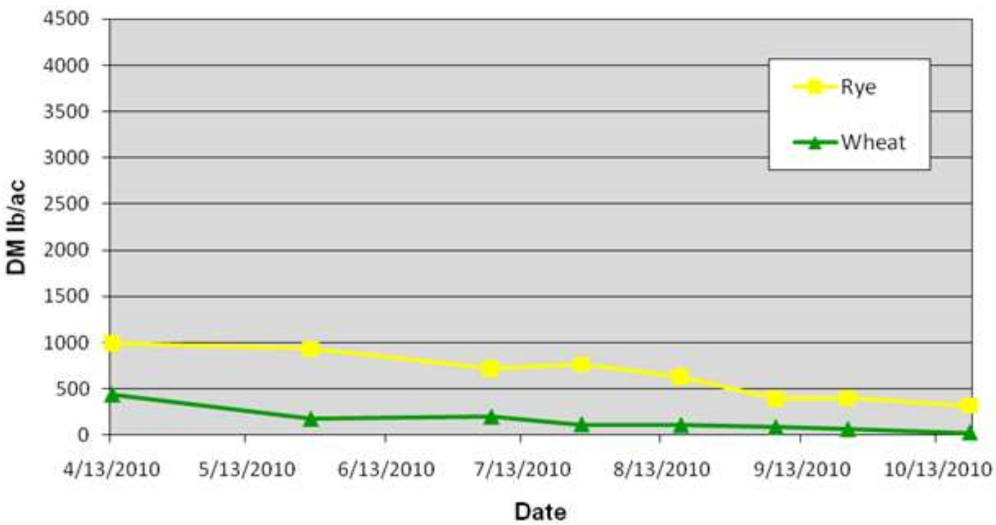

Figure 2. Cover Crop Biomass Breakdown Under Strip Tillage.

There were no major differences in biomass accumulation for the cotton among the various treatments in either conventional or strip-till. This is likely due a combination of the very low residue amounts of the cover crops aside from crimson clover and the masking of cover crop nutrients from the application of sidedress fertilizer in-season. Supplemental research projects are planned to assist in determining the effect of cover crops with various rates of sidedress fertilizer application in order to avoid this masking effect and assist with fertilization recommendations using different cover crops. It is noted that biomass accumulation did continue longer in plots where crimson clover was used than with any other cover crop treatment in conventional tillage (Fig. 3). Strip-tillage plots followed the same pattern regardless of cover crop used or lack of cover crop (Fig. 4), since residue levels were low and broke down slowly, thus neither causing tie up of N early in the season, nor providing nutritional benefits late in the season.

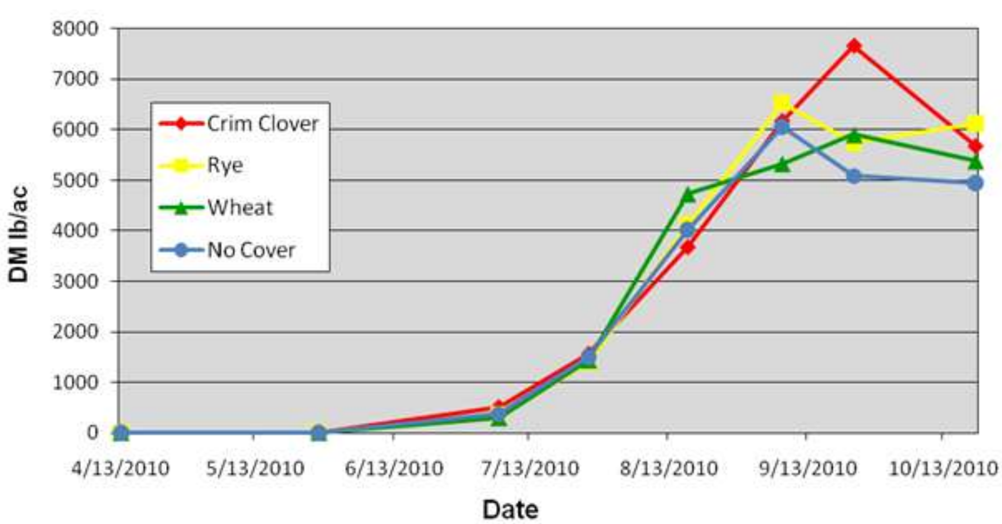

Figure 3. Cotton Vegetative Biomass Accumulation under Conventional Tillage.

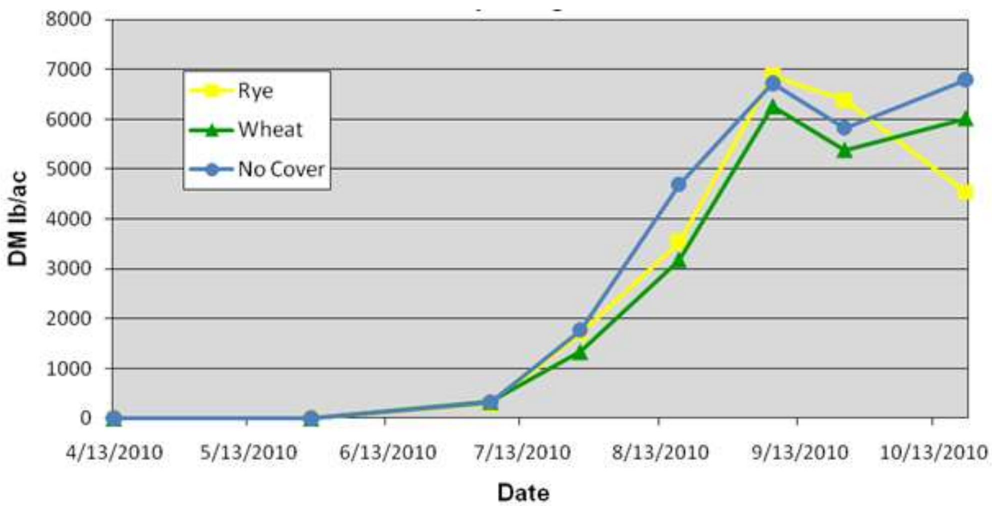

Figure 4. Cotton Vegetative Biomass Accumulation under Strip Tillage.

There were also no statistical differences among treatments in cotton plant height (Fig. 5). These data were from 16 Sept., approximately at maximum vegetative production, so cotton plants would have reached maximum height at this point. There was a trend that the plots supplying more nutrients over the course of the season did have the tallest plants numerically. This was seen in crimson clover plots in conventional tillage and in rye plots in strip-tillage. In these two scenarios, there was a larger total content of residue that decomposed over the course of the season, thus supplying greater total quantities of nutrients to the cotton plants.

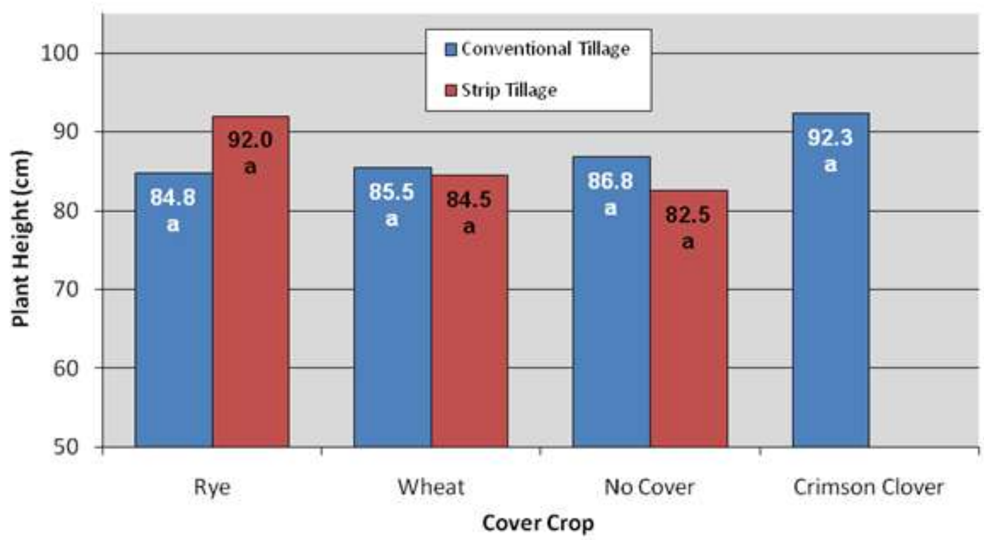

Figure 5. Cotton Plant Height by Tillage and Cover Crop

Similar to most of the other results, there ended up being no differences among treatments in regards to final lint yield (Fig. 6). There was a general trend that strip-till plots yielded greater than conventional tillage plots however, as seen in all three scenarios where both tillage systems occurred (rye, wheat, no cover). It should be noted that no plant growth regulator was applied in this project in order to gain a vegetative growth perspective on the cover crop treatment effects on the cotton plant behavior. Likewise, there were no plant stand differences among treatments (Fig. 7).

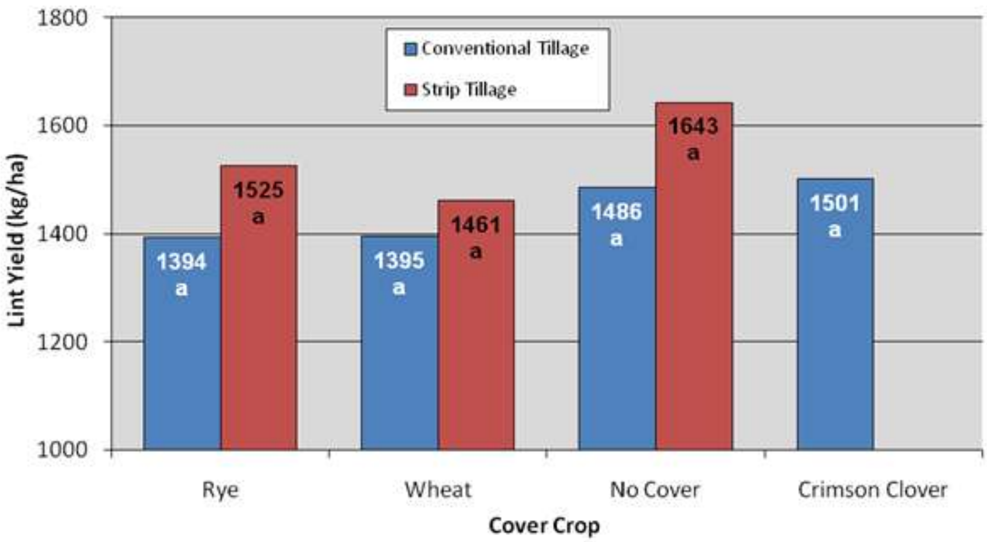

Figure 6. Cotton Yield by Tillage and Cover Crop.

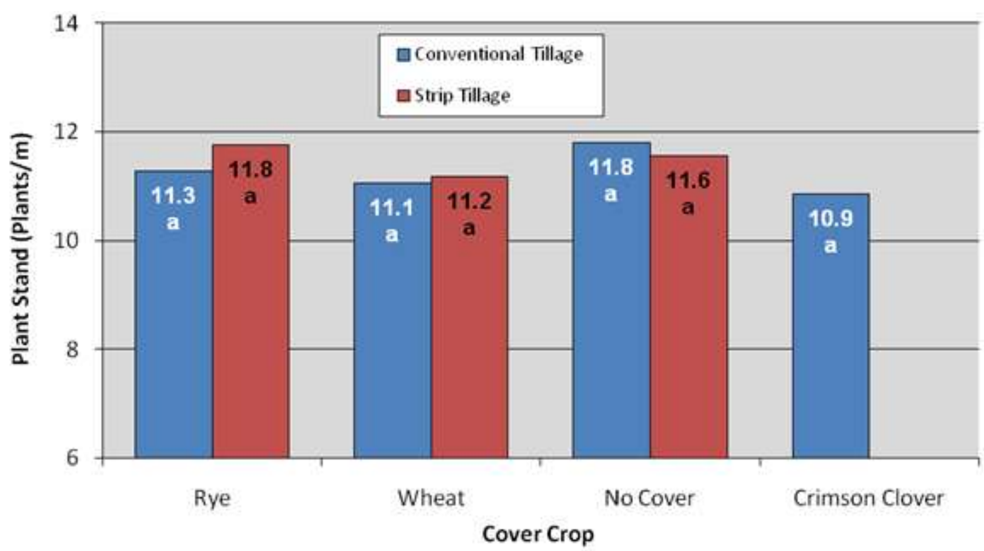

Figure 7. Cotton Plant Stand by Tillage and Cover Crop.

There were some minor fluctuations in economic differences for adjusted revenue (Fig. 8). Adjusted revenue is defined as revenue adjusted for yield, cover crop, tillage, and marketing costs. Gross revenue reflected base cotton prices for the southeast as of Dec. 2010. Total costs were higher for conventional tillage on a per acre basis (convent.

= $239.06 vs. strip-till = $216.01), primarily due to costs associated with tillage operations (additional trips through the field = more fuel and labor costs). When the cost of seed is factored into the equation, total costs are significantly higher for the various cover crops compared to where no cover crop was used. Since there were no major differences in yield, the adjusted revenue favored the treatments with low seed costs, especially the no cover crop treatment.

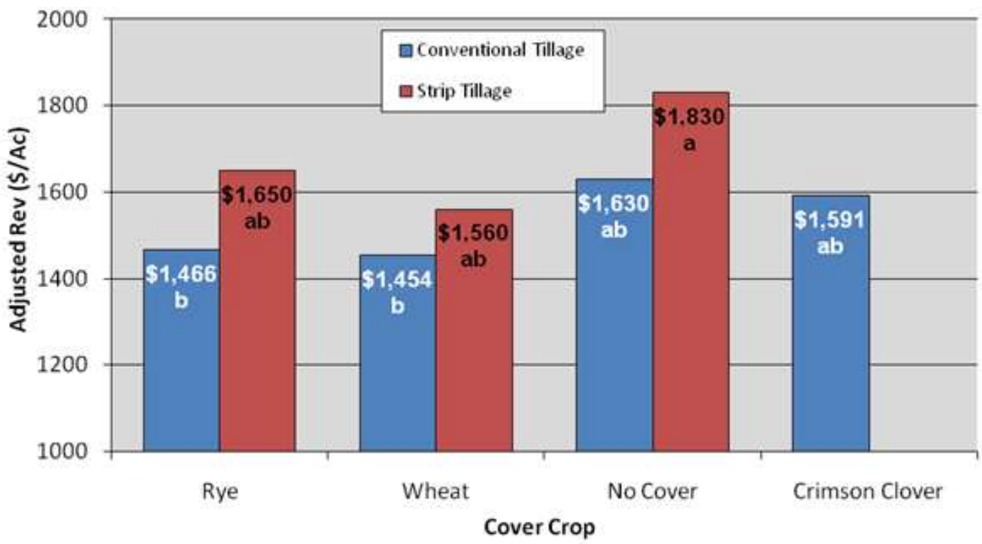

Figure 8. Cotton Adjusted Revenue by Tillage and Cover Crop.

These results as a whole tend to favor the use of no cover crop in a strip-till management scenario. However, there are a number of factors to contemplate that are not able to be incorporated into the final yield and revenue results. First, the inclusion of cover crops has been documented to reduce soil erosion and improve soil quality (improved organic matter and biodiversity) and structure. It is difficult to put a price tag on this, however it is widely recognized that the long-term sustainability of agronomic row cropping systems is dependent on maintaining valuable resources such as soil. In this year's results from this trial, the cover crop biomass residues achieved did not warrant the cost of the seed nor the effort to plant the cover crop. However, it was consistent throughout the southeastern crop production region that all cover crops were planted late in fall/winter 2009 heading into the 2010 growing season, and maximum benefits were not able to be achieved, as reflected in the final results of this experiment. The data did support the use of conservation tillage systems over conventional tillage systems however, and under normal circumstances, strip-tillage into a cover crop should usually offer much greater benefits than strip-tillage into weedy-fallow ground.

It is believed that the addition of supplemental fertilizer may have masked the effects of the cover crops, not allowing for as much separation among the treatments for biomass accumulation, yield, and other variables. The decision to add fertilizer was made in order to represent practices similar to what a grower might do. Since it is not realistic for a grower to forego N application, we opted to apply fertilizer, which in hindsight was likely at the expense of gaining a better grasp of the full comparative benefits of cover crops and their potential to reduce inputs like fertilizer. This information has given rise to a supplemental project to evaluate different fertilization rates for cotton and whether those applications are affected by the type of cover crop being grown prior to cotton using both grass and leguminous cover crops suitable for southeastern production systems.

Discussion and Summary

Cover crops decomposed at a greater rate in conventional tillage than in strip-till. Since the residues are incorporated into the soil using conventional tillage, there is more surface area of the residue being contacted by soil micro-organisms, and therefore it is more rapidly decomposed than when the residues remain on the soil surface and only a fraction of the material is exposed to the soil. The C:N ratio plays a large role in how rapidly plant tissue will breakdown. Legumes and immature plants have lower C:N ratios than mature grasses. In the results of this experiment, the majority (over 70%) of cover crop residue had decomposed within the first six weeks after planting in conventional tillage, but decomposition leveled off after that point with less than 20% decomposition for the remainder of the season after the initial six week period. The deterioration of cover crop residue was slower in strip-till with less than 25% decomposition of rye in the first six weeks, and 45% decomposition after that.

By the end of the trial, decomposition rates were the same regardless of cover crop, however (crimson clover = 75%, rye = 83%, wheat = 76%). But there were few cotton responses to cover crop treatment effects as plant biomass, height, stand, and yield all were statistically equal among treatments. Strip-till management did trend toward better results in yield and adjusted revenue than conventional tillage. In order to keep management similar to grower practices, there was supplemental fertilizer applied in this experiment, which apparently masked any beneficial nutrient effects being provided by decomposition of the cover crops. Yet, residue levels in this year were so low for most treatments, that total nutrient content would not have been at a sufficient level to support or supplement cotton growth at a very high level.

All in all, despite no yield differences, there were several positive results using strip-till management over conventional tillage. Although there were no economic advantages to using cover crops over having no cover crop in place, there are many documented benefits of growing cover crops which often have no inherent monetary value, but can save money in the long run. Reduced soil erosion on the highly erodible soils of the southeast is one of the most important, since a large rainfall can wash volumes of priceless soil out of a field, and leach nutrients out of the soil profile. Cover crops will hold soil and nutrients in place for future crops that follow. The long-term sustainability and productivity of coastal plains soils will depend heavily on ensuring good management practices are used to prevent misuse and eventual loss of the soil, our most valuable resource.

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STEER INTAKE AND DIGESTION OF CPM SUPER-P COTTON BY-PRODUCT BLOCKS

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Introduction

Cow herds in the Southeastern USA, and other regions depend upon hay as a winter feed source. Increased input costs in recent years have vastly increased cow-calf production costs. A key study was proposed to determine the first documented replicated comparison of the new CPM Super-P cotton by-product blocks (CPM; A. G. Daniel Co., 5120 5th Avenue, Eastman, GA 31023) with other supplements (SUP) and hay fed to beef cows during winter. The CPM blocks may supply a total replacement for hay and supplements for beef cows. and They contain considerable portions of cotton gin trash, a by-product of the cotton ginning industry that has environmental consequences if not disposed of properly. Incorporation of low-cost cotton gin trash as a feed ingredient could alleviate part of the environmental problems while providing locally available feed for beef cows across the SE USA. A short-term study was conducted to determine intake and digestion of the original CPM blocks compared with other supplements using 1000 lb steers as models for mature beef cows of similar weights.

Materials and Methods

The original CPM blocks were designed to be fed free-choice, as a replacement for hay and SUP, and they contain large amounts of cotton gin trash, distillers dried grain with solubles (DDG), wheat middlings, molasses, and minerals (Table 1). On November 2, 2009, large beef steers (n=30; approximately 2 yr of age; 1000 lb BW) were selected to simulate effects of feeding experimental diets to mature beef cows.

Steers were individually-fed the following SUP with or without hay (Table 3): 1) Hay only (H); 2) Hay with WCS fed at 0.5% BW daily (HWCS); 3) Hay with dried distillers grain with solubles (HDG); 4) Hay with CPM (HCPM); 5) CPM free-choice with no hay (CPMFC). The A. G. Daniel Company provided the CPM Super-P product in 15 kg (33 lb) blocks for this experiment, which greatly facilitated ease of individually-feeding CPM to steers. Steers on Treatments 1-4 were fed medium quality, coarsely ground, bermudagrass hay, free-choice, with treatment supplements, and CPM was fed without hay (Treatment 5), for 18 d. Feed intake and feed refusals were recorded. Nutrient content of hay, supplements and CPM blocks appears in Table 2**.** Chromic oxide (10 g/steer daily, last 9 days of trial) was fed as an indigestible marker. Fecal samples (11/steer over last 5 days of the experiment) were collected, dried, ground through a 1 mm screen, and SUP, hay, and fecal samples, were chemically analyzed for nutrient content to determine apparent digestion of organic matter, crude protein and fiber components of the diets. Statistical analyses were conducted for the intake and digestion experiment.

Results and Discussion

The concept of providing a product to cattle producers that held potential as a replacement for hay was a popular idea, especially if it could be economically manufactured using locally produced by-products. The original CPM Super-P blocks offer these features. Using cotton gin trash as a principal ingredient reduces cost of the product while providing a disposal mechanism for this abundant environmentally hazardous by-product of the cotton ginning industry. Combining the gin trash with three other by-products, namely wheat middlings, cane molasses, and a new product to South Georgia, dried distillers grain, adds to the strength of the concept of a locally produced cattle feed (Table 1). The A. G. Daniel Company is also producing small 15 kg blocks of the CPM product for deer, goats and cattle, with minor formulation variations for different species.

