Cotton

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THE 2014 CROP YEAR IN REVIEW

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The 2014 production season will be remembered as the year the rains stopped. Georgia producers planted 1.38 million acres in 2014, which was similar to 2013 acreage. USDA-NASS reported a state average yield of 876 lbs lint per acre on 1.37 million acres harvested. Georgia remains the second largest cotton producing state, trailing only Texas in acres and production.

Generally, good growing conditions were experienced from planting through July. Stand establishment and early-mid season growth and fruit set were generally good. Drier conditions became prevalent in July and August, however, depending upon location. These dry conditions persisted through harvest, except for the early part of September, which brought some rain and extended periods of cloudy weather that were extremely favorable for boll rot.

Dryland yields were highly variable ranging from poor to very good depending on planting date and rainfall. Irrigated yields were generally good to excellent. The 2014 crop matured very quickly. In most fields, good early boll retention followed by drier conditions contributed to a more determinate crop, and very few fields had late-season boll production in the top of the canopy. Early crop maturity and dry conditions allowed for timely harvest of the majority of the crop. There were, however, some harvest delays on late planted cotton.

The most common challenges for growers in 2014 included Palmer amaranth, thrips, nematodes, and droughty conditions. Georgia cotton producers continue to improve management programs for Palmer amaranth, and diligence with aggressive management and hand weeding appears to be paying dividends. Thrips management has become an increasing concern since the loss of aldicarb, and growers are supplementing at-plant insecticides with a foliar insecticide for thrips control, especially on early planted cotton. Nematodes are also a perennial pest and dry weather conditions were conducive for nematode damage. Despite these and other challenges, many parts of Georgia were blessed with better than expected yields, resulting in a statewide average yield of 876 lbs lint per acre.

Variety selection remains an important issue. New varieties are being released in a rapid manner due to increased competition and advancements by industry. Many of the newer varieties performed very well for growers in 2014. The 2014 cotton acreage in Georgia was predominantly comprised of DeltaPine varieties (58.99%), Stoneville varieties (15.36%), Phytogen varieties (14.42%), and FiberMax varieities (6.48%). Americot and Croplan varieties were planted on fewer acres and accounted for 3.78 and 0.92 percent, respectively, of the 2014 crop (http://www.ams.usda.gov/AMSv1.0/Cotton).

The quality of the 2014 crop was comparable to previous years (Table 1). Of 2.522 million bales classed as of February 12, 2015, 5 percent were short staple and 18 percent were high micronaire. Average staple was 36 and average micronaire was 4.7, which are similar to recent years. Uniformity averaged 81.3, which was slightly lower in 2014 compared with recent years. Strength averaged 29.0 and has been consistently around 29 in recent years. Timely harvest resulted in 62 percent of the crop grading 31 or better for color, which is the highest percentage in the last seven years. Bark issues were reported on 3.3 percent of bales classed, which is an improvement from the previous two years.

Table 1. Fiber Quality Summary for Georgia, 2014 and Previous Years

Year	Color Grade 31/41 or better (% of crop)	Bark/ Grass/ Prep (% of crop)	Average Staple (32nds)	Average Strength (g/tex)	Average Micronaire (units)	Average Uniformity (%)
2008	25 / 93	all < 1.0	34	28.7	4.6	80.2
2009	26 / 96	all < 1.0	35	28.8	4.5	80.3
2010	50 / 90	all < 1.0	35	29.9	4.8	81.0
2011	38 / 84	2.6 / <1 / 1	36	29.6	4.6	81.7
2012	48 / 91	11.9 / <1 / <1	36	29.0	4.6	81.7
2013	49 / 89	5.3 / <1 / <1	36	29.6	4.7	81.8
2014	62 / 87	3.3/ <1 / <1	36	29.0	4.7	81.3

Bales classed short staple (<34)
2008: 20%, 2009: 22%, 2010: 4%, 2011: 2.8%, 2012: 1.4%, 2013: 1%, 2014: 5.2%

Bales classed high micronaire (>4.9)
2008: 21%, 2009: 20%, 2010: 9%, 2011: 8.8%, 2012: 15.4%, 2013: 22.3%, 2014: 18.1%

Fiber quality data as of February 12, 2015. Source: http://www.ams.usda.gov/AMSv1.0/Cotton

Acknowledgement

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

YIELD, FIBER QUALITY AND ECONOMIC NET RETURN COMPARING TRADITIONAL vs. PLANT-BASED IRRIGATION TRIGGERS

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Introduction

Drought events and increased awareness of water supply and usage has increased emphasis on the need to utilize water resources more efficiently. In agriculture, increases in the efficiency with which water is used for irrigation could strongly impact water use and conservation. One way to improve water productivity—sometimes referred to as "water use efficiency"—is through efficient irrigation scheduling methods.

Irrigation scheduling is the process of determining how much water to apply and when to apply it. Traditional methods of scheduling irrigation are generally based on a water balance approach. That is, irrigation is applied as a supplement to rainfall such that the sum of rainfall plus irrigation meets the growth stage and environment-specific water requirements of the crop.

Crop water use can be estimated as crop evapotranspiration using weather station data and crop specific coefficients. An even simpler approach is to assume that crop water use during a particular stage of crop development will always be the same, regardless of atmospheric conditions such as humidity, solar radiation and air temperature. The "checkbook approach" recommended by University of Georgia Cooperative Extension (Collins et al., 2014) is one such method.

These methods for approximating crop water use do not, however, account for plant-based factors that impact actual crop water use. Leaf area, for example, strongly determines crop evapotranspiration (Gardner et al., 1985). As a result, water use can be inaccurately estimated for the cotton crop if canopy development differs between varying production systems at the same phenological stage of development. Furthermore, in determining the amount of water available in the soil profile, the effective rooting depth of the crop must be estimated. The effective rooting depth may also differ widely from one production system to the next.

Because the plant itself represents the best indicator of the need for irrigation (Grimes and Yamada, 1982; Jones et al., 2004), using a measure of plant water status should greatly improve water productivity. Predawn leaf water potential is one of the best indicators of the need for irrigation and has been successfully utilized as an irrigation-scheduling tool in tree species (Ameglio et al., 1999). In a study conducted concurrently to the study reported here, using predawn water potential to schedule irrigation produced optimal lint yields while maximizing water productivity. The impact of leaf water potential-based scheduling methods on net returns in cotton has not been addressed previously, but will be of substantial importance in determining economic viability of these methods in the future.

Objective

The objective of the current study was to assess the impact of predawn water potential plant-based scheduling methods on agronomic productivity and economic productivity in cotton in relation to traditional methods and dryland production.

Methodology

For the 2013 and 2014 growing seasons, research was conducted at the C.M. Stripling Irrigation Research Park near Camilla, Georgia. Two cotton cultivars—PHY 499 WRF and FM 1944 GLB2—were strip-till planted at a rate of 3 seed per foot at a depth of three-quarters of an inch and with 36-inch inter-row spacing. Plots were 40 feet in length and six rows wide. All fertility and pest management practices adhered to UGA Extension guidelines to prevent either factor from being a yield constraint.

Prior to squaring, rainfall was supplemented with sprinkler irrigation to promote uniform stand establishment in all treatments. At squaring, five different irrigation treatments were initiated:

T1 Irrigated according to the "checkbook method" recommended by UGA Extension. The total weekly water requirement for a given phenological stage was split into three applications made on Monday, Wednesday and Friday of each week. (For example, a weekly requirement of 1 inch per week would be split into three, one-third-inch applications in the absence of rainfall.) Rainfall was always subtracted from the checkbook requirement prior to irrigating, such that a crop with a weekly water requirement of 1 inch that received more than or equal to one-third inch of rainfall prior to an application day would not have been irrigated on that date.

T2-T4 Irrigation application was triggered when the average predawn (4 a.m. to 6 a.m.) leaf water potential—measured three times per week—for each treatment fell below the following predefined irrigation thresholds for each treatment: T2 = -0.5 megapascal (MPa), T3 = -0.7 MPa and T4 = -0.9 MPa. Measurements were conducted and irrigation decisions made on the same days that irrigation decisions were made for T1. Water was applied at one-third the weekly total checkbook rate when the given plant-based irrigation threshold was reached, regardless of rainfall.

T5 No supplemental irrigation provided beyond stand establishment

Irrigation treatment was the whole-plot factor, and the cultivar was the split-plot factor. Irrigation was accomplished with 30-centimeter-deep subsurface drip tape between every other row. Irrigation was terminated when open bolls were first observed in the latest maturing plots. The experimental design was a randomized, complete block split-plot design with four replications of each treatment.

Predawn leaf water potential measurements were conducted between 4 a.m. and 6 a.m. using a Scholander pressure chamber. Leaves from the fourth unfurled leaf node below the apical meristem were cut from one plant per plot using a razor blade, and the petiole was sealed with a compression gasket located in the chamber head. The leaf blade was then placed in the chamber, and air pressure was increased inside the chamber at a rate of 0.1 MPa per second until water first appeared at the cut surface of the stem. These positive pressures were expressed as negative water potentials. Measurements from leaves of both varieties with four replications for each treatment (n=8) were averaged and used to make irrigation scheduling decisions.

Plots were defoliated at approximately 70 percent open boll. The two center rows of each four-row plot were mechanically harvested using a two-row spindle picker. Seedcotton was weighed in the field and ginned at the UGA microgin to determine lint turnout and lint yield. Ginned cotton was sent to the U.S. Department of Agriculture Classing Office in Macon, Georgia, to determine fiber quality measurements.

Results and Discussion

Yield

In 2013, there was no statistical difference in yield among the five treatments (Figure 1). The highest yielding treatment was T3 (irrigating when leaf water potential was below -0.7 MPa). The lowest yielding treatment was T5, the non-irrigated treatment. But there was only an 83 pound-per-acre difference between the highest yielding irrigated treatment and lowest yielding (non-irrigated) treatment. There was no statistical difference in yield among any of the irrigation triggers.

2013 was a wet growing season, with season-long rainfall. Rainfall during the season totaled 26.35 inches. The T1 treatment using the UGA checkbook method received only 6.85 inches of irrigation. T2, the first that would have been triggered under the various leaf water potential treatments, received 4.5 inches of irrigation. T3, the highest yielding treatment numerically, received only 1 inch of irrigation. Treatment T4, -0.9 MPa, was never triggered (Figure 3).

In 2014, T1 (using the UGA checkbook method) and T2 (-0.5 MPa) were the highest yielding treatments and were significantly higher than T3, T4 and T5 (Figure 2). Both T1 and T2 yielded almost 1,800 lbs per acre.

2014 was the complete opposite of 2013. July and August were dry. Rainfall during the season was 10.63 inches. The T1 treatment (using the UGA checkbook method) triggered 11.1 inches of irrigation. T2 received 8.66 inches of irrigation (Figure 3). Yields for T1 and T2 were not statistically different, and T2 received 2.44 inches less irrigation water.

Fiber Quality

2013 was not a stellar year for fiber quality in the test. The predominant Color grade was 41, but there were several instances of 42, 51 and 52 Color. There was no relationship between treatment and Color grade, but there was a variety effect. There were seven instances out of 40 plots (five treatments x four replications each x two varieties) of below-base grade Color, and five were with PHY 499.

Micronaire was a significant problem in the test in 2013, as well as statewide. Thirty of the 40 plots were high micronaire, or having a micronaire of 5.0 or higher. This is thought to be due to plant stress caused by excessive rainfall. There was no relationship between treatment and the incidence of high micronaire, however.

For 2013, there was also no relationship between treatment and staple length, length uniformity and fiber strength. There was a variety effect on Staple but no treatment effect. Staple was higher for FM 1944.

The predominate Color grade for 2014 was 31. There was no treatment effect on Color. There was a treatment effect on micronaire. 2014 was dry during July and August. Micronaire increased as the amount of irrigation water applied decreased—micronaire was higher for T4 and T5 as compared to T1, T2 and T3. Fifteen of 16 plots in the T4 (-0.9 MPa) and T5 (non-irrigated) treatments were 5.0 or higher.

There were no treatment effects on Staple and Leaf grade, but there was a variety effect. FM 1944 was higher in Staple and better in Leaf grade.

Net Returns

For each treatment, all inputs and production practices were the same, except for irrigation. For treatments T1 through T4, irrigation was applied based on the specific trigger for that treatment. Irrigation cost was calculated for each treatment. T5 was non-irrigated. Net return was calculated as:

$$\text{Net} = (\text{Yield x Adjusted Price}) - \text{VC}$$

Yield = The average lint yield (pounds per acre) for both varieties (PHY 499 WRF and FM 1944 GLB2). Yield is the average of the four replications for each treatment, each year.

Adjusted Price = The November average Southeast cash market price per pound each year for grade 41-4/34, adjusted for Color, Leaf, Staple, Strength, Micronaire, and Uniformity. This adjusted price is calculated for the grades of the sample from each replication of each treatment and is the average of all replications for both varieties by treatment.

VC = The variable costs of irrigation application (fuel and/or electricity, repairs and maintenance, and labor). This cost is the estimated cost per acre-inch times the inches applied based on the respective treatment.

Fiber quality-adjusted prices used for the 2013 and 2014 tests were determined from the November 2013 and November 2014 spot (cash) market average price paid for Color 41-Leaf 4/Staple 34 and market differentials (premiums or discounts) paid for quality (USDA-AMS). The base price (for 41-4/34) was 75.63 and 60.70 cents per pound for November 2013 and 2014, respectively, and this price was adjusted up or down for fiber quality of the treatment.

In this study, irrigation, when triggered, was applied via subsurface drip irrigation (SSDI). However, in Georgia, most irrigation is overhead via center pivot. In an attempt to more closely apply these results and to simulate cost and net returns associated with center pivot, when calculating the variable cost of irrigation, the amount of irrigation applied by SSDI in the study was increased by 23.46 percent. This implies that irrigation by overhead is 81 percent as efficient as SSDI (Amosson, et.al.). In other words, if 11.1 inches were applied by SSDI, 13.7 inches would need to be applied by overhead irrigation in order for the cotton plant to have the same water availability. Table 1 shows the actual water applied via SSDI and the equivalent water assumed applied by overhead (OVH) based on 81 percent efficiency for OVH.

The variable cost of irrigation for each treatment is the estimated equivalent amount for an overhead pivot (Table 1) multiplied by $12.12 per inch for 2013 and $11.75 per inch for 2014 (Shurley and Smith, 2013; Smith, Smith and Shurley, 2013 and 2014).

Summary results for Net Returns are given in Table 2. Net Return is the composite comparison of differences in yield, fiber quality, and cost of irrigation between irrigation trigger treatments. In 2013, treatment T3 (plant-based trigger of -0.7 MPa) resulted in the highest net return. This was due to having the highest yield and low irrigation use and cost, despite not having quite the highest fiber quality. Net return for T3 was $1,129 per acre. There was, however, no statistical difference in Net Return between T2, T3, T4 or T5. T1 (using the UGA checkbook method) had the lowest net return and was statistically different.

In 2014, the highest net return was from treatment T2 (using a plant-based trigger of -0.5 MPa). Net return was $1,052 per acre. T2 was not statistically different than T1 (using the UGA checkbook), but both T2 and T1 were statistically different that the other three treatments.

2013 was a “wet” year. There was no statistical difference in yield between any of the treatments. Treatment T1 (using the UGA checkbook) had the highest irrigation application and cost and, therefore, resulted in the lowest net return. Treatment T4 (trigger of -0.9 MPa) did not trigger an irrigation application.

In contrast, 2014 was a “dry” year. Yield was statistically different between all but T1 and T2—the treatments using the UGA checkbook method and the highest plant-based trigger (-0.5 MPa), respectively. Net Return was highest for T2 due to slightly higher yield with less irrigation compared to T1, but Net Return was not statistically different between T1 and T2. The lowest Net Return was T5 (unirrigated) and T4 among the irrigated treatments.

Summary

One way to improve water productivity—sometimes referred to as water use efficiency—is through efficient irrigation scheduling methods. