Cotton

Research and Extension Report 2012

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TABLE OF CONTENTS

INTRODUCTION

AGRICULTURAL AND APPLIED ECONOMICS

CROP AND SOIL SCIENCES

ENTOMOLOGY

THE 2012 CROP YEAR IN REVIEW

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The 2012 production season was certainly unique and quite different from that of 2011. Cotton acreage harvested decreased approximately 14 % from that of 2011, with an estimated 1,285,000 acres harvested in Georgia during 2012, according to the National Agricultural Statistics Service. Approximately 2,807,821 bales were classed from Georgia for the 2012 season, resulting in an approximate average yield of 1093 lbs per acre, which is a new record for Georgia. Georgia remains the 2nd largest cotton producing state in the nation, second only to Texas. Most of the cotton crop this year was planted relatively on time, and frequent rains allowed for activation of residual herbicides, exceptional stand establishment, and early season vigor in most areas, which was quite a different and better scenario than what was experienced in the Spring of 2011. Slightly lower heat unit accumulation (slightly cooler day and nighttime temperatures) and frequent rains were observed throughout most of the summer, helping many fields to avoid stress that would normally occur in most other years. A few hot and dry spells occurred but were generally short-lived and were less severe than normal. In general, rainfall seemed sufficient during periods of peak demand; however, a few regions could have benefitted from a little more rain, which is nothing abnormal. Contrary to 2011, a prolonged period of cloudy, rainy, and foggy weather occurred during late summer, which resulted in some losses due to hardlock and/or boll rot for earlier planted cotton, as mature bolls began to crack open during that time. The slightly cooler, wetter and cloudier than normal weather during late July and August noticeably slowed boll development in many fields, prolonging the boll opening process and delaying the onset of harvest. Significant regrowth was also a challenge for many producers in defoliating the 2012 crop. In general, weather during the latter part of the 2012 harvest season was fairly cooperative.

The most common challenges for growers in 2012 included nematodes, which were observed in several more fields than normal, emphasizing the need for cultivar tolerance to nematodes or other effective treatment options. Glyphosate-resistant pigweed remains a significant challenge, although activation of residual herbicides by rainfall during 2012 noticeably improved control. Despite these and other challenges, many parts of Georgia were blessed with appreciable rains and/or less-than-normal stress, resulting in a projected statewide average yield of 1093 lbs/A, a new record. Although yields were variable depending upon rainfall, average statewide yields continue to remain above 800 lbs/acre, despite the loss of DP 555 BR, which is a true testament to Georgia's growers, their commitment to cotton, and the release of superior varieties. As modern varieties are currently being released onto the market in a much more rapid manner, due to increased competition and advancements by industry, variety selection remains a very important and costly issue; however, many of the new varieties performed very well for Georgia growers in 2012. The 2012 cotton acreage in Georgia was predominately comprised of Deltapine varieties (46.3%), FiberMax varieties (7.6%), Stoneville (3.7%), and Phytogen varieties (41.3%) (http://www.ams.usda.gov/AMSv1.0/).

Quality of the 2012 crop was comparable to previous years for some parameters. Of 2,807,821 bales classed as of February 7, 2013, 1.4 percent were short staple (<34) and 15.4 percent were high mic (>4.9). Average staple was similar to that of 2011; however, the incidence of short staple was very low. Average micronaire was similar to that in 2011, but the incidence of high mike was noticeably higher in 2012. Fiber length uniformity remained high, a likely result of the changes in varieties. Most noticeably, bark was significantly higher in 2012 than in several recent years (Table 1).

Table 1. Fiber Quality of Bales Classed at the Macon USDA Classing Office, 2008-2012

	Color Grade 31/41 or better (% of crop)	Bark/ Grass/ Prep (% of crop)	Avg. Staple (32nds)	Avg. Strength (g/tex)	Avg. Mic	Avg. Uniformity
2008	25 / 93	all < 1.0	34	28.7	46	80.2
2009	26 / 96	all < 1.0	35	28.8	45	80.3
2010	50 / 90	all < 1.0	35	29.9	48	81
2011	38 / 84	2.6 / <1 / 1	36	29.6	46	81.7
2012	48 / 91	11.9 / <1 / <1	36	29	46	81.6

Bales classed short staple (< 34) and high mic (>4.9)
2008: 20% & 21%   2009: 22% & 20%   2010: 4% & 9%   2011: 2.8% & 8.8%
2012: 1.4% & 15.4%
Fiber quality for 2,807,821 Georgia bales classed in 2012-2013 as of February 7, 2013.
Source: http://www.ams.usda.gov/AMSv1.0/

Acknowledgement

The UGA Cotton Team would like to sincerely thank the Georgia Cotton Commission for their generous support of the Cotton Team's research and extension programs, allowing us to better serve Georgia cotton growers.

GEORGIA COTTON ECONOMICS IN THE POST-555 ERA

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Abstract

The EPA registration for single-gene Bollgard® technology expired with the 2009 crop. One single-gene Bollgard variety, DeltaPine DP555BR, accounted for approximately 85 percent of all Georgia cotton acres planted. The net loss in farm and gin income in Georgia due to the loss of DP555BR and other single-gene varieties was estimated at $36.55 million annually. The elimination of single-gene (B1) technology after the 2009 crop year resulted initially in a shift to mostly Bollgard II (B2) varieties. Widestrike (W) varieties gained share in 2012 with the introduction of PHY499WRF. In 2010 and 2011, there was an increase in share for Liberty-Link (LL and LLB2) varieties but share declined in 2012. New Glytol/Liberty Link® (GL) technology grabbed 1 percent of acreage in 2012 and may increase further in 2013. Yield of the top-yielding newer varieties has generally been comparable to 555 especially under irrigation. Fiber quality has also improved significantly. B2 and W technology comes bundled with Roundup-Ready Flex technology (B2RF and WRF) or Liberty-Link (B2LL) or Glytol/Liberty-Link (GLB2). Thus, the loss of single-gene (B1) technology also meant that growers would have to move to RF, LL, or GL technology for weed control. B2RF, WRF, and LLB2 varieties were available to growers prior to the expiration of single-gene varieties but Georgia growers did not plant those varieties as long as DP555BR was available. After the loss of 555, Georgia growers switched largely to new Deltapine (DP) varieties and Phytogen (PHY) varieties but the proportion of acreage planted to PHY increased significantly and DP decreased in 2012 due to increased planting of PHY499WRF—a high yielding variety. Yield continues to be the number one factor in variety selection-- perhaps signaling that growers feel they can make any technology fit and that technology is secondary to yield potential. Combined technology-related costs (seed, technology fees, herbicides, and insecticides excluding tillage and application) are estimated to be $155 to $177 per acre for 2013 compared to $116 per acre for DP555BR in 2009.

Introduction

The EPA registration for single-gene Bollgard® technology (further referred to as B1 here) expired with the 2009 crop. Suppliers limited remaining seed inventory was allowed carried forward to 2010 and planted but, beginning with the 2011crop, producers had to plant two-gene varieties (Bollgard II® or Widestike® technologies) or non-transgenic varieties.

Prior to 2010, one single-gene Bollgard variety, DeltaPine DP555BR, accounted for approximately 85 percent of all Georgia cotton acres planted. In University of Georgia Official Variety Trials (OVT's), large on-farm trials, and in farmer's own experience, DP555BR had proven superior yield compared to other varieties and technologies then available.

The net loss in farm and gin income in Georgia due to the loss of DP555BR and other single-gene varieties was estimated at $36.55 million annually (Shurley and Roberts). Income loss was due largely to the difference in yield between DP555BR and other variety choices available to producers at the time (2004 through 2007). Producers were concerned about losing DP555BR because there was no replacement available with equivalent yield potential.

Objectives and Methodology

The objective of this research is to begin to determine the actual impact of the loss of DP555BR on profitability. Specifically, the objective is to explore changes in yield and fiber quality since 2009. The three years since the loss of single-gene (B1) technology (2010-2012) are compared to the three years prior to the loss (2007-2009). This research will also determine changes in costs of production since 2009 due directly to changes in producers' technology choices.

Results

Varieties and Technology

From 2007 to 2009, DP555BR averaged 84% of Georgia's acres planted. No other single variety during this time had even 3% of acreage (Table 1). In anticipation of losing single-gene cotton varieties and 555 in particular, UGA Extension encouraged growers to begin planting other varieties and technology in small amounts to gain knowledge and experience on their farm. In 2009, the last year single-gene technology was fully available, producers reduced 555 acreage only slightly and planted increased the percentage of Phytogen PHY370WR and new varieties DP0935B2RF and DP0949B2RF.

With the limited availability of DP555BR in 2010, producers shifted acreage to two-gene (B2) DP 09 and 10 varieties and Widestrike (W) PHY varieties. There was also increased planting of FiberMax FM varieties 1740B2F and 1845LLB2. Some varieties with increased acreage share in 2010 had a smaller share in previous years but increased with the demise of 555.

Beginning in 2011, the landscape has shifted mostly to newer available Deltapine (DP) varieties and Phytogen (PHY) varieties. Liberty-Link® (LL) varieties have also increased somewhat in acreage share but account for only about 5% of acres.

PHY499WRF was planted on almost one-third of Georgia acreage in 2012 followed by two DP varieties. PHY499WRF has been a top yielder in recent UGA Official Variety Trials (OVT's). With the loss of 555, Georgia cotton producers are now planting a wider/larger number of varieties. No single variety now dominates but the top three now did account for almost 70 percent of acreage in 2012.

Technology planted is a function of many factors including yield potential of available varieties, cost, weed and insect control required, desired pest management regime, and availability of seed supply. Table 2 shows cotton seed technology planted in Georgia for the period 2007 through 2012.

The elimination of single-gene (B1) technology after the 2009 crop year resulted initially in a shift to mostly Bollgard II (B2) varieties. Widestrike (W) varieties gained share in 2012 with the introduction of PHY499WRF. In 2010 and 2011, there was an increase in share for Liberty-Link (LL and LLB2) varieties but share declined in 2012. New Glytol/Liberty Link® (GL) technology grabbed 1 percent of acreage in 2012 and may increase further in 2013.

Two-gene varieties (B2 and W), come bundled with Roundup Ready Flex® (RF) technology compared to single-gene varieties like DP555BR that were bundled with regular Roundup Ready®. So effectively, the elimination of single-gene technology also required producers to purchase RF technology rather than R. Georgia producers have yet to embrace LL compared to other technologies although acreage share has increased since the loss of 555.

Other technologies (alternatives to BR) have been available to producers even when DP555BR was dominating Georgia acreage. Producers did not shift to these technologies until 555 was no longer available and because of the technology bundles available.

Fiber Quality

During the "555 era", Georgia cotton was often criticized by mills for poor fiber quality. Although many factors impact fiber quality and no relationship was ever established, 555 nonetheless became the target of criticism since it was the dominate variety planted. Specifically, quality concerns were fiber length Uniformity and Staple.

In recent years, the quality of Georgia cotton has improved significantly (Table 3). Staple and Uniformity have both improved. The percentage of the crop with less than 34 Staple has declined to less than 5 percent and the average Staple length has been roughly 36 for the last two years. The percentage of the crop with less than 80 Uniformity has also greatly declined. Average Uniformity has been 81 or higher each of the last three years.

Yield of DP555BR Compared to Other Varieties

Figures 1 and 2 compare DP555BR to other varieties and technologies in the last three years (2007 through 2009) that single-gene technology was fully available. DP555BR is compared to the top-yielding non-B1 variety each year and to non-B1 varieties that were in the tests all 3 years. Figure 1 is non-irrigated production in OVT's at three locations– Tifton, Plains, and Midville. Figure 2 is irrigated at four locations– Bainbridge, Tifton, Plains, and Midville.

In non-irrigated production (Figure 1), in 2 of the 3 years, a non-B1 variety out-yielded 555. Averaged across all three years, the top non-B1 variety each year averaged 1,286 pounds per acre compared to 1,278 pounds per acre for 555. Of the non-B1 varieties included in the tests all three years, they averaged 1,160 pounds per acre compared to 1,278 pounds for 555.

In irrigated production (Figure 2), DP555BR out-yielded the top non single-gene (Non-B1) variety in two of the three years. For the three years, 555 averaged 1,830 pounds per acre. The top non-B1 variety each year averaged 1,835 pounds per acre. The non-B1 varieties common to the tests all three years averaged 1,645 pounds per acre– almost 200 pounds per acre less.

UGA Extension recommends producers choose varieties on the basis of not only yield, but also yield stability. Stability is a characteristic of how a variety performs over both time and location– under multiple environments. For the period 2007 through 2009, data shows that a variety may outperform 555 in a given year but no single variety out-yielded 555 over all three years.

Yield of Newer Varieties Compared to DP555BR

Figures 3 and 4 compare the yield of newer varieties and technologies to the yield of DP555BR. The yield of varieties for 2009 through 2012 (the 3 years since the elimination of single-gene technology) is compared to the performance of 555 for the period 2007 through 2009 (the last 3 years prior to elimination). These yield data are from UGA Official Variety Trials (OVT's).

Non-irrigated yield is from three locations– Tifton, Plains, and Midville. For 2007-2009, DP555BR averaged 1,278 pounds per acre (Figure 3). The highest yielding variety each year for 2010-2012 averaged only slightly less at 1,241 pounds per acre. Yield is also shown for the highest five yielding varieties and the highest ten. In non-irrigated production, the yield of newer varieties has not equaled the performance of 555 although weather is always a factor.

In irrigated production (Figure 4), newer varieties have performed very well. Yield is from four locations– Bainbridge, Tifton, Plains, and Midville. For 2007-2009, DP555BR averaged 1,830 pounds per acre. By comparison, the top-yielder each year for 2010-2012, averaged 1,962 pounds per acre. The five highest yielding varieties averaged 1,920 pounds per acre.

Technology-Related Costs

The choice of technology is a selection of pest management regime. Since the loss of single-gene Bollgard technology, two-gene varieties are Bollgard II with Roundup-Ready Flex (B2RF or B2F), Widestrike with Roundup-Ready (WR) or Roundup-Ready Flex (WRF), or Bollgard II with Liberty-Link (LLB2) or Glytol/Liberty-Link (GLB2). While the loss of single-gene Bollgard technology and DP555BR specifically was of concern to growers from a yield perspective, newer technologies do offer considerable value to the grower.

Compared to single-gene technology, B2 and W offer better control in severe caterpillar pressure. B2 and W provide better control of corn earworm. Two-gene technology also provides broader spectrum control with improved control on armyworms and soybean looper. W provides better control of fall armyworm. B2 provides better control of corn earworm.

Most single-gene technology came bundled with Roundup-Ready technology (BR). Two-gene technologies, however, come bundled with RF or LL or GL for weed control. RF technology allows a later, post-emergence application which generally occurs between the 5 and 8-leaf stage. This would be problematic in R cotton. GL has added flexibility over RF or LL in that the grower can apply both Liberty and glyphosate as needed. Compared to GL, Widestrike (W) varieties can have injury from Liberty applications.

Technology-related costs include seed, technology fees, weed control, and insect control (Table 4). In 2009, the cost for DP555BR was $65.41 per acre (seed plus technology fee). Compared to 2009 (the last year single-gene Bollgard was available), growers are paying more due to the shift from B1 to B2 or W and from R to RF since B2 and W technologies are largely available only with RF or LL. For 2013, combined seed and technology fee cost is estimated at $84.24 per acre for B2RF, $82.42 for WRF, and $86.15 for GLB2. These costs in 2013 are approximately $19 per acre higher than DP555BR in 2009. This difference is due to change in technology and increase in seed and technology fees.

Herbicide costs for 2013 are based on UGA Extension recommendations for controlling glyphosate resistant Palmer Amaranth (Culpepper, et.al.). For Roundup-Ready Flex (RF) cotton, cost per acre is estimated at $63.18 per acre compared to only $33.15 per acre in 2009. Cost has increased due to the increased use of residual herbicides to battle glyphosate resistance even with more expensive RF technology.

Herbicide cost for Glytol/Liberty-Link (GL) technology is estimated at $82 per acre compared to $63.18 for RF. Higher cost is due to more expensive Liberty herbicide compared to glyphosate and not being eligible for Monsanto rebates available with RF varieties.

Insecticide cost is estimated at $9.10 per acre for 2013 for B2 and W cotton compared to $17.30 per acre in 2009 with single-gene (B1) technology. In 2009, budget estimates included 1 spray for caterpillar pests. With better control in B2, current budget estimates include 2 sprays for stinkbugs only- no caterpillar sprays.

Summary and Conclusions

Due to yield differences and lack of an adequate replacement, the loss in income due to the expiration of single-gene Bollgard technology, and DP555BR specifically, was estimated at $36.55 million. The last year DP555BR and other single-gene varieties were fully available was 2009.

Since 2009, however, new B2 and W varieties and technologies have provided yields that rival DP555BR, especially in irrigated production. Fiber quality has also improved significantly.

B2 and W technology most often comes also bundled with Roundup-Ready Flex technology (B2RF and WRF) or Liberty-Link (B2LL) or Glytol/Liberty-Link (GLB2). Thus, the loss of single-gene (B1) technology also meant that growers would have to move to RF, LL, or GL technology for weed control.

B2RF, WRF, and LLB2 varieties were also available to growers prior to the expiration of single-gene varieties in 2009 but Georgia growers did not plant those varieties as long as DP555BR was still available. After the loss of 555, Georgia growers switched largely to new Deltapine (DP) varieties and Phytogen (PHY) varieties but the proportion of acreage planted to PHY increased significantly in 2012 and DP decreased due to increased planting of PHY499WRF—a high yielding variety. Both before and after the loss of 555, these examples show that yield continues to be the number one factor in variety selection. Perhaps signaling that growers feel they can make any technology fit and, thus, the choice of technology is secondary to yield potential.

The combined cost per acre of seed and technology fees is essentially the same for B2RF, WRF, and GLB2. The costs of weed control and insect control for B2RF and WRF is budgeted the same. Herbicides for GL are about $19 per acre higher than RF. Combined technology-related costs (seed, technology fees, herbicides, and insecticides excluding tillage and application) are estimated to be $155 to $177 per acre for 2013 compared to $116 per acre for DP555BR in 2009.

This increase is due to increased seed price, additional technology bundles and increased technology fees, and increased use of residual herbicides to control glyphosate resistant Palmer Amaranth. Newer technologies do, however, have value to the grower and add flexibility in weed and insect control.

Acknowledgments

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Table 1. Percent of Cotton Acres Planted By Variety, Georgia, 2007-2012.

2007		2008		2009		2010		2011		2012	
Variety	Pct	Variety	Pct	Variety	Pct	Variety	Pct	Variety	Pct	Variety	Pct
DP555BR	83.59	DP555BR	85.85	DP555BR	82.53	DP555BR	24.74	DP1050B2RF	25.03	PHY499WRF	32.39
DP515BR	2.86	DP515BR	1.48	PHY370WR	2.74	DP0949B2RF	12.52	DP1048B2RF	16.38	DP1050B2RF	21.58
PHY480WR	1.66	PHY480WR	1.37	DP0935B2RF	2.61	PHY375WRF	8.40	PHY375WRF	12.98	DP1048B2RF	13.16
DP454BR	1.16	DP444BR	1.25	DP0949B2RF	2.14	PHY370WR	8.36	PHY565WRF	10.76	PHY375WRF	5.73
DP444BR	1.11	PHY370WR	1.18	ST5458B2F	1.07	FM1740B2F	7.01	FM1845LLB2	6.21	FM1845LLB2	4.63
DP445BR	.79	DP434RR	1.02	PHY480WR	.85	DP0935B2RF	5.63	DP0912B2RF	6.05	DP1252B2RF	4.07
DP488BR	.60	DP454BR	.77	FM1740B2F	.84	FM1845LLB2	4.77	DP1034B2RF	3.71	DP0912B2RF	2.97
PHY470WR	.57	DP432RR	.55	PHY485WRF	.68	DP1048B2RF	4.76	FM1740B2F	3.54	DP1137B2RF	2.42
FM960BR	.49	DP147RF	.46	PHY375WRF	.59	DP1050B2RF	4.62	DP1137B2RF	3.29	PHY565WRF	2.06
DP434RR	.49	FM960BR	.45	FM1845LLB2	.47	PHY480WR	2.75	DP0949B2RF	2.73	ST5458B2RF	1.83
All Others	6.68	All Others	5.62	All Others	5.48	All Others	16.44	All Others	9.32	All Others	9.16

SOURCE: USDA-AMS

Table 2. Percent of Cotton Acres Planted By Seed Technology, Georgia, 2007-2012.

Seed Technology	2007	2008	2009	2010	2011	2012
RR	2.36	2.34	.63	0.00	0.00	0.00
RF	.21	.68	.96	.90	.35	0.00
BR	92.29	90.33	83.03	25.6	.37	N/A
B2R	0.00	.38	.32	0.00	0.00	0.00
B2RF	.15	.90	7.93	40.70	65.20	50.66
LL	.07	0.00	0.00	0.00	.02	0.00
LLB2	.10	.12	.77	8.10	8.37	5.01
GLB2	N/A	N/A	N/A	N/A	N/A	1.02
W	0.00	0.00	.38	.90	.54	1.06
WR	2.30	2.55	3.59	11.20	.33	0.00
WRF	0.00	0.40	1.27	11.90	24.33	40.26
Non-Transgenic	.62	.62	.10	.00	.00	.20
Not Otherwise Specified	1.90	1.68	1.02	.70	.48	1.79

SOURCE: USDA-AMS

Table 3. Selected Fiber Quality Characteristics, Georgia, 2007-2012

	2007	2008	2009	2010	2011	2012
Average Staple	34.4	34.5	34.9	34.9	35.9	36.0
% Bales Staple 33 and shorter	20.9	16.5	4.9	16.3	3.7	1.4
Average Uniformity	80.1	80.2	80.2	81.0	81.7	81.6
% of Bales Uniformity Less Than 80	29.8	25.7	26.8	14.9	3.1	3.8

SOURCE: USDA-AMS

Table 4. Estimated Variety and Technology Related Costs[1] Per Acre in 2013 Compared to DP555BR.

	2009 DP555BR[3]	2013 B2RF	2013 WRF	2013 GLB2
Seed[2]	$20.03	$24.39	$25.73	$55.69
Technology Fees	$45.38	$59.85	$56.69	$30.46
Herbicides (conventional tillage)[4]	$33.15	$63.18	$63.18	$82.00
Insecticides (spray applications only)	$17.30	$9.10	$9.10	$9.10
Total Cost Per Acre	**$115.86**	**$156.52**	**$154.70**	**$177.25**

1/ Excludes tillage and application costs.
2/ Calculated based on 36-inch row spacing, 2.5 seed per foot of row. GLB2 seed cost includes GL tech fee.
3/ Based on UGA enterprise budget estimates for 2009 (Shurley and Smith).
4/ Assumes starting clean with tillage, no PPI (Culpepper, et. al.).

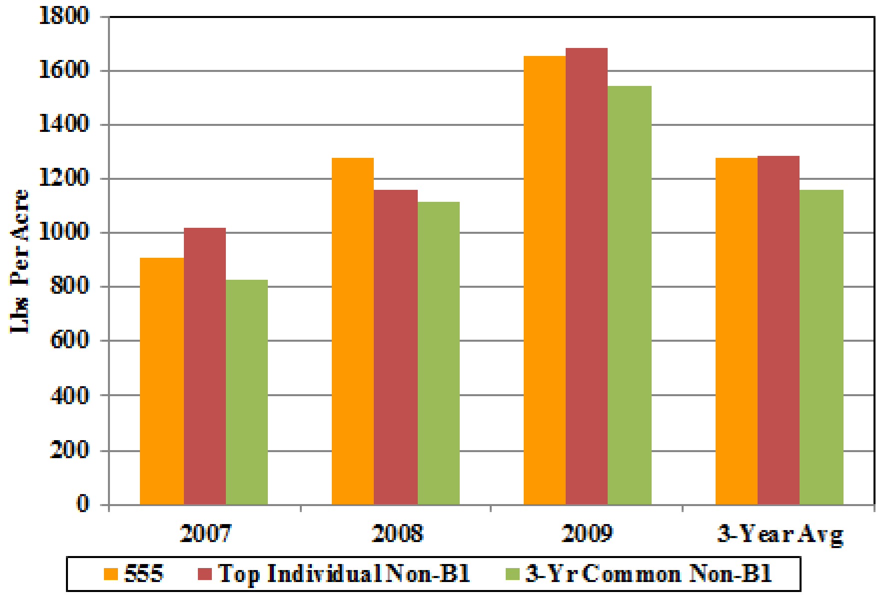

Figure 1. UGA OVT Yields, Non-Irrigated
3 Locations (Tifton, Plains, and Midville).

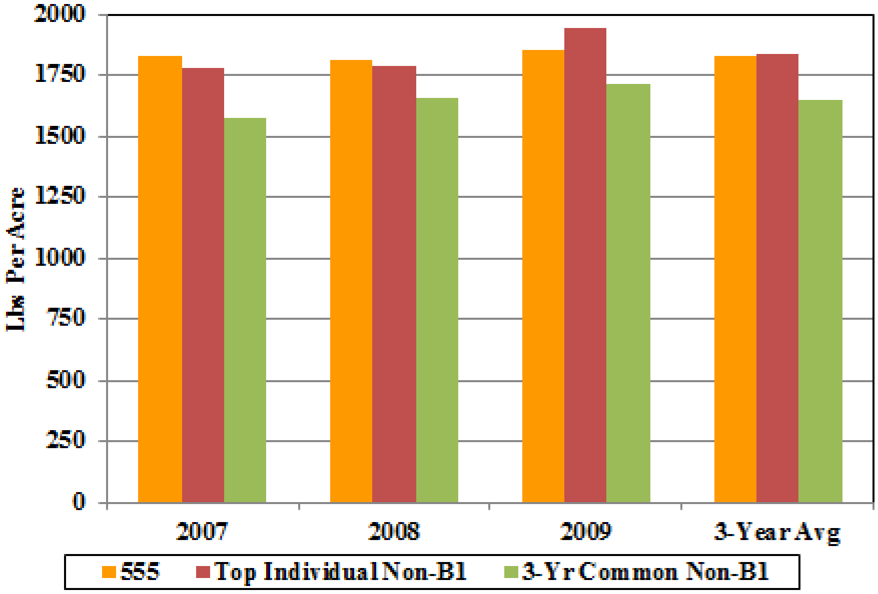

Figure 2. UGA OVT Yields, Irrigated
4 Locations (Bainbridge, Tifton, Plains, and Midville).

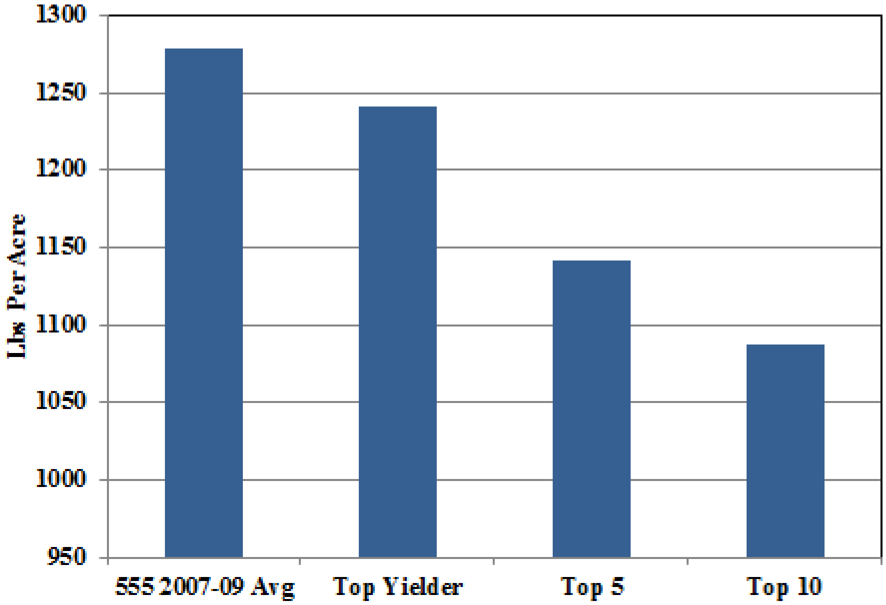

Figure 3. UGA OVT Yields, Newer Varieties 2010-12 Compared to DP555BR,
Non-Irrigated at 3 Locations (Tifton, Plains, and Midville).

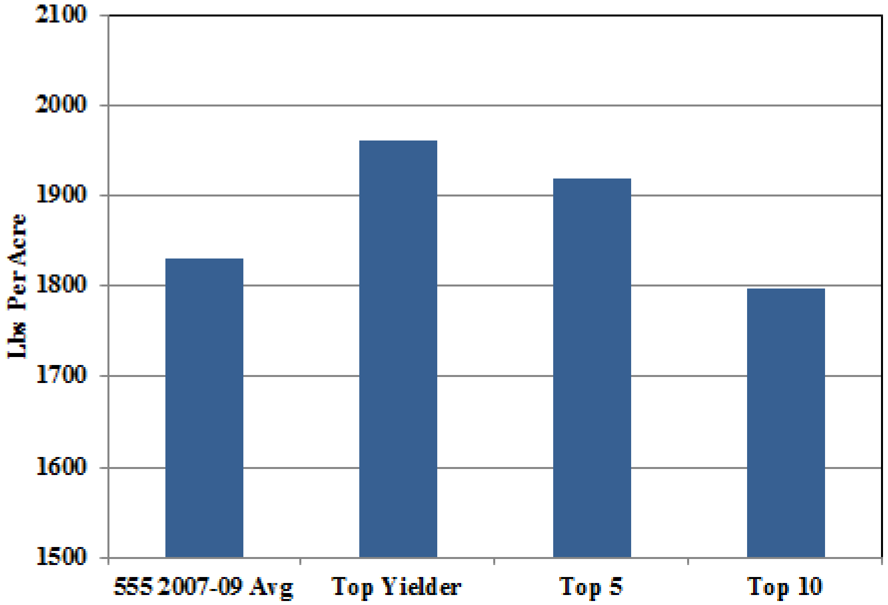

Figure 4. UGA OVT Yields, Newer Varieties 2010-12 Compared to DP555BR, Irrigated at 4 Locations (Bainbridge, Tifton, Plains, and Midville).

THE BARK PROBLEM IN 2012 GEORGIA COTTON: AN ANALYSIS OF CLASSING DATA

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Introduction

There are eight measurements used in the grading or "classing" of upland cotton fiber. These are Color, Leaf, Staple, Strength, Micronaire, Uniformity, Trash, and Extraneous Matter. The Trash measurement includes Extraneous Matter but Extraneous Matter is also reported in a separate measurement.

Extraneous Matter (noted as XM or EM on the classing record) is any substance in the bale sample other than cotton fiber and Leaf. The kind of Extraneous Matter and amount are noted on the classing record by a two-digit number. The number "11", for example, would signify type 1, level 1. Type 1 is bark and level 1 is "light". A designation "12" is heavier bark contamination.

"Bark" is cotton stalk particles or fragments that remain in the lint sample after cleaning and ginning. Bark is the result of fracturing and deterioration of the cotton stalk. This can be caused by delayed harvest, weathering, lodging, disease, and/or aggressive harvesting.

When bark is present in the cotton bale sample, the value of the cotton is reduced. The price of the cotton is discounted.

2012 Situation and Overview

Typically, bark is not a major problem for Georgia cotton growers. It is not unusual for a small percentage of cotton to have bark but bark is seldom a major problem. So, on occasion when a relatively higher than normal percentage of the crop has a problem with bark, it is a cause for concern and explanation.

For the 2012 Georgia cotton crop, 12.4% of the crop was graded with bark. This compared to only 3% or less for each of the previous 4 years (Table 1). The bales graded with bark were almost entirely Level 1. Less than .05% of the crop was a Level 2.

Discounts for Extraneous Matter can be severe. For the 2012 crop year, the typical discount for "11" was 4 cents per pound of lint (USDA-AMS). The typical discount for "12" was 8 cents per pound. It is estimated that these fiber quality price discounts and the resulting loss in value due to bark on the 2012 Georgia cotton crop was $7.09 million.

Table 1. Percentage of Bales Classed and Discounted for Bark, by Crop Year

	GA	FL	AL	NC	SC	VA
2008	2.2	1.8	3.4	0.3	0.5	0.3
2009	1.0	3.7	4.5	0.2	0.2	0.3
2010	0.6	.7	1.1	0.1	0.4	0.0
2011	3.0	2.7	4.1	0.4	0.4	0.3
2012	12.4	12.1	8.7	8.9	13.3	9.2

Source: USDA-AMS.

Examination of Classing Data

Bark Problem by State

For the 2012 crop, 12.4% of Georgia cotton was classed (graded) as having bark. The problem was not isolated to just Georgia. Neighboring states and all 6 Southeast states had a large increase in bark compared to previous years (Table 1). Proportionately, South Carolina actually experienced the largest increase and worst degree of the problem than any Southeastern state.

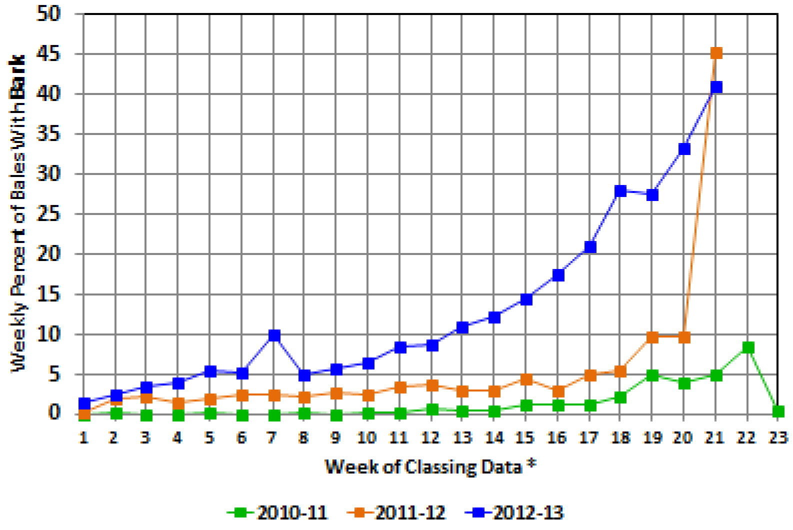
Georgia and Florida were similar in the amount of bark. Alabama and North Carolina had an increase in bark but the problem was not as severe as in Georgia.

The Problem by Week

Regardless of the severity of the problem overall, the incidence of bark increases as the harvest season progresses (Figure 1). In years when bark is relatively high (like 2012), and also years when bark is much lower (like 2010 and 2011), the incidence of bark still increases as the harvest season progresses.

Figure 1 shows the percentage of bales classed with XM 11 or 12 weekly beginning with the first week of available data and continuing weekly for the remainder of the season. Weekly reports and data are not available for the entire crop (a small amount of cotton continues to be classed after the last weekly report) but most of the crop is reflected in the weekly reports.

Figure 1. Percentage of Bales with Bark, By Week.

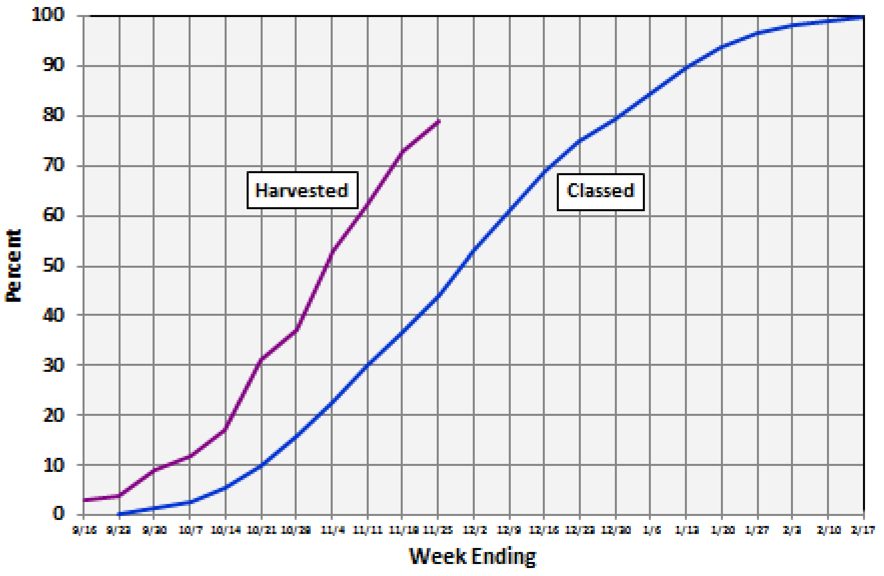


* 2010 crop year weekly data begins the week ending 9/16/2010 through 2/17/2011.
2011 crop year weekly data begins the week ending 9/22/2011 through 2/09/2012.
2012 crop year weekly data begins the week ending 9/20/2012 through 2/07/2013.

The 2012 crop started out early with less than 5% of bales with bark (Figure 1). The incidence of bark quickly began to increase, however, and by the 13th week over 10%of the cotton being classed weekly had bark. By the 18th week, over 1/4th of cotton samples weekly had bark and the final 2 weeks of weekly data shows that one-third or more of the cotton classed had bark.

The volume of bales classed is light early in the season, increases as harvest progresses further, then declines as harvest and ginning nears completion. There is also a lag in time between harvest, then ginning, then classing (Figure 2). Also, early in the harvest season a gin may not begin ginning immediately but instead wait until an adequate accumulated volume of cotton is available at the gin to require a minimum number of operating hours. For the 2012 crop, the crop was approximately 50% harvested on November 3, 2011 (USDA-NASS). Based on weekly reports of the volume of cotton samples classed, it is estimated that the 2012 crop was 50% classed on November 29, 2012. This would be 26 days from harvest to classing.

Figure 2. 2012 Season to Date Harvested and Classed



The 2012 crop averaged 12.4% with bark. The average occurred at approximately the 14th week of classing or on about December 20, 2012 (Figure 1). This would have coincided with cotton harvested on or about November 18th (Figure 2). Based on weekly classing data and the progression of harvest, it is estimated that cotton harvested prior to approximately November 18 was below average in bark. Cotton harvested after November 18 was above average in bark contamination.

Difference in Bark by Gin and Location

For the purposes of this analysis, a cotton gin is simply a representation/proxy for a group of producers. No inference is intended regarding ginning practices. The gin is simply a group of producers from the market area of the gin.

The degree of the problem with bark seemed to vary by gin and location. Classing data for individual gins (USDA Cotton Classing Office, Macon) indicates that some gins (growers) had a rather severe problem with bark while other gins (growers) had much less of a problem. Of 62 gins in Georgia, 16 gins (about one-fourth of the gins in the state) had less than 5% bark (Figure 3). On the other hand, 6 gins (or about 10%) had one-third or more of their cotton with bark.

One gin had almost no bark (.56%) while one gin had over 41% of its cotton with bark. Most gins (almost half) had 5% to 15% of bales with bark.

As previously mentioned, the 2012 crop had 12.4% of bales with bark. The simple average of all 62 gins (Figure 3) was about the same at 11.8%. This perhaps indicates that the incidence and degree of bark was fairly uniform across gin size.

Figure 3. Percent of Bales With Bark, By Gin.

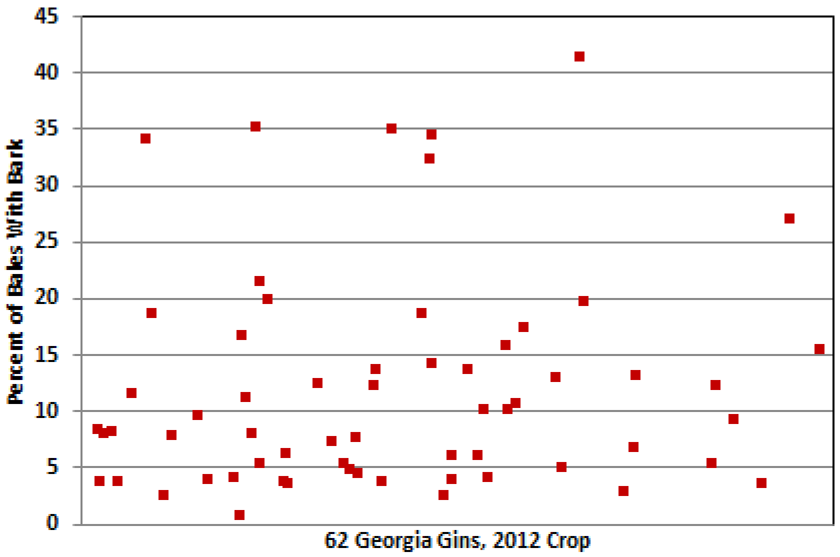
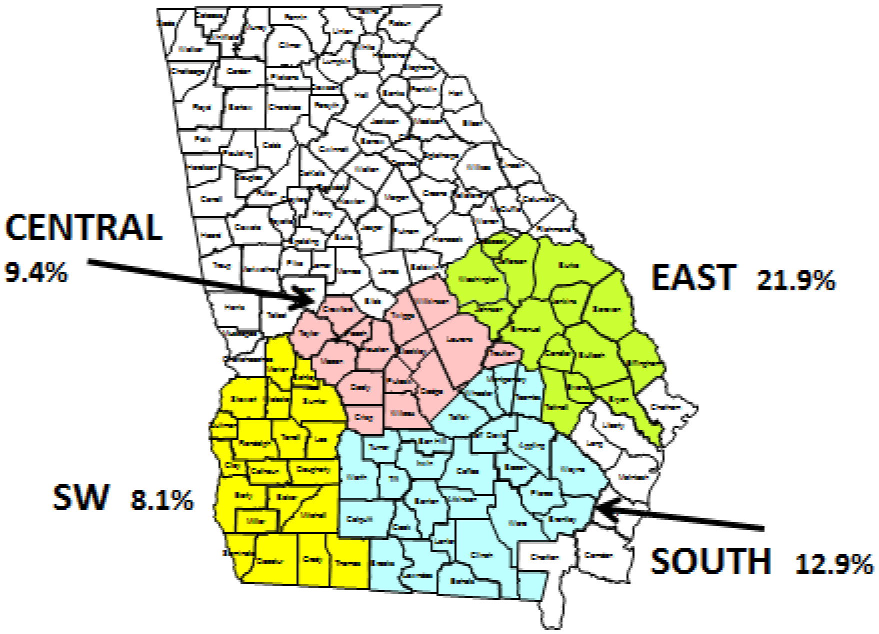


Figure 4. Cotton Grower Regions, Bark by Region



For this analysis, cotton-producing counties were placed into 1 of 4 regions (Figure 4). These regions were determined based on county location of the gin and the assumed majority market region for the gin. The purpose for this was to see if there were differences in the bark problem by location/region of the state. The analysis excludes 2 gins in the northern part of the state. These gins were omitted to avoid disclosure of individual data.

In the Southwest region, 8.1% of bales were discounted for bark. By comparison, 21.9% of bales in the East region had bark (Figure 4 and Table 2).

In the East region, there are 11 gins (grower groups). Of these 11 grower groups, the gin/group with the lowest bark problem had only 3.6% of bales with bark. The gin/group with the worst bark problem had 35.1% of bales with bark.

In the South region, there are 20 gins (grower groups). The gin/grower group with the worst bark problem had 41.3% of bales discounted for bark. By comparison, the gin/group with the least bark problem had only 2.4% of bales with bark.

The gin/grower group with the least bark problem was in the Central region with on .6% of bales with bark. The gin/grower group with the worst bark problem was in the South region with over 41% of bales with bark.

Table 2. Bark by Region and Gin/Grower Group.

Region[1]	# Gins (Grower Groups)	Percent of Bales Ginned With Bark	High Individual Group/Gin	Low Individual Group/Gin
Southwest	14	8.1%	15.4%	3.6%
South	20	12.9%	41.3%	2.4%
Central	15	9.4%	19.7%	0.6%
East	11	21.9%	35.1%	3.6%

1/ See Figure 4.

Discussion and Summary

The 2012 increase in bark prior to frost appeared to be caused by stalks shattering and tearing as the cotton was being harvested. Many opinions exist as to the cause(s) of the stalk shattering, however, no specific cause has been determined for all acres that resulted in barky cotton.

The sole purpose of this analysis was to examine fiber quality data in hopes that this might shed light on the problem. In doing so, aid to support or disprove the opinions or theories being tossed around about the reasons for the problem.

Classing data supports that the incidence of bark increases with later harvested cotton (Figure 1). The incidence of bark increases as the harvest season progresses due to weathering and frost. For the 2012 cotton crop, harvest was actually ahead of normal and not delayed (USDA-NASS). Weather during the harvest period has not been investigated but harvest timing itself suggests nothing unusual and does not explain the very dramatic increase in bark.

The 2012 crop was planted ahead of normal (USDA-NASS) but harvested at the normal time/pace. This means that, on average, the crop was in the field a little longer and perhaps took a little longer to mature. This is supported by the fact that progression of boll opening compared to normal appeared to slow down as the harvest season progressed (USDA-NASS). This could have been weather related.

Whatever the reason(s) for the dramatic increase in bark in 2012, classing data suggest the following:

- The bark problem appears to have been worse in the eastern part of the state
- The problem was highly variable and did not affect all growers equally
- There was high variability in the incidence of the problem even among growers/gins in close geographic proximity
- Other states, not just Georgia, also saw a marked increase in bark

Yield equals lint harvested per plant which is determined by boll load, bolls harvested, efficiency of harvest, and fiber length. Despite the increase in bark, the 2012 crop was a new record yield for Georgia.

Acknowledgements

Appreciation is expressed to the Georgia Cotton Commission and Cotton Incorporated for funding support. Special thanks to the USDA Cotton Classing Office in Macon for valuable assistance in assimilating gin-specific fiber quality data.

2012 COTTON OVT VARIETY TRIALS

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Introduction

The University of Georgia's 2012 Cotton Variety Trials (OVT) were conducted at five locations across Georgia, spanning the cotton belt from southwest to northeast Georgia. Irrigated trials were conducted on-farm in Decatur County and at UGA research and education centers in Midville, Plains, and Tifton. Dryland trials were conducted on University research and education centers in Athens, Midville, Plains, and Tifton. Performance data in these tables, combined with data from previous years should assist growers with variety selection, one of the most important if not most important decisions in an economically viable cotton production plan. Data collected from the University of Georgia Variety Testing Cotton Program can be found at the Statewide Variety Testing Website: www.swvt.uga.edu. Also, the data is published in the UGA Agricultural Experiment Station Annual Publication 104-3, January 2013.

Materials and Methods

The University of Georgia conducts Official Cotton Variety(OVT) and Strain(OST) trials across Georgia to provide growers, private industry, Extension specialists, and county agents with performance data to help in selecting high yielding adapted varieties. Data from the OVT assists the private seed companies to 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 Anton Coy, Senior Agricultural Specialist, Tifton, GA.

The OVT is split into released variety and strain trials with placement of varieties or strains into the particular trial chosen by its owner. Trials are separated by maturity. Irrigated OVT trials are conducted at Bainbridge, Midville, Plains, and Tifton, while dryland OVTs are conducted at Athens, Midville, Plains, and Tifton, thus varieties placed into the OVT are included in eight trials per year, giving a fair size data set with which to evaluate variety performance. The 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 cells. This system allows one person to harvest yield trials where the established bag-and-weigh approach required eight people or more. The electronic weigh system allowed for timely harvest of yield trials. Data from all trials and combined analyses over locations and years are reported as soon as fiber data are available from the test lab in Adobe PDF and Excel formats on the UGA Cotton Team Website maintained at www.ugacotton.com. Also, the data is available at the Statewide Variety Testing Website: www.swvt.uga.edu.

Results and Discussion

Agricultural producers in Georgia experienced another year of lower than normal rainfall. The state was dry as of March l, although there was adequate planting moisture in most areas. Planting progressed well ahead of 5-year averages. By early May, only a quarter of the state had adequate moisture. Except for south eastern Georgia, drought conditions continued through June. Irrigation began during early vegetative growth and continued through maturity in much of the state. Irrigation allowed 2/3 to 3/4 of the crop to remain in good condition throughout the season. Summer thunder storms were beneficial to some areas. Insect and disease pressure levels increased as the season progressed. Stink bugs were a concern in some areas.

Seasonal rainfall totals were 6 to 13 inches less than normal in north Georgia, with the most critical areas in the Limestone Valley region and Athens. In the Coastal Plain area rainfall was normal to 8 inches above long term average in the east and central to 17 inches below normal in the southwestern area around Plains. Extremely dry conditions (53% of normal rainfall) persisted for the last three years in Sumter (Plains) county and surrounding areas.

Crop maturity progressed ahead of the 5-year average and harvest conditions during 2012 were excellent. During 2012 Georgia cotton farmers planted 1.3 million acres-- 28% less than 2011.

The state 2012 average yield was 1,091 pounds per acre-- 38 percent higher than 2011and a new state record yield. This yield level totaled over harvested acres of cotton produced 2.9 million bales—a new record for cotton production in Georgia.

Among varieties in the Dryland Earlier Maturity Trials, PHY 499 WRF, DP 1137 B2RF, GA2009100, DP 1219 B2RF, DP 1028 B2RF, DP 1321 B2RF, and DP1034 B2RF stand out as varieties with high yield and relative yield stability in the dryland trials averaged over four locations (Table 1). There were also eight other varieties above average in yield (Table 1). When summarized over two years and four locations PHY 499 WRF was the top performer, while seven other varieties were above average (Table 2).

Among the best performing earlier maturing varieties produced under irrigation, DP 1137 B2RF and PHY 499 WRF were the top two highest in yield when averaged over locations (Table 3). Fourteen other varieties performed well and were above average in yield (Table 3). PHY 499 WRF was the top yielding variety when averaged over two years and locations in the Irrigated Early Maturity Trials conducted at Bainbridge, Midville, Plains, and Tifton (Table 4). Eight other varieties were above average in yield (Table 4).

The top yielding later maturity variety in the trial conducted without irrigation and averaged over four locations revealed the consistent performance of PHY 499WRF, CG 3787 B2RF, BX1348GLB2, DP 1252 B2RF, DP 1050 B2RF, and DG2610B2RF (Table 5). An additional four varieties were above average in yield (Table 5). Averaged over locations and years, PHY 499 WRF was the front runner along with four other varieties that yielded above average lint (Table 6).

Under irrigation, there were ten varieties, in the top significant group of the standard later maturing trials averaged over locations with DP 1252 B2RF, PHY 499 WRF, DP 1034 B2RF, PX 5322-11WRF, and NGX0012B2RF among the top five yielding varieties (Table 7). One other variety was above average in lint yield (Table7). Averaged over locations and two years, PHY 499 WRF and DP 1252 B2RF were the two front runners, while five other varieties were above average in yield (Table 8).

The Earlier Maturity and Later Maturity Strains Trials (OST) portend improved varieties for crop seasons 2013 and beyond (Tables 9). Varieties from Dow, All-Tex, Georgia, and Dyna-Gro, were high yielding performer among standard earlier and later maturing entries in the strains trial (Table 9).

For percent lint yield the total seed cotton from replicated plots of the 2012 Early and Later Maturity irrigated experiments at Tifton were processed through the Micro-gin, located on the UGA Tifton Campus and turn-out is presented in Table 10 and Table 11. To obtain quality fractions the Micro-ginned samples were sent to Starlab in Knoxville, TN for HVI analysis processing, and can be found in Tables 10 and 11.

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

Table 1. Yield Summary of Dryland Earlier Maturity Cotton Varieties, 2012

	Lint Yield[a]														
Variety	Athens		Midville		Plains		Tifton		4-Loc. Average		Lint	Unif. Index	Length	Strength	Mic.
	lb/acre										%	%	in	g/tex	units
PHY 499 WRF	**1439**	1	**2118**	1	**523**	26	**1465**	4	**1386**	1	46.3	84.4	1.14	30.4	5.2
DP 1137 B2RF	1168	4T	**2024**	2	**491**	28	**1561**	2	**1311**	2	45.3	84.0	1.14	27.7	4.8
GA2009100	**1330**	2	1921	3	**556**	17T	1342	15	**1287**	3	45.5	83.4	1.16	31.3	4.9
DP 1219 B2RF	1150	7	1866	5	**554**	18	**1572**	1	**1285**	4	44.8	83.5	1.18	30.8	4.8
DP 1028 B2RF	1143	8	1829	8	**648**	4	**1452**	7	**1268**	5	45.3	84.2	1.14	28.8	4.7
DP 1321B2RF	1089	12	1891	4	**605**	10	**1464**	5	**1262**	6	45.1	83.5	1.13	29.1	5.0
DP 1034 B2RF	1167	5	1841	7	**575**	15	**1456**	6	**1260**	7	46.0	84.2	1.17	28.2	4.7
PX 4339-06 WRF	1105	10	1757	14	**747**	1	**1402**	9	1253	8	44.9	84.5	1.17	29.9	4.8
PX-4339-CB WRF	1151	6	1812	9	**616**	8	1337	17	1229	9	44.4	83.7	1.15	29.2	4.8
BRS293	993	21T	1680	20	**619**	7	**1478**	3	1192	10	42.6	84.1	1.17	31.6	5.0
All-Tex LA122	1099	11	1844	6	**562**	16	1252	19	1189	11	44.9	84.6	1.16	29.3	4.7
DP 1311B2RF	1039	17	1806	10	**540**	22	1366	12	1188	12	44.8	83.4	1.17	28.0	4.9
FM1944 GLB2	865	28	1781	12	**689**	2	1391	10	1181	13	43.4	83.8	1.19	31.5	5.0
DP 0912 B2RF	1026	19	1746	16	**601**	12	1343	14	1179	14	43.6	83.5	1.12	29.1	5.3
GA2004143	997	20	1715	17	**603**	11	1388	11	1176	15	44.6	85.0	1.20	32.5	4.8
GA2006106	961	25	1762	13	**535**	23T	1340	16	1150	16	43.3	83.7	1.17	30.9	4.7
BX1346GLB2	1179	3	1681	19	**606**	9	1120	28	1146	17	44.9	83.4	1.14	29.2	4.9
Dyna-Gro 2570B2RF	1042	16	1561	26	**556**	17T	**1421**	8	1145	18	44.0	83.6	1.14	29.2	5.0
NG 1511 B2RF	1048	15	1750	15	**621**	6	1139	25	1140	19	46.6	83.4	1.13	29.6	5.0
SSG CT Linwood	984	23	1797	11	**634**	5	1129	27	1136	20	43.3	83.9	1.12	30.8	4.9
PHY 375 WRF	1168	4T	1644	23	**585**	13	1134	26	1133	21	44.6	83.5	1.14	29.0	4.6
DG2595 B2RF	1033	18	1660	21	**576**	14	1245	20	1128	22	44.5	83.2	1.15	29.3	5.1
All-Tex Nitro 44 B2RF	973	24	1698	18	**527**	24	1269	18	1117	23	43.4	84.3	1.19	31.5	4.3
BRS286	993	21T	1610	24	**672**	3	1184	23	1115	24	43.1	83.8	1.14	30.8	4.8
All-Tex 7A21	960	26	1596	25	**546**	21	1350	13	1113	25	43.9	84.0	1.16	29.8	4.8
PHY 367 WRF	1128	9	1484	28T	**547**	20	1187	22	1086	26	43.0	84.1	1.16	30.2	4.7
AM 1550 B2RF	1056	14	1484	28T	**553**	19	1161	24	1064	27	43.1	83.2	1.12	28.0	4.8
SSG HQ 210 CT	1067	13	1379	29	**510**	27	1239	21	1049	28	42.4	83.0	1.13	30.6	4.8
SSG AU 222	992	22	1650	22	**524**	25	988	30	1039	29	43	83.0	1.15	28.5	4.8
GA2008057	888	27	1547	27	**535**	23T	1048	29	1004	30	42.1	84.3	1.19	31.7	4.5
Average	1074		1731		582		1307		1174		44.2	83.8	1.15	29.9	4.8
LSD 0.10	137		184		N.S.[1]		179		12.6		1.5	0.8	0.03	1.4	0.3
CV %	10.8		9.0		23.5		11.7		11.9		2.7	1.2	0.03	5.1	4.8

[a] Superscripts indicate ranking at that location.

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

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

Table 2. Two-Year Summary of Dryland Earlier Maturity Cotton Varieties at Four Locations[a], 2011-2012

Variety	Lint Yield	Lint	Uniformity Index	Length	Strength	Micronaire
	lb/acre	%	%	inches	g/tex	units
PHY 499 WRF	**1397**	46.3	84.1	1.12	30.8	4.8
DP 1028 B2RF	1288	46.3	84.1	1.14	28.4	4.6
NG 1511 B2RF	1257	46.0	83.6	1.11	30	4.8
DP 0912 B2RF	1253	43.5	83.7	1.12	29.5	5.0
Dyna-Gro 2570B2RF	1182	43.3	83.6	1.12	29.4	4.7
All-Tex 7A21	1171	44.0	83.9	1.15	30.0	4.7
BRS293	1169	42.0	83.6	1.13	32.3	4.9
AM 1550 B2RF	1156	43.4	83.5	1.11	27.4	4.6
All-Tex LA122	1143	44.6	84.0	1.14	28.5	4.5
PHY 375 WRF	1142	44.4	83.4	1.11	28.6	4.3
GA2004143	1131	44.9	84.4	1.18	32.2	4.6
BRS286	1116	42.0	83.4	1.11	30.6	4.6
All-Tex Nitro 44 B2RF	1099	42.4	84.5	1.20	31.9	4.0
PHY 367 WRF	1086	43.5	83.8	1.14	29.9	4.4
GA2006106	1078	42.6	83.7	1.16	31.4	4.5
SSG HQ 210 CT	1064	41.9	82.8	1.12	30.6	4.7
SSG CT Linwood	1007	43.4	83.4	1.10	31.4	4.9
GA2008057	932	41.6	84.3	1.17	32.2	4.4
Average	1148	43.7	83.8	1.13	30.3	4.6
LSD 0.10	72	0.4	0.5	0.02	0.9	0.1
CV %	15.3	2.5	2.5	1.01	5.1	5.0

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

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

Table 3. Yield Summary of Earlier Maturity Cotton Varieties, 2012, 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 1137 B2RF	**1915**	2	**2384**	2	**2316**	1	**2091**	2	**2177**	1	44.0	84.2	1.15	26.6	4.3
PHY 499 WRF	**1922**	1	**2535**	1	2065	7	**2067**	3	**2147**	2	43.6	84.7	1.17	29.5	4.4
DP 1034 B2RF	**1911**	3	2056	18	**2171**	2	**2030**	5	2042	3	43.9	84.7	1.17	26.9	4.3
DP 1028 B2RF	**1762**	7	2249	5	**2144**	3	1913	7	2017	4	43.8	84.5	1.17	26.8	4.2
FM1944 GLB2	**1824**	5	2296	4	1909	16	**2036**	4	2016	5	40.2	84.4	1.23	31.0	4.0
DP 1219 B2RF	1658	14	2103	10	2036	8	**2143**	1	1985	6	42.0	84.0	1.21	30.9	4.1
PX 4339-06 WRF	1661	13	**2357**	3	2011	10	1816	17	1961	7	42.2	84	1.19	27.9	4.0
PX-4339-CB WRF	**1796**	6	2145	8	2024	9	1823	16	1947	8	41.8	84.5	1.21	27.6	4.1
GA2009100	**1841**	4	2126	9	1781	21	**2017**	6	1941	9	42.6	84.6	1.20	30.1	4.0
GA2004143	**1757**	8	2099	11	2079	6	1798	18	1933	10	43.1	84.5	1.22	31.3	4.3
DP 1311B2RF	1691	10	2153	7	1955	11	1895	8	1924	11	43.8	83.9	1.17	26.8	4.0
All-Tex Nitro 44 B2RF	1734	9	2058	17	1894	18	1885	9	1893	12	41.2	85.0	1.24	31.2	3.8
DG2595 B2RF	1550	20	2204	6	1908	17	1882	10	1886	13	40.8	83.5	1.17	28.2	4.4
NG 1511 B2RF	1536	22	2060	16	2105	4	1825	15	1881	14	43.0	84.1	1.14	27.3	4.3
BX1346GLB2	1645	15	2073	13	1947	13	1833	13	1874	15	41.6	83.9	1.15	28.8	4.0
All-Tex LA122	1565	19	1920	25	2100	5	1872	11	1864	16	43.0	84.3	1.17	27.1	4.0
All-Tex 7A21	1627	16	2045	21	1942	14	1759	21	1843	17	41.7	84.9	1.22	28.4	4.1
SSG AU 222	1544	21	2046	20	1939	15	1831	14	1840	18	41.4	84.2	1.21	27.8	4.2
GA2006106	1669	12	2017	23	1832	19	1836	12	1838	19	39.7	84.6	1.22	30.1	4.1
DP 0912 B2RF	1567	18	2086	12	1951	12	1743	23	1837	20	40.6	83.4	1.12	28.4	4.6
PHY 375 WRF	1514	25	2061	15	1746	23	1796	19	1779	21	42.0	83.3	1.15	27.7	3.9
BRS293	1679	11	1985	24	1696	26	1752	22	1778	22	39.8	84.2	1.18	29.9	4.5
SSG CT Linwood	1527	23	2047	19T	1717	24	1774	20	1766	23	41.8	84.2	1.12	29.5	4.7
DP 1321B2RF	1516	24	2063	14	1791	20	1668	26	1760	24	41.8	84.0	1.15	28.0	4.3
Dyna-Gro 2570B2RF	1477	26	2026	22	1655	28	1698	24	1714	25	39.4	84.1	1.16	28.9	4.4
AM 1550 B2RF	1609	17	1809	27	1776	22	1604	27	1700	26	40.2	83.3	1.13	26.8	4.1
GA2008057	1419	27	2047	19T	1638	29	1582	29	1671	27	40.1	85.0	1.23	30.7	4.0
BRS286	1410	28	1749	29	1595	30	1683	25	1609	28	39.4	84.0	1.16	30.3	4.3
SSG HQ 210 CT	1325	30	1829	26	1660	27	1587	28	1600	29	40.2	83.8	1.17	29.4	4.2
PHY 367 WRF	1360	29	1781	28	1710	25	1539	30	1598	30	39.9	83.4	1.16	28.2	4.0
Average	1634		2080		1903		1826		1861		41.6	84.2	1.18	28.7	4.2
LSD 0.10	184		223		184		160		110		1.1	0.7	0.02	1.1	0.2
CV %	9.6		9.2		8.2		7.4		8.5		2.6	1.1	1.99	4.4	5.8

[a] Superscripts indicate ranking at that location.

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

Table 4. Two-Year Summary of Earlier Maturity Cotton Varieties at Four Locations[a], 2011-2012, Irrigated

Variety	Lint Yield	Lint	Uniformity Index	Length	Strength	Micronaire
	lb/acre	%	%	inches	g/tex	units
PHY 499 WRF	**2143**	45.0	84.8	1.16	30.9	4.5
DP 1028 B2RF	2046	45.0	84.8	1.16	27.7	4.5
NG 1511 B2RF	1998	44.4	84.2	1.15	28.6	4.5
DP 0912 B2RF	1996	42.1	83.7	1.13	29.0	4.6
GA2004143	1920	43.6	84.9	1.22	32.6	4.3
All-Tex 7A21	1870	43.0	84.8	1.20	29.7	4.3
All-Tex Nitro 44 B2RF	1866	41.6	85.0	1.24	31.7	3.8
PHY 375 WRF	1865	43.1	83.8	1.15	28.4	4.1
All-Tex LA122	1845	43.6	84.5	1.17	28.1	4.2
GA2006106	1827	40.9	84.7	1.22	31.7	4.3
Dyna-Gro 2570B2RF	1816	40.9	84.4	1.16	29.6	4.4
BRS293	1781	40.8	84.1	1.17	32.0	4.5
AM 1550 B2RF	1779	41.2	83.8	1.14	27.5	4.3
PHY 367 WRF	1758	41.5	84.0	1.17	29.0	4.2
SSG CT Linwood	1690	42.2	84.5	1.12	31.6	4.9
SSG HQ 210 CT	1678	40.4	83.6	1.16	30.5	4.4
BRS286	1677	40.4	83.7	1.15	31.0	4.4
GA2008057	1586	40.6	85.1	1.22	32.1	4.1
Average	1841	42.2	84.4	1.17	30.1	4.3
LSD 0.10	72	0.4	0.5	0.01	0.8	0.1
CV %	9.5	2.5	1.0	1.96	4.6	5.4

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

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

Table 5. Yield Summary of Dryland Later Maturity Cotton Varieties, 2012

	Lint Yield[a]														
Variety	Athens		Midville		Plains		Tifton		4-Loc. Average		Lint	Unif. Index	Length	Strength	Mic.
	---------------------------- lb/acre								----------------------------		%	%	in	g/tex	units
PHY 499 WRF	**1270**	2	**2325**	1	516	14	**1235**	2	**1337**	1	45.6	83.6	1.14	30.1	5.0
CG 3787 B2RF	**1218**	4	1961	10	488	19	**1279**	1	**1236**	2	46.6	84.3	1.16	28.1	4.8
BX1348GLB2	**1156**	11	2011	7	519	13	**1178**	3	**1216**	3	43.5	83.5	1.20	29.6	4.8
DP 1252 B2RF	1135	13	2103	3	**705**	1	899	12	**1210**	4	46.9	84.5	1.16	27.5	4.9
DP 1050 B2RF	**1216**	5	2012	6	549	8	1043	6	**1205**	5	45.8	83.3	1.15	28.8	4.9
DG2610 B2RF	**1287**	1	1995	9	589	4	943	11	**1204**	6	45.8	83.7	1.16	28.9	4.8
PX 5322-11 WRF	**1186**	8	2061	4	484	21T	1001	7	**1183**	7	42.9	84.1	1.20	28.9	4.6
NGX0012B2RF	**1157**	10	2027	5	532	12	958	9	1168	8	45.4	84.2	1.16	27.7	4.9
DP 1137 B2RF	**1206**	6	2105	2	508	16	835	18	1163	9	46.4	83.4	1.14	27.9	5.1
GA2004230	**1164**	9	2010	8	484	21T	896	13	1139	10	43.4	84.2	1.21	30.8	4.7
DP 1048 B2RF	**1154**	12	1927	11	482	22	889	15	1113	11	46.0	84.1	1.17	28.8	4.9
PHY 565 WRF	935	23	1789	13	563	6	**1107**	4	1099	12	43.6	83.3	1.15	30.5	5.0
GA2007095	**1246**	3	1704	18	534	11	893	14	1094	13	43.3	83.3	1.19	29.8	4.7
MON 11R136B2R2	1012	17	1753	15	539	10	988	8	1073	14	43.7	84.5	1.22	32.1	4.7
DP 1359 B2RF	1014	16	1680	19	486	20	1078	5	1064	15	44.9	82.7	1.15	31.8	4.9
DP 1034 B2RF	**1200**	7	1585	21	**622**	3	803	19	1053	16	46.2	84.0	1.14	28.1	4.9
PHY 375 WRF	1011	18	1751	16	556	7	860	17	1044	17	44.9	83.2	1.14	28.8	4.7
MON 11R154B2R2	1016	15	1847	12	506	17	790	20	1040	18	43.3	83.8	1.18	31.9	4.8
PHY 440 W	994	19	1711	17	**637**	2	728	21	1018	19	43.9	83.7	1.12	30.6	4.8
NG 1511 B2RF	1070	14	1786	14	502	18	674	22	1008	20	45.4	83.5	1.15	30.3	4.9
GA2008083	936	22	1603	20	514	15	951	10	1001	21	43.8	83.1	1.13	30.9	4.9
All-Tex Nitro 44 B2RF	940	20	1493	22	584	5	610	23	907	22	44.2	84.3	1.20	30.9	4.6
SSG CT310 HQ	938	21	1241	23	547	9	869	16	899	23	41.3	83.7	1.14	31.9	4.9
Average	1107		1847		541		935		1108		44.6	83.7	1.16	29.8	4.8
LSD 0.10	222		188		225		171		152		0.8	0.7	0.02	0.8	0.2
CV %	11.5		7.8		10.9		7.6		9.4		1.7	1.2	1.93	3.9	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 (P = 0.10).

Table 6. Two-Year Summary of Dryland Later Maturity Cotton Varieties at Four Locations[a], 2011-2012

Variety	Lint Yield	Lint	Uniformity Index	Length	Strength	Micronaire
	lb/acre	%	%	inches	g/tex	units
PHY 499 WRF	**1360**	46.1	83.6	1.12	30.7	4.7
DP 1050 B2RF	1224	45.7	83.3	1.13	27.9	4.7
DP 1137 B2RF	1211	45.8	83.7	1.13	28.2	4.9
DP 1252 B2RF	1190	46.7	84.1	1.14	27.8	4.7
DP 1048 B2RF	1171	45.7	83.8	1.14	28.4	4.6
NG 1511 B2RF	1134	45.4	83.5	1.12	30.1	4.7
DP 1034 B2RF	1120	45.6	83.7	1.13	27.7	4.6
GA2004230	1104	42.7	83.8	1.19	30.4	4.5
PHY 565 WRF	1081	42.6	83.3	1.13	30.3	4.5
GA2007095	1073	42.5	83.3	1.16	29.8	4.5
PHY 375 WRF	1056	44.5	83.0	1.12	28.3	4.4
PHY 440 W	1029	43.0	83.7	1.11	30.8	4.5
GA2008083	955	44.7	82.8	1.11	31.3	4.7
Average	1131	44.7	83.5	1.13	29.4	4.6
LSD 0.10	62	0.4	0.5	0.02	0.7	0.1
CV %	13.3	2.3	1.1	2.37	4.3	5.0

[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, 2011, 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 1252 B2RF	1600^{11}	**2411**^{2}	**2142**^{1}	**2183**^{1}	**2084**^{1T}	45.4	84.4	1.16	26.6	4.2
PHY 499 WRF	1718^{8}	**2476**^{1}	**2111**^{3}	**2033**^{5}	**2084**^{1T}	43.6	84.9	1.19	28.6	4.3
DP 1034 B2RF	**1995**^{2}	2204^{8}	**2027**^{5}	**2021**^{6}	**2062**^{2}	44.5	84.3	1.18	26.3	4.1
PX 5322-11 WRF	1794^{5}	**2303**^{4}	**1954**^{8}	**2120**^{2}	**2043**^{6}	41.2	84.4	1.24	27.2	3.8
NGX0012B2RF	1795^{4}	**2298**^{5}	**1945**^{9}	**2105**^{3T}	**2036**^{4}	44.4	84.4	1.18	26.0	4.1
DP 1050 B2RF	**2025**^{1}	2107^{12}	1897^{10}	**2105**^{3T}	**2033**^{5}	43.9	83.9	1.18	26.6	4.0
DP 1137 B2RF	1792^{6}	**2403**^{3}	**2054**^{4}	1858^{12}	**2027**^{6}	44.0	84.4	1.15	26.6	4.2
DG2610 B2RF	1689^{9}	2165^{10}	**2137**^{2}	**2081**^{4}	**2018**^{7T}	43.8	84.5	1.19	27.1	4.1
DP 1048 B2RF	**1825**^{3}	2238^{7}	**1992**^{6}	**2017**^{7}	**2018**^{7T}	43.6	84.3	1.19	26.0	4.2
CG 3787 B2RF	1765^{7}	2280^{6}	**1962**^{7}	2005^{8}	**2003**^{8}	44.3	84.6	1.17	26.7	4.2
BX1348GLB2	1588^{12}	2193^{9}	1606^{17}	2001^{9}	1847^{9}	40.7	84.7	1.25	29.2	4.0
GA2004230	1510^{15}	2114^{11}	1702^{13}	1822^{16}	1787^{10}	40.5	85.1	1.27	29.4	3.8
All-Tex Nitro 44 B2RF	1613^{10}	1986^{17}	1665^{14}	1839^{13T}	1776^{11}	40.6	85.0	1.26	30.6	3.6
NG 1511 B2RF	1577^{13}	1972^{19}	1650^{16}	1830^{15}	1757^{12}	43.0	84.0	1.15	28.3	4.1
MON 11R136B2R2	1490^{16}	1988^{16}	1652^{15}	1839^{13T}	1742^{13}	41.0	86.0	1.26	30.2	3.9
GA2007095	1485^{17}	2065^{13}	1521^{19}	1835^{14}	1727^{14}	40.9	84.7	1.20	28.9	4.0
DP 1359 B2RF	1538^{14}	1985^{18}	1459^{21}	1905^{11}	1722^{15}	42.9	83.4	1.20	29.9	4.0
PHY 565 WRF	1367^{18}	1892^{21}	1769^{11}	1762^{17}	1697^{16}	41.1	84.2	1.20	29.4	3.9
PHY 440 W	1318^{21}	1911^{20}	1721^{12}	1637^{20}	1647^{17}	40.2	84.4	1.17	28.9	4.1
PHY 375 WRF	1357^{19}	2016^{15}	1472^{20}	1638^{19}	1621^{18}	41.5	83.7	1.15	27.5	3.7
MON 11R154B2R2	1161^{23}	1727^{22}	1582^{18}	1908^{10}	1594^{19}	42.4	83.2	1.20	31.0	3.9
GA2008083	1221^{22}	2062^{14}	1271^{22}	1720^{18}	1568^{20}	42.0	83.7	1.19	29.9	4.0
SSG CT310 HQ	1321^{20}	1693^{23}	914^{23}	1352^{21}	1320^{21}	37.7	83.7	1.15	32.1	4.0
Average	1589	2108	1748	1896	1835	42.3	84.3	1.19	28.4	4.0
LSD 0.10	222	188	225	171	152	0.8	0.7	0.02	0.8	0.2
CV %	11.5	7.8	10.9	7.6	9.4	1.7	1.2	1.93	3.9	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 (P = 0.10).

Table 8. Two-Year Summary of Later Maturity Cotton Varieties at Four Locations[a], 2011-2012, Irrigated

Variety	Lint Yield	Lint	Uniformity Index	Length	Strength	Micronaire
	lb/acre	%	%	inches	g/tex	units
PHY 499 WRF	**2132**	44.1	84.9	1.17	30.5	4.4
DP 1252 B2RF	**2090**	45.8	84.7	1.17	27.9	4.3
DP 1050 B2RF	2058	45.0	84.5	1.18	27.5	4.3
DP 1137 B2RF	2033	44.5	84.7	1.16	27.5	4.4
DP 1048 B2RF	2019	44.0	84.6	1.19	27.3	4.3
DP 1034 B2RF	2015	45.1	84.7	1.18	27.0	4.4
NG 1511 B2RF	1931	43.9	84.4	1.15	29.2	4.4
GA2004230	1823	41.2	84.9	1.25	30.4	4.1
GA2007095	1803	41.4	84.6	1.19	30.1	4.3
PHY 375 WRF	1757	42.6	84.0	1.16	28.4	4.0
PHY 565 WRF	1744	41.6	84.6	1.19	30.7	4.1
GA2008083	1692	43.2	84.1	1.18	30.6	4.3
PHY 440 W	1654	40.7	84.6	1.17	29.8	4.2
Average	1904	43.3	84.6	1.18	29.0	4.3
LSD 0.10	68	0.4	N.S.[1]	0.01	1.6	0.1
CV %	8.7	2.0	0.9	2.04	3.7	5.3

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

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

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

Table 9. Yield Summary of Cotton Strains, 2012, Irrigated

	Lint Yield[a]								
Variety	Midville	Plains	Tifton	3-Loc. Average	Lint	Unif. Index	Length	Strength	Mic.
	---------------------- lb/acre			----------------------	%	%	inches	g/tex	units
PX 5403-05WRF	**2327** ^{1}	**1796** ^{1}	**2438** ^{1}	**2187** ^{1}	43.0	85.1	1.23	30.9	3.9
PX 3122-40 WRF	**2299** ^{2}	1536 ^{3}	**2376** ^{2}	**2070** ^{2}	44.9	85.3	1.20	30.1	4.0
All-Tex 9C253 B2RF	**2144** ^{3}	**1623** ^{2}	1985 ^{7}	1918 ^{3}	43.0	84.0	1.15	29.9	4.5
GA2010098	2056 ^{5}	1470 ^{4}	**2185** ^{3}	1904 ^{4}	41.6	84.5	1.23	29.7	4.0
GA2009037	**2140** ^{4}	1415 ^{7}	2073 ^{6}	1876 ^{5}	42.5	84.2	1.20	29.5	4.6
DG CT12214	2017 ^{8}	1340 ^{8}	2108 ^{5}	1822 ^{6}	41.3	84.4	1.18	27.3	4.0
GA2008016	2042 ^{6}	1173 ^{9}	**2152** ^{4}	1789 ^{7}	40.6	85.1	1.22	33.1	4.5
All-Tex CR103233 B2RF	2003 ^{9}	1427 ^{6}	1684 ^{11}	1705 ^{8}	43.3	83.1	1.20	26.7	4.0
All-Tex 981221501 B2RF	1688 ^{13}	1439 ^{5}	1885 ^{9}	1671 ^{9}	41.4	85.8	1.23	31.6	4.1
GA2009180	2020 ^{7}	1165 ^{10}	1729 ^{10}	1638 ^{10}	43.3	85.6	1.24	31.5	4.3
GA2009148	1877 ^{11}	1146 ^{11}	1886 ^{8}	1636 ^{11}	42.8	84.4	1.19	31.2	4.6
GA2009147	1988 ^{10}	1075 ^{13}	1650 ^{12}	1571 ^{12}	40.6	83.9	1.20	32.2	4.0
All-Tex CR106466 B2RF	1755 ^{12}	1133 ^{12}	1556 ^{13}	1481 ^{13}	38.1	82.7	1.17	27.8	3.5
Average	2027	1365	1978	1790	42.0	84.5	1.20	30.1	4.1
LSD 0.10	199	226	318	188	1.6	0.9	0.20	1.3	0.2
CV %	8.2	13.8	13.5	11.8	2.6	1.1	2.28	3.9	6.1

[a] Superscripts indicate ranking at that location.

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

Table 10. Tifton, Georgia: Earlier Maturity Cotton Variety Performance Micro-Gin Quality Data, 2012, Irrigated

Variety	Lint Yield	Lint*	Uniformity Index*	Length*	Strength*	Micronaire*
	lb/acre	%	%	inches	g/tex	units
DP 1219 B2RF	**2143**	40.0	82.9	1.20	31.1	4.4
DP 1137 B2RF	**2091**	41.4	84.4	1.16	25.9	4.7
PHY 499 WRF	**2067**	41.0	83.5	1.16	29.3	4.8
FM1944 GLB2	**2036**	38.0	83.8	1.22	30.1	4.5
DP 1034 B2RF	**2030**	41.2	84.0	1.16	27.4	4.7
GA2009100	**2017**	39.8	84.3	1.22	31.0	4.1
DP 1028 B2RF	1913	39.1	83.5	1.16	26.6	4.4
DP 1311 B2RF	1895	41.7	83.4	1.18	26.6	4.3
All-Tex Nitro 44 B2RF	1885	37.8	84.7	1.25	32.1	3.9
DG2595 B2RF	1882	38.1	83.8	1.18	29.6	4.9
All-Tex LA122	1872	39.4	84.2	1.18	26.8	4.1
GA2006106	1836	37.4	84.0	1.22	29.9	4.3
BX1346GLB2	1833	38.3	83.5	1.14	27.5	4.4
SSG AU 222	1831	37.8	83.4	1.19	27.6	4.3
NG 1511 B2RF	1825	39.1	83.2	1.11	27.8	4.8
PX-4339-CB WRF	1823	39.1	83.9	1.21	27.3	4.5
PX 4339-06 WRF	1816	39.0	83.4	1.18	28.7	4.3
GA2004143	1798	41.2	84.6	1.20	29.9	4.8
PHY 375 WRF	1796	39.9	83.0	1.16	27.8	4.4
SSG CT Linwood	1774	39.0	83.7	1.15	30.3	4.8
All-Tex 7A21	1759	39.0	83.8	1.20	28.6	4.2
BRS293	1752	37.5	83.2	1.16	30.7	4.6
DP 0912 B2RF	1743	37.4	82.4	1.13	27.9	5.0
Dyna-Gro 2570B2RF	1698	38.4	83.0	1.14	29.0	4.8
BRS286	1683	37.2	83.5	1.17	29.9	4.6
DP 1321 B2RF	1668	39.1	83.1	1.14	27.4	4.9
AM 1550 B2RF	1604	37.8	82.9	1.14	25.8	4.7
SSG HQ 210 CT	1587	36.4	82.4	1.16	27.8	4.5
GA2008057	1582	36.5	83.9	1.23	29.8	4.3
PHY 367 WRF	1539	37.7	83.0	1.16	28.1	4.2
Average	1826	38.9	83.5	1.17	28.6	4.5
LSD 0.10	160	0.8	1.0	0.03	1.6	0.3
CV %	7.4	1.8	0.7	1.35	3.2	3.9

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

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

Planted:	April 30, 2012.
Harvested:	September 28, 2012.
Seeding Rate:	4 seeds/foot in 36' rows.
Soil Type:	Tifton loam.
Soil Test:	P = Medium, K = Medium, and pH = 5.9.
Fertilization:	18 lb N, 54 lb P_2O_5, and 108 lb K_2O/acre. Sidedress: 80 lb N and 60 lb K_2O/acre.
Previous Crop	Peanuts.
Management:	Disked, ripped, and bedded; Prowl, Cotoran, and Reflex used for weed control; Bidrin and Tracer used for insect control; Temik applied 5 lb/acre.

	April	May	June	July	Aug.	Sept.	Oct.
Irrigation (in):	0.80	0.50	0.80	3.00	0	0	0
Rainfall (in):	1.13	3.20	4.61	3.20	9.95	2.21	2.48

Trials conducted by A. Coy, R. Brooke, D. Dunn, S. Willis and L. Thompson.

Table 11. Tifton, Georgia: Later Maturity Cotton Variety Performance Micro-Gin Quality Data, 2012, Irrigated

Variety	Lint Yield	Lint*	Uniformity Index*	Length*	Strength*	Micronaire*
	lb/acre	%	%	inches	g/tex	units
DP 1252 B2RF	**2183**	43.2	84.1	1.17	26.9	4.3
PX 5322-11 WRF	**2120**	38.4	84.3	1.25	27.0	4.0
NGX0012B2RF	**2105**	42.0	84.4	1.20	26.2	4.4
DP 1050 B2RF	**2105**	41.8	84.1	1.19	26.5	4.3
DG2610 B2RF	**2081**	41.5	84.6	1.19	26.9	4.3
PHY 499 WRF	**2033**	41.4	84.1	1.17	28.8	4.5
DP 1034 B2RF	**2021**	42.1	83.8	1.20	26.2	4.4
DP 1048 B2RF	**2017**	41.5	84.3	1.20	25.7	4.3
CG 3787 B2RF	2005	42.1	84.9	1.20	27.2	4.4
BX1348GLB2	2001	38.7	83.8	1.25	29.1	4.3
MON 11R154B2R2	1908	40.8	84.1	1.21	30.5	4.5
DP 1359 B2RF	1905	40.1	83.0	1.20	30.5	4.4
DP 1137 B2RF	1858	41.5	84.5	1.18	28.0	4.5
All-Tex Nitro 44 B2RF	1839	37.8	85.2	1.27	31.3	3.8
MON 11R136B2R2	1839	38.9	85.7	1.27	31.3	4.1
GA2007095	1835	38.2	83.7	1.19	29.5	4.3
NG 1511 B2RF	1830	39.5	82.9	1.16	28.7	4.4
GA2004230	1822	38.5	84.2	1.26	30.1	3.9
PHY 565 WRF	1762	38.6	84.3	1.20	29.9	4.1
GA2008083	1720	39.6	84.1	1.17	30.8	4.3
PHY 375 WRF	1638	38.8	83.6	1.15	27.9	4.2
PHY 440 W	1637	37.5	84.4	1.18	29.3	4.2
SSG CT310 HQ	1352	34.5	83.4	1.16	33.1	4.2
Average	1896	39.9	84.1	1.20	28.7	4.2
LSD 0.10	171	0.4	N.S.[1]	0.03	1.8	0.2
CV %	7.6	0.9	0.8	1.42	3.6	3.3

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

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

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

Planted:	April 30, 2012.
Harvested:	September 28, 2012.
Seeding Rate:	4 seeds/foot in 36' rows.
Soil Type:	Tifton loam.
Soil Test:	P = Medium, K = Medium, and pH = 5.9.
Fertilization:	18 lb N, 54 lb P_2O_5, and 108 lb K_2O/acre. Sidedress: 80 lb N and 60 lb K_2O/acre.
Previous Crop:	Peanuts.
Management:	Disked, ripped and bedded; Prowl, Cotoran and Reflex used for weed control; Bidrin and Tracer used for insect control; Temik applied 5 lb/acre.

	April	May	June	July	Aug.	Sept.	Oct.
Irrigation (in):	0.80	0.50	0.80	3.00	0	0	0
Rainfall (in):	1.13	3.20	4.61	3.20	9.95	2.21	2.48

Trials conducted by A. Coy, R. Brooke, D. Dunn, S. Willis and L. Thompson.

BREEDING CULTIVARS AND GERMPLASM WITH ENHANCED YIELD AND QUALITY, 2012

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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 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 2012 production season.

Materials and Methods

Our crosses mate elite University of Georgia breeding lines with promising germplasm and non-transgenic commercial cultivars to produce 12 sets of 6 half-sib families for 2012. 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 230, 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.

Selections normally are advanced to F_4 progeny rows in Plains, GA, 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 230 with two secondary check cultivars. 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 230 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, later-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 2012 PTs were conducted at the William Gibbs Research Farm, UGA – Tifton Campus, Tifton, GA in fields 04211, 04213, 04253, 04261, 04262, 04263, and 04264. Each PT had between 14 and 31 F_5 breeding lines and 2 commercial conventional checks (GA 230 and Deltapine DP 493) in a three replicate, randomized complete block designs for a total of 111 experimental entries. The Advanced Trials (AT1 and AT2) were conducted at the University of Georgia – Tifton campus, Tifton, GA (at the William Gibbs Research Farm, fields 04240, 04241, and 04242) and Southwest Georgia Research and Education Center, Plains, GA (in fields 25/26). The AT1 consisted of 28 experimental F_7 entries retested from 2011 because of poor emergence. The AT2 consisted of 25 F_6 entries considered the best from the PTs grown in 2011. The trials were planted in a three replicate, randomized complete block design with GA 230, GA 2004303, GA 2004143, and Monsanto DP 493 as the four checks. 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 2012 Georgia Official Strains Trial (OST) and Official Variety Trials (OVTs) (Day and Thompson, 2013).

Results and Discussion

Seven of our lines (GA 230, GA 2007095, and GA 2008083 with the later maturing varieties and GA 2004143, GA 2006106, GA 2008057, and GA 2009100 with the earlier maturing varieties) were tested in the 2012 GA OVTs (Day and Thompson, 2013). The following is a general synopsis of these lines with further details found in the Georgia 2012 Peanut, Cotton, and Tobacco Performance Tests (Coy et al., 2013).

In the irrigated Earlier Maturity Trial, GA 2009100 and GA 2004143 were ranked 9th and 10th over all of the locations for lint yield out of 30 entries. All of the entries that we entered have a superb fiber quality package. GA 2009100 appears to perform better than most of its competitors in a dry condition; it ranked 3rd overall in lint yield this year within the dryland trial. It was decided to give GA 2006106 another chance in 2012, but as it did in 2010 and 2011, it was good in 2012 but not good enough. GA 2008057 also again compared poorly to the best yielding variety this year, but even with its excellent strength (2nd ranking overall), it won't be tested further. GA 2009100 and GA 2004143 had some excellent yields and ranked toward the top of the test, thus showing the eliteness of our program.

In the Later Maturity Trial, the three GA entries (GA 230, GA 2007095, and GA 2008083) ranked overall from the middle to the bottom third of the trial, respectively. GA 230 and GA 2007095 persist in showing solid fiber packages in the irrigated trial while there was some separation in the dryland trial. GA 230 continues to show excellent length under all conditions with very good uniformity, strength, and micronaire except for one instance in the dryland test in Plains. Oddly enough it appeared normal (i.e., among the longest cotton) in the irrigated test in Plains. GA 2008083 did not fare well enough in yield or quality and will be dropped.

Five lines were retested last year in the 2012 Georgia OSTs (GA 2008016, GA 2009037, GA 2009147, GA 2009148, and GA 2009180) with one new line GA 2010098 (Day et al., 2013). The other line from 2011 GA 2009100 was promoted to the 2012 GA OVTs. The entire group has solid to excellent fiber packages, as good as or better than the competition. The new entry GA 2010098 was the best yielder of our material and ranked 4th across the three locations (Midville, Plains, and Tifton) though significantly less than the top entry. Our next best yielders GA 2009037 and GA 2008016 will also be promoted to the 2012 GA OVTs with GA 2010098.

The 2011 AT1 trial was replanted as the 2012 AT1 trial and the 2012 AT2 trial was of promoted lines from the 2011 PT tests, both of which were in our two standard locations Tifton and Plains. Both of the trials had interactions between the cultivars and the locations, and oddly enough the traits that did not have the interactions were not the same across AT1 and AT2 except for the length measure UHM (Table 1 and Table 2). Tables 3 to 6 show the individual performances of the lines within their locations. This also shows the variability of the response of the lines to the two differing locations. An additional trial called the Elite Trial will be planted in 2013 with the best 25 lines of these two AT trials (a weaker selection pressure than we normally use at this stage) so the proper selections can be made with these lines.

From the 2012 PTs, twenty-six lines were selected for testing in the 2013 AT1 trial based primarily on lint yield and fiber qualities as compared to checks. Higher lint % and uniformity index as well as of course increased lint yield are the primary components of the selection within these populations looking to develop a cultivar better than our GA 230.

Based on lint yield comparisons and fiber quality measures, one hundred thirty-eight F_4 progenies were selected for placement in the 2013 PTs, more than we normally have had in total. Twenty populations from the 2012 F_2 yield test were selected for placement in the 2013 F_3 nursery for single plant selections.

Seventy-one F_1 crosses 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 2013 F_2 yield tests to determine the suitability of the germplasm populations to be further tested.

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Table 1. Results of 2012 Advanced (F_7) Trial 1.

ENTRY	Lint Yield, lbs./acre	Lint %	UHM in.	UI %	mic	Str g/tex
GA 2010019	1475	42.0	1.22	85.5	4.7	32.6
GA 2010076	1469	41.7	1.23	84.9	5.1	**35.7**
GA 2010102	1463	40.0	1.24	85.4	5.1	34.8
GA 2004143	1413	43.5	1.23	84.9	4.8	34.0
GA 2010085	1409	43.5	**1.27**	85.0	4.6	33.1
GA 2010079	1400	41.4	1.23	84.6	5.1	33.6
GA 2010074	1399	42.9	1.21	84.9	5.2	33.4
GA 2010064	1385	41.6	1.25	85.8	4.7	33.6
GA 2010002	1376	41.9	**1.27**	85.9	5.0	34.5
GA 2010052	1371	41.9	1.22	85.2	4.6	32.8
GA 2004303	1370	42.3	1.19	84.8	5.1	33.4
GA 2010032	1369	42.8	**1.28**	84.9	4.5	32.7
GA 2010106	1362	41.9	1.24	85.6	4.6	33.2
GA 2010070	1362	43.2	1.23	85.3	4.7	33.9
DP 493	1357	41.9	1.22	84.6	4.9	32.2
GA 2010063	1354	43.3	1.22	85.4	5.0	33.5
GA 2010016	1326	40.6	1.24	85.2	4.7	33.0
GA 2010069	1326	42.2	1.24	85.8	4.9	33.4
GA 2010038	1314	41.4	1.24	85.6	4.5	34.7
GA 230	1299	40.2	1.21	85.1	4.8	33.2
GA 2010098	1291	39.8	1.23	85.2	5.1	32.6
GA 2010047	1287	42.4	1.22	85.8	4.9	32.7
GA 2010086	1283	41.9	1.24	85.7	4.8	32.4
GA 2010068	1273	42.1	1.23	85.6	4.6	33.0
GA 2010024	1262	41.2	**1.27**	85.7	4.5	33.0
GA 2010030	1253	41.3	**1.27**	85.7	4.6	32.5
GA 2010049	1249	40.2	**1.27**	85.3	4.9	33.7
GA 2010050	1249	39.3	1.24	85.1	4.9	33.1
GA 2010067	1213	41.3	1.25	86.3	4.8	34.4
GA 2010021	1168	40.2	1.24	85.3	4.5	32.8
GA 2010015	1095	41.4	1.24	85.5	4.9	33.2
GA 2010058	1054	42.5	1.23	84.7	4.6	32.1
Cultivar by Location interaction	**	†	NS	*	***	NS
$\text{LSD}_{0.10}$			**1.26**			**34.9**

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 493, GA 230, GA 2004143, and GA 2004303 are check varieties for comparison purposes.

Table 2. Results of 2012 Advanced (F_6) Trial 2.

ENTRY	Lint Yield, lbs./acre	Lint %	UHM in.	UI %	mic	Str g/tex
GA 2011004	1444	**45.7**	1.18	84.8	**5.2**	31.1
GA 2011191	1442	43.6	1.19	84.7	5.1	31.3
GA 2011113	1405	42.8	1.19	85.0	**5.2**	31.4
GA 2011156	1392	44.0	1.20	84.8	**5.2**	31.2
GA 2011093	1391	42.5	1.21	85.9	**5.2**	32.5
GA 2011005	1375	44.6	1.19	85.7	5.0	32.3
GA 2011158	1370	44.3	1.18	85.0	**5.3**	31.8
GA 2011124	1364	44.4	1.17	84.8	**5.3**	30.7
GA 2011042	1334	43.8	1.21	84.2	4.9	32.0
GA 2004303	1322	43.2	1.20	84.7	5.0	32.1
GA 230	1319	43.0	1.19	85.1	5.1	31.1
GA 2011167	1309	41.1	1.17	84.8	5.1	32.5
GA 2004143	1307	45.0	1.19	84.8	4.9	33.0
GA 2011021	1275	43.1	**1.23**	85.3	4.9	32.0
DP 493	1264	44.0	1.17	83.9	5.0	32.0
GA 2011013	1261	**46.6**	1.18	85.5	4.9	32.8
GA 2011181	1259	43.3	1.17	84.5	**5.4**	31.9
GA 2011061	1253	44.6	1.16	84.8	**5.2**	30.4
GA 2011174	1222	41.7	1.17	84.9	**5.4**	33.0
GA 2011015	1216	42.6	**1.25**	85.8	4.6	33.7
GA 2011030	1211	41.9	1.21	85.2	5.0	32.0
GA 2011108	1205	41.7	1.20	85.0	5.0	32.7
GA 2011121	1200	44.7	**1.23**	83.4	5.0	34.9
GA 2011057	1165	41.4	1.20	84.7	5.1	31.4
GA 2011044	1143	42.8	1.12	84.3	**5.5**	29.9
GA 2011038	1132	42.1	1.22	85.2	4.8	30.8
GA 2011051	1044	44.7	1.20	85.1	5.0	31.8
GA 2011001	1044	40.2	1.21	85.0	4.7	32.4
GA 2011090	1028	39.6	1.18	85.0	5.1	31.9
Cultivar x Location Interaction	*	NS	NS	†	NS	*
$LSD_{0.10}$		**0.92**	**0.02**		**0.15**	

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. Exception: acceptable micronaire (mic) is a range; so the significant differences above 5.0 that are considered unacceptable are highlighted (i.e. > 5.15 is significant). DP 493, GA 230, GA 2004143, and GA 2004303 are check varieties for comparison purposes.

Table 3. Results of 2012 Advanced (F_7) Trial 1 in Tifton.

ENTRY	Lint Yield, lbs./acre	Lint %	UHM in.	UI %	mic	Str g/tex
GA 2010074	**1369**	44.8	1.22	85.8	**5.5**	35.0
GA 2010102	**1336**	41.3	1.25	86.2	**5.4**	35.9
GA 2010002	**1335**	43.6	1.24	86.2	**5.3**	36.0
GA 2010052	**1300**	43.4	1.21	86.2	4.9	34.0
GA 2010030	**1293**	43.7	1.26	86.0	4.8	33.3
GA 2010085	**1291**	**46.6**	1.24	85.3	5.0	34.1
GA 2010032	**1271**	**45.4**	1.26	85.1	5.1	33.2
GA 2010069	**1268**	43.3	1.23	85.7	5.0	34.7
GA 2010063	**1268**	44.8	1.22	86.1	**5.2**	34.5
GA 2010019	**1265**	43.9	1.20	86.0	5.1	33.3
GA 2010024	**1250**	42.8	1.25	85.7	4.9	34.1
GA 2010070	**1240**	45.1	1.22	85.6	4.9	35.0
GA 2004143	**1231**	44.8	1.20	84.8	**5.2**	35.6
GA 2010016	**1227**	42.5	1.23	85.4	5.1	33.6
GA 2010038	**1222**	42.3	1.23	85.7	4.8	35.3
GA 2010079	1193	41.8	1.21	85.2	**5.5**	35.6
GA 2010068	1184	44.7	1.24	85.6	4.9	34.2
GA 2010047	1166	44.5	1.23	86.1	5.0	34.0
GA 2010076	1162	43.1	1.23	85.1	**5.2**	**37.4**
GA 2010049	1150	43.3	1.27	**86.7**	**5.2**	35.7
GA 2010021	1139	42.5	1.26	86.0	4.9	33.1
GA 2004303	1136	43.8	1.18	85.1	**5.5**	33.6
GA 230	1124	41.0	1.21	85.8	5.1	34.2
GA 2010064	1117	43.3	1.23	86.4	**5.3**	34.1
GA 2010098	1116	41.5	1.22	85.6	**5.3**	34.1
DP 493	1105	43.6	1.18	84.8	**5.4**	32.9
GA 2010106	1038	43.4	1.24	85.6	4.9	33.9
GA 2010050	1015	41.3	1.22	85.6	**5.3**	34.2
GA 2010015	989	43.3	1.19	85.0	**5.5**	34.3
GA 2010086	985	42.5	1.26	**87.1**	5.0	33.8
GA 2010067	865	42.9	1.25	**86.8**	5.0	35.1
GA 2010058	814	44.9	1.22	84.6	4.9	33.3
$LSD_{0.10}$	**158**	**1.18**	**ns**	**0.68**	**0.15**	**1.27**

ns (no significance) among any of the particular cultivar measure. The bold type indicates the measures that are not significantly different from the best when the location data is properly pooled. Exception: acceptable micronaire (mic) is a range; so the significant differences above 5.0 that are considered unacceptable are highlighted (i.e. > 5.15 is significant). DP 493, GA 230, GA 2004143, and GA 2004303 are check varieties for comparison purposes.

Table 4. Results of 2012 Advanced (F_7) Trial 1 in Plains.

ENTRY	Lint Yield, lbs./acre	Lint %	UHM in.	UI %	mic	Str g/tex
GA 2010076	**1732**	40.3	1.24	84.8	5.0	**34.1**
GA 2010079	**1640**	**40.9**	1.25	84.0	4.7	31.6
DP 493	**1640**	40.3	1.26	84.4	4.3	31.5
GA 2010074	**1630**	**41.0**	1.20	84.0	5.0	31.9
GA 2010019	**1622**	40.1	1.25	85.1	4.3	31.9
GA 2004143	**1600**	**42.2**	1.25	85.0	4.4	32.3
GA 2010106	**1586**	40.4	1.25	85.7	4.3	32.5
GA 2010067	**1586**	39.7	1.26	85.9	4.7	**33.7**
GA 2010070	**1560**	**41.3**	1.24	85.0	4.5	32.7
GA 2004303	**1534**	**40.7**	1.21	84.6	4.6	**33.2**
GA 2010064	**1534**	39.9	1.27	85.2	4.1	**33.1**
GA 2010102	**1531**	38.7	1.23	84.5	4.7	**33.7**
GA 2010086	**1522**	**41.2**	1.22	84.3	4.5	30.9
GA 2010085	**1494**	40.5	**1.30**	84.7	4.2	32.1
GA 2010052	**1478**	40.4	1.23	84.2	4.3	31.6
GA 2010016	1426	38.7	1.26	84.9	4.3	32.4
GA 2010098	1412	38.1	1.25	84.9	5.0	31.2
GA 2010032	1409	40.1	**1.30**	84.7	3.9	32.1
GA 2010050	1409	37.4	1.26	84.6	4.5	32.0
GA 2010049	1390	37.0	**1.28**	84.0	4.6	31.7
GA 2010069	1364	**41.1**	1.25	85.8	4.7	32.2
GA 2010063	1361	**41.8**	1.22	84.8	4.8	32.6
GA 230	1361	39.5	1.22	84.5	4.6	32.3
GA 2010038	1329	40.6	1.25	85.5	4.1	**34.1**
GA 2010047	1325	40.2	1.21	85.6	4.8	31.4
GA 2010002	1322	40.1	**1.29**	85.6	4.7	33.0
GA 2010068	1283	39.5	1.22	85.7	4.4	31.9
GA 2010058	1209	40.1	1.25	84.8	4.3	30.9
GA 2010030	1158	38.9	**1.28**	85.3	4.5	31.7
GA 2010015	1114	39.5	**1.29**	86.0	4.4	32.1
GA 2010024	1095	39.6	**1.30**	85.7	4.2	32.0
GA 2010021	968	37.8	1.23	84.7	4.1	32.5
$LSD_{0.10}$	**264**	**1.54**	**0.03**	ns	**0.28**	**1.12**

ns (no significance) among any of the particular cultivar measure. The bold type indicates the measures that are not significantly different from the best when the location data is properly pooled. Exception: acceptable micronaire (mic) is a range; so the significant differences above 5.0 that are considered unacceptable are highlighted (i.e. > 5.28 is significant). DP 493, GA 230, GA 2004143, and GA 2004303 are check varieties for comparison purposes.

Table 5. Results of 2012 Advanced (F_6) Trial 2 in Tifton.

ENTRY	**Lint Yield, lbs./acre**	**Lint %**	**UHM in.**	**UI %**	**mic**	**Str g/tex**
GA 2011042	**1290**	45.1	1.18	84.7	5.2	33.7
GA 2011158	**1244**	46.0	1.15	85.1	**5.5**	33.5
GA 2011113	**1225**	44.5	1.17	85.3	**5.5**	32.1
GA 2011191	**1207**	45.6	1.17	84.5	**5.4**	32.6
GA 2011093	**1182**	44.0	1.19	**86.1**	**5.5**	33.8
GA 2004143	**1143**	**46.7**	1.15	85.4	**5.3**	**34.6**
GA 2011108	**1141**	44.3	1.17	84.8	**5.3**	33.6
GA 2011124	1114	**46.5**	1.13	84.8	**5.6**	31.6
GA 2011004	1105	**46.8**	1.16	85.5	**5.4**	32.3
GA 2011005	1088	45.7	1.16	85.8	**5.3**	**34.6**
GA 2011044	1078	45.5	1.09	85.0	**5.8**	31.0
GA 2011057	1053	41.7	**1.20**	85.6	**5.3**	32.7
GA 2004303	1043	44.6	1.18	84.3	**5.4**	32.9
GA 230	1034	44.6	1.16	84.9	**5.3**	31.9
GA 2011156	1029	44.7	1.18	85.0	**5.5**	32.9
DP 493	999	44.6	1.14	84.5	**5.3**	32.6
GA 2011013	991	**47.4**	1.18	85.5	5.2	**34.8**
GA 2011038	989	42.7	**1.21**	**85.9**	5.1	32.1
GA 2011090	981	41.0	1.17	84.5	5.2	34.3
GA 2011174	981	43.0	1.14	84.8	**5.6**	**34.8**
GA 2011030	970	42.6	**1.20**	85.2	5.2	34.2
GA 2011021	956	44.3	**1.20**	85.3	**5.3**	33.8
GA 2011181	949	44.0	1.14	84.4	**5.6**	32.2
GA 2011061	924	45.6	1.15	84.4	**5.4**	32.3
GA 2011167	915	41.9	1.17	84.8	5.2	33.4
GA 2011001	894	42.1	**1.20**	85.5	4.9	**34.5**
GA 2011015	892	44.3	**1.23**	**86.5**	5.2	**35.5**
GA 2011121	883	45.6	**1.20**	83.9	5.1	**35.6**
GA 2011051	763	**46.6**	**1.20**	**85.9**	5.2	33.2
$LSD_{0.10}$	**150**	**1.07**	**0.04**	**0.60**	**0.20**	**1.20**

ns (no significance) among any of the particular cultivar measure. The bold type indicates the measures that are not significantly different from the best when the location data is properly pooled. Exception: acceptable micronaire (mic) is a range; so the significant differences above 5.0 that are considered unacceptable are highlighted (i.e. > 5.2 is significant). DP 493, GA 230, GA 2004143, and GA 2004303 are check varieties for comparison purposes.

Table 6. Results of 2012 Advanced (F_6) Trial 2 in Plains.

ENTRY	Lint Yield, lbs./acre	Lint %	UHM in.	UI %	mic	Str g/tex
GA 2011004	**1782**	**44.5**	1.20	84.0	5.0	29.9
GA 2011156	**1754**	43.3	1.23	84.7	5.0	29.6
GA 2011167	**1703**	40.3	1.17	84.9	5.0	31.6
GA 2011191	**1678**	41.6	1.21	85.0	4.7	30.0
GA 2011005	**1663**	43.6	1.22	85.6	4.8	30.1
GA 2011124	**1613**	42.3	1.21	84.8	5.0	29.9
GA 230	**1604**	41.4	1.23	85.4	4.9	30.4
GA 2004303	**1602**	41.9	1.23	85.2	4.7	31.4
GA 2011093	**1600**	41.0	1.23	85.7	4.9	31.1
GA 2011021	**1594**	41.9	**1.26**	85.4	4.6	30.2
GA 2011113	**1586**	41.1	1.22	84.7	4.9	30.7
GA 2011061	**1583**	43.7	1.18	85.2	4.9	28.5
GA 2011181	**1568**	42.6	1.20	84.7	5.1	31.5
GA 2011015	**1541**	40.9	**1.28**	85.2	4.1	31.9
GA 2011013	1532	**45.7**	1.19	85.6	4.7	30.8
DP 493	1529	43.5	1.21	83.4	4.8	31.4
GA 2011121	1516	43.7	**1.26**	82.9	4.8	**34.1**
GA 2011158	1496	42.6	1.20	84.9	5.0	30.1
GA 2004143	1471	43.4	1.23	84.3	4.6	31.5
GA 2011174	1464	40.3	1.20	85.1	5.2	31.2
GA 2011030	1452	41.3	1.23	85.3	4.7	29.9
GA 2011042	1377	42.5	1.24	83.8	4.6	30.4
GA 2011051	1325	42.9	1.20	84.3	4.8	30.3
GA 2011057	1278	41.1	1.20	83.8	5.0	30.2
GA 2011038	1276	41.5	1.23	84.6	4.5	29.5
GA 2011108	1269	39.2	1.24	85.2	4.8	31.9
GA 2011044	1209	40.1	1.15	83.7	**5.3**	28.9
GA 2011001	1193	38.4	1.23	84.5	4.6	30.2
GA 2011090	1076	38.3	1.18	85.5	4.9	29.4
LSD$_{0.10}$	**245**	**1.52**	**0.03**	**ns**	**0.23**	**0.94**

ns (no significance) among any of the particular cultivar measure. The bold type indicates the measures that are not significantly different from the best when the location data is properly pooled. Exception: acceptable micronaire (mic) is a range; so the significant differences above 5.0 that are considered unacceptable are highlighted (i.e. > 5.23 is significant). DP 493, GA 230, GA 2004143, and GA 2004303 are check varieties for comparison purposes.

ROOT-KNOT NEMATODE RESISTANCE IN COMMERCIAL AND PUBLIC COTTON CULTIVARS, 2012 PROGRESS

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Introduction

Host plant resistance is overall the most economical, practical, and environmentally sound method to provide crop protection against root-knot nematodes (RKN). Despite the widespread occurrence of RKN in most cotton production areas in the Southeast and that genetic resistance to RKN has existed since 1974 (Shepherd, 1974), private cultivar developers have exhibited minor interest in fulfilling this need.

However, now that it was announced in August, 2010 that the registered use of Temik is scheduled to be phased out by 2018 (High Plains Journal, 2010), RKN control in cotton has lost an important tool. Temik has been the most widely used nematicide in US cotton production and works well in controlling RKN, but it is already becoming difficult to find.

Previously, RKN resistance in commercial cotton cultivars has been garnered only through direct utilization by the commercial cotton breeding companies of cultivars developed by public cotton breeders. These include the RKN-resistant CPCSD Acala NemX and the tolerant ST LA887 and PM H1560 that have been distributed by commercial cotton seed companies; none of which were particularly developed for cotton production in the Southeast.

There are now four other cultivars that are directly touted in the websites of the three major commercial cotton breeders in the United States. Unbiased testing regarding the strength of the resistance offered to the cotton grower and the improvement of yield from this trait is needed to determine the value of RKN resistant cultivars in the Southeast. Additional testing of several newly released public cultivars is also needed to determine if any RKN resistance is available from these new public genetic resources. Altogether this will benefit United States producers by providing an evaluation of these cultivars for yield and decreased production costs.

Materials and Methods

Parallel yield tests of the four RKN tolerant commercial cultivars (PhytoGen PHY 367 WRF, Bayer CropScience ST 4288B2F and ST 5458B2RF, and Monsanto DP 174 RF) and four newly released public conventional cultivars (University of Georgia's GA 230, University of Arkansas' UA 48, and Louisiana State University's LA 17 and LA 35rs were planted with three checks (University of Georgia's GA 120R1B3, a resistant check; Acala NemX, a resistant check; and Monsanto's DP 0935 B2RF, a susceptible check) in soils with and without high populations of root-knot nematodes over a two year span at the Gibbs Farm of the University of Georgia-Tifton Campus. The tests use standard agronomic practices promulgated by UGA Extension.

The test in the infested field for 2011 had 8 replications to cover an expected biological variability of the RKN infestation of the cotton roots. In 2012, 6 replications were considered adequate. The test without high nematode populations had 4 replications in 2011 and 5 replications in 2012. We used granular, gypsum-based Temik insecticide banded in at planting at 5 pounds/acre which is generally considered a nematicidal rate. The seed was treated with Baytan, Thiram, and Allegiance for fungal control as labeled. We have found no nematicidal effects reported by others using this seed treatment. In addition to yield, lint percentage and fiber quality data were also collected.

Results and Discussion

In 2011, the data of the nematode counts indicate that the four touted commercial cultivars are definitely not extremely susceptible to RKN, but nothing is as resistant as the two resistant checks, GA 120R1B3 and NemX (Fig. 1). In comparing the resistant checks, GA 120R1B3 is significantly better than NemX or any other cultivar. One conventional cultivar LA 17 appears to have a level of RKN resistance that is essentially equivalent with the commercial cultivars. All of the commercial cultivars along with LA 17 seem to cluster between the resistant checks and the susceptible check. The other conventional cultivars cluster with the susceptible check as would be expected if they are indeed susceptible. In 2012, we had very low gall ratings and the nematode count data did not match what we expected. Root-Knot nematode, as a biological entity, is difficult to clearly understand its relationship with the environment. Further effort is needed to have clear understanding how these cultivars react to infested and clean conditions.

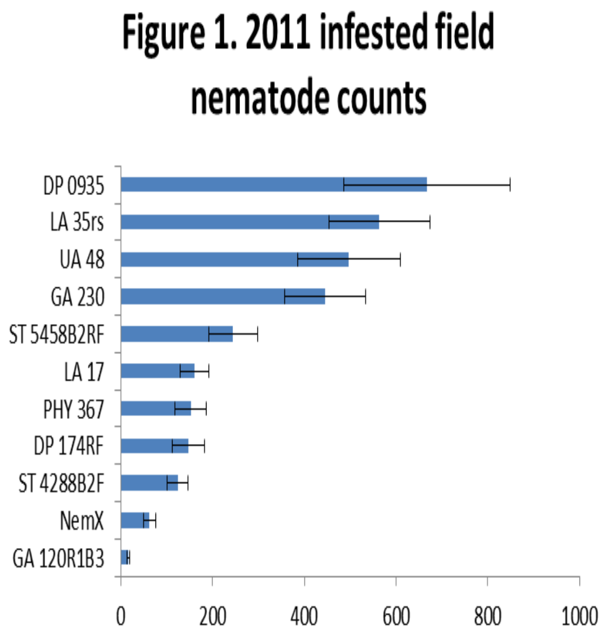

Figure 1. 2011 infested field nematode counts

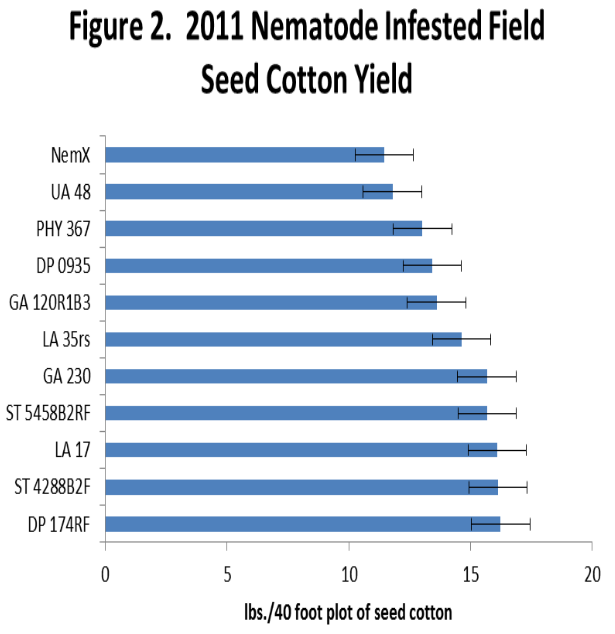

Figure 2. 2011 Nematode Infested Field Seed Cotton Yield

The best seed cotton yielder in the RKN infested field in 2011 was DP 174RF followed by two commercial cultivars and two public cultivars that were not significantly different (Fig. 2). In 2012, ST 5458B2RF was the top yielder with LA 17 and LA 35rs following (Fig. 3). The next three cultivars were the other three commercial cultivars ST 4288B2F, DP 174RF, and PHY 367 WRF. This generally followed the rankings in 2011 with the commercial lines doing better than their resistance levels would explain. The lowest yielding cultivar in 2011 was the resistant cultivar NemX while the lowest cultivar in 2012 was UA 48.

The rankings of the cultivars for seed cotton yield do not match the ranking of the cultivars for the nematode counts. This was not unexpected since the background genetics for the agronomic performance of the cultivars is unlikely to be correlated with the RKN resistance trait. For example, NemX is an Acala cotton that is not adapted to the Southeast. In 2011, the high RKN resistance of NemX could not completely compensate for the fact that NemX is not adapted to the Southeast. The resistant check GA 120R1B3 yielded better than the NemX because it was developed in and for the Southeast and has two major genes of an elite RKN resistance. However, in 2012, GA 120R1B3 did not show that adaption as it yielded essentially the same as NemX.

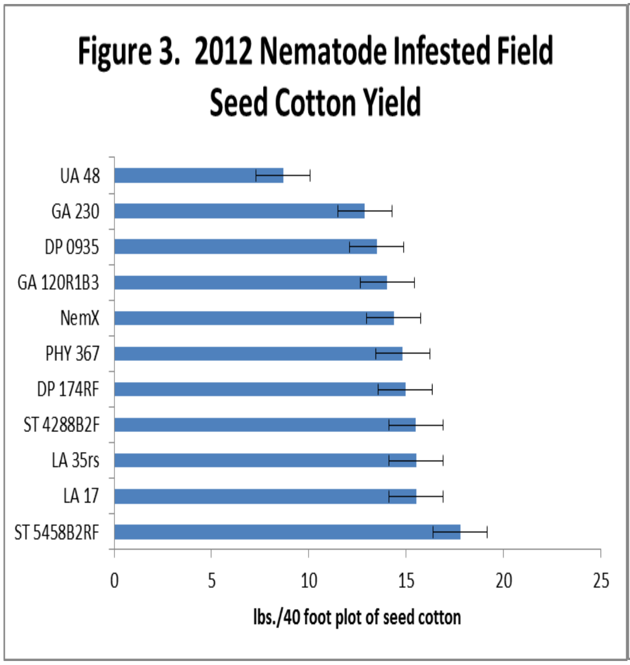
Figure 3. 2012 Nematode Infested Field Seed Cotton Yield

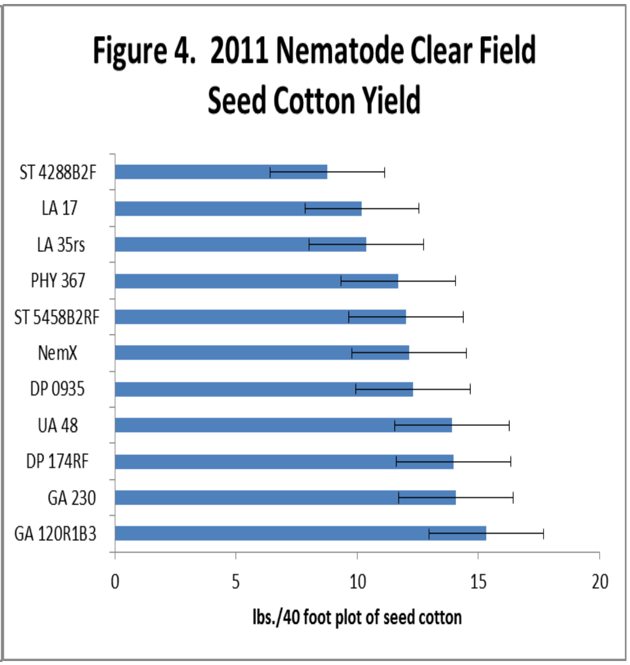
Figure 4. 2011 Nematode Clear Field Seed Cotton Yield

The top yielders in the nematode clear field in 2011 were GA 120R1B3 and GA 230 which were the only two cultivars developed in and for the Southeast (Fig. 4). In 2012, GA 120R1B3 was again in the top tier at #2 while GA 230 was in last place (Fig 5). As is demonstrated, one would expect that the RKN resistant cultivar GA 120R1B3 would rank high in both fields since it was developed for Georgia conditions. However, the same expectation would hold for GA 230 which

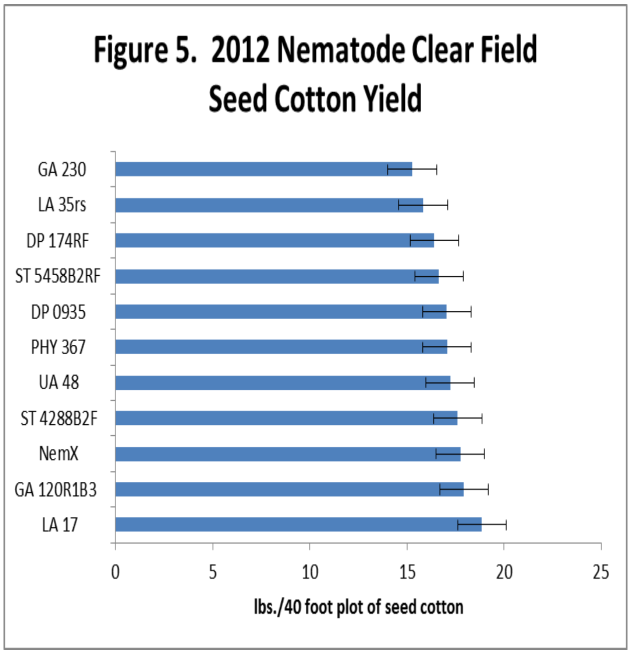
Figure 5. 2012 Nematode Clear Field Seed Cotton Yield

did not maintain its ranking in 2011 for the 2012 season. Again, the interactions between the yields of the infested field and the clear field are not completely evident. Another putative susceptible cultivar UA 48 with the susceptible check DP 0935 B2RF also did better in the clear field vs. the infested field. Neither of these occurrences is completely unexpected since we are unaware that they have any resistance genes. DP 174RF ranked high in both fields, but ST 4288B2F was on opposite ends of the rankings. Further research is needed to determine the nature of the interaction between the RKN resistance and traits required for adapted cultivars.

We will continue to look at these issues of high interaction effects in the next year of this research project, 2013. It appears that the variability of yields may have as much to do with the RKN resistance as year to year variability. Near-isogenic lines and better (more costly) experimental designs may be required to definitively extract the answer to the question of how beneficial can the RKN resistance genes be to the cotton industry.

Acknowledgements

We thank Cotton Incorporated (Project No. 11-931) for financial support for this project.

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

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Introduction

The 2010 production season was the last season that DP 555 BR was planted on a limited basis in Georgia. Prior to 2010, DP 555 BR was the predominant cotton variety planted on approximately 85 % of Georgia's cotton acreage. Beginning in 2010, newer varieties were planted on approximately 70 % of Georgia's cotton acreage, and by 2011, the transition to newer varieties was complete. However, since the loss of DP 555 BR, newer varieties are being released and removed from the market in a much more rapid manner. This rapid turnover of new varieties allows very little time for growers to effectively evaluate yield potential and variety characteristics that help them better manage these varieties for maximum yield potential.

Secondly, despite the loss of DP 555 BR, most management practices, such as PGR management, are still geared towards that of DP 555 BR (full-season, very indeterminate growth characteristics) which could be yield inhibitory for some varieties. Research conducted in 2010 and 2011 by the Extension Cotton Agronomists suggests that many of the newer varieties may be earlier maturing than DP 555 BR, and therefore may need less aggressive PGR management in general, may not need pre-bloom PGR applications, and may require the use of Stance for sufficient growth management versus some of the standard PGR products. This is likely due to natural variety genetics but it is also possibly due to the improved Bt technologies, allowing for better retention of bolls. However, this is not always the case, as some newer varieties exhibit similar growth potential, indeterminacy, and fruiting characteristics to that of DP 555 BR.

The research trials conducted throughout 2010 and 2011, regarding the necessity of pre-bloom PGR applications and the utility of Stance for earlier maturing varieties, has brought usable information to growers with regard to how specific new varieties should be managed with PGRs. However, the continued rapid release of newer varieties, which vary widely in growth potential and fruiting characteristics, warrants continued research to investigate, quantify, and rank growth potential of newer varieties compared to standards. This effort will utilize standard varieties that have been previously quantified for growth, but will focus largely on the newer non-tested varieties, in hopes to provide this information before these newer varieties are released on a large-scale basis.

Additionally, the release of newer herbicide technologies within a few years could pose some challenges for Georgia cotton growers. One such technology is the Enlist technology from Dow AgroSciences which conveys tolerance to 2,4-D herbicide. Drift injury from 2,4-D is not currently uncommon, but yield loss due to drift is often difficult to predict or quantify. Most assessments of yield loss are subjective, or lack objectivity, and have little regard to growth stage etc. This issue will most certainly become a much larger problem for Georgia cotton growers upon the release of these technologies and increase the likelihood that drift will occur. The increased risks associated with these new technologies warrant extensive research to develop sound scientific techniques for quantifying yield loss due to 2,4-D drift, and will account for growth stage and drift rate of the herbicide on both early and later maturing varieties.

Materials and Methods

PGR experiments were initiated in 2012 at Tifton and Midville. These experiments investigated the response of several new varieties (ranging from early to late maturity) to PGR treatments similar to what was required for DP 555 BR in previous years, to quantify differences in PGR responses of these new varieties with commercial standard varieties that have been evaluated in previous years. Varieties were ranked according to their non-treated planted plus PGR-treated plant height, to develop a categorized ranking based on growth potential and response to PGRs. This ranking can then be used to establish PGR recommendations for groups of varieties that are similar in terms of growth potential. The following data was collected: plant heights and number of nodes collected at most PGR timings and again just prior to harvest. Nodes above white flower was collected when the earliest-maturing treatment(s) reached cutout (NAWF= 4 to 5). Mapping of boll distribution was collected between defoliation and harvest. The latter parameters provided insight on maturity of these new varieties.

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

Results and Discussion

Figure 1 illustrates the response of modern and brand new varieties to an aggressive PGR treatment that was commonly used for DP 555 BR (12 oz applied at 9-leaf, 12 oz applied at first bloom, and 16 oz applied at first bloom+2weeks). Although frequent rains / irrigation and optimal soil moisture was observed in 2012, this data clearly shows noticeable differences in plant height and thus growth potential of modern commonly-planted varieties in Georgia. In the absence of a PGR treatment, there was a range of 8 inches in non-treated plant height, and this difference was only slightly smaller in non-treated plant height. The degree of plant height suppression as a result of the PGR treatment was approximately the same in all varieties; however, this degree of suppression in an early maturing, short-statured variety may result in sub-optimal final plant height, especially if water stress is experienced. Ideally, final plant height of all cotton should be short enough to be harvest efficient and to avoid lower fruit abortion / delayed maturity; however, plants should still be tall enough to support an optimal boll load for optimal yields. Aggressive PGRs, especially on less aggressive varieties, could result in inadequate development of fruiting sites.

Figure 2 illustrates the yield response of these same varieties subjected to an aggressive PGR treatment. The more noticeable effect in these results is that an aggressive PGR treatment reduced yield (at least numerically) in all varieties. The least reduction occurred in the later-maturing DP 1252 B2RF and the greatest reduction occurred in FM 1740 B2F which is similar to what we would normally expect. However, growers should remember that this experiment was conducted in very wet conditions with adequate water throughout the season, without stress, and PGRs still resulted in no positive yield response for any variety.

Results of the simulated 2,4-D drift experiment are illustrated below. Figure 3 illustrates the effect of the low rate (1/421 X rate) on boll distribution in all regions of the plant. The most notable effects of the low rate on boll distribution occurred on the 2nd foot of stalk, where there was a mild reduction in harvestable bolls observed in all application timings. The greatest reduction in this region occurred when the low rate was applied at the 4-leaf stage.

Figure 4 illustrates the effects of the high rate (1/21 X rate) applied at various growth stages. The high rate obviously resulted in the most significant distortion of boll distribution. This rate applied at the 4-leaf stage substantially reduced the number of bolls in the bottom foot of stalk, but had a similar number of bolls to the non-treated cotton in the second foot of stalk. However, the 4-leaf treatment shifted a large proportion of bolls to the third foot of stalk suggesting a delay in maturity is realistic. Also noted as a result of the 4-leaf treatment, was a high number of split-terminal plants which further delays maturity as most of the boll population is set on vegetative branches. The high rate applied at all other timings, resulted in significantly less bolls set on both the second and third foot of stalk.

Figure 5 illustrates the effect of both rates on total bolls per plant for all application timings. Compared to non-treated cotton, only the high rate applied at first bloom significantly reduced the total number of bolls per 10 plants, suggesting that this growth stage may be most likely to result in yield loss if significant 2,4-D drift occurs.

Figure 6 illustrates the most important data in this experiment, yield responses of simulated 2,4-D drift at all growth stages. Despite the mild distortion in boll distribution previously illustrated, the low rate (1/421 X rate) did not adversely affect yield when compared to the non-treated control. However, the high rate (1/21 X rate) resulted in significant yield loss at all growth stages. The least yield reduction occurred when the high rate was applied at the 4-leaf stage, followed by the 9-leaf stage, First Bloom + 2 weeks, and the most yield was lost when applications were made at First Bloom. This data suggests that the most yield-sensitive growth stage to 2,4-D drift is at First Bloom, and to a lesser degree at more distant growth stages. More importantly, this research illustrates the need to quantify injury in drift situations to determine whether or not yield loss is likely to occur.

Acknowledgements

The authors wish to acknowledge and thank the Georgia Cotton Commission for supporting this research.

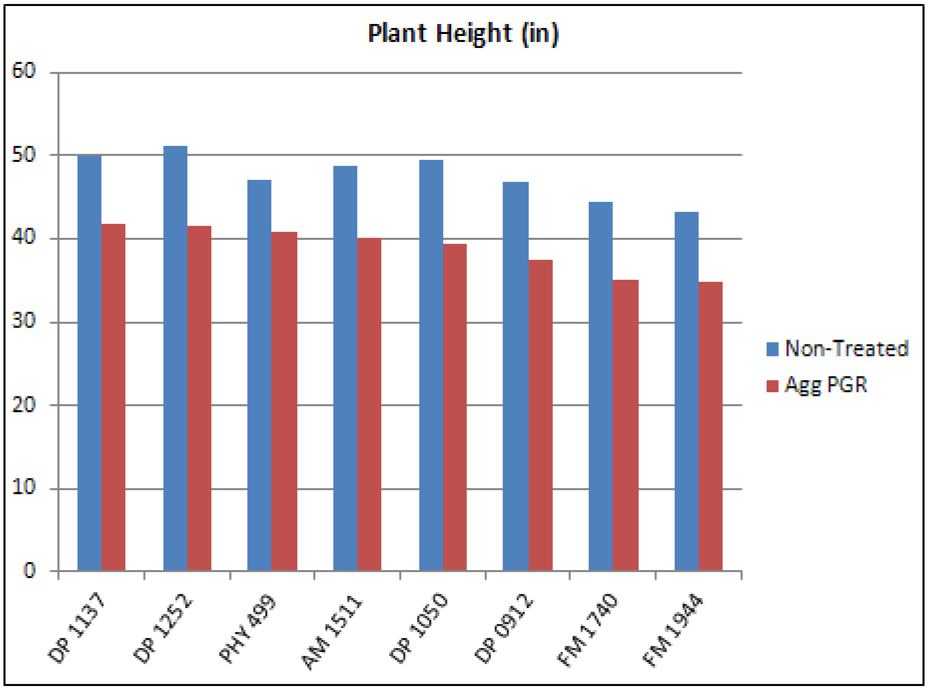

Figure 1. Plant height of non-treated and PGR-treated cotton varieties ranked in descending order.

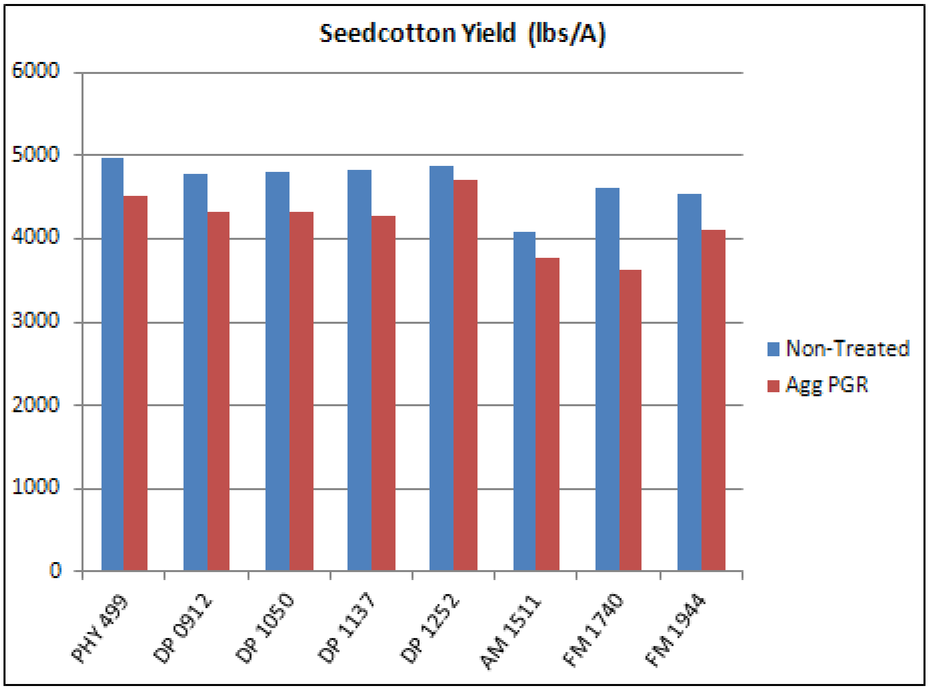

Figure 2. Seedcotton yield response of non-treated and PGR-treated cotton varieties.

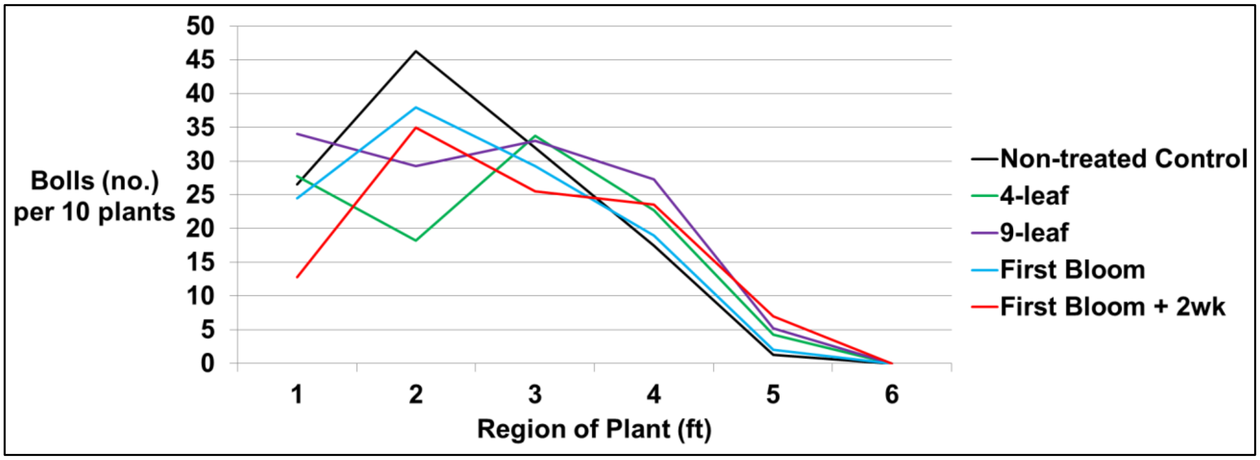

Figure 3. The effects of 2,4-D (0.00178 lbs a.i./A – 1/421 X rate) applied at various growth stages on the number of bolls per foot of plant stalk.

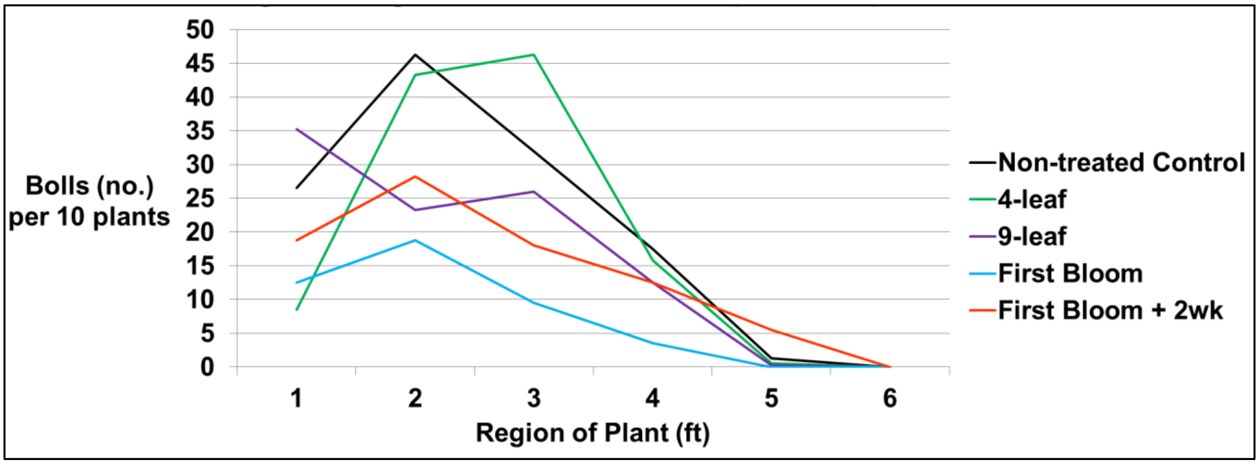

Figure 4. The effects of 2,4-D (0.0357 lbs a.i./A – 1/21 X rate) applied at various growth stages on the number of bolls per foot of plant stalk.

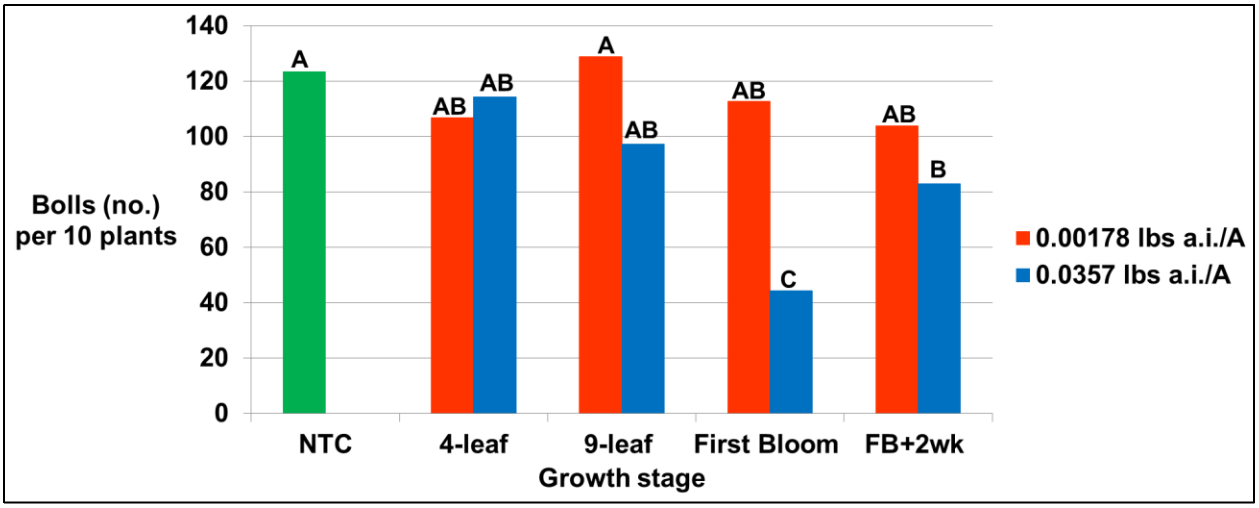

Figure 5. The effects of simulated 2,4-D drift at various growth stages on bolls per 10 plants.

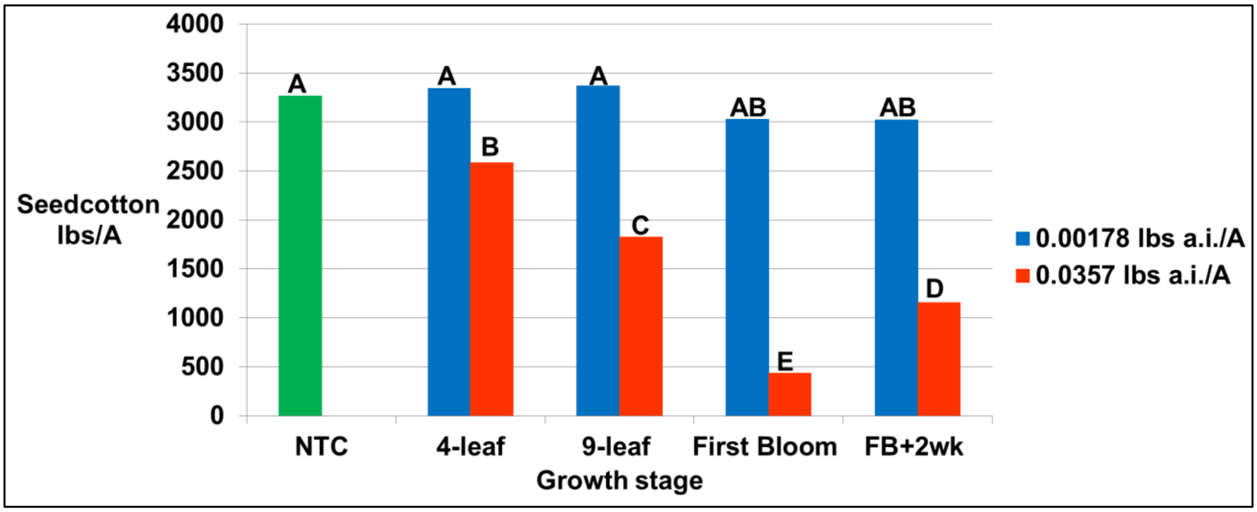

Figure 6. Yield response of simulated 2,4-D drift at various growth stages.

THE EFFECT OF WATER DEFICIT ON PHOTOSYNTHETIC ELECTRON TRANSPORT AND NET CO_2 ASSIMILATION RATES IN FIELD-GROWN COTTON

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4/ Crop and Soil Sciences, University of Georgia, Athens

Introduction

Water availability is the primary limitation to crop productivity worldwide (Sharp et al., 2004) and water deficit is well-known to limit photosynthesis in upland cotton (*Gossypium hirsutum)* (Ennahli and Earl, 2005; Zhang et al., 2011). Despite exhaustive literature describing drought stress effects on photosynthesis, the exact mechanism of photosynthetic inhibition is heavily debated (Flexas and Medrano, 2002; Loka et al., 2011).

For example, in some species, actual quantum yield and photosynthetic electron transport rate through photosystem II (ETR) are sensitive to drought stress conditions (Flexas et al., 1999; Flexas et al., 2002; Zhang et al., 2011). However, contrasting reports exist for *G. hirsutum*. For example, Pettigrew (2004) reported significant declines in photosynthetic electron transport rate (ETR), and actual quantum yield of photosystem II (Φ_{PSII}) even under water deficit conditions (Ψ_l = -2.36 MPa) producing no decline in net photosynthesis (P_N) for field-grown *G. hirsutum*. For greenhouse grown cotton, Ennahli and Earl (2005) reported substantial declines in P_N and ETR when Ψ_l declined from -1.6 to -2.0 MPa. More recently, some authors (Massacci et al., 2008; Zhang et al., 2011) have reported increased ETR under water deficit conditions for field-grown *G. hirsutum*. Additionally, Snider et al. (2013) recently reported either stable or increased midday ETR at times during the growing season coinciding with extreme water deficit conditions (Ψ_l = -3.1 MPa).

It is hypothesized that electron transport rate through photosystem II would not be limited even under a wide range of Ψ_l sufficient to significantly limit P_N. Consequently, the objective of the current study was to quantify the relationship between Ψ_l, P_N, and primary photochemistry under a wide range of leaf water status.

Materials and Methods

Plant Material and Study Sites

Experiments (one dryland and one irrigated) were conducted at one site near Tifton, Georgia and another site near Camilla, Georgia (a randomized arrangement of dryland and irrigated plots) in 2012. Seeds of two commercially-available cultivars [PHY499 WRF (PhytoGen, Dow AgroSciences) and DP 0912 B2RF (Delta and Pine Land, Monsanto Company)] were sown on May 2, 2012 (Tifton, GA) and three cultivars (PHY499 WRF, DP 0912 B2RF, and DP 1050 B2RF) were sown on May 5, 2012 (Camilla, GA) at a 0.91m inter-row spacing and at a rate of 11 seeds m^{-1} row. Plots for each cultivar (n = 4) were four rows wide, 12.2 m long, and had 3 m bare-soil alleys. Plots were arranged using a randomized complete block design at each location. All replicate plots at the Tifton site were well-watered, whereas at the Camilla study site, all cultivars were grown under both dryland and well-watered conditions to generate variation in leaf water supply at different times during the growing season.

Dryland plots are defined as those plots only receiving water via rainfall during the growing season, and well-watered plots received supplemental irrigation to meet weekly water requirements for cotton as defined using University of Georgia Cooperative Extension "Checkbook" recommendations.

Midday quantification of Ψ_l, P_N, ETR, and Φ_{PSII}

To evaluate the relationships between P_N, Φ_{PSII}, ETR, and Ψ_l in field-grown *G. hirsutum*, all measurements were conducted at midday (1200-1400 h), under saturating light intensity (PAR > 1200 µmol m^{-2} s^{-1}) using the fourth main-stem leaf below the apical meristem. This measurement time was chosen because ETR rates were maximal and stable during this time frame (data not shown), and this is one of the most stable time frames to measure leaf water potential during daylight hours (Grimes and Yamada, 1982). For each sample date and location, three readings were taken per plot for each parameter, and the average of those readings was used for subsequent statistical analysis. The resulting data set encompassed 76 replicate samples at two study sites in Georgia from July 9 to July 26, 2012.

Actual quantum yield of electron transport through photosystem II (Φ_{PSII}) was measured *in-situ* using the OS5p Modulated Fluorometer (Opti-Science, Tyngsboro, MA). Φ_{PSII} was calculated according to the equations given in Maxwell and Johnson (2000). Electron transport rate (ETR) through photosystem II was calculated for each leaf by multiplying ΦPSII × PAR (at the leaf surface) × 0.5 (excitation energy is divided between two photosystems) × 0.84 (a common leaf absorbance coefficient for C_3 plants) (Flexas et al., 1999). Single-leaf gas exchange (P_N quantification) was performed immediately following chlorophyll fluorescence measurements using an LI-6400 portable photosynthesis system (Li-Cor, Lincoln, NE), where all leaves were measured under natural irradiance (PAR > 1200 µmol m^{-2} s^{-1}) and chamber CO_2 concentration of 380 p.p.m. For Ψ_l determinations, immediately following ETR and gas exchange measurements, leaves were excised from the same position on the plant as those that were used for the previous measurements. The leaf petiole was immediately sealed in a compression gasket with the cut surface of the petiole exposed. The leaf blade was sealed in a pressure chamber (Model 615; PMS Instruments, Albany, OR) and the chamber was pressurized using compressed nitrogen at a rate of 0.1MPa s^{-1} until water first appeared at the cut surface of the stem. The total elapsed time from when the leaf was cut from the plant to the initial pressurization of the chamber was 5-10 s. The relationship between midday Ψ_l and primary photochemistry was evaluated by plotting Ψ_l versus Φ_{PSII} and ETR.

Statistical Analysis

Prior to regression analysis, mean midday Ψ_l, P_N, ETR, and Φ_{PSII} values for each cultivar × sample date × location × irrigation treatment were determined. A total of 19 means for each parameter were generated, where each value is the average of four replicate plots. On the aforementioned data set, regression analyses to determine the relationship between Ψ_l, P_N, and primary photochemistry were performed using Sigma Plot 11 (Systat Software Inc., San Jose, CA).

Results and Discussion

The relationships between midday Ψ_l, P_N, Φ_{PSII}, and ETR are presented in Figure 1. Midday values for Ψ_l ranged from -1.0 to -2.9 MPa. There was a strong non-linear (quadratic; $r^2 = 0.755$) relationship between Ψ_l and midday P_N (Fig. 1A), where the maximum predicted value for P_N was 32.1 µmol m^{-2} s^{-1} at $\Psi_l = -1.1$ MPa and declined 57.9% to 13.5 µmol m^{-2} s^{-1} at $\Psi_l = -2.9$MPa. In contrast, there was not a significant relationship between Ψ_l and ETR (Fig. 1B; $r^2 = 0.075$), and there was not a significant relationship between Ψ_l and midday Φ_{PSII} (Fig 1C; $r^2 = 0.0002$).

In this study, the range of Ψ_l values was much broader than in previous studies with field-grown cotton (-1.0 to -2.36; Pettigrew, 2004; Zhang et al., 2011), and many of the Ψ_l values were well below those previously reported to cause significant declines in net photosynthesis (-1.9; Zhang et al., 2011) and yield (< -2.0; Grimes and Yamada, 1982), yet ETR remained stable. Our findings are not in agreement with those of Ennahli and Earl (2005), who reported declines in ETR at Ψ_l = -2.0 MPa. However, the aforementioned study was conducted under greenhouse conditions with potted plants. Because root growth can be restricted in such studies, drought stress undoubtedly occurs much more rapidly than under field conditions, limiting the acclimation response of the plant that is normally observed under field conditions (Kitao and Lei, 2007). Similar to the findings of the present study, previous authors have reported either stable or increased ETR for field grown *G. hirsutum* (Kitao and Lei, 2007; Massacci et al., 2008; Snider et al., 2013).

It has been reported that photorespiration rates typically increase under water-deficit conditions, allowing for maintenance of electron flow through photosystem II and possibly protecting against oxidative stress (Kitao and Lei, 2007). Because P_N was substantially reduced under water-deficit (Ψ_l = -2.9 MPa) without concomitant changes in ETR (Fig. 1), we find no evidence for reduced electron flow under water-deficit in field-grown cotton, as reported previously under mild drought stress (Pettigrew, 2004). Our findings support the hypothesis that electron flow through photosystem II is insensitive to water-deficit stress in field-grown cotton.

Acknowledgements

The authors thank the Georgia Cotton Commission and Cotton Incorporated for funding this research. We also thank Lola Sexton, Katie Davis, Dudley Cook, Tyler Beasley, Calvin Meeks, and Jenna Pitts for their assistance in the field.

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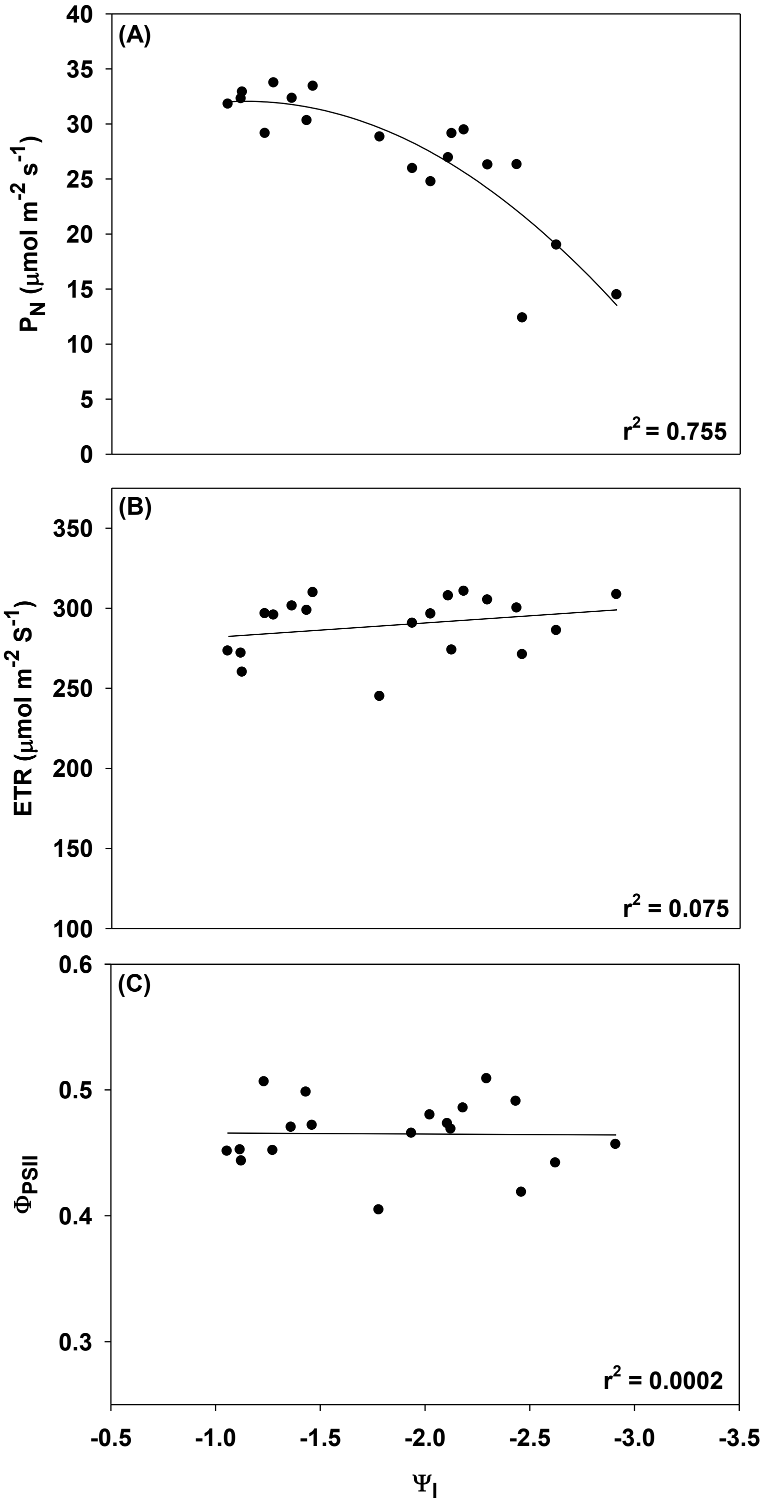

Figure 1. The relationship between midday (1200 to 1400 h) leaf water potential and net photosynthesis (P_N; A), electron transport through photosystem II (ETR; B) and actual quantum efficiency of photosystem II (Φ_{PSII}; C) Each data point represents an average of four replicate plots, where three measurements were taken in each replicate plot. The data presented in A-C were obtained from two study sites in Georgia on four sample dates from July 9 to July 26. All measurements were conducted on fourth-node, main-stem leaves.

PLANT WATER STATUS AND LEAF TEMPERATURE AS INDICATORS OF WATER DEFICIT STRESS IN COTTON

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Introduction

The future success of agriculture has been said to mainly be limited by water availability. In locations such as the humid southeastern United States, rainfall can supply much of the water needed for profitable crop production; however, the benefits of supplemental irrigation such as increasing yield and avoiding environmental unpredictability, lead many farmers to adopt an as-needed irrigation approach (Farahani and Munk, 2012). This has resulted in concerns over the sustainability of current irrigation practices. When rainfall deficits necessitate irrigation, uncertainty about the effect that overuse of water resources has on human and non-human ecosystems necessitates a better understanding of the underlying mechanisms that allow for drought tolerance as well as investigations into techniques that allow for decreased water use and maintenance of profitable yields.

Current irrigation practices seek to balance rainfall amounts and water loss due to crop transpiration with supplemental irrigation. While this method has been successful at providing high crop yields, there is evidence that plant-based irrigation triggers could provide a means to conserve water resources, while maintaining profitable yields (Jones, 2004, 2007). Specifically, pre-dawn water potential (Ψ_{PD}) has been considered the best available measurement of crop water status (Ameglio et al., 1999). Additionally, leaf temperature has been shown to provide an indirect indication of plant water status (Ehrler et al., 1978). In this study, we evaluated whether these two indicators of water-deficit stress could be linked to decreased photosynthetic rates and lint yield in dryland cotton, relative to fully irrigated cotton.

Materials and Methods

Plant Material and Study Sites

Experiments were conducted near Camilla, Georgia in 2012. Seeds of three commercially-available cultivars [PHY499 WRF (PhytoGen, Dow AgroSciences), DP 0912 B2RF, and DP 1050 B2RF (Delta and Pine Land, Monsanto Company] were sown on May 5, 2012 at a 0.91m inter-row spacing and at a rate of 11 seeds m^{-1} row. Plots for each cultivar (n = 4) were four rows wide, 12.2 m long, and had 3 m bare-soil alleys. Plots were arranged using a randomized complete block design. All cultivars were grown under both dryland and well-watered conditions to generate variation in leaf water supply at different times during the growing season. Dryland plots are defined as those plots only receiving water via rainfall during the growing season, and well-watered plots received supplemental irrigation to meet weekly water requirements for cotton as defined using University of Georgia Cooperative Extension “Checkbook” recommendations.

Quantification of Ψ_{PD}, P_N, and lint yield

To evaluate the relationships between canopy temperature (IRT), net photosynthesis (P_N), and Ψ_{PD} in field-grown cotton (*Gossypium hirsutum)*, IRT and P_N measurements were conducted at midday (1200-1400 h), under saturating light intensity (PAR > 1200 µmol m^{-2} s^{-1}) using the fourth main-stem leaf below the apical meristem. This measurement time was chosen because cotton plants are under the highest levels of water stress during this time frame (Grimes and Yamada, 1982). Single-leaf gas exchange (P_N quantification) was performed using an LI-6400 portable photosynthesis system (Li-Cor, Lincoln, NE), where all leaves were measured under natural irradiance (PAR > 1200 µmol m^{-2} s^{-1}) and chamber CO_2 concentration of 380 p.p.m. Ψ_{PD} measurements were taken on the same leaves, before sunrise (0500-0600 h). Lint yield data were obtained at the end of the growing season.

Statistical Analysis

Lint yield data were analyzed by two-way ANOVA using Sigma Plot 11 (Systat Software Inc., San Jose, CA). Prior to regression analysis, mean midday Ψ_{PD} and P_N values for each sample date × irrigation treatment were determined. A total of 6 means for each parameter were generated, where each value is the average of 12 replicate plots pooled across three cultivars. On the aforementioned data set, regression analyses to determine the relationship between IRT, Ψ_{PD}, and P_N were performed using Sigma Plot 11.

Results and Discussion

Overall, there was no evidence for variation in response to irrigation by cultivar, implying that either the cotton cultivars tested were not different in terms of drought tolerance, or the stress was not severe enough to differentiate genotypic differences in physiological and yield responses to water deficit.

Cotton grown under dryland conditions had significantly lower lint yields (~35%), when compared to fully irrigated cotton (Fig. 1). This was likely due to decreased P_N in dryland cotton (unpublished data). Regression analysis showed a strong, non-linear (quadratic; r^2=0.886) relationship between P_N and IRT (Fig. 2A) for temperatures between 30 and 38°C. This suggests that the use of canopy temperature as a possible irrigation trigger and an indirect measure of plant water status, despite concerns of the efficacy of this method in humid regions (Jones, 2004, 2007). Additionally, a strong, non-linear (quadratic; r^2=0.942) relationship between P_N and Ψ_{PD} was observed between -0.95 and -0.54 MPa (Fig. 2B), suggesting that this parameter was strongly indicative of water stress in cotton.

In future studies, we plan to evaluate the use of Ψ_{PD} as a direct indicator of crop water stress and irrigate accordingly. In addition, we plan to continuously monitor IRT and evaluate the efficacy of indirect, automated sensors of plant water status for use in irrigation scheduling.

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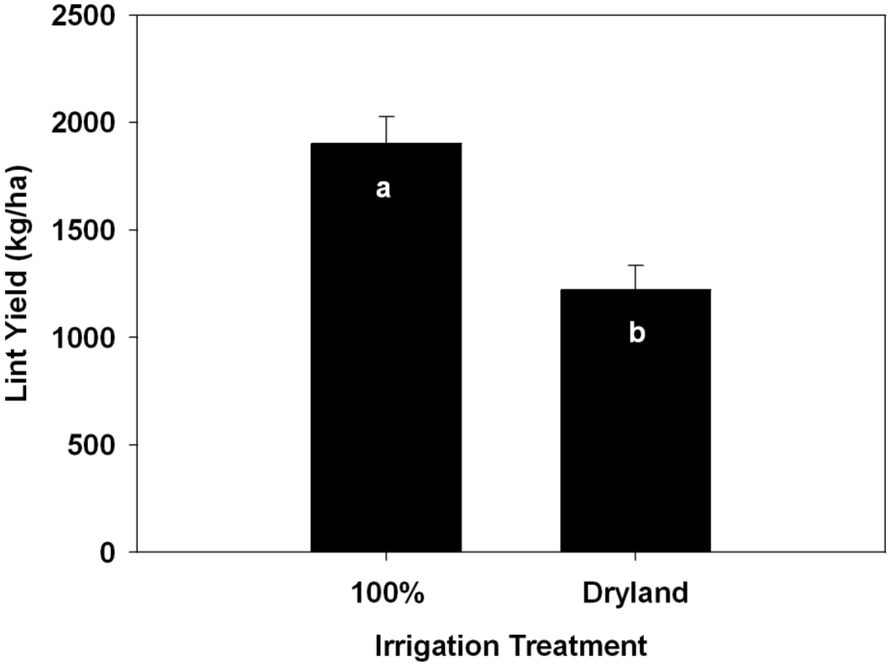

Figure 1. Effect of irrigation treatment on cotton lint yield. Bars not sharing letters are significantly different (P<0.05). Data are means for three cultivars ± standard errors (n=4).

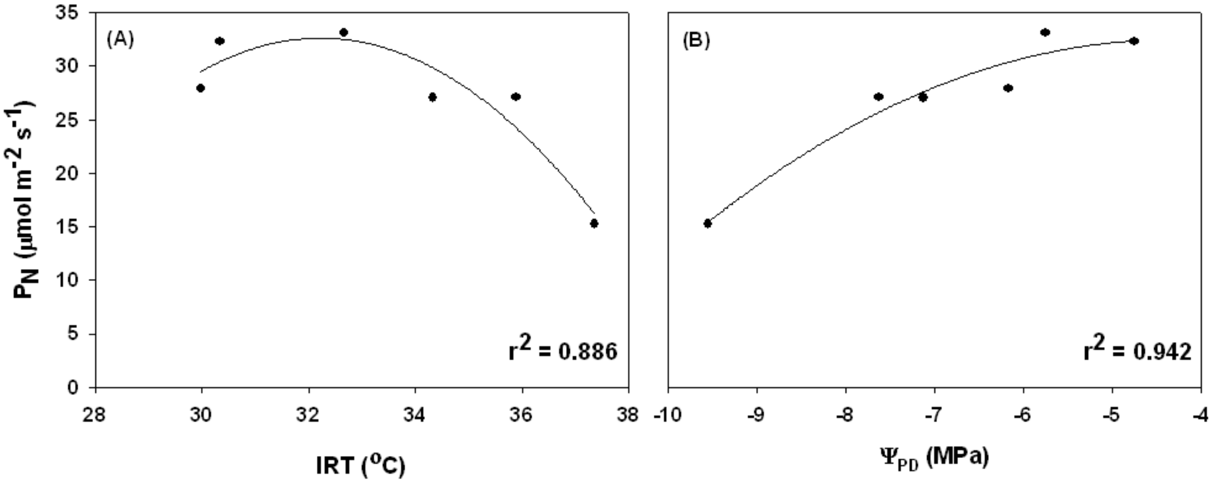

Figure 2. The relationship between net photosynthesis (P_N), canopy temperature (IRT, A), and predawn water potential (Ψ_{PD}, B). Each data point represents the average of 12 replicate plots, where three measurements were taken per plot.

FERTILIZATION AND COVER CROP INTERACTIONS FOR STRIP-TILL COTTON

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Introduction

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

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

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

Materials and Methods

A split-plot experiment with four replications was established on the University of Georgia's Lang Farm on the Tifton Campus in a 1.0 acre field. Main plot treatment areas measuring 48 ft wide and 45 ft long were planted to one of five treatment effects as cover crop establishment. These included 1. no cover crop, 2. crimson clover (*Trifolium incarnatum* L.), 3. hairy vetch, 4. rye, and 5. winter wheat (*Triticum aestivum* L.). Sub-treatment effects of sidedress fertilization were randomly designated within each main plot treatment as 12 ft x 45 ft sub-plots, including 0, 30, 60, and 90 lb N/ac.

Cover crops were planted on 11/4/11 as follows:

Crimson clover @ 18 lb/ac
Hairy Vetch @ 20 lb/ac
Rye @ 90 lb/ac
Wheat @ 90 lb/ac

Rye and wheat cover crops were terminated on 3/12/12 and crimson clover and vetch were terminated on 4/3/12 with Roundup at 2 qts/ac. Plots were strip-tilled on 5/9/12. Cotton ('DPL 1252') was planted at 3 seed/ft of row at approximately 0.75 inches deep on 5/11/12. Pre-emergence herbicides were applied on 5/11/12 including Prowl at 10 oz/ac, Reflex at 10 oz/ac, and Cotoran at 1 pt/ac. On 6/11/12, an application of Roundup Powermax (1 qt/ac) + Staple LX (3 oz/ac) + surfactant was applied for supplemental weed control. In addition, a directed spray of MSMA (2.5 pt/ac) + Direx (1 qt/ac) + Crop Oil (1 qt/ac) was applied on 7/13/12.

Biomass of cover crop and soil sampling occurred around the time of cover crop termination on 4/2/12, prior to sidedress N application (7/3/12), and at maximized vegetative growth (9/25/12). The mid-season and final sample dates also included cotton whole plant biomass sampling. Treatment specific sidedress N rates were applied on 7/10/12. Lint harvest occurred on 11/2/12.

Results

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

The mineral concentration in the cover crops varied at time of termination, and it was common for the two leguminous cover crops (crimson clover and vetch) to have similar values to each other and the two grass cover crops (rye and wheat) to have similar values to each other. But, the legume vs. grass comparisons were often different. The legume cover crops had greater mineral concentrations for Ca, Mg, N, K, Cu, Zn, and B, while the grass cover crops had more P, and there was no difference among any of the species for Mn (Figs. 1-3).

Table 1. Cover crop residue decomposition and cotton vegetative growth for cover crop effects, averaged over N rates. Univ. of Georgia, Tifton, 2012.

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

[x] CC = Cover Crop

[y] DM = Dry Matter

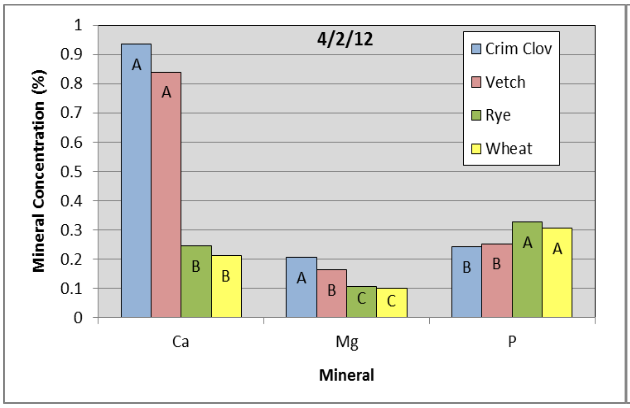
[z] SE = Standard Error

Table 2. Cotton vegetative growth for four N rates, averaged over cover crops. Univ. of Georgia, Tifton, 2012.

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

[y] DM = Dry Matter

[z] SE = Standard Error



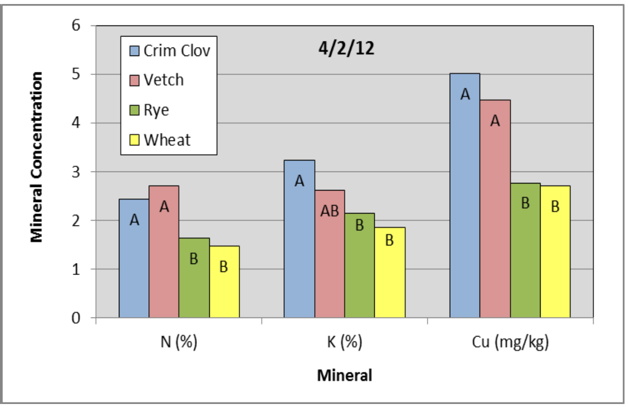


Figure 1 (left). Mineral concentration of Ca, Mg, and P in cover crop residue at cover termination. Univ. of Georgia, Tifton, 2012.

Figure 2 (right). Mineral concentration of N, K, and Cu in cover crop residue at cover termination. Univ. of Georgia, Tifton, 2012.

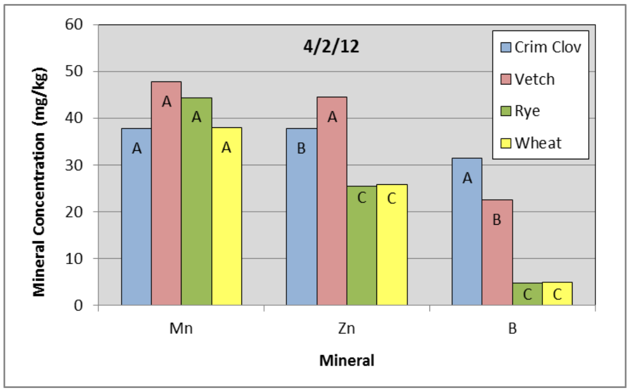
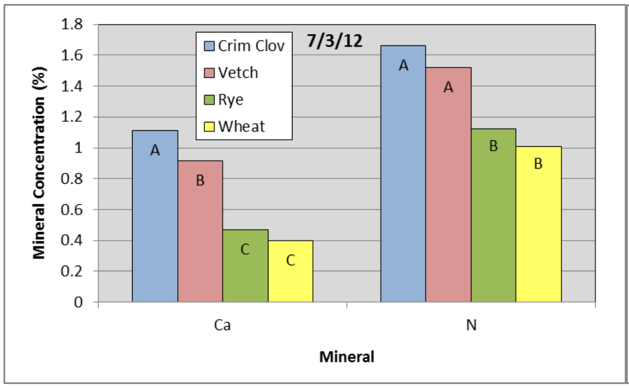


Figure 3. Mineral concentration of Mn, Zn, and B in cover crop residue at cover termination. Univ. of Georgia, Tifton, 2012.

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

Soil test levels for Ca responded as expected. Calcium increased in plots where the leguminous cover crops were planted, as they had rapid decomposition and much higher Ca concentration than the grass covers (Fig. 8). Soil Ca decreased during the first 3 months after cover crop termination where grass covers were grown, since there was very little decomposition of residues during this timeframe and the cotton plants were removing Ca from the soil at a more rapid rate than replenishment by the covers. By the end of the season, additional deterioration of cover residues and less need by the cotton plant (seen in the reduction in concentration within the cotton plant by late September, Fig. 9) caused soil test Ca levels to remain the same or slightly increase.



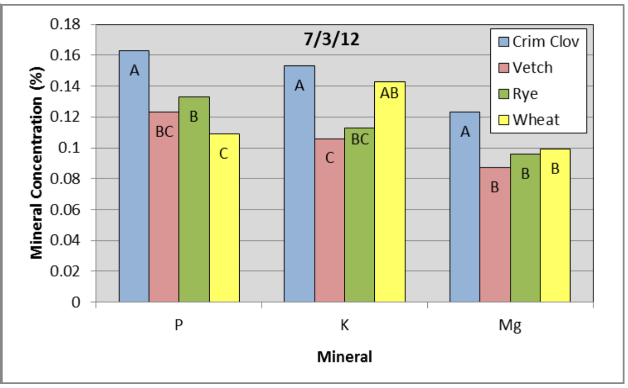
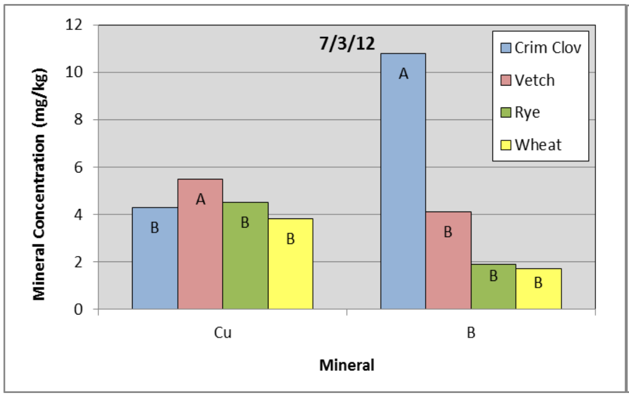


Figure 4 (left). Mineral concentration of Ca and N in cover crop residue prior to sidedress N application. Univ. of Georgia, Tifton, 2012.

Figure 5 (right). Mineral concentration of P, K, and Mg in cover crop residue prior to sidedress N application. Univ. of Georgia, Tifton, 2012.



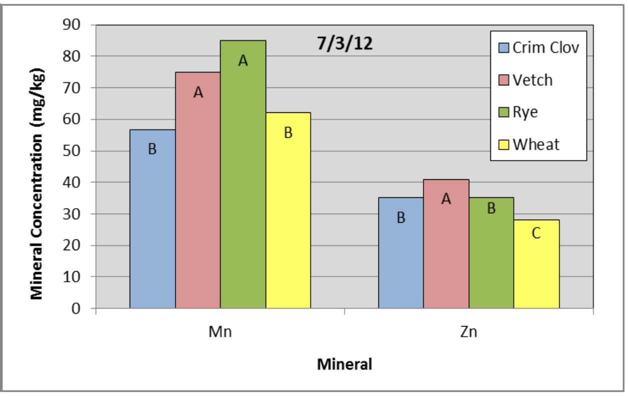
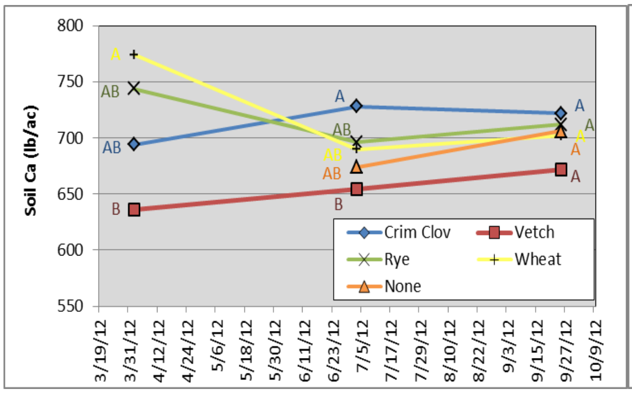


Figure 6 (left). Mineral concentration of Cu and B in cover crop residue prior to sidedress N application. Univ. of Georgia, Tifton, 2012.

Figure 7 (right). Mineral concentration of Mn and Zn in cover crop residue prior to sidedress N application. Univ. of Georgia, Tifton, 2012.

Potassium concentration in residue decreased dramatically from April until July (Figs. 2 and 5), meaning the majority of K left the residue since it is a mobile element. This may explain why soil K levels increased from April until July for most plots (Fig. 10). But since cotton biomass increased ten-fold from July until Sept., yet the K concentration remained nearly the same during this timeframe (Fig. 11), it caused soil K levels to decrease. In addition, there were relatively consistent rains during the latter half of the season, and with the relative mobility of K in the soil, it is possible that some leaching of the element occurred, pushing it below our sample depth.



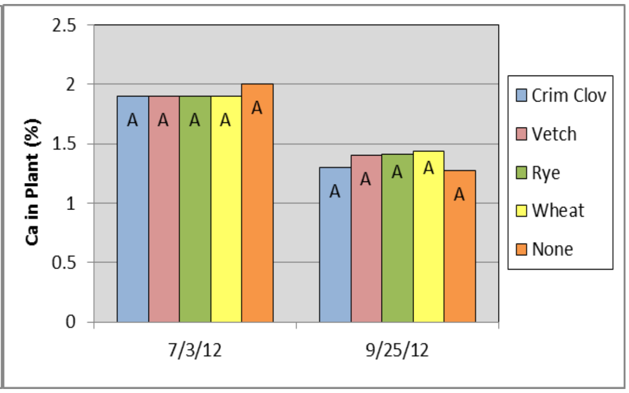
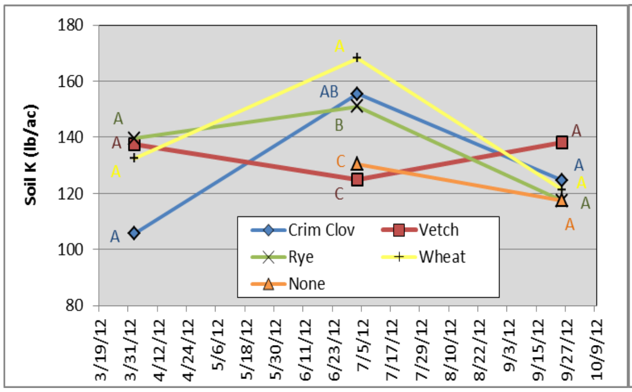


Figure 8 (left). Soil Ca during growing season. Univ. of Georgia, Tifton, 2012.

Figure 9 (right). Mineral concentration of Ca in cotton plants averaged over sidedress N treatments, pre-sidedress (7/3/12) and pre-defoliation (9/25/12). Univ. of Georgia, Tifton, 2012.



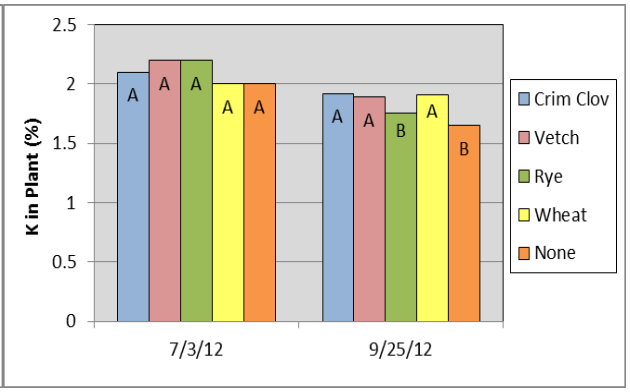
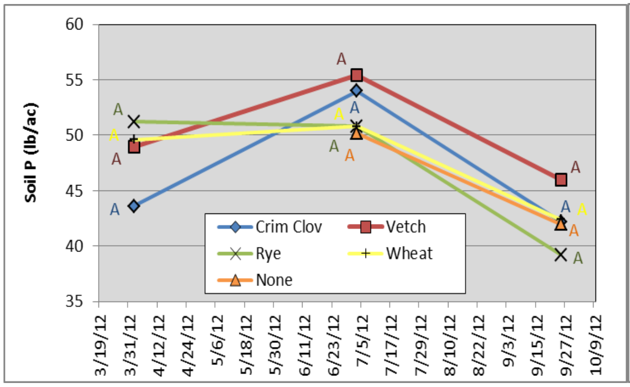


Figure 10 (left). Soil K during growing season. Univ. of Georgia, Tifton, 2012.

Figure 11 (right). Mineral concentration of K in cotton plants averaged over sidedress N treatments, pre-sidedress (7/3/12) and pre-defoliation (9/25/12). Univ. of Georgia, Tifton, 2012.

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



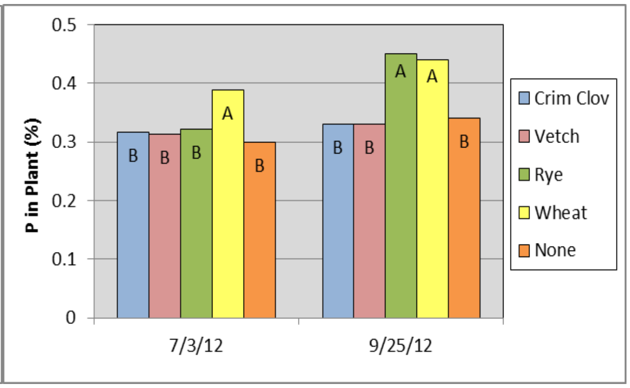
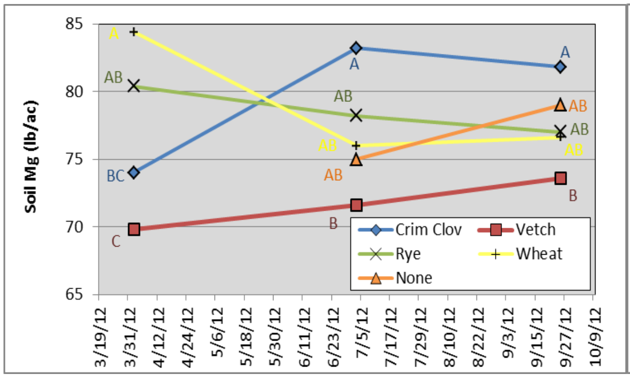


Figure 12 (left). Soil P during growing season. Univ. of Georgia, Tifton, 2012.

Figure 13 (right). Mineral concentration of P in cotton plants averaged over sidedress N treatments, pre-sidedress (7/3/12) and pre-defoliation (9/25/12). Univ. of Georgia, Tifton, 2012.

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



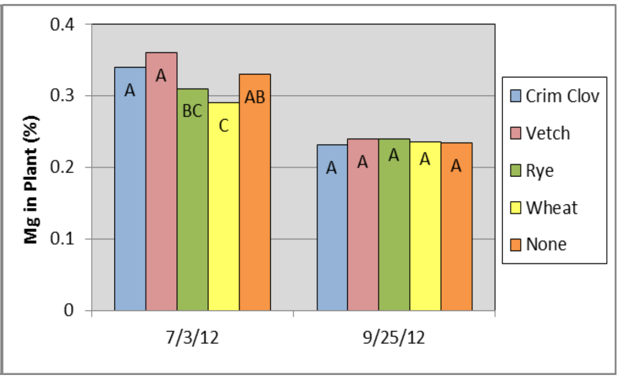
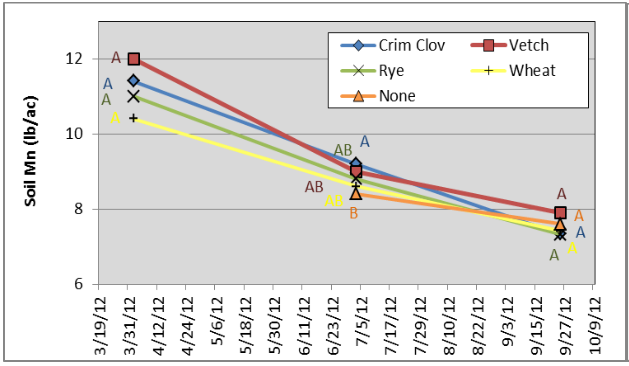


Figure 14 (left). Soil Mg during growing season. Univ. of Georgia, Tifton, 2012.

Figure 15 (right). Mineral concentration of Mg in cotton plants averaged over sidedress N treatments, pre-sidedress (7/3/12) and pre-defoliation (9/25/12). Univ. of Georgia, Tifton, 2012.

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



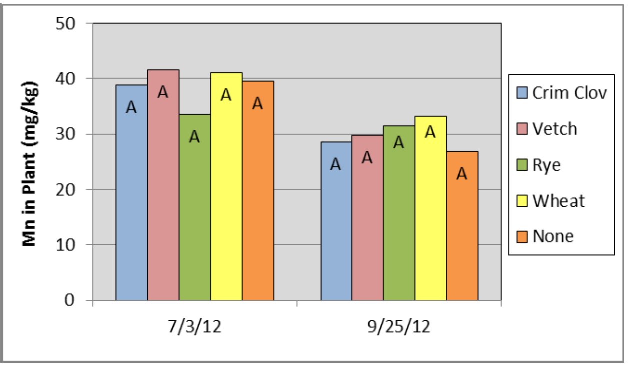
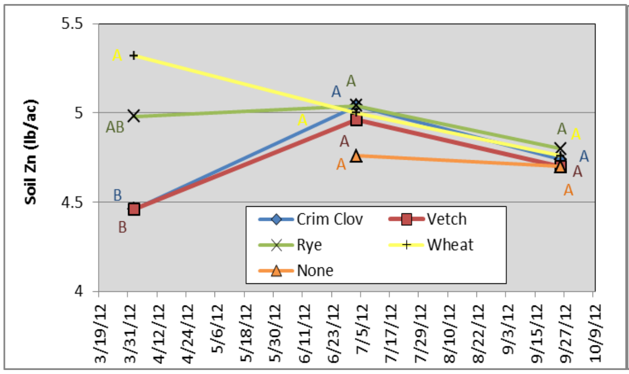


Figure 16 (left). Soil Mn during growing season. Univ. of Georgia, Tifton, 2012.

Figure 17 (right). Mineral concentration of Mn in cotton plants averaged over sidedress N treatments, pre-sidedress (7/3/12) and pre-defoliation (9/25/12). Univ. of Georgia, Tifton, 2012.

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



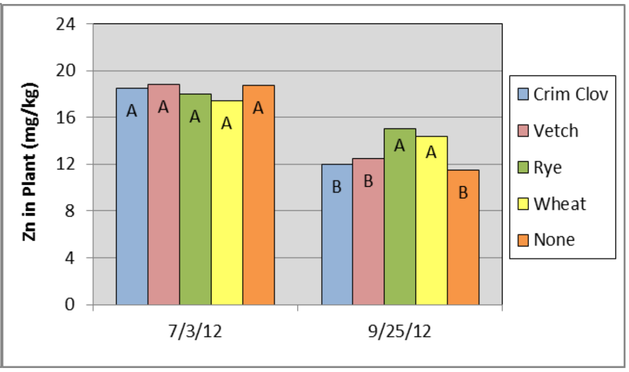
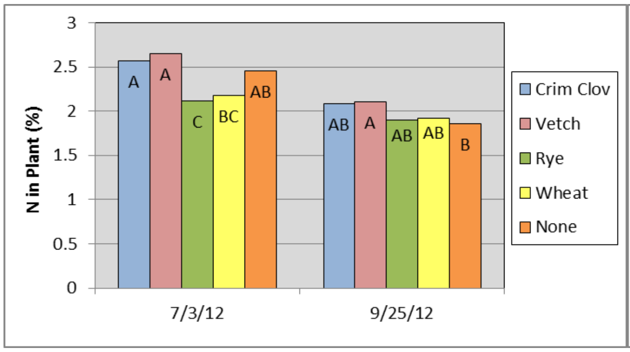


Figure 18 (left). Soil Zn during growing season. Univ. of Georgia, Tifton, 2012.

Figure 19 (right). Mineral concentration of Zn in cotton plants averaged over sidedress N treatments, pre-sidedress (7/3/12) and pre-defoliation (9/25/12). Univ. of Georgia, Tifton, 2012.

Concentration of N was highest in leguminous cover crops at burndown and mid-season, as expected (Figs. 2 and 4). This translated to higher levels of N in cotton plants following the leguminous covers in most pairwise comparisons to other cover crop treatments (Fig. 20). Soil N was not collected because of the extreme mobility in sandy soils and expense for conducting soil N tests for relatively inaccurate information. Results for Cu in both cover crop (Figs. 2 and 6) and cotton plant tissues (Fig. 21) were similar to Zn over the course of the season.



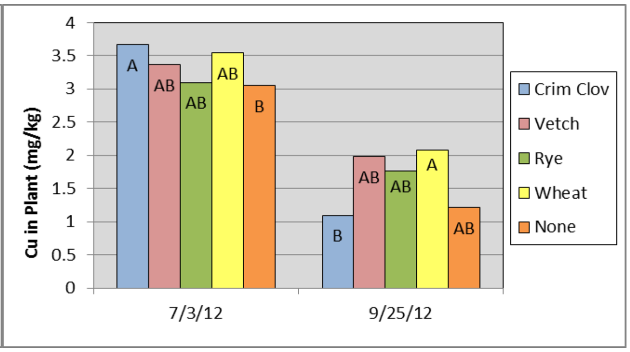


Figure 20 (left). Mineral concentration of N in cotton plants averaged over sidedress N treatments, pre-sidedress (7/3/12) and pre-defoliation (9/25/12). Univ. of Georgia, Tifton, 2012.

Figure 21 (right). Mineral concentration of Cu in cotton plants averaged over sidedress N treatments, pre-sidedress (7/3/12) and pre-defoliation (9/25/12). Univ. of Georgia, Tifton, 2012.

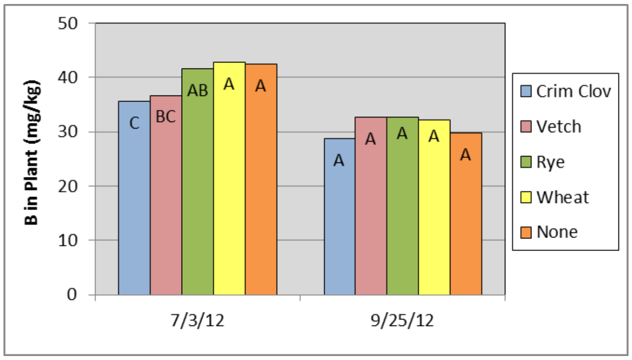
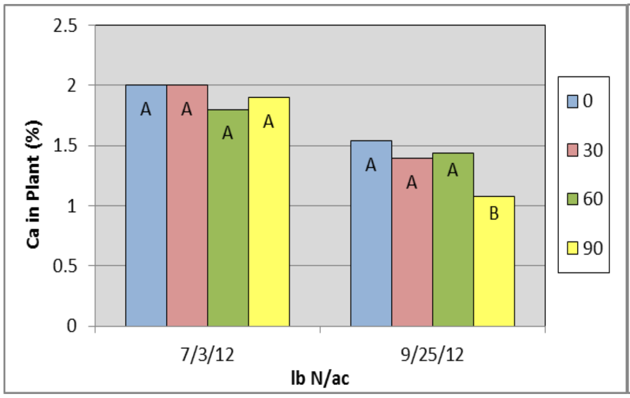


Figure 22. Mineral concentration of B in cotton plants averaged over sidedress N treatments, pre-sidedress (7/3/12) and pre-defoliation (9/25/12). Univ. of Georgia, Tifton, 2012.

Boron had much higher concentrations in leguminous crops, especially in crimson clover (Figs. 3 and 6), although this did not result in higher B concentrations in the cotton plants (Fig. 22).

General trends for application of sidedress N were similar for most minerals (Figs. 23-31). In most cases, there was a decreasing trend in concentration of the various nutrients tested with increasing rate of N application. This was noted for Ca, P, Mg, Mn, and Zn, especially at the end of the season. There was no evidence of nutrient differences for K, N, or B at any of the sidedress N rates, especially at the end of the season. The only nutrient with a highly abnormal response at the various N rates was Cu, where the 0, 30, and 90 lb N/ac rates followed a decreasing trend with increasing N rate, but the 60 lb N/ac rate resulted in the highest concentration of Cu (Fig. 28).



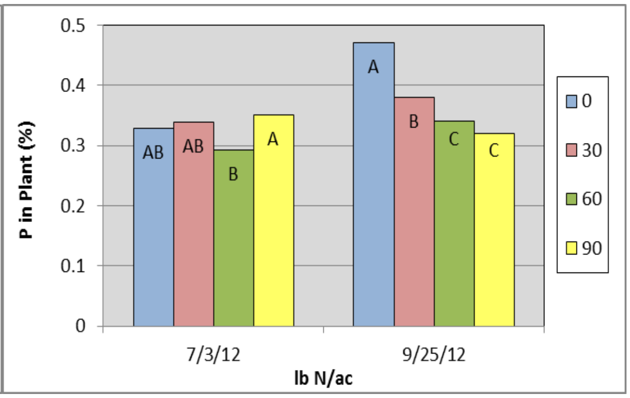
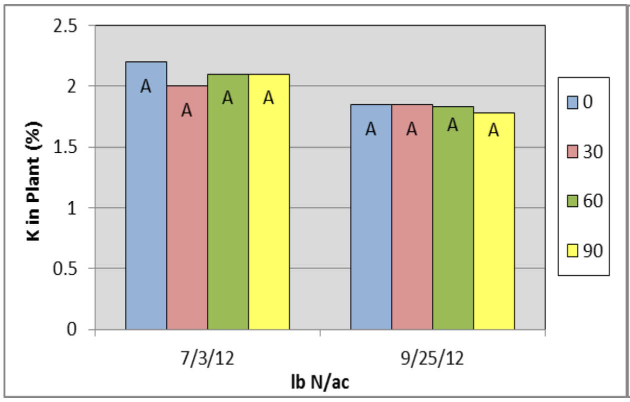


Figure 23 (left). **Mineral concentration of Ca in cotton plants averaged over cover crop treatments, pre-sidedress (7/3/12) and pre-defoliation (9/25/12). Univ. of Georgia, Tifton, 2012.**

Figure 24 (right). **Mineral concentration of P in cotton plants averaged over cover crop treatments, pre-sidedress (7/3/12) and pre-defoliation (9/25/12). Univ. of Georgia, Tifton, 2012.**



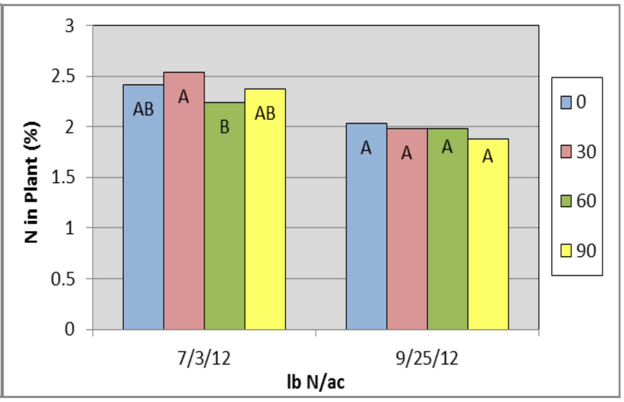
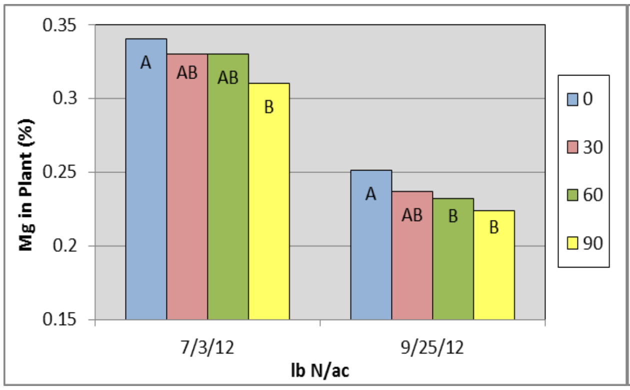


Figure 25 (left). **Mineral concentration of K in cotton plants averaged over cover crop treatments, pre-sidedress (7/3/12) and pre-defoliation (9/25/12). Univ. of Georgia, Tifton, 2012.**

Figure 26 (right). **Mineral concentration of N in cotton plants averaged over cover crop treatments, pre-sidedress (7/3/12) and pre-defoliation (9/25/12). Univ. of Georgia, Tifton, 2012.**



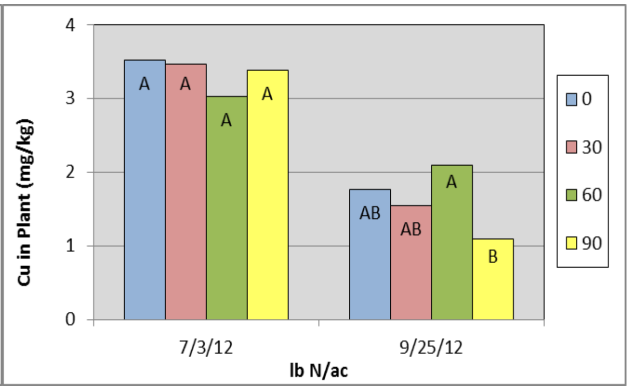
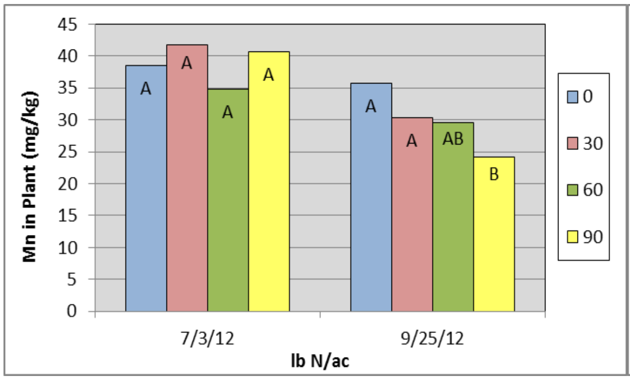


Figure 27 (left). Mineral concentration of Mg in cotton plants averaged over cover crop treatments, pre-sidedress (7/3/12) and pre-defoliation (9/25/12). Univ. of Georgia, Tifton, 2012.

Figure 28 (right). Mineral concentration of Cu in cotton plants averaged over cover crop treatments, pre-sidedress (7/3/12) and pre-defoliation (9/25/12). Univ. of Georgia, Tifton, 2012.



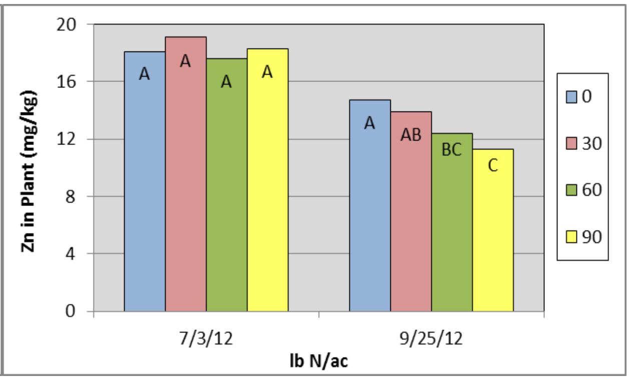


Figure 29 (left). Mineral concentration of Mn in cotton plants averaged over cover crop treatments, pre-sidedress (7/3/12) and pre-defoliation (9/25/12). Univ. of Georgia, Tifton, 2012.

Figure 30 (right). Mineral concentration of Zn in cotton plants averaged over cover crop treatments, pre-sidedress (7/3/12) and pre-defoliation (9/25/12). Univ. of Georgia, Tifton, 2012.

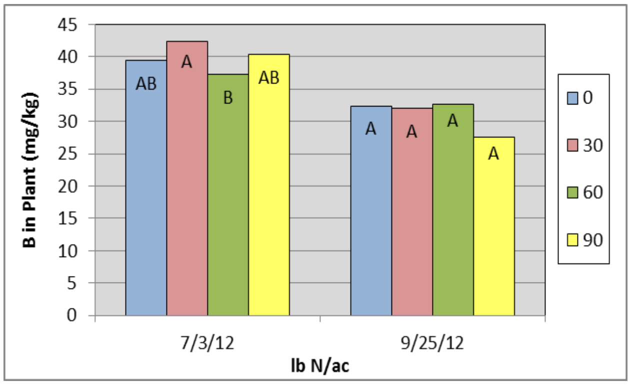


Figure 31. Mineral concentration of B in cotton plants averaged over cover crop treatments, pre-sidedress (7/3/12) and pre-defoliation (9/25/12). Univ. of Georgia, Tifton, 2012.

Aside from all nutrient data, the most important take-home message to a grower is yield. There were significant differences in yield response to cover crop (Table 3) and to sidedress N Rate (Table 4). There was an interaction of cover crop x sidedress N Rate at the $0.10 > p > 0.05$ level of significance, although data for the interaction will not be shown in this report. When analyzed at the $\alpha=0.10$ level, the primary trend in the interaction effects were that there was no statistical difference in N Rate at any level for crimson clover and vetch, while there was a difference for low input rates (0 and sometimes 30 lb N/ac) when compared to high input rates (60 and 90 lb N/ac) for the rye, wheat, and no cover crop treatments. This would indicate that the supplemental nutrients supplied by leguminous cover crops (crimson clover and vetch) may make it possible for reduced sidedress N applications for cotton, or less detrimental effect of untimely or lost fertilizer N due to volatilization or leaching, when following these cover crops.

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

Table 3. Lint yield (lb/ac) for cover crop effects, averaged over N rates. Univ. of Georgia, Tifton, 2012.

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

^{z} SE = Standard Error

Table 4. Lint yield (lb/ac) for sidedress N Rate effects, averaged over cover crops. Univ. of Georgia, Tifton, 2012.

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

^{z} SE = Standard Error

Acknowledgements

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MANAGEMENT OF SHORT-HORNED GRASSHOPPERS AND THRIPS IN CONSERVATION TILLAGE USING INSECTICIDE-HERBICIDE TANK MIXES WITH ROUNDUP-READY AND LIBERTY LINK COTTON

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2/ Crop and Soil Sciences, University of Georgia, Athens

Introduction

Short-horned grasshopper (Acrididae) infestations are increasing in conservation tillage cotton, with damaging populations associated with small grain cover crops and grassy fallow areas that are planted with minimal or no plowing. Reduced tillage has the reverse effect on thrips, in several years' tests where tobacco thrips infestations were monitored on cotton seedlings, numbers were always fewer in conservation tillage as compared to plow tillage plots. The project proposed to develop information on cost effective management of short-horned grasshoppers, thrips, and other early season pests in conservation tillage cotton using replicated field experiments at the UGA Southeastern Branch Research and Education Center (SEBREC) near Midville and the Plant Sciences Farm (UGAPSF) near Athens. The objective was to examine the influence of different surface residue management procedures, particularly use of insecticide-herbicide tank mixes in Roundup-Ready and Liberty Link cotton on pest management. The project also had the purpose of evaluating alternative thrips management procedures to cope with the regulatory loss of Temik and to seek cost effective management systems for early season pests in conservation tillage.

Materials and Methods

Two fields were planted in wheat at the SEBREC and a fallow area was used for conservation tillage cotton at the UGAPSF. A randomized complete block experiment was established in the test fields with seedbed preparation of strip tillage plots having wheat or fallow cover killed with either glyphosate or paraquat. Treatment plots had insecticide-herbicide mixtures applied 3 weeks before planting (glyphosate) or at planting time (paraquat). The experimental plots were 8 rows at SEBREC and 4 rows wide at UGAPSF x 40 (SEBREC) or 30 (UGAPSF) feet long. Selected plots were sprayed with an appropriate herbicide for weed control and certain plots were sprayed with a herbicide+insecticide mixture.

The insecticides that were evaluated in in-furrow application or herbicide tank mixes were Thimet @ 1.0# a.i./A (planting time application of granules in the seed furrow at Midville only), Orthene (acephate) @ 0.75# a.i./A, and Diamond (novaluron)+thiamethoxam) @ 0.06#a.i./A. Herbicide systems for the FM 1944 (Roundup-Ready and Liberty Link) cotton was glyphosate plus 2,4-D or glyphosate plus flumioxazin (Valor) for the 3 week burn down treatments and paraquat (Gramoxone) for the planting time burn down treatments.

Thrips populations and damage to cotton were sampled 14 and 35 days after planting by washing 10 plants/ plot in alcohol to remove adult and immature insects. The fields were monitored for short-horned grasshopper infestations weekly by walking 2 x 4 ft wide transits across the field while counting all short-horned grasshoppers. Short-horned grasshopper specimens were returned to the laboratory and identified. Yields were taken at the end of the season by harvesting the two middle rows of each plot.

Results and Discussion

Thrips populations were very low at 14 days and 35 days after planting at both the SEBREC and UGAPSF with fewer than one adult or immature per plant at either test site. Low thrips populations in cotton were observed in other tests with FM 1944 and other cotton. The cotton was treated with Cruiser @ 0.25 mg a.i. thiomethoxam/seed and was probably responsible for low thrips numbers. The Thimet 1.0 # a.i./A in furrow treatment did not enhance thrips control in the Midville test, nor the Orthene @ 0.75 # a.i./A or Diamond @ 0.06# a.i. treatments at both locations.

Short-horned grasshopper (differential grasshopper, *Melanoplus diffferentialis* and red-legged grasshopper *M. femurrubrum*) populations were low at both locations, but were highest at the SEBREC during the season. Figure 1 shows that numbers of adults and large immature short-horned grasshoppers were highest in plots that received herbicide burn down at planting time as compared to chemical application 21 days before planting. The planting time applications of Orthene @ 0.75 # a.i./A and Diamond @ 0.06 # a.i./A reduced short-horned grasshopper numbers to similar levels as in the 21 day herbicide + insecticide burn down treatments, whereas the Thimet @ 1.0 # a.i. in-furrow treatments did not control short-horned grasshoppers. Yield at either location was not significantly different, but at the UGAPSF there was a trend for higher yield in non-insecticide treated plots (up to 50% greater in certain Roundup Weathermax treatments and 40% greater in gramoxone plots without insecticide tank mixes as compared either of the two herbicide + insecticide treatments) which may indicate that a negative cotton growth interaction occurred with the herbicides and insecticide tank mixes. Cotton yields at the SEBREC were similar among the treatments.

In 2012 tests, insect populations were low at the SEBREC and UGAPSF, but the data supports previous research indicating that timing of weed burn down prior to planting conservation tillage cotton influences short-horned grasshoppers and thrips. In previous research, higher thrips occur in 21 or 35 day burn down no till cotton systems as compared to applying herbicides at planting time, whereas grasshopper numbers are higher in planting time burn down treatments. Further research with higher insect populations is needed in order to verify the dynamic impact that conservation tillage and weed management have on early season cotton insect pest management.

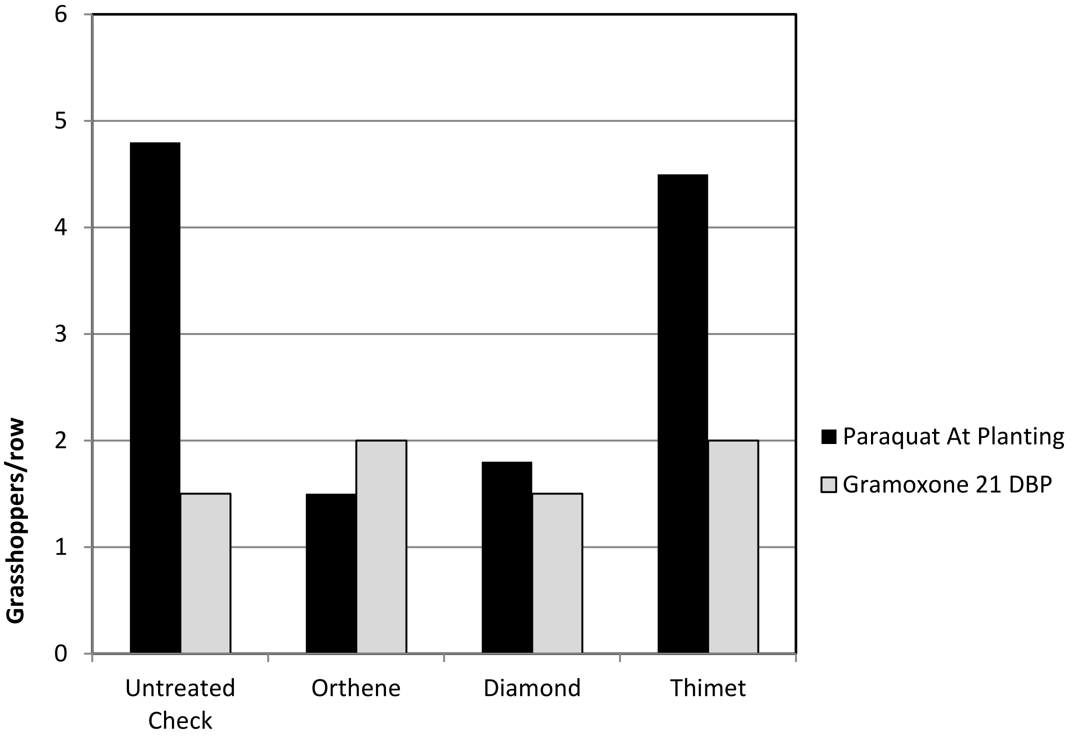

Figure 1. Short-horned grasshopper populations during 30 days after planting in no-till cotton treated with herbicide + insecticides in burn down applications 21 days before planting or at planting, SEBREC.

PLANTING DATE AFFECTS STINK BUG INJURY, YIELD, AND FIBER QUALITY IN GEORGIA COTTON

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1/ Department of Entomology
2/ Department of Agricultural and Applied Economics

Introduction

Stink bugs are serious economic pests of cotton in Georgia. They feed on cotton bolls and cause abscission of young bolls, or a loss of lint quality when larger bolls are damaged. Feeding injury is characterized by rough warty growths on the inner carpel walls and stained lint. Stink bug feeding is occasionally followed by boll rot because some stink bug species can transmit cotton seed and boll rotting bacteria through their piercing and sucking mouthparts. Of the species of stink bugs that are encountered in cotton fields, southern green stink bug, brown stink bug and green stink bug are most common. Stink bugs have been ranked among the most damaging insect pests in the southeastern states for the last several years. Approximately 1.3 million acres of cotton in Georgia were infested with stink bugs in 2011 and those infestations required insecticide treatment of approximately 1 million acres; at an average of two applications per season. The reduction in broad spectrum insecticide use brought about by boll weevil eradication and widespread adoption of transgenic cotton varieties is believed to have contributed to the emergence of stink bug complex as an economic pest group in cotton.

Polyphagous pests such as stink bugs are often highly mobile and their population dynamics are influenced by continuous availability of suitable plant hosts. Stink bugs overwinter as adults, emerge in early spring and feed on seed bearing weed hosts and subsequently move to crop fields. In cotton, stink bug damage is most critical during third, fourth and fifth week of bloom. Current Extension thresholds recommend insecticide treatment when 10-15% of quarter-sized bolls exhibit stink bug damage. Cultural practices, such as manipulation of planting dates, may allow the crop to escape in time from the most damaging populations. The objective of this project was to study the influence of four different planting dates on stink bug damage in cotton in terms of boll injury, yield, lint quality, and economic value.

Materials and Methods

This experiment was conducted over a 2 yr period in Georgia. In 2011, trials were conducted near Tifton, Midville and Plains. Trials were repeated in 2012 near Tifton and Plains. A second generation cotton cultivar, 'DP 0912 B2RF,' containing Cry1ACc and Cry2Ab proteins for resistance to lepidopteran caterpillars was planted in all plots over four planting dates: 5/10, 5/24, 6/7 and 6/21. Plots at each site were arranged in randomized complete block design with 3-5 replicates. In 2011, plots were 8-rows wide and 15.24m long, except in Midville, where the plots were 30.48 meters long. In 2012, plots at Tifton were 8-rows wide and 12.19m long, while plots in Plains were 4-rows wide and 15.24m. Regardless of planting date or location, all plots were planted using seed from the same bag. The same pneumatic planter and planting depth was utilized for all plots.

Starting in the second week of bloom, plots were sampled weekly for stink bugs using sweep nets, and immature cotton bolls were assessed for stink bug injury. Twenty immature bolls were collected from each plot and internally evaluated for symptoms of stink bug feeding to estimate percent boll injury in each week. Stink bugs captured were identified to species and life stages. For yield and fiber quality assessments, two-rows from each plot were mechanically harvested, weighed, and ginned at the UGA Microgin (Tifton, GA). Representative ginned fiber samples from each plot were sent to the USDA Classing Office located at Macon, GA for official grading. Cotton lint classification followed USDA's official grade standards for American Upland cotton. Lint characteristics such as color, leaf, staple, micronaire, uniformity, strength, color Rd (a measure of fiber brightness) and color +b (a measure of fiber yellowness) were determined using the Uster High Volume Instrument (HVI).

Percentage boll damage data were analyzed using linear regression methods because the data were collected weekly throughout the six weeks of the bloom cycle. Simple linear curve models were fitted using the PROC REG procedure in SAS 9.3 (SAS Institute 2012), with weeks of bloom on the x-axis (independent variable) and mean percentage boll injury on y-axis (dependent variable). Regression model fit was evaluated using pattern of residuals and F tests for lack of fit. Comparisons among individual slopes were made possible by testing slopes of two planting dates at a time. Lint yield, seedcotton yield, gin turnout, and cotton fiber quality parameters were compared using analysis of variable SAS (9.3) among the four planting dates. Data from all trials within a single; year were pooled together for analysis. Economic analyses were based on the average Georgia cash (spot) prices received for base quality (Color 41, Leaf 4, Staple 34) in December 2011 and December 2012 (USDA-AMS) adjusted up or down (a price premium or discount) for the specific quality characteristics of the cotton from each plot. There were few stink bugs captured in the sweep net, so stink bug captures were summed across planting dates and weeks of bloom to illustrate the stink bug species composition.

Results and Discussion

Number of stink bugs captured by the sweep net was generally very low in both years. In 2011, from 287 samples (20 sweeps per sample), only 14 stink bugs were captured. Of these, 42.8% were brown stink bug and 57.1% were green stink bugs; no southern green stink bugs were captured. Much greater stink bug pressure was observed in 2012. From 166 sweep net observations, a total of 39 stink bugs were captured with 92.3% of them being southern green stink bugs and the rest being brown stink bugs. Statistical comparisons were not attempted on stink bugs captures due to low response. Low capture rates were possibly due to the inefficiency of sampling using sweep nets. Other factors such as time of sampling, stage of cotton growth might have also influenced the capture rates. Stink bug sampling using sweep nets gets more difficult later in the bloom cycle as mature bolls tend to break off the plant when sweeping.

The sampling for stink bugs and boll damage commenced around the same period in both years (July 14th in 2011and July 16th in 2012). The mean percent boll damage due to stink bug feeding over a five week period was significantly lower in May planted cotton compared to June planted cotton in 2011 and the results were similar in 2012 (Figure 1). Percent boll injury in June planting dates exceeded the Extension recommended treatment threshold much more frequently than May planting dates. In 2011, the percent boll injury for both the May 10 and May 24 planting dates never exceeded the threshold (10-15%) during weeks 3 to 5. However, both June planting dates exceeded the threshold on three of the possible five dates. Similarly in 2012, the May planted cotton exceeded the Extension recommended threshold only during last two weeks, whereas the June planted cotton exceeded the threshold in 4 out of 5 weeks. Overall mean percentage boll damage was numerically greater in 2012 (17.3 ± 1.5) compared to 2011 (12.6 ± 0.9). The results clearly indicate that the cotton planted later in the season was at a higher risk of being infested with more number of stink bugs. The results also suggest that stink bug infestations are predictable. Early planting could possibly eliminate the need for insecticidal spray later in the season because most of the harvestable bolls will be immune to stink bug injury after the 6th week of bloom.

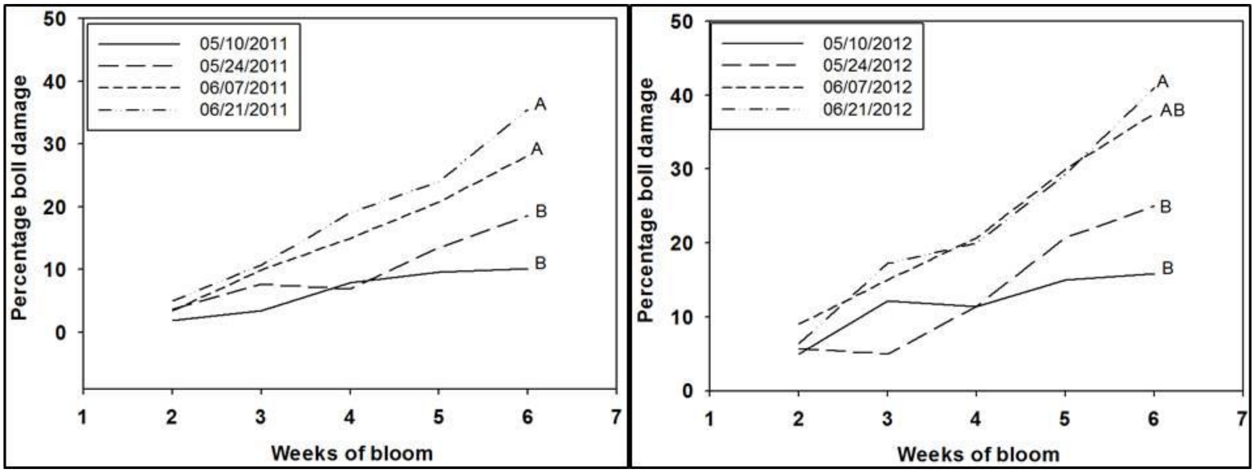

Figure 1. Mean percentage boll damage by week of bloom over four different planting dates in 2011 and 2012. Lines denoted by same letters are not significantly different.

Both planting dates in May had statistically comparable lint yield, which was significantly greater than the yield from both June planting dates in 2011 (Figure 2). The general trend was similar in 2012, except that only 05/10 cotton had statistically greater yields. Other yield parameters such as seedcotton yield and percent gin turnout showed similar trends. Here, yield and fiber quality both decreased in June planted cotton and stink bugs were a likely cause. Early planted cotton showed consistently better (less yellowness) values for HVI color +b in both years. In 2011, both May plantings had significantly better HVI color +b values while in 2012 only the May 10 plantings exhibited significantly better HVI color +b values. HVI color Rd values, which indicate fiber reflectance, indicated slightly better quality in the June planted cotton. Differences in HVI color Rd likely indicated changing environmental conditions, such as rainfall, after the bolls opened. The responses of other quality variables were not consistent between years.

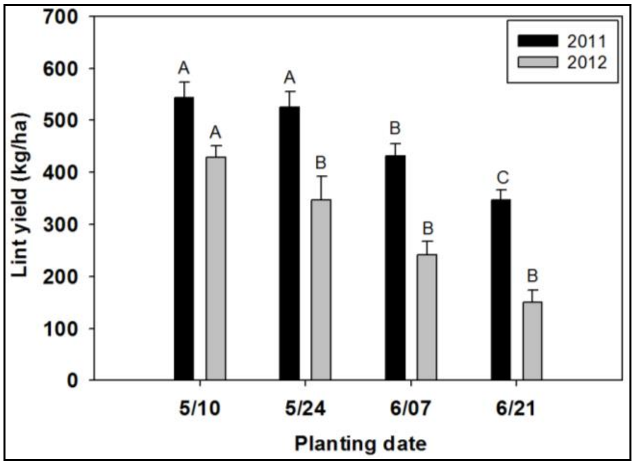

Figure 2. Mean lint yield (kg/ha) ± SEM recorded for four different planting dates in 2011 and 2012. Bars denoted by same letters are not significantly different.

Lint value based on yield, fiber quality, and price (the December 2011 and 2012 average spot price adjusted for quality) differed significantly as a function of planting date (Table 1). Both May planting dates were similar, but greater than the June planting dates in 2011; late June planted cotton exhibited the least lint value. Early May planted cotton had significantly greater lint value in 2012 compared to the remaining planting dates. Lint value was primarily decided by lint yield and the influence of quality parameters was not evident in the results. Previous research has showed that stink bug damage can affect the economic value of lint. Although there were documented statistical differences among planting dates, the remaining quality parameters were not sufficiently different to affect economic returns. Considering that the optimal planting window starts in late April, there may be potential for further improvement in yield and fiber quality by planting earlier than May 10.

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Table 1. Mean ± SEM of various parameters evaluated for cotton planted at four different planting dates, 2011 and 2012. Means followed by same letter not significantly different.

		2011		2012	
Parameters	**Planting date**	**Mean**	**Std. Error**	**Mean**	**Std. Error**
	5/10	3126.01a	178.19	2494.78a	116.43
	5/24	3026.75a	175.38	1979.18b	253.43
	6/07	2472.80b	141.70	1051.68b	60.52
Seedcotton yield (kg/ha)	6/21	2053.87c	124.89	1208.07b	150.49
	5/10	0.39a	0.00	0.38a	0.00
	5/24	0.38a	0.00	0.38a	0.00
	6/07	0.39a	0.00	0.36b	0.00
Gin Turnout ratio	6/21	0.37b	0.01	0.35c	0.01
	5/10	3420.76a	176.26	2276.72a	115.46
	5/24	3264.73a	175.15	1880.76b	259.55
	6/07	2749.79b	161.87	935.99b	34.93
Lint value ($/ha)	6/21	2232.18c	134.71	1089.17b	143.85
	5/10	7.54a	0.35	8.07a	0.16
	5/24	7.54a	0.35	8.81b	0.24
	6/07	8.17b	0.34	8.71b	2.42
HVI color +b	6/21	8.82c	0.35	8.84b	0.11
	5/10	72.54a	0.86	74.09a	0.38
	5/24	73.65b	0.68	76.10b	0.67
	6/07	74.75c	0.62	75.37ab	0.26
HVI color Rd	6/21	76.41d	0.52	75.53ab	0.62

AUTHORS

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