The original CPM blocks were formulated to meet the nutrient requirements of beef cows through the first 2 months after calving. During this period of time, cows would be at peak lactation, and if they calve in winter, they may be almost totally dependant on the CPM block for nutrients to maintain themselves and produce milk for suckling calves. This is a critical time for cows as they prepare for the upcoming breeding season. In Table 2, chemical analyses are shown for hay, cottonseed, distiller grains, and original CPM blocks that were fed in the steer experiment. The hay was selected to be less than 10% CP, to allow expression of protein supplementation responses with WCS or DDG supplements. The bermudagrass hay was baled in large round bales, stored outside, and then processed with a round bale chopper, yielding 5 cm to 7.5 cm (2-3 inch) hay lengths. The chopped hay resulted in minimal waste, and assured more accurate hay consumption records for the individually-fed steers. The WCS and DDG had typical analyses for these products, except that TDN was lower for both by-products than values found in NRC (1996), which lists TDN for WCS at 96%, DDG at 90% on a DM basis. Over the last 5 yr, Dairy One Labs, Ithaca, NY has consistently reported lower TDN values for WCS than TDN values in NRC (1996). Additionally, sulfur content of DDG and CPM blocks were determined, since sulfur concentrations above 0.4% of the total diet can present metabolic problems for cattle. The CPM blocks contain both molasses and DDG, two sources of sulfur that should be monitored. The CPM blocks used in our experiment contained 0.342% S on a DM basis, which may not be a problem, unless cattle consume large portions of CPM block. The medium quality hay fed in this experiment had lower CP, but somewhat higher TDN, NE_m, and NE_g than the CPM blocks.

Selection of two-yr old 450 kg beef steers to be individually-fed the CPM blocks, compared with hay and other supplements occurred because the steers were similar in size to many beef cows. The steers were large enough to have extra rumen capacity, as cows do, allowing processing of large quantities of hay or other fibrous feeds. In Table 3, the intake of hay, supplemental WCS and DDG were compared with consumption of CPM blocks fed with free-choice hay or CPM blocks fed as the sole feedstuff. Hay consumption tended to be similar for steers fed hay only (TRT 1), compared with similar sized steers fed hay only diets in previous experiments (Hill et al., 2007; 2008a,b), but hay intake tended to be lower on HWCS (TRT 2, Table 3) than in the previous studies when steers weighing over 400 kg were utilized in the experiments. The WCS and DDG supplement intake (Table 3) was controlled by feeding pre-designated amounts of each supplement. The WCS was fed at 0.5% of steer initial body weight, adjusted for feed refusals. The DDG was fed at rates to meet CP and TDN requirements of beef cows in the first 2 mo of lactation, when fed with hay. The total DMI was similar for H, HWCS, and HDG.

The steer intake and digestion experiment was the first formal feeding experiment conducted with the original CPM Super-P blocks, therefore intake, acceptance by cattle, and substitution rate for hay by cattle were unknown. Some producers may have hay available, and may wish to feed hay with the CPM blocks. Treatment 4 was designed to determine how much hay would be consumed if it was fed with the CPM blocks, compared with feeding CPM blocks as the sole feedstuff (Table 3). Steers on HCPM began the 18-day experiment by eating mostly hay on d 1, with increasing CPM consumption so that mostly CPM, and very little hay was consumed by d 5. This trend continued for the duration of the experiment. Apparently, given a choice, cattle will consume CPM blocks and leave medium quality hay behind. The CPM blocks have been promoted as a replacement for hay, but no data existed prior to this research regarding intake, palatability, or digestibility of the CPM product. Steers fed CPMFC (Table 3), consumed 15.61 kg (34.41 lb) of block on a DM basis, or 17.48 kg (38.56 lb/steer daily) on an as-fed basis. Steers on HCPM and CPMFC began by breaking the formed blocks up, then consuming the block material. There was no evidence of sorting or picking through the block material, all of each block was consistently consumed. The intake was averaged over the 18 d experimental period, and steers had consistently higher ($P < 0.01$) CPM block intake on both HCPM and CPMFC than hay or hay with supplement treatments. This level of intake exceeded the expectations of the company, which had predicted as-fed intake of 11.4 kg/day (25 lb/cow daily).

Table 4 shows the percentages of various nutrients in the total diet DM for each treatment. Ash content was similar for H, HWCS, and HDG, which were hay-based diets. Ash content in total diet DM increased markedly for HCPM and CPMFC, containing CPM blocks, reflecting higher ash content of CPM blocks (Table 2). Crude protein percentage of DMI was similar for HWCS and HDG, and both had higher CP compared with H. Crude protein was higher in dietary DM for HCPM and CPMFC, resulting from higher CP in DDG contained in CPM blocks. NDF was highest for hay only H, intermediate for HWCS, and HDG, and tended to be lower for diets with CPM (HCPM and CPMFC; Table 4). Higher ash and lower NDF in HCPM and CPMFC could affect digestibility of OM and NDF. While CP content of all supplemented treatments exceeded requirements for beef cows, total diet digestibility may be affected by lower quality cotton gin trash in CPM blocks compared with hay-based supplemented diets.
Determination of digestibility of the original CPM blocks by steers was a primary goal of this experiment. The original CPM blocks contained large amounts (59%, Table 1) of

lower quality cotton gin trash (27.1% IVDMD digestibility, Newton et al., 2000), which was countered with distillers grains, wheat middlings and molasses, resulting in a medium quality product. The original CPM blocks contained 16.4% CP in DM, and lower NDF than the hay fed in the same experiment on other treatments. In Table 5, organic matter (OM) digestibility was highest ($P < 0.05$) for HCPM, followed by CPM, and both were higher than H, HWCS and HDDG. The OM was determined by removing ash from the DM of each diet and fecal DM for each treatment. Interestingly, CPM had the highest level of ash of any feed ingredient (Table 2), but OM digestibility was higher for CPM treatments. All treatments had relatively high OM digestibility (> 69%), and although significant, treatment differences were not that great. The CP digestibility was highest (Table 5; $P < 0.01$) for HCPM, intermediate for HWCS, HDG, and CPMFC, and lowest for the non-supplemented hay treatment. Again, supplemented treatments had higher CP digestion, compared with Hay Only (Table 4). As with OM digestibility, HCPM had the highest CP digestibility. Although consumption of hay was low for the HCPM treatment, increased OM and CP digestibility for this treatment suggests that the Tifton 85 hay was apparently digested at higher rates than CPM blocks, containing 59% cotton gin trash. Cotton gin trash is lower in digestibility than average quality hay (Newton et al., 2000; NRC, 1996), and may not support cow gains without higher level energy supplementation (Hill et al., 2000a,b). Therefore, higher digestibility hay complemented higher CP of CPM blocks. Rate of passage of the short fiber in cotton gin trash might have been decreased in CPM blocks by feeding longer fiber hay, allowing higher nutrient absorption of the total diet. Tifton 85 hay harvested at various maturity stages has had relatively high OM, CP, and fiber digestibility in small plot and steer digestion experiments (Corriher et al., 2007; Hill et al., 2001; Mandebvu et al., 1999; West et al., 1998). Fiber digestibility of the steer diets was variable, with ADF digestibility being highest ($P < 0.01$; Table 5) for the Hay Only treatment, again indicating the higher digestibility of the Tifton 85 hay. This is further supported by increased ADF digestibility for HCPM compared with CPM. The ADF digestibility was similar for HWCS, HDG, and CPMFC. Increased ADF and fat in WCS, and increased fat in DDG (Tables 2 and 4) probably contributed to lower ADF digestibility for these treatments. The NDF digestibility was highest ($P < 0.01$; Table 5) Hay Only, intermediate for HWCS, HDG, HCPM, and all were substantially higher than CPMFC digestibility. Once again, lower NDF digestibility of CPM probably resulted from the combination of lower quality cotton gin trash in blocks, and possible negative associative effects of including DDG with increased fat, which contributed to depressed fiber digestibility. This could be contrasted to the HWCS and HDDG NDF digestion rates being higher because of increased digestion of the hay. Fiber (ADF and NDF) digestibility is important, because they affect dietary intake, and fiber is converted to energy. Even though CPM treatments had twice the DMI as other treatments (Table 3), digestibility coefficients were adjusted for individual steer intake on each treatment, and the fecal Cr marker concentrations were different for these treatments compared with other treatments, resulting in consistent digestibility coefficients for the nutrients. The relatively low standard errors of means (Table 5; SE) indicate consistent digestibility for each steer on each treatment.

Consumption of original CPM blocks, first documented in this research project, invokes questions of economics. If the original CPM product costs $160 / ton, and if a beef cow consumed 17.5 kg/day (38.56 lb/day), as steers did in the present experiment, the cost would be $3.08 / cow / day for the product. If intake was conservatively increased by 15%, which is conceivable assuming beef cows may weigh 1300 lb or more, and if she was suckling a calf during winter, the cost would rise to $ 3.55 / cow /day (38.56 lb/d X 1.15=44.34 lb/d; 44.34 lb CPM X $0.08= $3.55 / cow /day). This may be compared with feeding WCS at 0.5% cow weight with hay priced at $100/ton when WCS is priced at $160 / ton or $200 / ton. Using intake data for cows fed WCS with hay (Hill et al., 2008b), total cost of hay and WCS with were $1.94 and $2.07/cow daily. The steer intake data suggested that cows may consume higher rates of CPM than predicted, consequently, costs of the original product may prove to be prohibitive, even when feeding convenience, ease of storage, and possibly higher nutrient content of the feed are considered. Higher consumption may require CPM block formulation changes, or employment of alternative feeding methods to limit product consumption.

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Table 1. Description of original CPM Super-P Cotton Gin Trash Blocks Fed to Steers in the Intake and Digestion Experiment.

Item	Lb/ton	% as mixed
CGBP(Cotton Gin Trash)	1182	59.1
Dried Distiller Grain w/Solubles	300	15.0
Wheat Middlings	300	15.0
Purina Liquid Supplement (12% CP)	200	10.0
AG Pro Mineral	10	0.5
Binder	5	0.25
Mold Inhibitor	2	0.1
Oil	1	0.05
Total	2000	100.00

Table 2. Nutrient analyses of hay, supplements, and original CPM Super P Blocks fed to steers in the intake and digestion experiment.

Item[a]	No. Samples	DM, %	Ash	CP	ADF	NDF	Crude Fat	TDN, %	NE_m Mcal/lb	NE_g Mcal/lb	Sulfur %DM[b]
			------------DM Basis, %--------------								
Hay	7	87.06	6.79	9.33	44.06	76.91	-----	52.4	0.416	0.169	0.21

WCS[c]	11	91.44	3.85	23.38	39.21	53.53	18.12	71.2	0.828	0.548	-----
DDG[c]	11	86.70	5.68	31.63	15.07	31.69	11.17	82.4	0.971	0.664	0.657
CPM	10	89.26	9.90	16.43	44.66	56.63	5.22	47.7	0.393	0.147	0.342

[a]Abbreviations: DM=Dry Matter; CP=Crude Protein; ADF=Acid Detergent Fiber; NDF=Neutral Detergent Fiber; TDN=Total Digestible Nutrients; NE_m =Net Energy, Maintenance; NE_g= Net Energy, Gain; WCS=Whole Cottonseed; DDG= Dried distillers grain with solubles; CPM= A.G. Daniel Co. CPM Super-P Blocks.
[b]Sulfur analyses conducted on following number of samples: Hay= 1; DDG= 6; CPM= 5.
[c]TDN values for WCS and DDG were consistently lower in the computations from samples submitted to Dairy One Labs, Ithaca, NY, compared with NRC values. NRC (2000) lists TDN for WCS at 96%, DDG at 90% on DM basis.

Table. 3. Hay and supplement or original CPM block intake by steers individually-fed diets for 18 days.

Item[a]	Hay Only H	Hay + WCS HWCS	Hay + DDG HDG	Hay + CPM HCPM	CPM Only CPMFC	SE	*P*<
No. steers	6	6	6	6	6		
Initial BW, kg	455.1	454.5	453.3	453.0	451.8		
Hay, as fed, kg	7.67	6.05	5.88	2.2	0.0		
Hay, DMI, kg	**6.68**	**5.30**	**5.12**	**1.90**	**0.0**		
Hay, LSM, kg	**6.68**	**5.30**	**5.15**	**1.98**	**0.0**	**0.23**	**0.01**
SUP or CPM, as-fed, kg	0.0	2.06	1.72	15.09	17.49		
SUP or CPM, DMI, kg	**0.0**	**1.88**	**1.49**	**13.09**	**15.61**		
Total, as-fed, kg	7.67	8.11	7.60	17.29	17.49		
Total,DMI,kg[b]	**6.68**	**7.15**	**6.61**	**14.99**	**15.61**		
Tot.LSM, kg	**6.77**	**7.20**	**6.67**	**15.51**	**15.64**	**0.37**	**0.01**

[a]Abbreviations: WCS=Whole cottonseed; DDG=Dried Distillers grain; CPM= CPM Super P block; SUP=Supplement, DMI=Dry Matter Intake. Tot = total; LSM= Least squares adjusted means, adj. for TRT, Steer breed, Steer initial body weight.
[b]Total DMI includes corn fed as carrier for Chromic oxide marker fed last 9 d on all treatments: (0.55lb = 0.25kg/steer daily, as-fed, last 9 d).

Table 4. Nutrient content of diets in total dry matter consumed by steers.

Item[ab]	Hay Only H	Hay + WCS HWCS	Hay + DDG HDG	Hay + CPM HCPM	CPM Only CPMFC
DM, %	87.31	88.13	87.01	88.98	89.26
Ash, %	6.70	5.97	6.46	9.45	9.84
CP, %	9.32	12.80	14.00	15.50	16.38
ADF,%	43.39	42.22	37.30	44.29	44.37
NDF, %	75.83	70.09	66.32	58.81	56.30

[a]Abbreviations: WCS=Whole cottonseed; DDG=Dried Distillers grain; CPM= CPM Super P block; DMI=Dry Matter Intake; DM=Dry matter; CP=Crude Protein; ADF=Acid Detergent Fiber; NDF=Neutral Detergent Fiber.
[b]Total DMI includes corn fed as carrier for chromic oxide marker fed last 9d on all treatments: (0.55lb = 0.25kg/steer daily, as-fed, last 9 d)

Table 5. Apparent digestion of hay with supplements and original CPM Super P cotton by-product blocks individually-fed to beef steers

Item[a]	Hay Only H	Hay + WCS HWCS	Hay + DDG HDG	Hay + CPM HCPM	CPM Only CPMFC	SE	*P*<
TRT	1	2	3	4	5		
No. Steers	6	6	6	6	6		
Avg.wt,kg	455.1	454.5	453.3	453.0	451.8		
Digestion	-------------------Apparent Digestibility, % ------------------------						
Organic matter	70.58	69.13	70.29	74.03	72.25	1.00	0.02
Crude protein	63.66	69.78	70.84	73.33	71.15	1.06	0.01
Acid det. fiber	69.91	57.91	57.55	61.68	57.81	1.41	0.01
Neutral det. fiber	70.66	66.57	66.89	65.70	62.66	1.32	0.01

[a]Abbreviations: WCS=Whole cottonseed; DDG=Dried Distillers grain; CPM= CPM Super P block.

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WINTER-CALVING PERFORMANCE OF COWS FED WHOLE COTTONSEED AND OTHER SUPPLEMENTS WITH HAY

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Introduction

Cow herds in the Southeastern USA, and other regions depend upon hay as a winter feed source. Amount of hay required depends upon geographical location of herds, weather conditions in particular years, and availability of stockpiled or winter annual forages. Increased fertilizer, labor, and equipment costs in recent years have increased production costs for cow-calf producers. A key study was planned to determine the first documented replicated comparison of the new CPM Super-P cotton by-product blocks (CPM**;** A. G. Daniel Co., 5120 5th Avenue, Eastman, GA 31023) with other supplements (SUP) and hay fed to beef cows during winter. The CPM blocks potentially could supply a total replacement for hay and supplements for beef cows, and it contained considerable portions of cotton gin trash, a by-product of the cotton ginning industry. Incorporation of low-cost cotton gin trash as a feed ingredient could alleviate part of the environmental problems associated with gin trash disposal, while providing locally available feed for beef cows across the SE USA. A large, replicated cow study was proposed to compare CPM blocks and other supplements with hay as feedstuffs for winter-calving cows. Unfortunately, the large CPM blocks were not being manufactured at the time the cow study began December 17, 2009, and supplementation with whole cottonseed (WCS) compared with other supplements continued through March 15, 2010, while treatment effects were monitored until calf weaning in September, 2010.

Materials and Methods

Pregnant, mature (> 3 yr of age) beef cows (n= 110; Brangus and Angus X P. Hereford) were assigned to 10 groups on December 17, 2009, with regard to body weight (BW), age, breeding, and estimated fetal age. Groups were then randomly assigned to 10 paddocks of dormant bermudagrass and bahiagrass mixtures. Cows were fed these dietary treatments for 92 d (**Table 1**): **1)** Hay only (**H**), **2)** Hay plus free-choice commercial protein blocks (Super Mol 32% Molasses Block, Florida Mineral, Salt & Agricultural Products, Inc., 4014—40th Street North, Tampa, FL; 32% CP; **HPMP**), or **3)** Hay plus whole cottonseed at 0.5% of cow body weight daily (**HWCS**), **4)** Hay plus distillers dried grain with solubles (**HDG;** 4.5 lb DDG/cow daily); **5)** Hay plus corn/distillers grain (**HCDDG**; 50/50 corn and DDG mixture fed at 6 lb/cow daily). The **HCDDG** treatment was included as a substitute treatment replacing the planned CPM block treatment, and it provided additional information relative to comparisons of WCS with dried distillers grains with solubles (DDG) fed to beef cows during winter.

Mixed bermudagrass hay was fed free-choice in hay rings to all cows. The cows were weighed on two consecutive days, body condition scored visually (Scale 1 to 9; 1=emaciated, 5=normal flesh, 9=obese), and had rib fat and rump fat measured by ultrasound on December 17, 2009, before assignment to treatment pastures 2 weeks prior to the initiation of calving season. Hay disappearance and supplement dry matter intake (DMI), cow weight change and cow body condition score (BCS) changes were determined during the supplementation period. Periodic samples of cottonseed, hay, and supplements were analyzed for nutrient content and DM. A commercial mineral containing at least 8% P and salt was available free-choice to all cows. Following the supplementation period, groups were reassigned and exposed to either Angus or Brangus bulls that had passed BSE examinations, for 75 days. Pregnancy rates were determined by rectal palpation of cows and ultrasound 45 days after the breeding season ended. Cow and calf weights (2 consecutive daily unshrunk BW, averaged), cow visual BCS, and ultrasound cow rib and rump fat depth were determined at the end of the supplemental period, March 19, and cow and calf BW and BCS were recorded on June 29, 2010. Calf weight change from birth to the end of supplementation period, March 19 to end of breeding interval, and from birth to end of breeding season and weaning were determined. Cows and calves were reassigned to summer grazing treatments with regard to the original supplementation treatments, from June to weaning in September. Hay disappearance, cottonseed intake, and supplement intake were carefully measured during the supplemental period. Statistical analyses of the cow data included treatment, rep, rep X treatment in the model, and cow breed, age of dam and initial cow weight were covariates used to adjust least squares means.

Results and Discussion

In Table 1, the chemical analyses of the hay and supplements fed to the cows during the 92-d SUP period (December 17–March 19) are displayed. Hay nutrient content was somewhat higher than most farmers might feed to beef cattle, according to the average of thousands of bermudagrass hay samples submitted to state laboratories for analyses. The typical bermudagrass and bahiagrass hay samples submitted average about 7-8 % crude protein (CP), but may range from 5% to > 15% CP. Bermudagrass hays typically have higher ADF and NDF concentrations than other kinds of hay. Depending on variety, higher NDF may not affect digestibility of the hay. The S content of the hay was higher than expected in the 7 hay samples (Table 1). The total digestible nutrients (TDN) content of the hay was in expected ranges, and it should be noted that Dairy One Labs, Ithaca, NY, typically report lower TDN values for forages and concentrates than those reported in NRC and other publications. The WCS and dried DDG used in the study (Table 1) had CP and TDN values, respectively, of 26.33 and 26.59 % CP, and 73 and 88% TDN. The 2007 Feedstuffs Reference Issue (Vol. 78; pg 21) reported average values for WCS and DDG, respectively, of: 23 and 29 % CP; and 96 and 98% TDN. According to the analyses (Table 1), CP of WCS and DDG fed to cows in this experiment had similar CP, but different amounts of each SUP were fed on the different treatments.

Cow performance (Table 2) was typical for larger beef cows that were pregnant at the initiation of the experiment, and that calved during the supplemental period. Cow initial BW for all treatments averaged 1333.6 ±119.56 lb. Initial BW was higher for Brangus cows (n= 78, 1359 lb) than Angus X P. Hereford cows (n=32, 1272 lb). Because of this breed difference ($P < 0.01$; SE 17.5 lb), cow breed was used as an adjustment in Least Squares Means for cow performance. Cows on all treatments lost body weight and body condition during this supplementation interval, which was normal for cows during the time they are calving. Cows fed the HWCS and the HCDDG treatments lost less weight than cows fed HDG; however, cows fed Hay Only and HPMP had the greatest weight losses during the 92-d SUP interval. Body condition score and US ribfat and rump fat changes during the December-March SUP interval followed the same general trends as body weight losses for the treatments (Table 3). The additional energy in WCS, and in the corn and DDG mixture in HCDDG, and the amounts of these SUP fed, increased cow body weight retention. Since DDG became available in our region in recent years, it must be fed in limited amounts because of the high fat content, and possible high sulfur content. Cows on the HDG treatment had intermediate performance, lower than WCS, but higher than HPMP and Hay Only treatments during the SUP interval. Depending upon price and availability, WCS and DDG may be the most effective supplements for wintering beef cows with hay.

Cow gain performance during the 102-d interval from the end of SUP feeding (March 19) until June 29 (Table 2), which included the transition to summer perennial forages, mostly bahiagrass, and the breeding interval, was positive for all treatments. Cows on H and HWCS SUP treatments tended to have higher ADG than cows that were previously fed the other three SUP treatments. The ADG during this interval was similar for the cows previously fed HPMP, HDG, and HCDDG SUP treatments. The Dec-Sep 278-d ADG, and a comparison of LS Mean Initial BW with September 21 BW, in Table 2, indicates that cows on all treatments regained their bodyweight by the time calves were weaned in September. It is important to remember that the goal of these low-level winter supplementation programs was to have cows perform well, re-breed, and regain their weight before their next calf is born. These SUP with hay accomplished these goals. Pregnancy rates were above 95% for all SUP treatment groups, including the cows fed Hay Only (Table 2). In previous similar studies, SUP treatments including WCS and other protein-based SUP, had high (> 90%) pregnancy rates, but hay-only had significantly lower pregnancy rates. In those studies, CP of hay was around 9%, compared to hay in this study which averaged above 10% CP, with 53% TDN (Table 1).

Hay as-fed intake was reduced for HWCS, HDG, and HCDDG compared with H and HPMP treatments (Table 2). Supplement intake was controlled for HWCS, HDG, and HCDDG, but hay intake on all treatments and consumption of protein blocks for HPMP were not controlled. Total feed intake was similar for all treatments. Results indicate that the traditional feeding of WCS at 0.5% of cow weight is competitive with other supplementation treatments, and continues to support higher performance than the protein blocks used in the present study.

Cow performance (Table 1) indicated that cows on HWCS and HCDDG treatments had the quickest recovery of BW, exceeding the December 17 BW by June 29. Cows on these two treatments had slightly higher BCS scores by June 29 than their initial Dec 19 BCS Scores. All cows made very acceptable gains during the spring grazing and breeding interval from March 19 to June 29. Cows continued grazing through summer on perennial pastures of Coastal bermudagrass, common bermudagrass and Tifton 9 bahiagrass. Cows lost some weight during summer as grazing pressure increased, pasture quality declined, and cow milk production waned with increasing calf age and weight. For the interval from pre-calving weight, December 17, to weaning, September 21, cows originally supplemented with WCS had the smallest weight loss. Pregnancy rates were extremely good for cows on all treatments. Calf ADG (Table 4) averaged 2.0 lb for all treatments during summer. Calf weaning weights were outstanding, ranging from 640 to 670 lb, with no differences associated with pre-weaning treatments. The cost of feeding the HCDDG SUP was higher than feeding WCS on the HWCS treatment during the winter feeding interval. Results indicate that the traditional feeding of WCS at 0.5% of cow weight is competitive with other supplementation treatments, and continues to support higher performance than the protein blocks used in the present study.

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Table 1. Chemical analyses of hay and supplements fed to cows during the winter calving interval from December to March

Item[a]	Hay	32 CP Block[b]	WCS	DDG	Corn/DDG
No Samples	7	6	3	3	3
DM basis, %					
DM	89.44	82.20	90.30	88.53	88.52
Ash	7.12	44.95	4.13	4.60	2.80
Crude Protein	10.73	29.98	26.33	26.59	17.00
Acid detergent Fiber	40.64	7.08	45.03	11.26	5.15
Neutral detergent fiber	72.99	13.55	59.03	32.98	17.95
Crude Fat (EE)	1.70	4.42	16.60	14.43	7.15
Sulfur	0.21	0.56 (1)	------	0.48 (1)	
TDN	53.71	42.67	73.00	88.00 (1)	
Mcal/lb DM					
NEm	0.44	0.34	0.84	1.07 (1)	
NEg	0.19	0.10	0.55	0.75(1)	

[a]Abbreviations: CP = crude protein; WCS = whole cottonseed; DDG = Dried distillers grain with solubles; Corn/DDG = a 50/50 mixture of ground corn with DDG; TDN = Total digestible nutrients; NEm = Net energy for maintenance; NEg = Net energy for gain (TDN, Net energy, S were determined by Dairy One Labs, Ithaca, NY); Hay was fed in round bales with hay rings, disappearance accounted for during hay/SUP period. Parenthetical designations indicate no. of samples analyzed for mineral or energy.
[b] The Molasses protein blocks were advertised as “32% CP Blocks”; Samples from blocks that were analyzed indicated that blocks contained 29.98% CP on a DM basis, and 36.47% CP on an as-fed basis. The blocks contained 4.42% crude fat on a DM basis; and 5,38% crude fat on an as-fed basis. Both CP and fat content were near advertised concentrations.

Table 2. Performance of beef cows fed WCS and supplements with hay in winter during the calving interval and subsequent performance until weaning (LS Adjusted Means).

Item[a]	Hay only H	32% CP Block HPMP	0.5% BW WCS HWCS	DDG 4.5 lb/d HDG	Corn/ddg 6 lb/d HCDDG	SE
No. Cows[b]	22	22	22	22	22	
Dec 17 BW (actual)	1329	1340	1332	1337	1328	
LS mn Dec 17 BW**	1303	1321	1318	1323	1312	27.8
Mar 19 BW	1193	1213	1251	1225	1254	18.9
Jun 29 BW**	1321	1315	1371	1321	1365	21.2
Sep 21 BW	1292	1306	1331	1293	1294	28.3
Reproductive performance						
Cows Pregnant	22/22	22/22	21/22	21/22	21/22	
Pregnancy, %	100	100	95.4	95.4	95.4	
Days Preg atPalpation	79.43	88.84	86.99	82.52	90.05	4.43
Cow gain, lb						
Dec-Mar 92d ADG	-1.53	-1.31	-0.89	-1.18	-0.87	0.205
Mar-Jun102dADG**	1.26	1.01	1.17	0.94	1.09	0.140
Dec-Jun 194d ADG**	-0.06	-0.09	0.19	-0.07	0.17	0.109
Jun-Sep 84d ADG**	-0.40	-0.12	-0.48	-0.48	-0.86	0.336
Dec-Sep278d ADG	-0.15	-0.09	-0.01	-0.14	-0.14	0.103
SUP & Hay intake, 92 d, as-fed						
Hay, lb/d	39.0	39.3	35.8	36.6	35.1	
SUP, lb/d	0.0	0.76	6.82	4.54	6.0	
Total, lb/d	39.0	40.1	42.6	41.1	41.1	

** Cow breed effect ($P < 0.01$); LS means adjusted for Cow Breed .
[a]All weights and ADG reported in pounds. Abbreviations: SUP= Supplement; WCS = Whole cottonseed; DDG = dried distillers grain with solubles; ADG = avg daily gain; BW = body weight.
[b]Two pens of 11 cow-calf pairs/treatment; Cows on Corn/DDG treatment combined into one group because of pasture soil saturation with rain, moved from original 2 pens.

Table 3. Body condition scores and ultrasound measurements of ribfat and rump fat in cows fed different supplements with hay while calving during winter (LS Means).

Item[a]	Hay only H	32% CP Block HPMP	0.5% BW WCS HWCS	DDG 4.5 lb/d HDG	Corn/ddg 6 lb/d HCDDG	SE
BCS Score(Scale 1-9)						
Dec 17**	5.57	5.03	4.86	4.93	5.12	0.122
Mar 19 End SUP	4.80	4.92	5.05	5.08	5.16	0.107
BCS Chg Dec-Mar	-0.29	-0.20	-0.07	-0.04	0.04	0.109
Jun 29 After breeding	5.36	5.52	5.68	5.53	5.78	0.107
BCS Chg 102 d	0.55	0.60	0.63	0.44	0.62	0.102
Sep 9 Just before wn	5.36	5.44	5.57	5.39	5.52	0.101
BCS Chg Dec-Sep	-0.24	0.33	0.46	0.28	0.40	0.101
US Ribfat, cm						
Dec 17*	0.405	0.597	0.412	0.451	0.397	0.050
Mar 19EndSUP time	0.300	0.368	0.294	0.415	0.359	0.045
US ribChg Dec-Mar*	-0.125	-0.180	-0.136	-0.045	-0.062	0.034
Jun 29 After breeding	0.618	0.746	0.766	0.647	0.709	0.066
US ribChg Mar-Jun*[d]	0.316	0.379	0.475	0.252	0.354	0.049
US rib– Chg Dec-Jun[d]	0.191	0.340	0.196	0.206	0.293	0.059
US Rump fat, cm						
Dec 17	0.629	0.808	0.547	0.625	0.580	0.079
Mar 19End SUP time[c]	0.391	0.557	0.419	0.564	0.552	0.063
USrumpChg DecMar*	-0.248	-0.184	-0.174	-0.065	-0.060	0.046
Jun 29 After breeding	0.814	1.072	0.966	0.964	1.098	0.094
USrump ChgMar-Jun[d]	0.418	.0508	0.557	0.410	0.553	0.067
USrump ChgDec-Jun[d]	0.175	0.334	0.388	0.349	0.499	0.080

** Treatments differ ($P < 0.01$); * Treatments differ ($P < 0.05$).
[a]Abbreviations: SUP= Supplement; WCS = Whole cottonseed; DDG = dried distillers grain with solubles; ADG = average daily gain; BW = body weight; Chg= change; US=Ultrasound measured in cm; BCS=Body Condition Score (1=emaciated; 5 = average flesh; 9 =obese).
[b]Two pens of 11 cow-calf pairs/treatment; Cows on Corn/DDG treatment combined into one group because of pasture soil saturation with rain, moved from original 2 pens.
[c]Rump fat affected by cow breed ($P < 0.05$). LS Means adjusted for cow breed.
[d] Change in ribfat and/or rump fat affected by cow breed ($P < 0.01$); LS Means adjusted.

Table 4. Calf Performance after their dams were fed the SUP treatments for 92 d during the winter calving interval

Item[a]	Hay only H	32% CP Block HPMP	0.5% BW WCS HWCS	DDG 4.5 lb/d HDG	Corn/ddg 6 lb/d HCDDG	SE
No calves	22	22	22	20	22	
Calf data, lb						
Birth weight	88.4	91.4	89.5	93.2	89.5	2.80
Calf age Mar 18, d	53.1	51.9	53.4	55.5	55.0	3.63
BW Mar 18	206.4	208.8	222.7	226.6	221.8	9.75
BW Jun 29	484.2	488.3	489.8	494.0	496.6	11.99
102-d ADG Mar-Jun[b]	2.71	2.70	2.59	2.60	2.67	0.05
Wean wt Sep 21[c]	648.1	662.5	657.1	672.6	644.1	14.33
205-d BIF adj. Wn wt[c]	583.9	594.6	586.1	591.7	572.6	13.31
84-d ADG Jun-Sep	2.06	1.98	2.00	2.05	1.98	
186-d ADG Mar-Sep[c]	2.39	2.45	2.35	2.38	2.29	0.08
ADG Birth to Wean[c]	2.36	2.42	2.42	2.41	2.33	0.07

[a]Abbreviations: SUP= Supplement; WCS = Whole cottonseed; DDG = dried distillers grain with solubles; ADG = average daily gain; BW = body weight; BIF = Beef Improvement Federation (Guidelines for Adj. Wt.). LS means adjusted for covariant effects of: Calf sex, calf breed, cow age, initial cow wt, calf birth weight.

[b] Calf breed effect ($P < 0.01$); Brangus calves greater than AN X PH (ADG :2.83 vs. 2.52 lb).

[c] Calf breed effect ($P < 0.05$); Brangus calves heavier weights or higher ADG for each variable.

SUPPRESSION OF THRIPS BUT ENHANCEMENT OF SHORT-HORNED GRASSHOPPERS IN CONSERVATION TILLAGE: INFLUENCE OF COVER CROPS AND INSECTICIDES ON INFESTATIONS

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Abstract

In 2010, three field experiments were conducted in two locations in Georgia in conservation tillage cotton to determine the influence of cover crop (wheat or crimson clover) and insecticides (Temik (aldicarb) @ 1.75 or 5.0 lbs product/acre or Temik @1.75 lbs/acre + Diamond (novaluron) applied seven days after planting) on management of short-horned grasshopper (Acrididae) and tobacco thrips (*Frankliniella fusca* (Hinds)). Results showed significant reduction in thrips numbers in non-insecticide treated cotton in conservation tillage as compared to conventional tillage, but the reverse situation occurred with short-horned grasshoppers, which had higher populations in all conservation tillage systems as compared to plow tillage. In conservation tillage, thrips numbers were generally similar on cotton planted in crimson clover as compared to wheat. Overall, clover had a greater impact on reducing thrips populations than did wheat, but also had a greater negative impact on cotton height, stand count, and yield, especially in the low rates and absence of Temik (aldicarb). Insecticide treatment with Temik @ 1.75 or 5.0 lbs/acre reduced thrips population in all treatments compared to untreated plots, but numbers were typically 2x or higher reduction in conservation tillage. Short-horned grasshoppers were not controlled with either Temik rate in any tillage system in the three tests and populations were not significantly reduced in plots sprayed with Diamond (novaluron) @ 10 oz/acre.

Introduction

Use of conservation tillage cotton has economic advantages for growers, and it is important for entomologists to develop increased knowledge on pest biology and control in reduced tillage environments (All 1989). Conservation tillage changes the cropping environment and can influence risks for different pests in a positive, negative, or neutral manner as compared to plow tillage. Cotton stand establishment in conservation tillage cotton is a concern, so management of seedling pests such as thrips with preventive applied insecticides is common. In recent years, short-horned grasshopper (Acrididae) populations have produced serious cotton seedling damage in conservation tillage fields. All et al. (1994) reported that thrips (mostly tobacco thrips, *Frankliniella fusca* (Hinds)) infestations in seedling cotton were reduced in conservation tillage systems as compared to conventional tillage, and this observation has been verified in many experiments with cotton. The anomaly of having reduced risk in conservation tillage for thrips injury but increased hazard for short-horned grasshopper infestations is a good example of why individual pests must be considered independently, as well as collectively, in developing pest management programs in crops. Wheat and crimson clover are cover crops that may reduce thrips infestations in conservation tillage cotton. Unfortunately, conservation tillage with either cover does not eliminate economic damage on cotton at the same level as systemic insecticides such as Temik^{tm} (aldicarb), which controls thrips for 45 days or more. Additionally, aldicarb has been shown to have little impact on short-horned grasshopper infestations in cotton, whereas various insecticides, including the IGR insecticide novaluron, have shown effectiveness for pest management. The objectives of the study were to evaluate the effect of cover crop, herbicide burndown timing, and insecticide treatment individually, and in combination, on hazard for economic damage by thrips and short-horned grasshoppers in conservation tillage cotton.

Methods

Three field tests were conducted during 2010 at the UGA Southeastern Branch Research and Education Center in Burke County and at the UGA Plant Sciences Farm near Athens. The fields were each approximately 2 acres in size and were separated into four blocks each with wheat or clover, or left fallow in November 2009. In May, the cover crops received a burndown application of glyphosate (broadcast application @ 0.74 lbs a.i./acre) at seven days or 22 days before planting cotton. The fallow blocks were plowed at least three times beginning 15 days before planting so that a smooth seed bed was present for plow tillage treatments. Eight row plots of insecticide treatment (and a nonchemical check) were randomized in each block. The insecticide treatments in-furrow applications of Temik 15G @ 1.75 lbs/acre, Temik 15G @ 5.0 lbs/acre + novaluron @ 10oz/acre, or Temik @ 5.0 lbs/acre). Novaluron (Diamond 0.83 EC) was applied in a broadcast spray in a volume of 10 gal/acre over plots seven days after planting. The cotton variety used in the test was DP164BIIRR which was tolerant to glyphosate, and herbicide was used as needed for weed control during the season following thrips sampling. Other standard agronomic practices for cotton at the locations were applied at appropriate times. The thrips were sampled on the cotton seedlings at 21 days after planting by immersing 10 randomly selected seedlings in a specimen cup containing alcohol. Thrips were counted and identified using a dissecting microscope. Short-horned grasshoppers were sampled weekly during the season by counting adults and nymphs while walking 2 x 3 ft. wide swaths transecting each plot. Data analysis utilized SAS (Statistical Analysis System) procedures for ANOVA at P<0.05 considering experiment design with mean separation using LSD t Test for split plot design.

Results and Discussion

The data demonstrates that thrips populations were significantly greater on cotton in plow tillage (overall) as compared to conservation tillage (Table 1 and Figure 1). Adult populations were over 90% tobacco thrips. Significantly higher numbers of thrips were present on cotton in conventional tillage as compared with wheat and crimson clover. Clover had a negative impact on yield, plant height, and stand count. Most of the insecticide treatments produced significant reduction in thrips numbers compared to non-insecticide treated plots. In almost all combinations of cover crop and Temik rate, thrips populations were lower than any conventional tillage plots treated with Temik. Compared to the plow tillage check plot yield, wheat check plots had a higher yield in both years. Short-horned grasshopper populations were low (did not exceed 1 short-horned grasshopper/10ft2) in both test fields located at the UGA Southeastern Branch Research and Education Center throughout the season, but higher numbers were present in the UGA Plant Sciences Farm experiment. At all three locations, more short-horned grasshoppers were usually observed in the conservation tillage systems (wheat or clover) as compared to plow tillage until late in the season. Observations of grasshopper adults and immatures in insecticide treatments indicated that novaluron @ 10 oz/acre did not reduce short-horned grasshoppers in treated plots in all three field tests.

Table 1. Tobacco thrips management with selected rates of Temik in conservation tillage (CT) or plow tillage (PT) cotton, 21 days after planting, Midville, GA.

Insecticide Rate	Average Number of Thrips		
	PT	CT Wheat	CT Clover
Check	14.1 a	5.1 bc	6.6 b
Temik 1.75	2.5 bc	2.8 bc	4.9 bc
Temik 5.0	2.2 bc	2.1 c	3.1 bc

P<0.05 Means followed by the same letter are not significantly different in Tukey analysis.

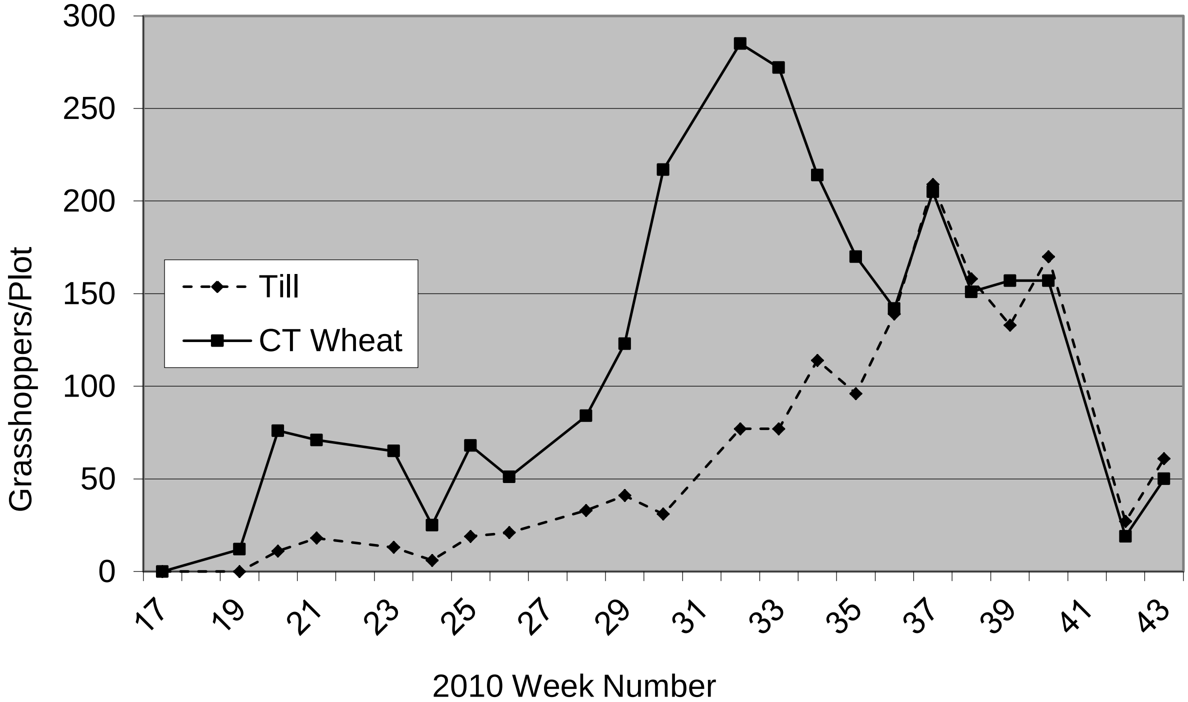

Figure 1. Influence of Cover Crops on Short-horned Grasshopper Populations in Cotton at the University of Georgia Plant Sciences Farm, 2010

Acknowledgment

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STINK BUG AND PREDATOR POPULATION DENSITIES IN CORN, COTTON, SOYBEAN AND PEANUT: COMPARISONS BETWEEN TWO REGIONS IN SOUTHERN GEORGIA

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Introduction

Stink bug field research commonly occurs at between-crop or between-field spatial scales. However, given the polyphagous habits of stink bugs, and their strong capacity for dispersal, it is likely that stink bug management would need to be conducted at larger scales. Landscape-level management will require detailed knowledge of the pattern of movement of the bugs in the landscape in response to available food plants and time of year. Here we examine the effects of two regions in southern Georgia with differences in their scale of production, especially of corn, an early season host of stink bugs, to determine how populations of stink bugs move and develop in the landscape among corn, cotton, peanut and soybean. We chose these crops because: they are all stink bug hosts (at least for feeding), they temporally coincide, and rotation practices in the region often result in their being grown in close proximity. We surveyed the abundance of stink bug egg predators such as the red imported fire ant, *Solenopsis invicta*, big-eyed bugs (*Geocoris* spp.) and long-horned grasshoppers (Family Tettigoniidae), and also estimated the survival of stink bugs in corn, cotton, peanut and soybean.

Material and Methods

In 2009 and 2010, we sampled for the stink bugs *Nezara viridula, Euschistus servus* and *Acrosternum hilare* in corn, peanut, cotton and soybean fields located in 2 regions: the Mitchell region (which included Mitchell and Colquitt Counties), and the Coffee region (which included Coffee and Irwin Counties) in southern Georgia. Field sizes ranged from 1 ha to 85 ha. In 2009, two, 4.8 × 4.8 km sites were demarcated within each region and three corn, peanut, cotton and soybean fields were identified within each site and sampling points were established within each field. In 2010, three, 4.8 × 4.8 km sites were demarcated in each region and three corn, peanut, cotton and soybean fields were identified within each site with sampling points were established within each field. Each field had two transects running perpendicular to the edge of the field along a woodland. We chose to standardize the type of edge for our studies to minimize potential variability in the crops. A total of 20 sampling points were established along each transect with the first sample at 1 m from the crop edge and the next 19 samples at 5 m intervals (= 101 m from crop edge) in 2009. There were a total of 15 sampling points in 2010, collected similarly to 2009 except the last five sampling points along the transect and away from the field edge were at 10 m intervals.

Sampling of corn was done using a two-person, whole plant count with one individual on each side of the corn plants for a total sampling distance of 4.5 m (ca 8 plants/sample) at each sample location. Peanut was sampled using a Vortis® suction sampler pulling 12 samples along 4.5 m of a peanut row at each sample location. Cotton and soybean were sampled using a 1.5 m drop cloth at each sample site. Sampling was done weekly and all stages of the stink bugs species were identified and recorded. A subset was also collected to evaluate parasitism (see Ruberson et al., this volume). Each week we sampled the transect row then alternated to the left and right of the transect row up to five rows on either side of the first sampling row. This was done to minimize the potential of missing counts as we collected all adults and instars.

Results and Discussion

Stink bug numbers were low throughout both years and were similar in 2009 and 2010. *Euschistus servus* was the most abundant species both years. There were very few *Acrosternum hilare* found in 2009 or *Nezara viridula* in 2010 so we did not report their numbers for these years.

In 2009 adult *E. servus* was more abundant in Mitchell corn than Coffee corn, cotton and peanut and had similar numbers in soybean in both regions (Figure 1). *E. servus* was also more abundant in Mitchell peanut than in Coffee peanut. Adult *N. viridula* had a similar density pattern in both regions with more found in corn and very low numbers found in the other crops.

In 2010, adult *E. servus* was more abundant in Mitchell corn, cotton and peanuts than Coffee but more abundant in Coffee soybean than Mitchell (Figure 1). Adult *A. hilare* was more abundant in Coffee corn and soybean than Mitchell corn and soybean.

In 2009, adult *E. servus* was more abundant in Coffee corn and soybean than in Coffee cotton and peanut (Figure 1). Adult *N. viridula* was more abundant in Coffee corn with very low numbers found in Coffee cotton, peanut and soybean. Adult *E. servus* was more abundant in Mitchell corn than the other Mitchell crops with the lowest numbers found in Mitchell cotton and similar numbers found in Mitchell peanut and soybean. Adult *N. viridula* was more abundant in Mitchell corn than Mitchell cotton, peanut and soybean with very low numbers found in cotton, peanut and soybean.

In 2010, adult *E. servus* was more abundant in soybean, than corn, cotton and peanuts with the lowest numbers found in cotton and peanut in the Coffee region (Figure 1). Adult *E. servus* was more abundant in Mitchell corn than in Mitchell peanut, cotton and soybean with the lowest numbers found in Mitchell cotton. Adult *A. hilare* were more abundant in Coffee soybean, than Coffee corn, cotton and peanut. There were no adult *A. hilare* found in Coffee peanut but their numbers were very low in all 3 crops. Adult *A.*

hilare was more abundant in Mitchell soybean than in Mitchell cotton and corn. There were no adult *A. hilare* found in Coffee and Mitchell peanut. *A. hilare* does not appear to colonize or build up populations in peanut.

In 2009, *Geocoris* spp. (adults and nymphs) were more abundant in Coffee cotton and peanut than in Mitchell cotton, peanut and soybean (Figure 2). Long-horned grasshoppers were more abundant in Mitchell than in Coffee peanut.

In 2010, *Geocoris* spp. were more abundant in Mitchell cotton and Mitchell peanut than in Coffee cotton and Coffee peanut (Figure 2). Long-horned grasshoppers were more abundant in Coffee soybean than in Mitchell soybean.

In 2009, more *Geocoris* spp. were found in Coffee cotton and peanut than in Coffee soybean (Figure 2). More *Geocoris* spp. were found in Mitchell peanut and Mitchell soybean than in Mitchell cotton. Long-horned grasshoppers were low overall and similarly abundant in all crops in the Coffee region and higher in peanut than in cotton and soybean in Mitchell.

In 2010, more *Geocoris* spp. were found in Coffee and Mitchell soybean than in Coffee and Mitchell cotton and Coffee and Mitchell peanut (Figure 2). Long-horned grasshoppers were low overall and similar in all crops in the Mitchell region.

In both 2009 and 2010, fire ants were more abundant in Coffee cotton, peanut and soybean than in Mitchell cotton, peanut and soybean (Figure 2).

In 2009 and 2010, fire ants were more abundant in Coffee cotton and Coffee peanut than in Coffee soybean. Fire ants were more abundant in Mitchell peanut than in Mitchell cotton and Mitchell soybean.

There were regional differences in estimates of stink bug survival in corn, peanut and cotton. Corn, cotton and peanut in the Coffee region had lower survival of stink bugs in than in the Mitchell region (Figures 3, 4, 5, 6, 7). Stink bug reproduction was high in corn and soybean and low in cotton and peanut, except for Mitchell peanut in 2009 which had reproduction in peanut as high as in soybean in both regions. This was attributed to two peanut fields at the Baggs site in 2009. Overall, corn and soybean have the highest reproduction of stink bugs and cotton had the lowest compared to the other crops (Figures 5, 6, 7).

In summary, regional differences were found for *E. servus* in corn, cotton and peanut. The Mitchell region always had more stink bugs in these crops than in the Coffee region. Stink bugs in soybean were similar in both regions. Overall, peanuts and cotton tend to have lower numbers of stink bugs than corn and soybean in both regions. The exception was Mitchell peanut in 2009, which had numbers of *E. servus* and estimates of their survival, as high as those in soybean in both regions. Estimates of survival indicate that there were regional differences in survival in peanut and cotton with higher survival in Mitchell than in the Coffee region. There were also regional differences in fire ants. More fire ants were found in Coffee than in Mitchell, but over all crops in both regions the numbers were always highest in peanut and cotton than in soybean. We will need to conduct estimates of survival for each field and obtain grower insecticide applications to determine if there is a correlation between the presence of fire ants and/or spray frequency and stink bug survival in cotton and peanut.

Acknowledgements

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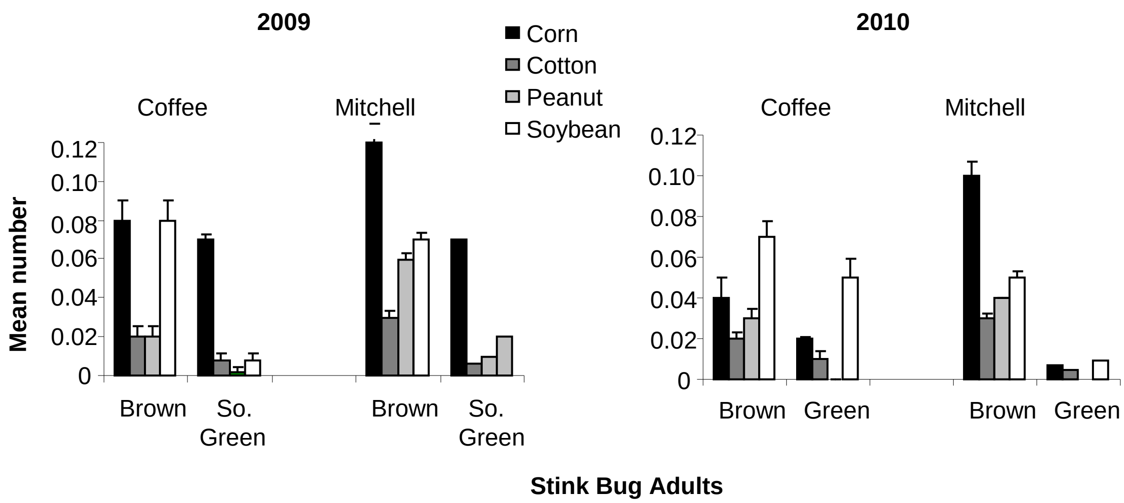

Figure 1. Mean and SEM number of adult stink bugs per region and crop in 2009 and 2010.

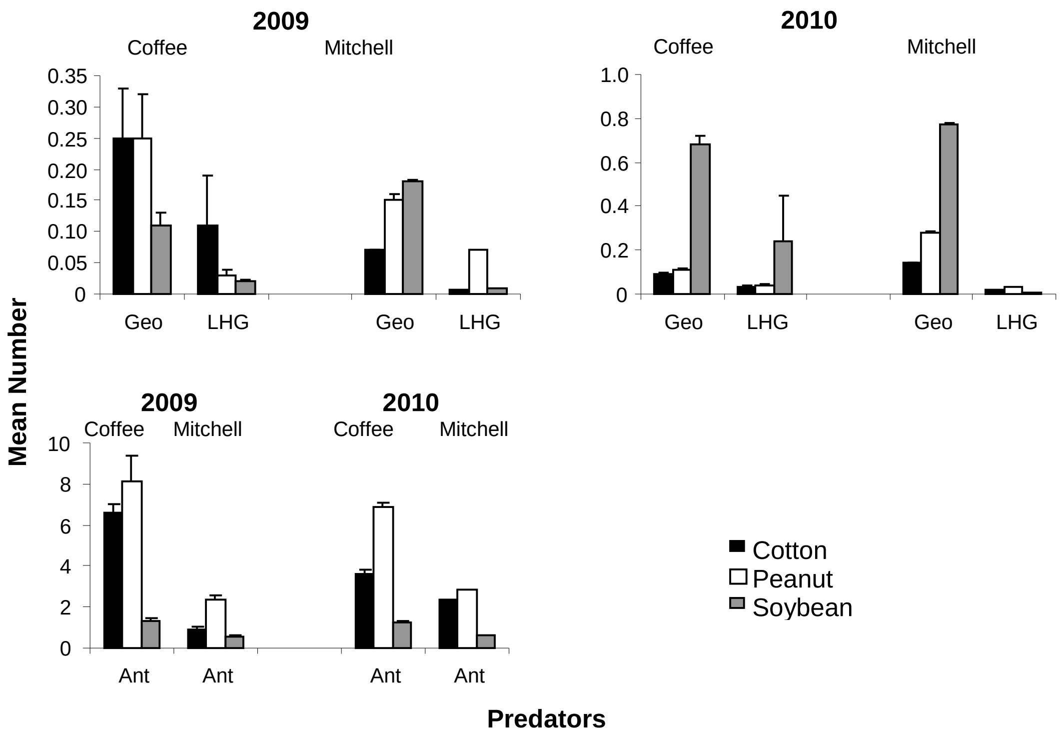

Figure 2. Mean and SEM number of *Geocoris* spp. nymphs and adult (Geo), long- horned grasshoppers (LHG) and the red imported fire ant (ant), *Solenopsis invicta* per crop and region in 2009 and 2010.

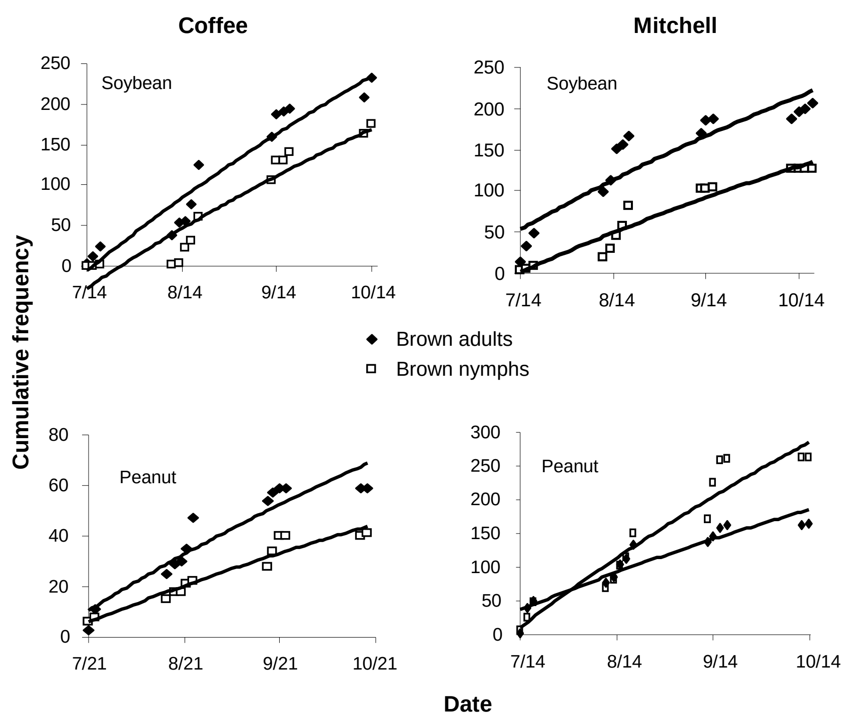

Figure 3. Cumulative frequency of brown stink bug adults and nymphs (all instars combined) in soybean and peanut in Coffee and Mitchell regions in 2009.

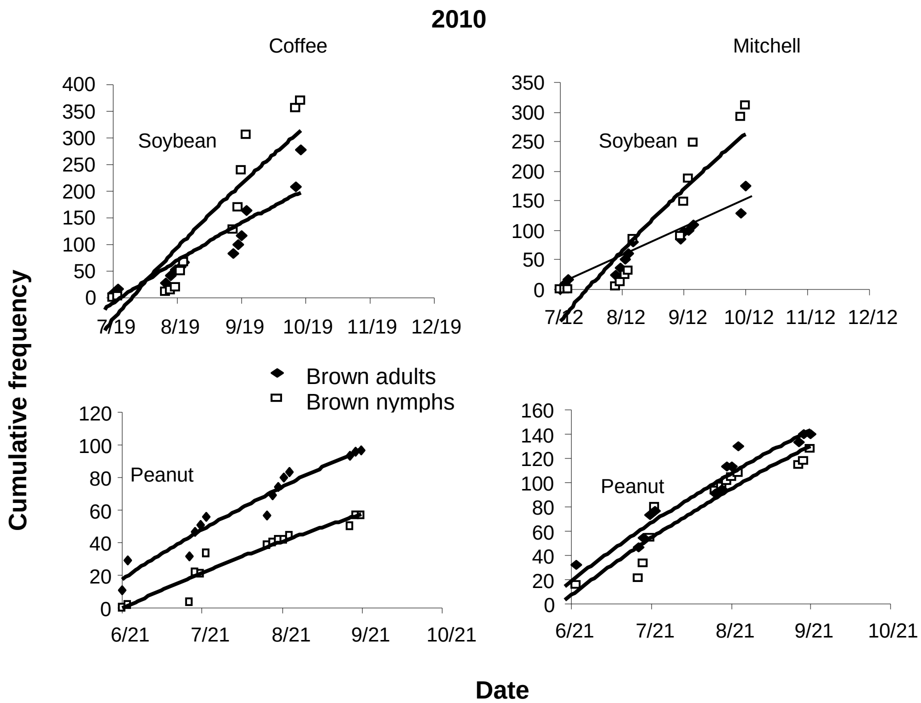

Figure 4. Cumulative frequency of brown stink bugs and nymphs (all instars combined) in soybean and peanut in the Coffee and Mitchell regions in 2010.

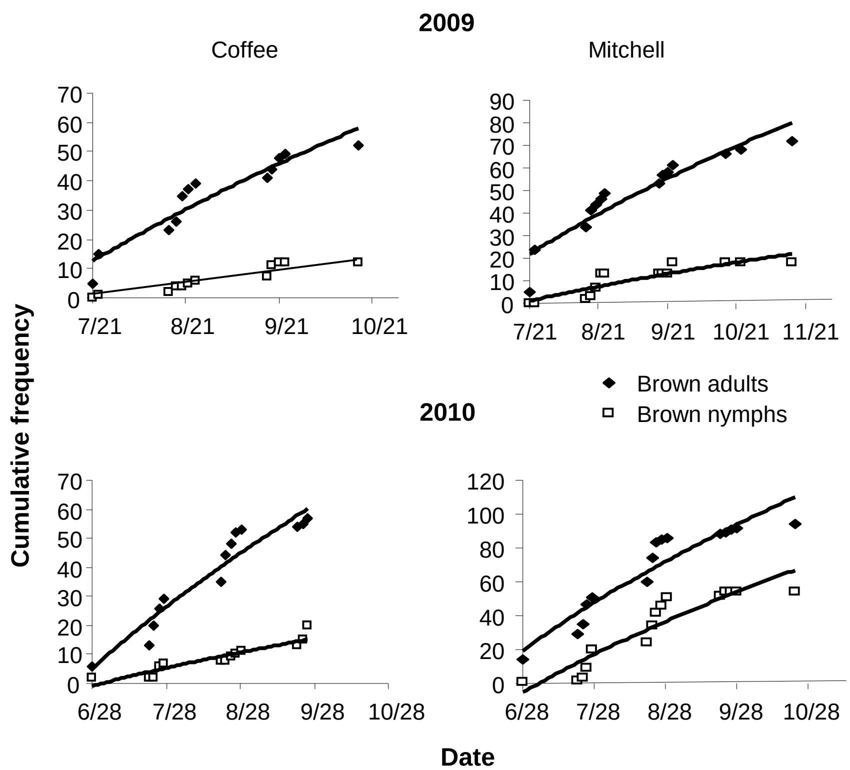

Figure 5. Cumulative frequency of brown stink bug adults and nymphs (all instars combined) in cotton in the Coffee and Mitchell regions in 2009 and 2010.

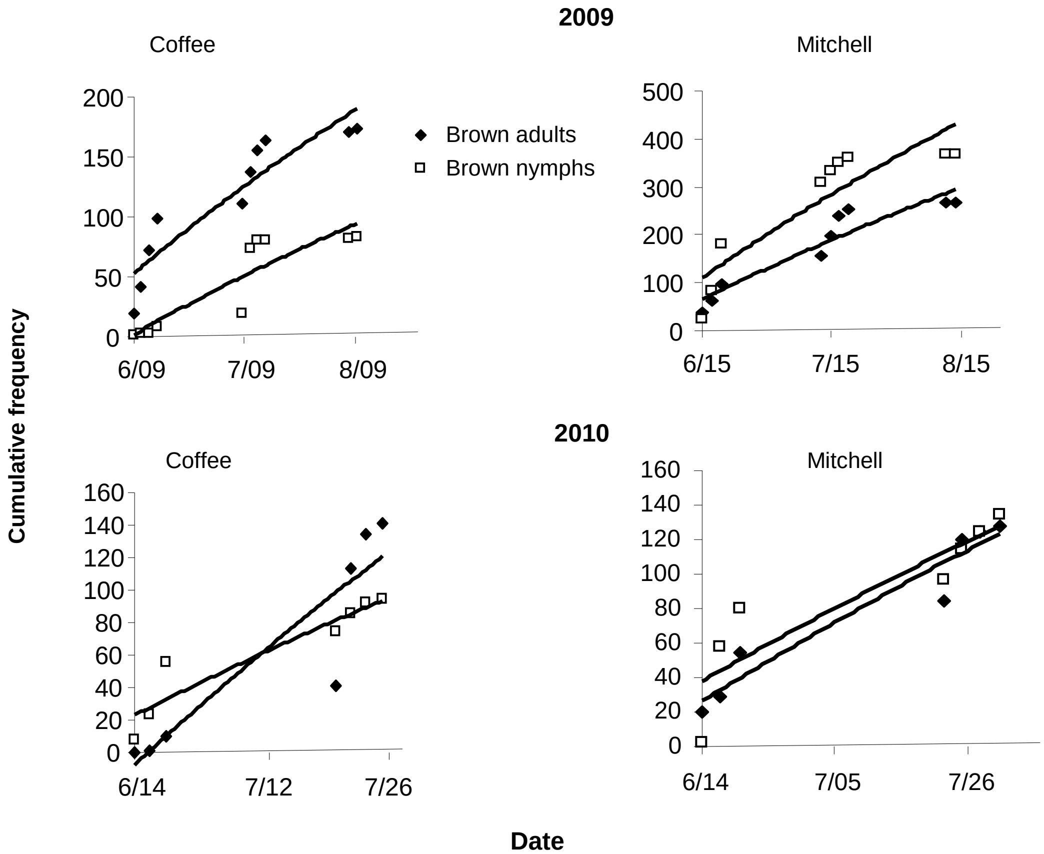

Figure 6. Cumulative frequency of *E. servus* adults and nymphs (all instars combined) in corn in the Coffee and Mitchell regions in 2009 and 2010.

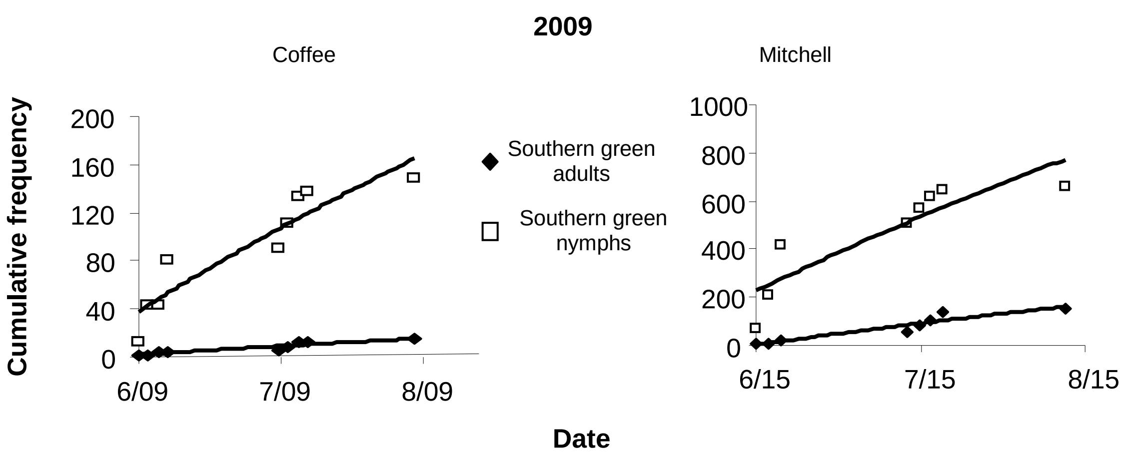

Figure 7. Cumulative frequency of *N. viridula* adults and nymphs (all instars combined) in corn in the Coffee and Mitchell regions in 2009.

TEMPORAL SUSCEPTIBILITY OF COTTON TO EARLY SEASON THRIPS

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Introduction

Thrips are predictable, consistent and economic pests of seedling cotton in Georgia. Preventive insecticides such as Temik or neonicotinoid seed treatments are used at planting by most growers to manage thrips. However, supplemental foliar insecticides are also needed in some environments to mitigate economic losses. Foliar treatments are recommended when 2-3 thrips per plant are counted and immatures are present; the presence of numerous immatures suggests the preventive insecticide used at planting is no longer active. Foliar treatments are rarely necessary after plants reach the 4 true leaf stage and are growing vigorously.

Early season foliar insecticide applications applied for thrips are broad spectrum and disruptive of natural controls such as predatory and parasitic insects. The reduction of beneficial insects increases the risk of secondary pest outbreaks such as spider mites and aphids and thus intervention with foliar insecticides for thrips should only be made when absolutely necessary. The objective of this project was to better define the susceptibility of cotton seedlings at various growth stages to thrips injury.

Materials and Methods

Field trials were established at the Coastal Plain Experiment Station in Tift County Georgia during 2009 and the Sunbelt Agricultural EXPO in Colquitt County Georgia during 2010 to evaluate the susceptibility of cotton seedling growth stages to thrips infestations and injury. Plots were four rows wide and 40 feet in length with four replications arranged in a randomized complete block. Trials were grown in a conventional tillage irrigated environment and were established on April 30 (DP 0935 B2RF) in 2009 and May 12 (DP 0949 B2RF) in 2010. Treatments included progressive and regressive foliar treatment regimes, Temik applied in-furrow at planting, Temik plus foliar insecticides, and an untreated check. Foliar treatments were applied to seedlings which were not treated with a preventive at plant insecticide and included applications of acephate at 0.2 lb. ai/acre at 0 days after emergence (DAE), 0 and 7 DAE, 0, 7, and 14 DAE, 0, 7, 14, and 21 DAE, 0, 7, 14, 21, and 28 DAE, 7, 14, 21, and 28 DAE, 14, 21, and 28 DAE, 21, and 28 DAE, and 28 DAE. Acephate was also applied to the Temik plus foliar insecticide treatment at 0, 7, 14, 21, and 28 DAE. Plots were sampled weekly for thrips beginning at emergence for five weeks and two days after each foliar acephate spray by collecting five random plants per plot which were immediately immersed and swirled in a container filled with 70% ETOH to dislodge and preserve thrips specimens. Thrips samples were returned to the laboratory and immature and adult thrips were enumerated. Subjective thrips injury ratings were also assigned to individual plots on a scale of 1-5 where 1=no damage, 3=moderate (acceptable damage), and 5=severe damage. Individual plant (above ground plant parts) dry weights were quantified 35 days after emergence by cutting five random plants per plot at the soil surface, bagging, and drying plants for 48 hours at 60C in a forced air oven. The center two rows were spindle picked and a 38 percent lint fraction was assumed when calculating lint yields. Data were subjected to analysis of variance and means were separated using LSD, p=0.05

Results and Discussion

Thrips populations were moderate to high during both years. Adult infestations peaked at 2-3 days after emergence (DAE) in untreated plots and immature infestations peaked one week later at 15 and 20 per plant in 2009 and 2010 respectively (Figure 1). Plant growth was more vigorous during 2010 compared 2009, due in part to increased accumulation of heat units or DD 60s (Table 1). Seedlings reached the 4 leaf stage approximately five days earlier in 2010 compared with 2009. At 35 DAE, 721 DD 60s had accumulated during 2010 compared with only 528 during 2009. Vigorous growing seedlings shorten the susceptibility window and may allow seedlings to better tolerate thrips infestations.

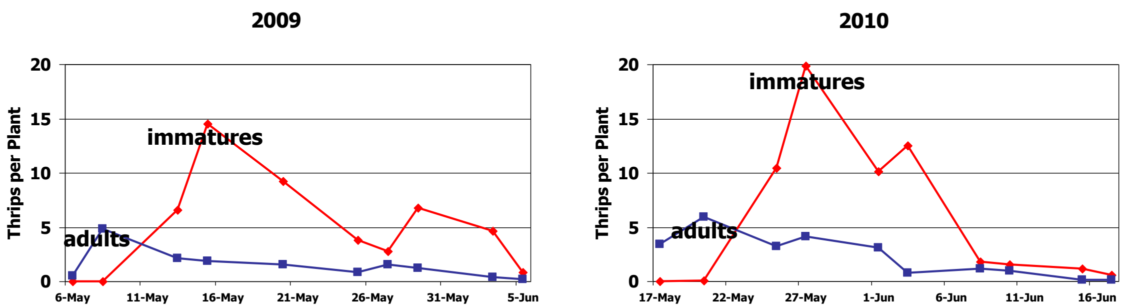

Figure 1. Adult and immature thrips population dynamics in untreated plots, Coastal Plain Experiment Station in 2009 and Sunbelt Agricultural EXPO in 2010.

Table 1. Cumulative heat unit accumulation after emergence at the Coastal Plain Experiment Station during 2009 and the Sunbelt Agricultural EXPO during 2010.

	CPES 2009		EXPO 2010	
Days After Emergence	Cumulative DD 60s	True Leaves	Cumulative DD 60s	True Leaves
7	115	1	145	1
14	188	2	262	3.5
21	285	4	399	5.5
28	411	6.5	560	8.5
35	528	9	721	11.5

Planting Date: April 30, 2009 and May 12, 2010
Emergence Date: May 6, 2009 and May 17, 2010

All treatments except foliar Orthene sprays initiated at 14, 21, and 28 DAE significantly reduced thrips damage at 35 DAE compared with the untreated during 2009 (Table 2). However, only treatments including Temik and foliar spray regimes which included applications at 0 and 7 DAE had damage ratings less than or equal to three which is defined as acceptable control. There was no significant reduction in thrips damage when additional foliar sprays were applied after the 0 and 7 DAE applications. In general, Temik treatments had significantly lower thrips damage ratings compared with foliar spray regimes. Temik treatments and foliar spray regimes initiated at 0 or 7 DAE significantly increased plant dry weights at 35 DAE compared with the untreated during 2009. There was no significant increase in plant dry weights when additional foliar sprays were applied after 0, 7, and 14 DAE applications. Delaying the initial foliar spray from 0 DAE to 7 DAE significantly reduced plant dry weight. A significant reduction in plant dry weight was also observed when the initial spray was delayed to 14 DAE when compared with the 7 DAE foliar spray regime. Temik treatments and the most aggressive foliar spray treatment significantly increased yield compared with the untreated. An outbreak of spider mites occurred in the trial area and required multiple treatments to preserve the integrity of the trial.

Table 2. Thrips damage ratings and plant dry weights at 35 DAE and yield, Coastal Plain Experiment Station, 2009.

2009 Treatment	Thrips Damage Rating (1-5)	Plant Dry Weight (g)	Yield (lbs. lint/acre)
Untreated	4.25 a	8.36 f	1498 bc
28 DAE Orthene	4.38 a	10.88 ef	1476 abc
21+28 DAE Orthene	4.00 a	9.29 ef	1579 c
14+21+28 DAE Orthene	4.00 a	8.62 f	1473 c
7+14+21+28 DAE Orthene	3.13 b	15.02 de	1476 abc
0 DAE Orthene	3.13 b	22.11 bc	1613 c
0+7 DAE Orthene	2.75 bc	16.92 cd	1649 abc
0+7+14 DAE Orthene	2.88 bc	19.00 bcd	1635 abc
0+7+14+21 DAE Orthene	2.50 cd	23.29 ab	1688 abc
0+7+14+21+28 DAE Orthene	2.75 bc	16.88 cd	1639 ab
Temik	2.13 d	24.50 ab	1753 a
Temik+Orthene	1.50 e	29.21 a	1755 a

Means followed by the same letter in a column do not significantly differ (P=0.05, LSD)

All treatments except foliar sprays initiated at 21 DAE significantly reduced thrips damage ratings at 35 DAE compared with the untreated during 2010 (Table 3). However only foliar spray regimes initiated at 0 and 7 DAE had damage ratings less than or equal to three which is defined as acceptable control. There was not a significant reduction in thrips damage when additional foliar applications were made after 0 DAE. Although thrips populations were generally higher in 2010 compared with

2009, damage ratings tended to be lower and this is likely attributable to the rapid seedling growth observed during 2010 (see Table 1). Thrips damage ratings were generally lower in 2010 compared to 2009. Foliar spray regimes initiated at 0 and 7 DAE and Temik treatments significantly increased plant dry weights compared with the untreated. No significant differences in yield were observed during 2010. We experienced problems applying Temik during 2010 in that only a portion of individual Temik plots actually received Temik. Damage ratings and plant dry weights were collected from treated areas of Temik plots.

Table 3. Thrips damage ratings and plant dry weights at 35 DAE and yield, Coastal Plain Experiment Station, 2010.

2010 Treatment	Thrips Damage Rating (1-5)	Plant Dry Weight (g)	Yield (lbs. lint/acre)
Untreated	4.33 a	13.50 f	1203 a
28 DAE Orthene	3.50 bc	24.68 ef	1328 a
21+28 DAE Orthene	4.00 ab	17.45 ef	1343 a
14+21+28 DAE Orthene	3.17 cd	22.22 ef	1400 a
7+14+21+28 DAE Orthene	2.50 de	27.81 de	1595 a
0 DAE Orthene	2.33 e	39.91 cd	1188 a
0+7 DAE Orthene	1.83 ef	49.81 bc	1470 a
0+7+14 DAE Orthene	2.00 ef	56.10 b	1607 a
0+7+14+21 DAE Orthene	2.00 ef	41.55 c	1425 a
0+7+14+21+28 DAE Orthene	2.00 ef	43.95 bc	1591 a
Temik[1]	2.00 ef	55.80 b	1403 a
Temik+Orthene[1]	1.50 f	70.37 a	1550 a

Means followed by the same letter in a column do not significantly differ (P=0.05, LSD)

[1]Application problems occurred in Temik treatments and some areas of the plots were not treated. Thrips damage ratings and plant height and dry weight data were collected from treated areas of plots whereas yield was taken from the entire plot and included cotton which was not treated with Temik.

In summary, thrips populations and field environments are unique and vary by location. Such variability demands proper pest and damage monitoring. Preventive insecticides used at planting provide a consistent benefit. However, foliar sprays may be needed to supplement control in some environments. These data demonstrate that protection from early season thrips during early stages of seedling development (the first 14 days) is critically important.

IMPORTANCE OF NATURAL ENEMIES FOR STINK BUG CONTROL

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Introduction

A complex of stink bug species has become a very serious problem in Georgia cotton production. The problem is exacerbated by the widespread distribution of stink bugs across the landscape, the numerous host plants available to them for feeding and reproduction, the sporadic and unpredictable occurrence of their populations, and the difficulties associated with finding them in cotton and characterizing their damage. The dominant stink bug species in Georgia are the Southern green stink bug, *Nezara viridula*, the Green stink bug, *Acrosternum hilare*, and the brown stink bug, *Euschistus servus*, with the Southern green stink bug generally dominating by a significant margin (but see below). In addition to these species, several other species have become increasingly abundant including the red banded stink bug, *Piezodorus guildinii*, and *Euschistus quadrator*, both of which seem to be more abundant in the southernmost portions of the state (pers. observ.).

Various natural enemies have been reported attacking stink bugs in various regions of the world (e.g., Yeargan 1979, Jones 1988, Ehler 2002), but the natural enemy complex in the southeastern United States has been poorly defined. This project was initiated in 2007 to characterize the suite of stink bug natural enemies present in Georgia and to determine their efficacy. We found that the parasitoid complex attacking stink bugs was primarily active against adult stink bugs, and had little impact on immatures. However, we obtained a few specimens of an exotic braconid wasp (*Aridelus rufotestaceus*) from nymphs of the southern green stink bug and an adult brown stink bug, *Euschistus servus*, in 2007 and 2008. These studies were continued in 2010 to obtain further information on the role and diversity of stink bug natural enemies.

Materials and Methods

<u>Stink Bug Nymphal Mortality</u>. A colony of Southern green stink bugs was established in the laboratory in Fall of 2009 and to a limited degree in Spring of 2010 that were to be used for placing eggs and nymphs in the field to evaluate mortality by predation, loss, and parasitism. The colony was maintained at 24 $\pm$ 1°C (L:D 14:10) with snap beans and shelled sunflower seeds as food sources, and water-saturated cotton for moisture. Forty whole-plant cages for the nymphal survival studies (20 total exclusion and 20 partial exclusion) were prepared using 50-gallon plastic garbage cans, with large openings cut in the garbage can frames. All openings on the total exclusion cages were

covered with fine mesh to exclude natural enemies. Half of the openings on the partial exclusion cages were covered with fine mesh. The partial exclusion cages were to serve as cage controls that allowed natural enemies to enter, while exposing the stink bugs to a cage environment. One acre of cotton (DP 143B2RF) each was planted in Attapulgus (Decatur County), Tifton (Tift County), and Plains (Sumter County) in May in preparation for the whole-plant cage studies of nymphal survival in cotton. Cotton plots were maintained using standard methods, but without use of insecticides.

The colony growth was much slower than expected due to low numbers of unparasitized bugs in the spring and throughout the summer. As a result, only a single set of stink bug nymphs was placed in the field – in Attapulgus, from 20-26 July. The cotton was squaring, with 11-12 nodes. Twelve plants were designated for the study, and adjacent plants were removed to discourage nymphs from moving from the target plant. Thirty 2nd-instar nymphs were placed on each plant on 20 July. Four plants were covered by total exclusion cages, four other plants were covered with partial exclusion cages, and the remaining four were left uncaged. Numbers of nymphs remaining on plants were counted on 26 July.

Parasitoid Surveys. Stink bugs of all life stages were surveyed weekly in corn, cotton, peanuts, and soybeans in selected fields in Coffee, Colquitt, Irwin, and Mitchell Counties. Beginning on 21 June with corn and peanuts, and adding cotton and soybeans on 6 July, and ending all sampling on 12 October, 12 commercial fields (three each of corn, cotton, peanuts, and soybeans) were sampled in each of two counties each week. Locations were alternated so that one week we sampled in Colquitt and Mitchell Counties, and the next in Coffee and Irwin. Twenty-four fields (6 of each crop) were sampled each week for stink bugs. Sampling was conducted along two transects in each field, each extending 120 meters into the field perpendicular to a tree line. Fifteen sample points were designated along each transect, with 10 samples in the first 60 meters (spaced at 6-meter intervals) and the remaining 5 points placed at 12–meter intervals. Sampling in corn consisted of visual examinations on each side of a 2-meter section of row at each sampling point. Samples in soybeans and cotton consisted of shake-cloth samples of 1.5-meter row sections at each point. Peanut was sampled with a Vortis suction sampler, sampling 2 meters of row at each sample location. Different rows were sampled at each sample date to reduce significant prolonged population disturbance. All stink bugs observed in samples were identified to species and stage, and returned to the laboratory where they were held with snap beans and shelled sunflower seeds to monitor for parasitism. All bugs from which no parasitoids had emerged were dissected upon death to assess the presence of mature parasitoid larvae (small larvae are much more difficult to detect).

Biology of the Parasitoid *Aridelus rufotestaceus*. Individual newly emerged female *A. rufotestaceus* were provided thirty 3rd-instar nymphs of the Southern green stink bug each day from the day of emergence until death. Nymphs were removed daily and placed individually in cups with pieces of bean pods and sunflower seeds for food. Fresh beans and seeds were provided every other day. Wasps and bugs were held at

25 ± 1°C, L:D 14:10, and were checked daily. Nymphs were checked for molting and for parasitoid emergence. Bugs that died prematurely were dissected and examined for the presence of parasitoid larvae to assess parasitism. Female parasitoids were checked daily for mortality. Offspring sex ratio was also evaluated.

A cohort of 60 Southern green stink bug nymphs for each of three instars (2, 3, and 4) was stung by female *A. rufotestaceus* and the stung nymphs were placed at 15 ± 1°C, L:D 14:10 to assess parasitoid development and survival at this temperature. Nymphs were placed individually in cups with pieces of bean pods and sunflower seeds for food. Fresh beans and seeds were provided every other day. Nymphs were checked for molting and for parasitoid emergence. Bugs that died were dissected and examined for presence of parasitoid larvae to assess parasitism.

Results and Discussion

Stink Bug Nymphal Mortality. No nymphs were recovered from the field study in any of the treatments 6 days after placement on plants. The cause of the complete loss of nymphs is unclear. Fire ants were found on 9 of the 12 plants, and may have been a major factor in the loss of nymphs. Other predators also were observed on inoculated plants (3 *Theridion* spiders, 2 *Cheiracanthium* spiders, 2 salticid spiders, 1 *Orius* nymph, and 1 *Geocoris punctipes* adult), but they were not as abundant as the ants. Temperature also may have played a significant role in stink bug mortality. The average daily high (in the plant canopy, measured with WatchDog® monitor) during the study was 99.8°F, and the canopy of the crop was still open, so heat may have been a problem for the nymphs. Because of limited stink bug numbers noted above, we were unable to run additional tests at this or the other locations, which might have better elucidated the results of this one trial.

Parasitoid Surveys. Seven stink bug species were collected, of which three were collected in sufficient numbers to yield meaningful numbers (Table 1). Southern green stink bug numbers were exceptionally low throughout the season, following high rates of parasitism on individuals of this species on spring weeds (personal observation).

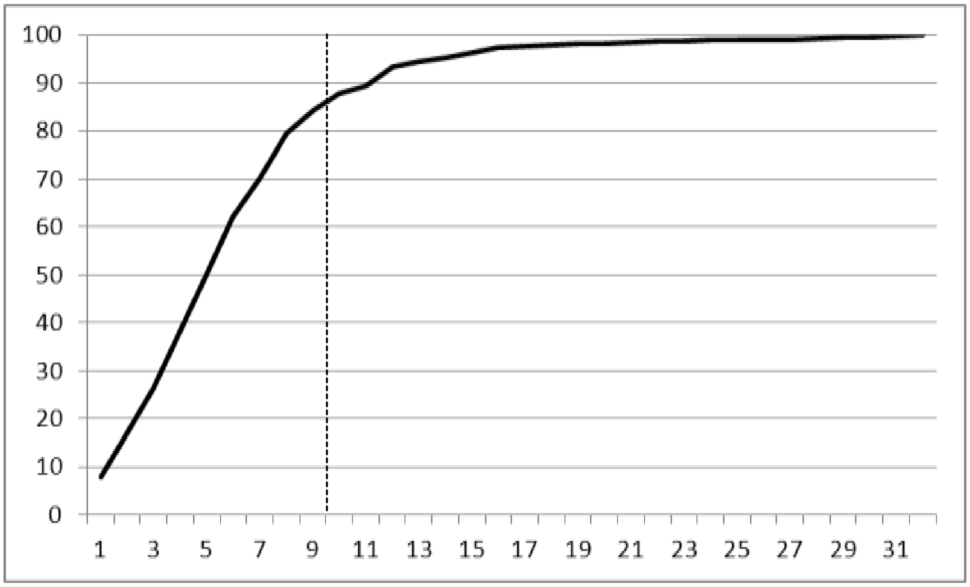
The factors that led to the low populations are unknown, but the result was that Brown stink bugs predominated in all of the crop landscapes. A total of 1,757 bugs of all life stages were collected, of which only 31 were parasitized. As is typical of stink bug parasitism by tachinid flies, all parasitism was concentrated in the 5th instar and adult stages. The dominant parasitoid species of the Brown stink bug, *E. servus*, was *Cylindromyia binotata*, followed by *Euthera tentatrix*, and a single specimen of an unidentified tachinid fly species (believed to be a *Gymnosoma* sp.). All parasitism of the Southern green (*N. viridula*) and Green (*A. hilare*) stink bugs was by the tachinid *Trichopoda pennipes* and overall parasitism rates were low (1.2% for Green stink bugs and 5.8% for Southern green stink bugs). The parasitism rates observed for *E. servus* in this study (1.7% out of 1147, or 2.5% of the 753 5th-instar nymphs and adults) were low and similar to rates observed in other studies for this species. For reasons not entirely clear, this stink bug species suffers little parasitism beyond the egg stage. Therefore, parasitoids of nymphs and adults probably have little impact on *E. servus* populations. Egg parasitoids and predators may, however, significantly impact populations of the brown stink bug. More work is needed to examine this possibility, particularly if brown stink bugs continue to be dominant pests.

Table 1. The most common bug species collected (by life stages) in each crop, and number parasitized (2010). Numbers are seasonal totals. All parasitoids were tachinid flies. Bugs were collected in Coffee, Colquitt, Irwin and Mitchell Counties.

	Nymphal Instars					
Crop	2	3	4	5	Adult	No. Parasitized (life stage)
Brown stink bugs, *Euschistus servus*						
Corn	19	12	19	19	75	2 (Ad)
Cotton	20	11	6	11	88	6 (Ad)
Peanuts	15	35	24	18	200	4 (Ad)
Soybeans	67	83	83	136	206	1 (N5), 6 (Ad)
Total	121	141	132	184	569	19
Southern green stink bugs, *Nezara viridula*						
Corn	0	8	8	3	7	3 (Ad)
Cotton	3	11	4	2	3	1 (N5), 1 (Ad)
Peanuts	13	11	0	3	2	0
Soybeans	1	8	5	3	9	1 (Ad)
Total	17	38	17	11	21	6
Green stink bugs, *Acrosternum hilare*						
Corn	0	1	0	0	0	0
Cotton	32	12	8	12	24	1 (Ad)
Peanuts	0	1	1	0	2	0
Soybeans	108	87	48	89	81	2 (N5), 3 (Ad)
Total	140	101	57	101	107	6

<u>Biology of the Parasitoid *Aridelus rufotestaceus*</u>. The average longevity of female *A. rufotestaceus* was 23.3 $\pm$ 14.45 days (at 25°C), and average fecundity was 141.7 $\pm$ 57.06. Interestingly, almost 90% of offspring were produced in the first 10 days after female adult emergence (Fiure 1). Therefore, females continue to live for almost two weeks after they have produced the majority of their offspring. Sex ratio of offspring was 98.4% female, characteristic of thelytokous parasitoids and corresponding with the preponderance of females observed in field collections and rearing. The few males that have been observed appear to be non-functional. They make no effort to mate with females, nor is mating necessary for females to produce viable offspring. Most of the sons were produced after the adult females had produced most of their offspring, suggesting that some factor changes later in life, affecting the sex ratio. Sex ratios of thelytokous wasp species are often regulated by bacterial symbionts (Stouthamer et al.,

1999), and it is possible that as the female wasp ages that the bacterial symbiont level declines, allowing more sons to be produced (Van Meer 1999).



Female adult age(days)

Figure 1. Cumulative percent progeny production (y axis) of female *Aridelus rufotestaceus* in relation to female adult age (25 + 1C). Vertical dashed line indicates 10 days after adult

No parasitoids emerged at 15°C from any of the nymphal instars. Rather, all stink bug nymphs died within 24 days of being placed in the chamber. The Southern green stink bug appears to be limited in its geographic range by poor tolerance to low temperatures, and it appears that constant 15°C is too low to support survival of the bugs in immature stages. Although many of the stink bugs were successfully parasitized at 15°C (based on dissections of dead bugs), the inability of the hosts to survive at this temperature likely also limits the development and survival of the parasitoid. The prolonged development times of this wasp in a more suitable temperature range for the stink bugs (outlined in previous studies) of ca. 62 days at 20°C, 40 days at 25°C, and 35 days at 30°C limit the population growth rate of the parasitoid on the one hand, but also synchronize the wasp's development very well with the development of the southern green stink bug so that the host is in the proper stages when adult parasitoids emerge. Further, the parasitoid nearly always kills the host before the host can reach the adult stage and reproduce, unlike the adult parasitoids that have been the focus of many biological control studies targeting stink bugs. Therefore, the wasp may make valuable contributions to reducing stink bug populations if the wasp populations are sufficiently abundant and widespread. The question that is unclear is how abundant these parasitoids are in Georgia. Surveys have suggested that they are relatively rare, but many stink bug nymphs die after field collections, and some or many of the nymphs that die may be parasitized.

The importance of natural enemies in managing stinkbug populations is still unclear, although there are hints they may be very important. For example, the complete disappearance of the stink bug nymphs in cotton six days after inoculation suggests that there are factors that are limiting growth of stink bug populations at least in pre-squaring cotton. Similarly, Southern green stink bugs were common in the spring of 2010, but their populations diminished significantly by mid-summer. These dramatic population shifts may be due to enemies or weather, a combination of both, or other yet unclear factors. However, if these same factors are at work in other crops and non-cultivated hosts, they may exert considerable influence on stink bug populations and their manipulation may hold promise for managing these pests.

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APPLICATION OF BORDER SPRAYS TO MITIGATE STINK BUGS IN COTTON

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Introduction

Southeastern cotton producers have effectively transitioned from an insecticide intensive management system to a low spray (non-disruptive) system. This dramatic change was made possible by key developments including: boll weevil eradication, changing cultural land management practices, transgenic cotton cultivars, and selective insecticide chemistries. For example, Georgia growers averaged 14.3 insecticide applications per cotton field in 1986. Currently, the boll weevil has been eradicated from this region and the bollworm/budworm complex is generally managed below economic injury levels using transgenic *Bacillus thuringiensis* (*Bt*) cotton cultivars. Selective insecticides are used judiciously to mitigate pest outbreaks without disrupting natural enemies or flaring secondary pests. As a result of these changes, southeastern region cotton producing states averaged 2.0 and 2.3 insecticide sprays per year during 2006 and 2007, respectively. However, the substantial decline in insecticide usage has left an ecological niche for stink bugs in southeastern cotton production. The stink bug complex has become a serious production challenge that could compromise the delicate balance between not spraying and depending on natural control to regulate the remaining pests. Particularly troublesome in this trend is the fact that populations of brown stink bugs are tolerant of pyrethroid insecticides. Growers must use more disruptive organophosphate insecticides like dicrotophos, methyl parathion, and acephate to control these pests. Alternative approaches to stink bug management are needed to prevent widespread secondary pest outbreaks.

We previously conducted research on the process of stink bug invasion in a cotton field. Results showed that stink bug captures spiked sharply with the onset of bloom. In addition, we noted that populations were strongly clumped and tended to be more common on the edges of fields. We also noted that adults were captured at the periphery of the fields a week before we observed populations in the center of the field. Last year, we initiated a study to try to decrease stink bug population density and observed boll damage by spraying the borders of cotton fields starting as soon as stink bugs were observed. Unfortunately, data show that strategy did not work. We hypothesized that we waited too long before spraying and this prevented us from actually stopping the bugs before they dispersed into the field. This year we planned to automatically make border applications during the first and second weeks of bloom in hopes of targeting stink bugs as they moved in the fields. This strategy could be considered risky because there is the potential for applying insecticides in the absence of stink bugs. However, if this strategy would prevent the need for one or more field wide insecticide applications, there would be tangible benefits to growers including preservation of natural enemies, reduced incidence of secondary pest outbreaks, and significant savings in insecticide and application costs. The objective of this study was to evaluate in-field border sprays to mitigate whole field stink bug infestations in commercial cotton.

Materials and Methods

Three commercial cotton fields in Georgia were selected for inclusion in the border spray trial in 2010. Two of these fields were assigned border spray applications as soon as the fields reached first bloom and the third field was left untreated during the entire study. Fields were spatially mapped using GIS mapping software and then overlaid with a grid of sampling points at approximately 1-acre intervals. Additional sampling points around the perimeter of the entire field were used to get complete coverage of fields (Table 1). Each sampling point was marked using an 8-foot tall flag on a fiberglass pole. Starting at first bloom, weekly sampling at each sampling point included 20 sweeps with a 15-inch sweep net collection of 10 soft quarter-sized bolls. Sampling was conducted on opposite sides of the flag each consecutive week to prevent sampling the exact same plants or removing too many bolls from the any one plant. Bolls were pooled by sampling location in each field and placed in labeled plastic bags. At the laboratory, each boll was internally examined for evidence of stink bug feeding such as internal warts or stained lint.

Table 1. Acreage and border crops of cotton fields selected for study

Location	Treatment	Acres	Number of Sample Locations	Field Perimeter (feet)	Adjacent crops
Nashville	Border spray	61	77	7075	Peanut
Rebecca	Border spray	55	64	6587	Peanut, woods
Tifton	Untreated	17	24	3516	Peanut

Figure 1. Mist blower being pulled around the perimeter of a cotton field.

In the border sprayed fields, the outer perimeter of the field was treated using a trailer mounted mist or blast sprayer pulled behind a pickup (Figure 1). The blower delivered the pesticide about 20 rows into the interior of each field and was calibrated to deliver a tank mix of dicrotophos (Bidrin 8) at 4 oz per acre + beta-cyfluthrin (Baythroid XL) at 2 oz per acre. One week after the first application, we planned to make a second automatic application. Each sampling point was classified as being on the edge of the field or in the center, defined as flags that were generally about 200 feet from a field border.

Data analyses were conducted at the end of the year. By week, the mean percent boll damage was calculated for edge sampling locations, center sampling locations, and a field wide average. Second, the mean number of stink bug captures (all species combined) was calculated for the same sampling locations. Finally, the mean percent boll damage at each sampling location was plotted using spatial maps to visualize damage.

Results and Discussion

There were a total of 8770 bolls collected 142 adult stink bugs captured during the study. The majority (75%) of the captured stink bugs were *Euschistus* spp., primarily the brown stink bug. Green stink bugs comprised 18% of the captures and finally southern green stink bug comprised 7% of the captures. The total amount of insecticide sprayed per treatment was approximately 10% of the active ingredient that would have been sprayed in a whole field application. Border applications required 21 to 23 minutes each.

Sampling commenced during the first week of bloom as determined by white flowers on at least one-half of the plants across the entire field. Treated fields were sampled and then immediately sprayed so that we had data from the same day the spray was made. While the field at Nashville received planned applications on July 19 and July 26, the field at Rebecca received a scheduled treatment on July 15, and then delayed application on July 24, due to heavy rains during the previous week. Environmental stress including extreme heat and drought precluded production of sufficient quarter sized bolls during the sixth week of bloom at Rebecca.

Extension based thresholds for application of foliar insecticides for stink bugs were reached on each field. Those thresholds are 20, 15, 15, 15, 20, and 30% for the 2nd, 3rd, 4th, 5th, 6th, and 7th weeks of bloom, respectively. The untreated field exceeded the treatment threshold during four of the six possible weeks (Table 2). Moreover, during those four weeks, the average percent damage above the threshold was greater than 16%. Conversely, the border sprayed field at Rebecca only exceeded threshold by less than 2% during the 7th week of bloom. The border sprayed field at Nashville exceeded the threshold during the final two weeks of bloom only, and by an average of 4 percent weekly. There were nearly twice as many stink bugs captured per sample in the untreated field compared to the border treated fields (Table 3). For example, the average number of stink bugs per sample across the entire year at Rebecca was 0.08 stink bugs per sample, 0.17 stink bugs per sample at Nashville, and 0.30 stink bugs per sample at Tifton.

Table 2. Mean percent boll damage observed by treatment strategy, week of bloom, and field location. Whole field means followed by an asterisk (*) indicate that the field exceeded the Extension recommended threshold for triggering an insecticide application

Week of Bloom	Rebecca (Border Treated)			Nashville (Border Treated)			Tifton (Untreated)		
	Edge	Center	Whole Field	Edge	Center	Whole Field	Edge	Center	Whole Field
2	6.9	10.6	9.03	3.6	4.2	3.4	15.4	13.8	14.8
3	13.3	15.8	14.8	12.7	11.9	12.2	30.62	20.0	27.1*
4	15.5	13.5	14.4	12.5	16.3	14.9	16.87	17.5	17.1*
5	14.3	11.1	12.5	37.7	13.2	22.7*	22.5	2.0	14.6
6	-	-	-	31.2	15.0	20.7*	59.4	38.8	53.1*
7	37.6	27.6	31.9*	-	-	-	49.7	26.3	41.9*

Table 3. Mean number of adult stink bugs (all species) per 20 sweeps by treatment strategy, week of bloom, and field location

Week of Bloom	Rebecca (Border Treated)			Nashville (Border Treated)			Tifton (Untreated)		
	Edge	Center	Whole Field	Edge	Center	Whole Field	Edge	Center	Whole Field
2	0.04	0.03	0.03	0.00	0.04	0.03	0.00	0.38	0.13
3	0.07	0.08	0.08	0.00	0.00	0.00	0.44	0.13	0.33
4	0.12	0.11	0.11	0.30	0.04	0.14	0.19	0.13	0.17
5	0.04	0.03	0.03	0.80	0.00	0.33	0.56	0.13	0.41
6	-	-	-	0.87	0.06	0.37	0.44	0.13	0.34
7	0.31	0.05	0.16	-	-	-	0.62	0.00	0.41

Spatial mapping of each field by week was conducted to show how boll damage changed in a spatial context. At Nashville, the most significant damage occurred on the northern edge of the field, which bordered a similar sized peanut field (Figure 3). The two border sprays appeared to keep the infestations at relatively low levels until the 5th week of bloom when extremely heavy stink bug damage was detected on the border with the peanut field. Regardless of week of bloom, the percent damage in the center of the field never exceeded 16.3%. At Rebecca, border sprays also appeared to do a good job suppressing early and midseason stink bug damage (Figure 4). The percent damage in the center of the field did not exceed threshold until the 7th week of bloom when most of the crop would have been made. The most serious damage at Rebecca was along the west and northwest sides of the field, which also bordered large peanut fields. Late season damage was apparent on the eastern edge of this field, which matured slightly slower than the rest of the field. Finally, the untreated field at Tifton had the heaviest stink bug infestations (Figure 5). This field was bordered by peanut on the north and east sides. Damage exceeded threshold in the center of the field nearly as often as on the edges.

Data collected in 2010 suggest that the border sprays provided measureable stink bug and damage suppression compared to the untreated field. Admittedly, the unsprayed field was considerably smaller than the two treated fields and there could be inherent differences in stink bug movement between the two field sizes, but the smaller field was necessitated because growers were unwilling to maintain a large unsprayed field. This study suggested that the two border applications may prevent the need for whole field application during weeks three through five of bloom, which are the most important weeks to “make the crop.” The Nashville field nearly made it through the first 6 wk of bloom without exceeding the threshold. In fact, the boll damage in the center of the treated field did not exceed 16.3 % in the first 6 wk of bloom, whereas the center of the unsprayed field nearly reached 40% damage in the same amount of time. Although stink bug population density and boll damage increased sharply in the 7th week of bloom, there is comparatively little cotton being produced at this time relative to weeks 3 though 5.

This study is currently incomplete because it requires more replications for statistical comparison between treatments. To address this situation we are continuing the study in 2011 and collaborating with researchers at Clemson University who followed the same protocol. In the future we will likely be comparing the number of whole field insecticide applications required for a border sprayed field managed field to a field simply managed without border sprays. Even savings of one whole field spray per year could be economically valuable from a cost savings perspective.

Acknowledgments

We appreciate excellent technical support from Kevin Frizzell John Herbert, Annie Horack, Ta-I Huang, and Ishakh Pulakkatu thodi. This study was supported by the Georgia Cotton Commission under agreement number *10-683GA.*

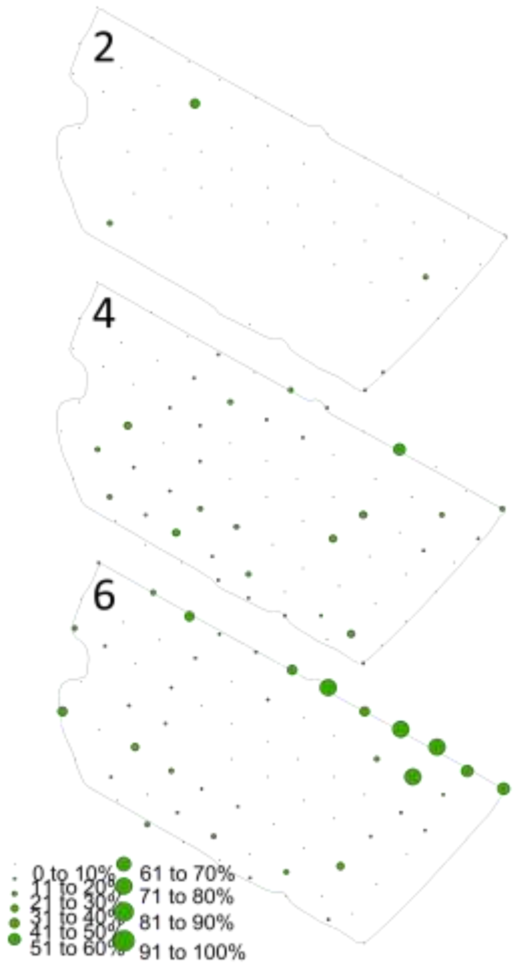

Figure 2. Percent damaged bolls during 5 weeks of bloom in a 61 acre border treated field located at Nashville, GA. Increasing circle diameter indicates increased boll damage.

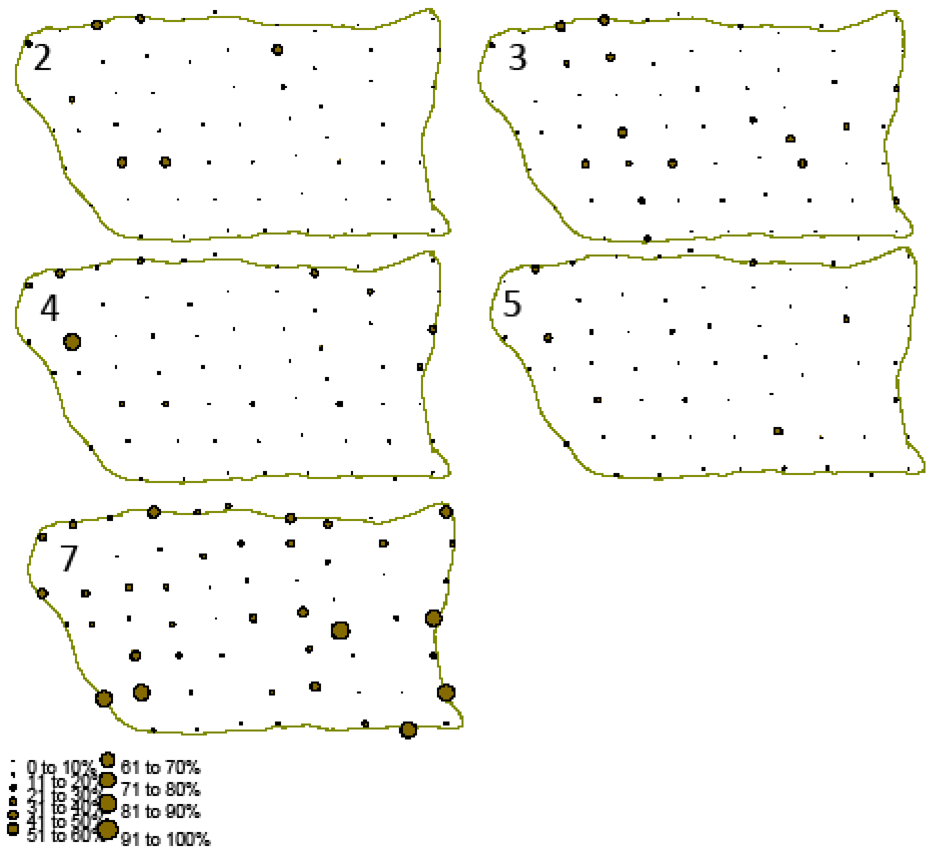

Figure 3. Percent damaged bolls during weeks 2 through 7 of bloom (no correctly sized bolls available during 6th week) in a 55 acre border treated field located at Rebecca, GA. Increasing circle diameter indicates increased boll damage.

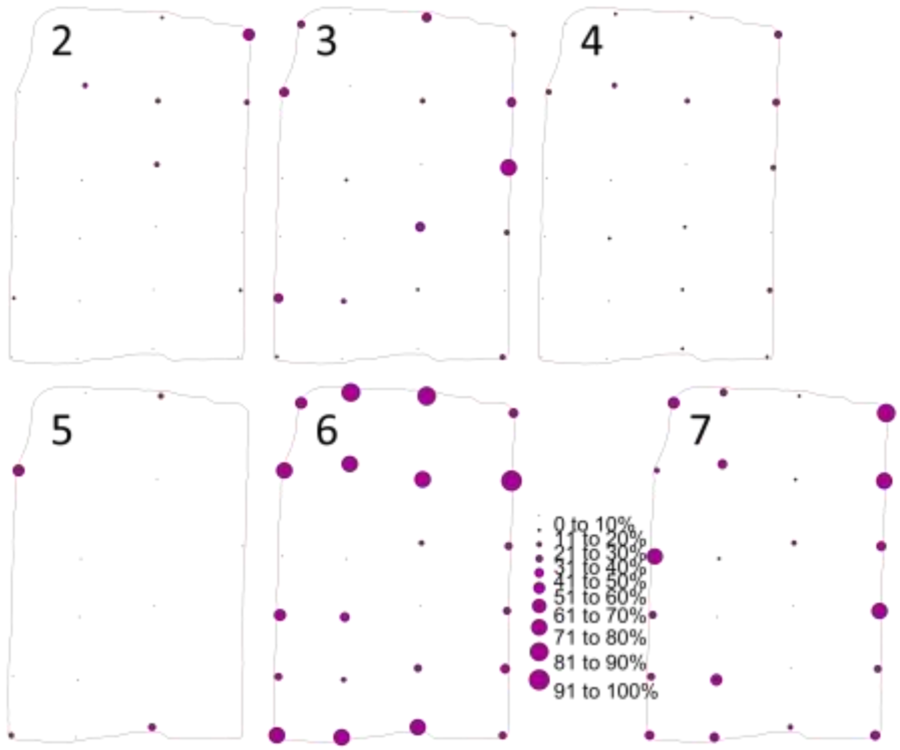

Figure 4. Percent damaged bolls during weeks 2 to 7 of bloom in a 17 acre untreated field located at Tifton, GA. Increasing circle diameter indicates increased boll damage.

EVALUATION OF COTTON FOR PREEMERGENCE INTERACTION BETWEEN HERBICIDES AND INSECTICIDES

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Introduction

Approximately 50% of southeastern cotton production is grown using conservation tillage practices. In order to control glyphosate tolerant and resistant weeds, tankmixtures of contact and residual herbicides are often applied. Specifically, saflufenacil (Sharpen) and flumioxazin (Valor) are PPO herbicides registered for this use. Saflufenacil can be PRE applied up to 42 day before cotton is planted providing contact and residual weed control. Fomesafen can be PRE applied from 14 to 30 days before planting, with planting restriction dependent on the planting technique. These plant back restrictions to cotton are on both herbicides labels due to potential PPO injury.

Aldicarb (Temik), a thiocarbamate, and phorate (Thimet), an organic phosphate (OP), are insecticides applied at cotton planting for control of thrips, aphids, and other insects. Aldicarb and phorate are most commonly applied in-furrow at planting. The water solubility of aldicarb and phorate are 4.9 and 0.05 g L-1, respectively. Both are absorbed by developing seedlings providing systemic insect control. Aldicarb moves via passive transport with water while phorate is taken up rapidly in developing root systems via contact and high lipid solubility. Pesticide interactions can be variable with respect to measures of plant growth and yield. For example, aldicarb and trifluralin plus diruron, had no interactive effect on stand, plant weight, or cotton yield while injury from trifluralin resulted in decreased uptake of phorate and terbufos by seedling cotton.

There is very little information about PPO herbicide and insecticide interaction with respect to cotton injury. Therefore, field studies were carried out in 2010 to evaluate cotton response to herbicide /insecticide interactions for cotton emergence, stand establishment, height, and yield in two different soil types in Georgia.

Materials and Methods

Experiments were conducted during 2010 at Plains and Tifton GA on a Faceville sandy loam and Tift loamy sand, respectively. Experimental design was 7 herbicide treatments by 3 insecticides arranged as a factorial in a RCB with 4 replications. Herbicides were saflufenacil at 20 g ha^{-1} (1X rate) and flumioxazin at 142 g ha^{-1} (2X rate to simulate injury) applied at 42, 28, and 14 days prior to planting (DBP) and included a nontreated control. Insecticides were aldicarb (1X rate) and phorate (1X rate) applied in furrow at planting and a nontreated control. The experimental area was irrigated after all herbicide treatments and planting. Data included stand counts, height measures, and yield (Tifton). Data were subjected to analysis of variance appropriate for the 3 (insecticide) by 7 (herbicide) factorial treatment arrangement. Analysis of variance procedures were conducted with means for significant main effects and interactions separated using Fisher's protected LSD method test at $P \leq 0.05$.

Results and Discussion

The 2-way interactions between insecticide and herbicide were not significant for stand at Tifton or Plains, and height and yield at Tifton. Therefore, data for the main effects of insecticide were combined and analyzed across herbicide treatments, and data for the main effects for herbicide were combined and analyzed across insecticide treatments. There was a height difference at Plains for the 2-way interaction. Cotton injury was evident for the 14 DBP flumioxazin and saflufenacil treatments as cotton emerged from soil in the form of stunting, leaf chlorosis, and stand loss. Flumioxazin injury was observable up to 30 days after planting and with final stand differences (Figure 1).

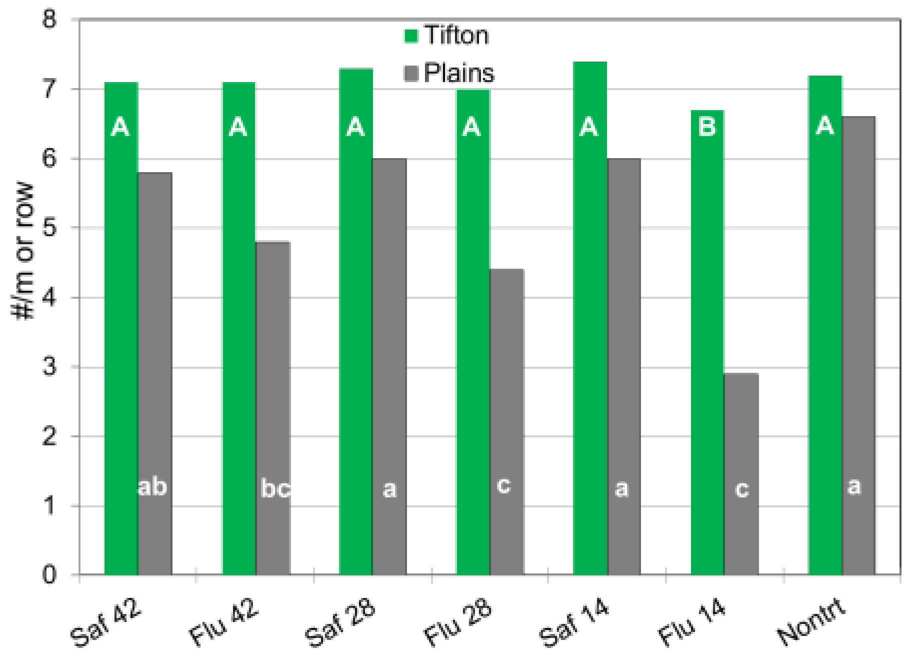

Figure 1. Final cotton stands as affected by herbicide treatment. Letters within location indicates significant differences at P<0.05. Abbreviations: saflufenacil, Saf; Flu, flumioxazin; 42, 28, 14 are days before planting.

Saflufenacil did not reduce stand at either location compared to the nontreated control. Cotton growth trends remained consistent up to 50 DAP among treatments when compared to timing of application (Figures 2 & 3).

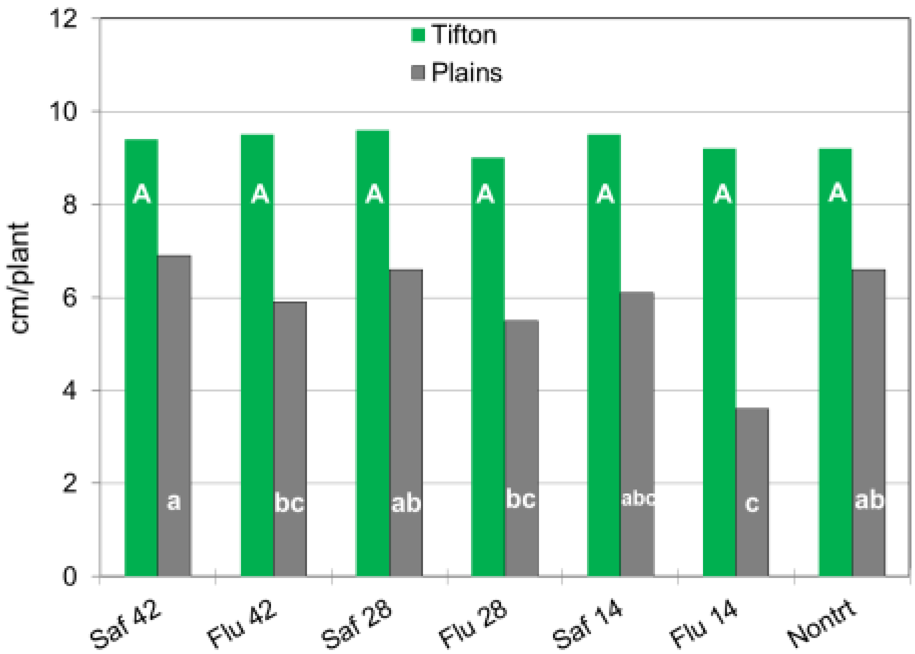

Figure 2. Cotton height as affected by herbicide treatment 14 days after planting. Letters within location indicates significant differences at P<0.05. Abbreviations: saflufenacil, Saf; Flu, flumioxazin; 42, 28, 14 are days before planting.

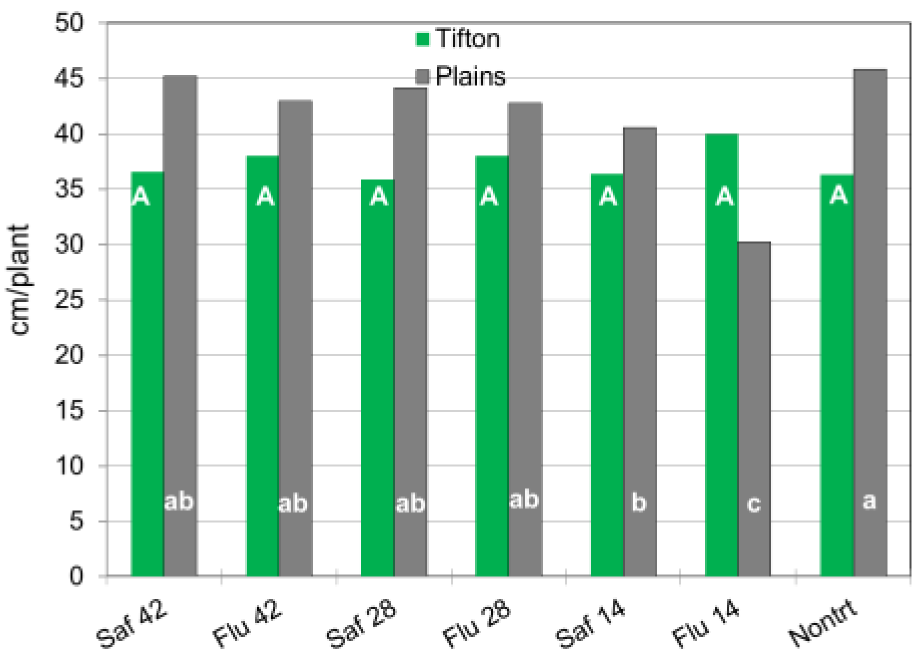

Figure 3. Cotton height as affected by herbicide treatment 50 and 30 days after planting at Plains and Tifton, GA respectively. Letters within location indicates significant differences at P<0.05. Abbreviations: saflufenacil, Saf; Flu, flumioxazin; 42, 28, 14 are days before planting.

By mid-season, there were no differences in height and no observable injury for saflufenacil applied at 42 and 28 DBP. Saflufenacil applied 42 and 28 DBP exhibited little to no injury at either location. Insecticides did not cause any cotton stand or height concerns (Figure 4).

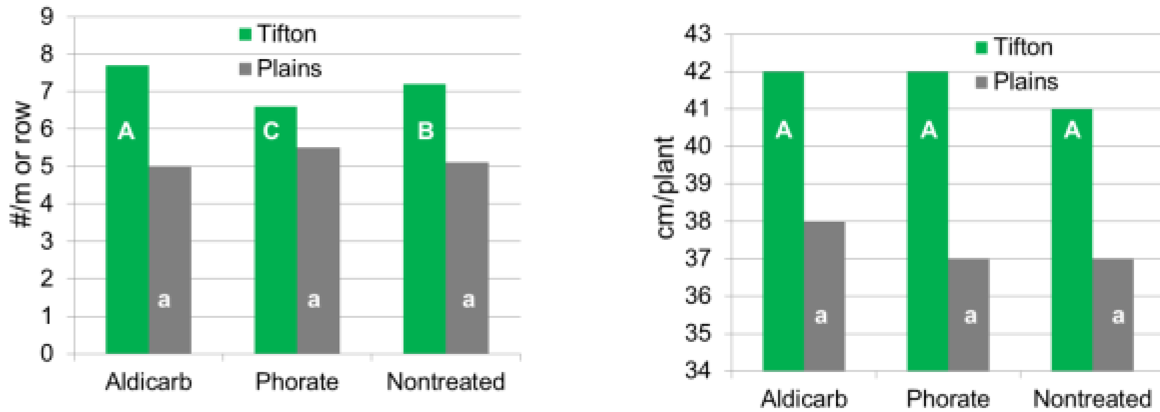

Figure 4. Cotton final stands and heights as affected by insecticide treatment. Letters within location indicates significant differences at P<0.05. Abbreviations: saflufenacil, Saf; Flu, flumioxazin; 42, 28, 14 are days before planting.

These data indicate that there were no insecticide by saflufenacil 42 DBP issues with stand, growth (height measures), or yield of cotton (Figure 5).

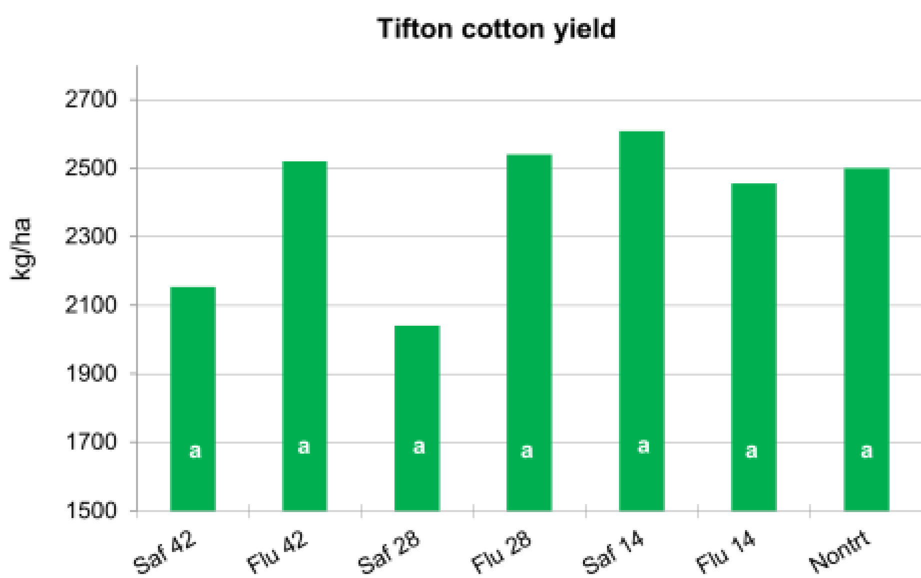

Figure 5. Cotton yield as affected by herbicide treatment. Letters within location indicates significant differences at P<0.05. Abbreviations: saflufenacil, Saf; Flu, flumioxazin; 42, 28, 14 are days before planting.

Saflufenacil applied 42 and 28 days before planting exhibited little to no cotton injury. Insecticides did not cause any cotton stand or height concerns. These data indicated that there were no insecticide by saflufenacil issues with stand, growth (height measures), or yield of cotton.

Acknowledgements

The authors wish to thank the University of Georgia and BASF Corp. for support of this research.

EARLY GROWTH OF COTTON AND PALMER AMARANTH IN RESPONSE TO INORGANIC FERTILIZERS AND BROILER LITTER

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Introduction

Inorganic fertilizer costs reached an all-time high in 2008. Uncertain and increasing prices are causing growers to consider alternate, but more economical, sources of nutrients. One such alternative is poultry (broiler) litter (manure mixed with bedding materials, which is readily available in the SE US. In GA in 2009, 12,008 poultry houses produced an average of 25,000 birds per house. Historically, most of the broiler litter used in the SE US has been applied to pastures and hay crops although an increasing number of producers in GA are using it in cotton production. This increased adoption of broiler litter has caused growers to question if and how chicken manure will affect the growth of both crops and weeds relative to traditional inorganic fertilizer sources. The objective of this study was to evaluate early season growth and development of cotton and Palmer amaranth in response to nutrient level (particularly N) and source.

Materials and Methods

The study was conducted in a greenhouse in 2009. The fertilizer treatments consisted of a control (no fertilizer), 10-10-10 Super Rainbow Plant Food (to provide a total of 120-120-80 lbs/A inorganic N-P-K), 5-10-15 Rainbow Plant Food (to provide a total of 60-120-120 lbs/A inorganic N-P-K), and broiler litter (to provide a total of 120-120-80 lbs/A organic N-P-K). N rates of 120 lbs/A are recommended in such instances where deep, sandy soils exist or when cotton follows cotton. Fertilizers were thoroughly incorporated into potting soil (composted wood products, reed sedge, peat, and perlite) using a steel cement mixer. Plastic pots (138 cubic inches) were filled with the soil-fertilizer mixes and were arranged randomly on the greenhouse benches. Pots were seeded with either cotton (Roundup Ready Flex and Widestrike) or Palmer amaranth (glyphosate-resistant [GR] and susceptible [GS]). Following emergence, all pots were thinned to one plant/pot. Pots were watered daily; no supplemental fertilizers were applied. The height in inches and the number of expanded leaves/plant were recorded at 14, 21 and 28 days after planting (DAP). Each nutrient treatment (none, 10-10-10, 5-10-15, broiler litter) by variety/biotype (Roundup Ready Flex cotton, Widestrike cotton, GR Palmer, GS Palmer) combination was replicated five times; the entire experiment was conducted twice. Plant height and leaf production data were statistically analyzed using SAS software; cotton and Palmer amaranth data were analyzed separately.

Cotton Results

Statistical analyses indicated that there were no differences between the Roundup Ready Flex and Widestrike varieties with respect to growth and leaf production; significant differences in early cotton development were observed among the fertilizer treatments (Figures 1 and 2). At 14 DAP, cotton plants grown in soil amended prior to planting with the 10-10-10 Super Rainbow formulation were an average of 4.92 inches in height, whereas cotton grown in the absence of fertilizer or using 5-10-15 Rainbow Plant Food and broiler litter as nutrient sources ranged from 3.2 to 3.4 inches in height (Figure 1). At 21 and 28 DAP, cotton grown using 10-10-10 fertilizer was 5.4 and 6.0 inches tall respectively; these heights were significantly greater than the heights (3.4 to 4.2 inches) obtained for the other treatments. There were no significant differences in height among cotton plants grown using 5-10-15 or broiler litter as a fertilizer source and cotton plants in the non-fertilized control. Leaf production at 21 and 28 DAP was significantly affected by fertilizer treatment (Figure 2). At 21 DAP, cotton grown using the 10-10-10 fertilizer source produced an average of 2.1 leaves/plant as compared to an average of 1.1 to 1.5 leaves/plant for the other treatments. At 28 DAP, cotton in the 10-10-10 treatment produced almost 3 leaves/plant as compared to an average of 1.6 to 1.7 leaves for the 5-10-15, broiler litter, and non-fertilized treatments.

Palmer Amaranth Results

Statistical analyses indicated that there were no differences between the GR and GS Palmer amaranth biotypes with respect to growth and leaf production; significant differences in early Palmer amaranth development were observed among the fertilizer treatments (Figures 3 and 4). For all observation periods, Palmer amaranths grown using the 10-10-10 Super Rainbow formulation were significantly taller (2.4 to 3.5 inches) than the plants grown using broiler litter (1.1 to 1.6 inches) or 5-10-15 Rainbow Plant Food (0.7 to 0.8 inches) as a nutrient source and the plants in the non-fertilized control (0.4 inches) (Figure 3). For all three evaluation periods, the plants produced using broiler litter as a nutrient source were significantly taller (175% to 310%) than those grown using the 5-10-15 fertilizer than those in the non-fertilized control. Leaf production at all observation periods was also significantly affected by fertilizer treatment (Figure 4). At 14 DAP, Palmer amaranths grown using the 10-10-10 and broiler litter as a fertilizer source produced an average of 1.9 and 2.2 leaves/plant, respectively as compared to the other treatments (0 to 0.9 leaves/plant). At 21 and 28 DAP, Palmer amaranths in the 10-10-10 treatment produced an average of 6.5 leaves/plant as compared to averages of 0.9 to 3.6 leaves/plant for the 5-10-15 and broiler litter treatments. At 21 and 28 DAP, Palmer amaranths grown using broiler litter as a nutrient source produced 211% and 260% more leaves/plant, respectively, than those in the 5-10-15 treatment.

Discussion

The local availability of broiler litter, coupled with the rising costs of inorganic fertilizers, has increased GA growers' interest in using chicken manure as a source of macro and micronutrients for row crop production. Before including manures into their cotton systems, growers will need to know if and how crop and weed growth will be affected. Palmer amaranth can grow rapidly (up to several inches per day), which means that the window of time available for postemergence chemical control can be quite short.

Enhanced growth of palmer amaranth when using broiler litter as fertilizer could significantly impact management options. Results from this study indicate that cotton grew taller and produced more leaves when 120 lbs/A N were applied preplant as an inorganic fertilizer (10-10-10) as compared to the non-fertilized control, when 60 lbs/A N were applied as an inorganic fertilizer (5-10-15), and when 120 lbs /A N was applied as a manure. Although the total amount of N applied using broiler litter was equal to that of the 10-10-10 fertilizer, the amount of available N was, most likely, significantly less. According to the GA cotton production handbook, only 60% (72 lbs/A) of the total N in broiler litter is made available for the crop during the growing season. The use of 5-10-15 and broiler litter as nutrient sources did not improve cotton growth and development over the non-fertilized control. Unlike cotton seed, which has a large endosperm (and, therefore, greater internal nutrient reserves to facilitate early plant growth), the seed of Palmer amaranth is small (~1 mm). Readily available external sources of N are likely to be more crucial for Palmer amaranth to ensure plant establishment. Future studies will be needed to evaluate the development of Palmer amaranth using common crop production practices, including split inorganic nitrogen applications, and in the presence and absence of irrigation.

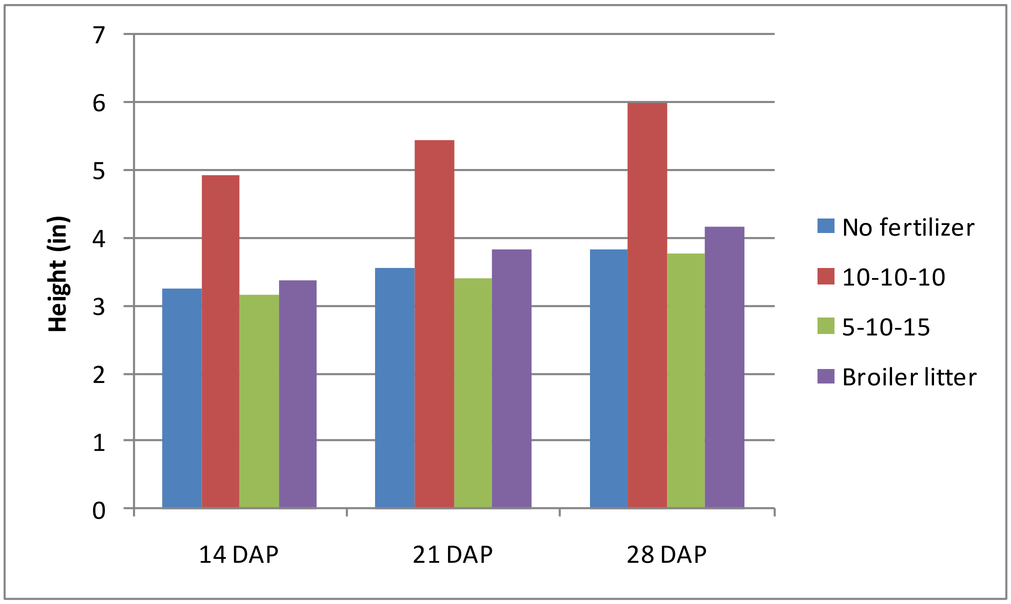

Figure 1. Height in inches of cotton 14, 21, and 28 DAP in response to fertilizer source. Cotton grown in the absence of fertilizer or using 5-10-15 and broiler litter as nutrient sources were significantly smaller than cotton grown using 10-10-10 for all observation periods.

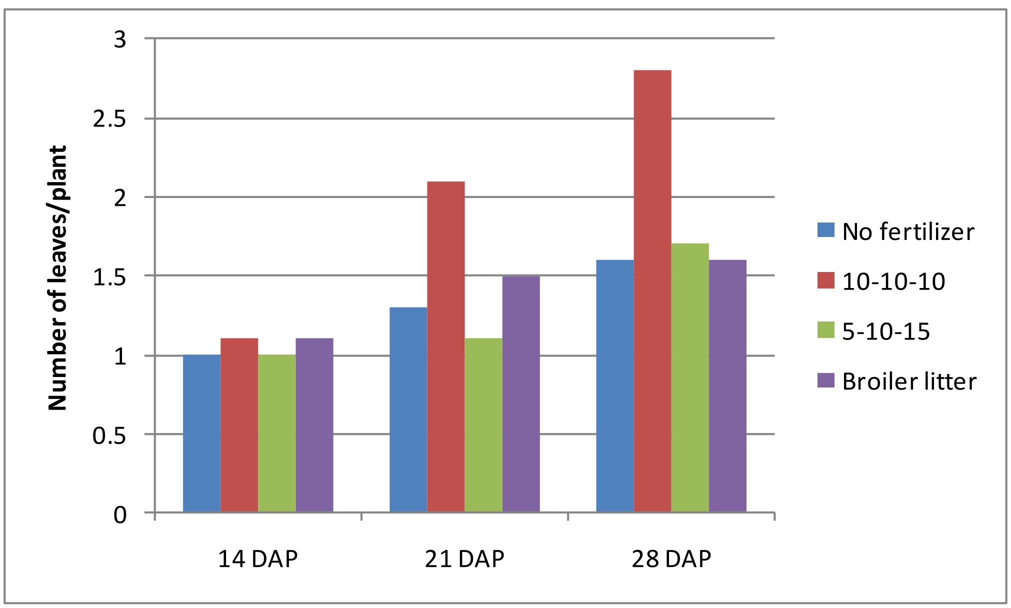

Figure 2. Number of leaves /cotton plant 14, 21, and 28 DAP in response to fertilizer source. Cotton grown in the absence of fertilizer or using 5-10-15 and broiler litter as nutrient sources produced significantly fewer leaves per/plant than cotton grown using 10-10-10 at 21 and 28 DAP.

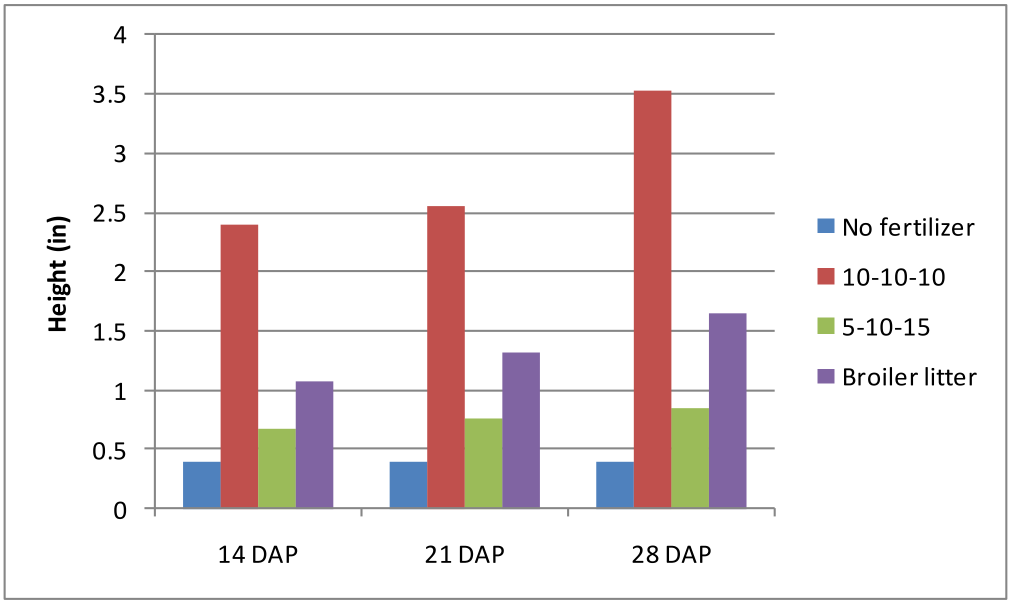

Figure 3. Height in inches of Palmer amaranth 14, 21, and 28 DAP in response to fertilizer source. Palmer amaranths grown in the absence of fertilizer or using 5-10-15 and broiler litter as nutrient sources were significantly smaller than Palmer amaranths grown using 10-10-10 for all observation periods. Palmer amaranths grown using broiler litter were significantly taller than those grown using the 5-10-15 fertilizer.

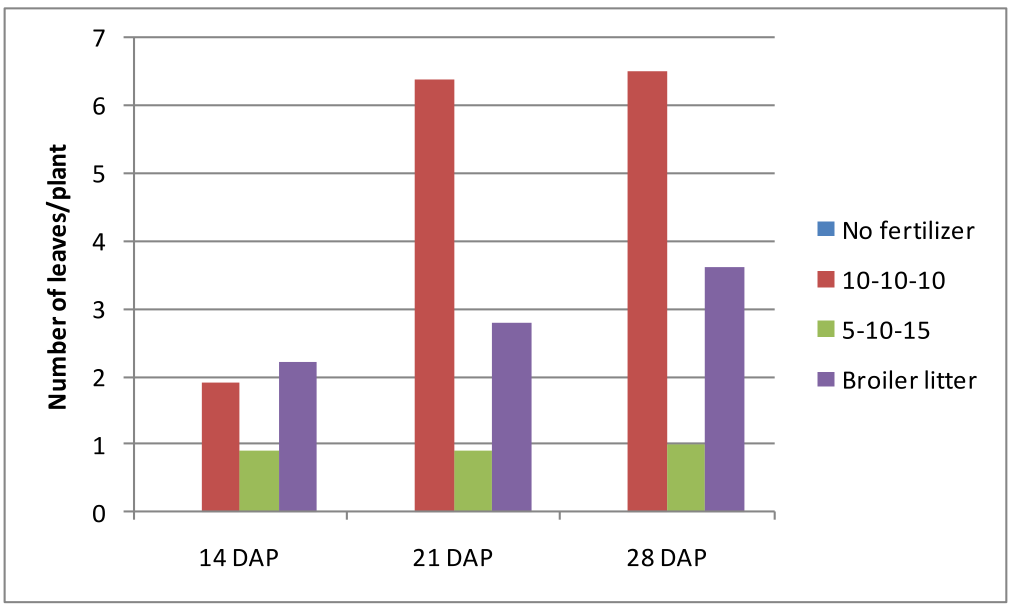

Figure 4. Number of leaves/Palmer amaranth plant 14, 21, and 28 DAP in response to fertilizer source. Palmer amaranths grown in the absence of fertilizer or using 5-10-15 and broiler litter as nutrient sources produced significantly fewer leaves/plant than Palmer amaranths grown using 10-10-10 for all observation periods. Palmer amaranths grown using broiler litter had significantly more leaves/plant than those grown using the 5-10-15 fertilizer.

GROWTH AND DEVELOPMENT OF PALMER AMARANTH FOLLOWING A SIMULATED FAILED ATTEMPT AT HAND REMOVAL

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Introduction

Palmer amaranth is a highly competitive weed of field corn, cotton, peanut, and soybean and has been confirmed to be resistant to glyphosate in nearly every agronomic county in GA. Palmer amaranth's successful establishment in GA cotton fields is due, in part, to the presence of a deep taproot as well as a network of finer, fibrous roots. Because of its rooting structure, Palmer amaranth is able to penetrate compacted soils, thereby gaining access to water and nutrients, more effectively than many commonly grown crops. This contributes to Palmer amaranth's rapid growth rate (up to inches per day) and competitiveness. The presence of a taproot can make it difficult to remove Palmer amaranth by hand. Growers, extension agents, and university research personnel have observed instances where: 1) previously pulled Palmer amaranth plants have re-rooted and become reestablished in a field and 2) plants that have been cut back (using hoes or machetes) have re-sprouted from dormant buds and resumed normal growth. Current GA recommendations for Palmer amaranth management stress the need to remove all plants from a field prior to their achieving reproductive maturity in an effort to mitigate the size of the soil seedbank. Plants that escape removal could flower and produce progeny that could severely impact the following year's crop. The objective of this study was to evaluate the potential of Palmer amaranth to grow and develop following defoliation occurring during a simulated hand-weeding failure.

Materials and methods

This study was conducted in a field planted to Widestrike cotton in Tifton, GA in 2010. Individual plots were 20 feet long by two rows wide. Average Palmer amaranth densities of 6 to 7 plants/plot were set and maintained by applications of glyphosate (0.75 lb/A) plus *S*-metolachlor (1.33 lb/A) and hand-weeding. At the start of Palmer amaranth flowering (June 18), plots were randomly assigned to one of three pruning treatments: 1) no defoliation, 2) removal of all stem and leaf tissue to a height of 1 inch above the soil line, and 3) removal of all stem and leaf tissue to a height of 6 inches above the soil line. Only female plants were cut back; male plants were allowed to continue flowering to ensure an ample source of pollen for seed production. The 1 and 6 inch treatments were replicated 8 times and the non-cut treatment, 7 times. Plant heights and percent flowering plants were recorded regularly throughout the remainder of the growing season (June 28 to September 17). Floral tissue (inflorescences and seed) was harvested between September 10 and September 17. Tissue was air dried in a greenhouse and the seed from each plant was hand harvested and weighed.

Results and Discussion

All Palmer amaranth plants were between 24 and 48 inches when flowering was initiated. By the end of the season, the non-cut plants were an average of 77 inches tall; maximum plant height was achieved by July 15 (Figure 1). On June 28, July 7 and July 15, the plants cut back to 1 inch were an average of 7, 16 and 33 inches tall, respectively; the plants cut back to 6 inches were an average of 16, 23 and 40 inches tall for the same observation periods. The 1 and 6 inch plants reached their maximum heights of 55 and 59 inches, respectively, by July 26. Despite the heights achieved, the 1 and 6 inch plants were less robust (i.e. smaller stem and canopy diameters, fewer number of flowering branches produced, etc…) than the non-cut, control plants (personal observation). By August 16, approximately 2 months after flowering, was initiated, all of the plants that had been cut back to either 1” or 6” had returned to flowering (Figure 2). Palmer amaranths that were allowed to grow and develop normally produced an average of 46 g of seed/plant (~160,000 seed/plant); Plants cut back to 1 and 6 inches produced an average of 10 and 15 g of seed/plant, respectively (~35,000 to 50,000 seed/plant) (Figure 3).

Palmer amaranth can be difficult to remove by hand weeding. Growers and university personnel have observed hand-weeding and mechanical removal failures in which previously pulled Palmer amaranth plants have re-rooted and become reestablished and/or plants that have been cut or pruned back have re-sprouted from latent buds. Results from this field study show that Palmer amaranth plants cut back (all stem and leaf tissue removed) to 1 and 6 inches above the soil line are able to successfully regrow and achieve reproductive maturity. Although the defoliated plants never achieved the same size or produced the same amount of biomass and their intact counterparts, they were still able to produce significant amounts seed. Current recommendations urge cotton growers to remove Palmer amaranth plants escaping early season control measures by hand if they wish to try and reduce the size of the residual seedbank. Growers need to be aware that ineffectual salvage attempts could negate efforts designed to manage the size of Palmer amaranth populations in the field.

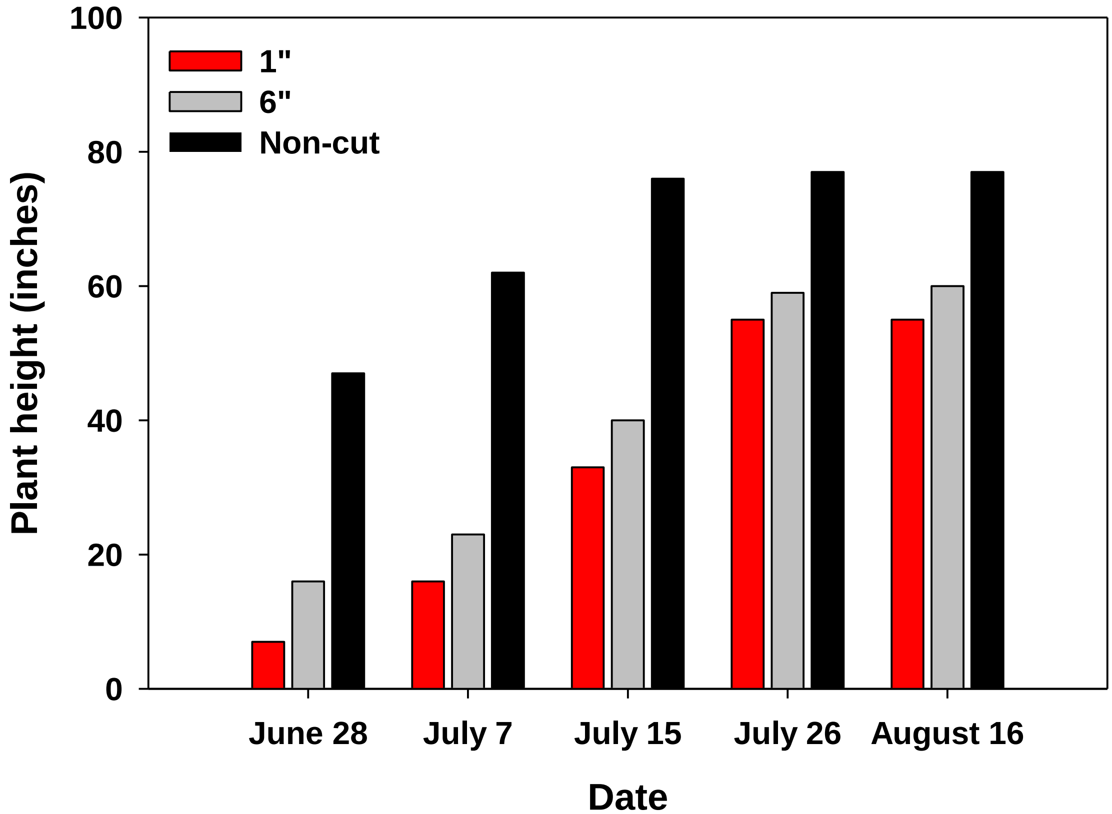

Figure 1. Average heights/plant, in inches, of Palmer amaranths that were left intact or cut back at flowering to 1 or 6 inches above the soil line as recorded throughout the growing season.

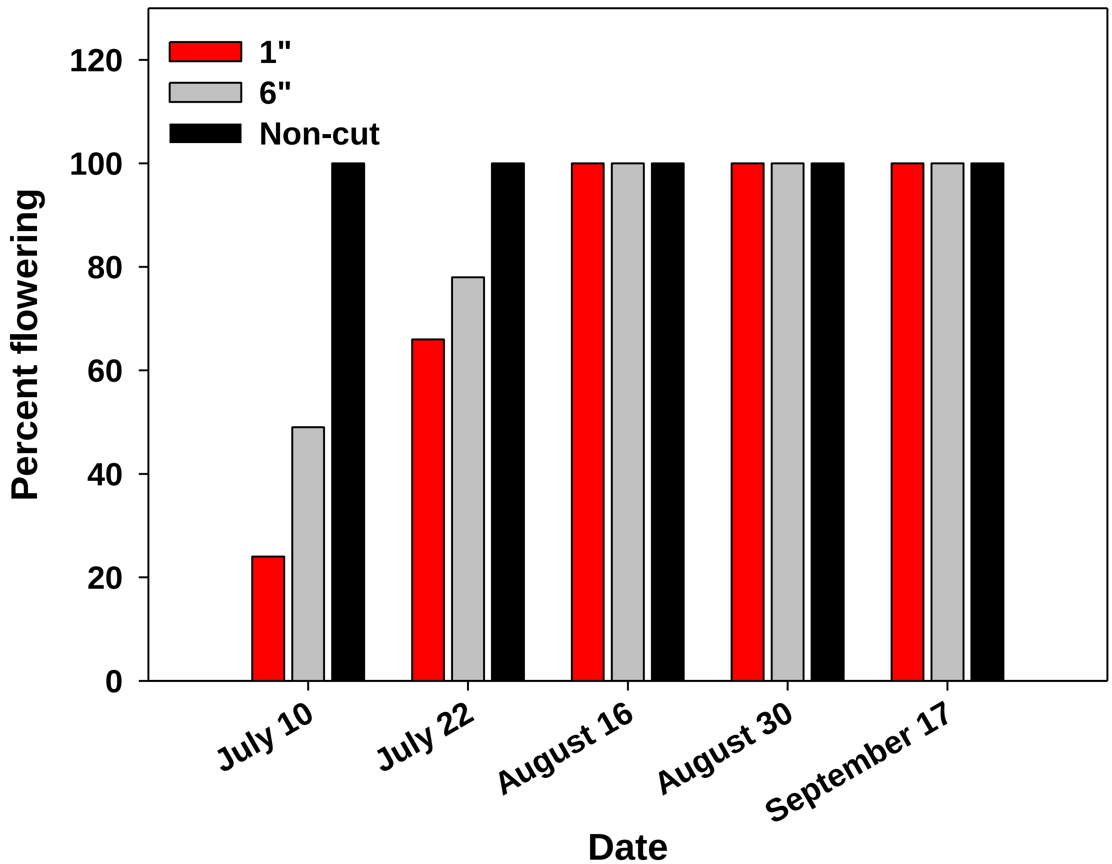

Figure 2. Average proportion of flowering Palmer amaranth females that were left intact or cut back at flowering to 1 or 6 inches above the soil line as recorded throughout the growing season.

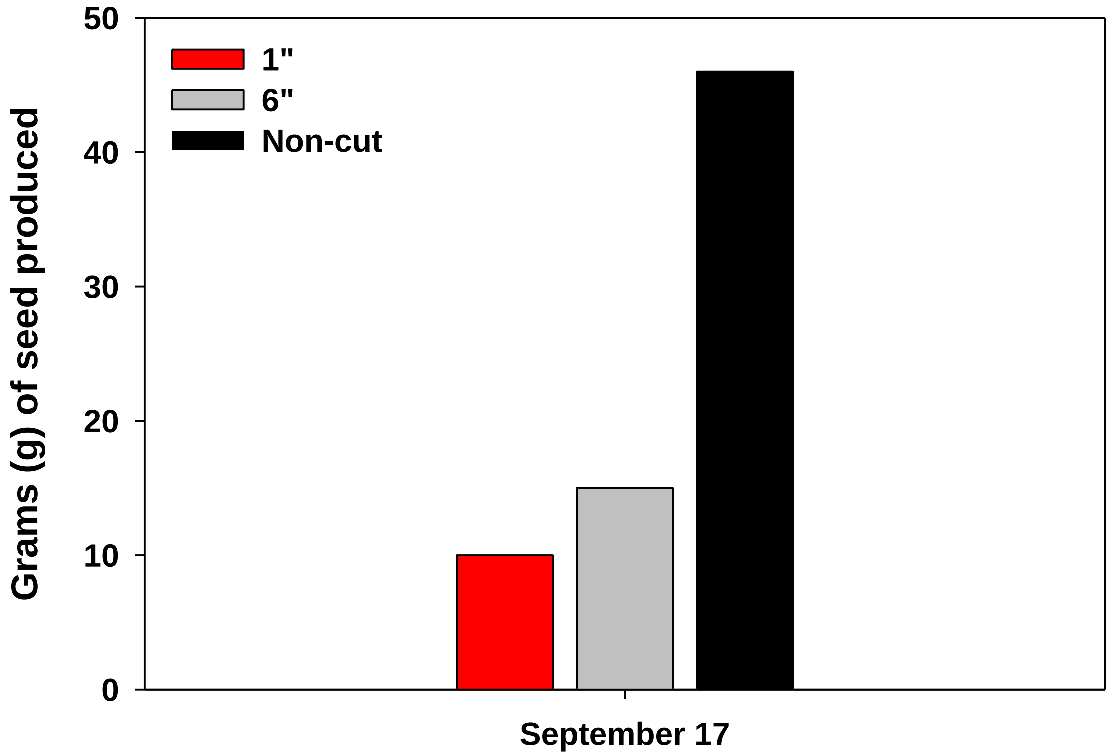

Figure 3. Amount of seed produced/plant, in grams, by Palmer amaranth plants that were left intact or cut back at flowering to 1 or 6 inches above the soil line.

AUTHORS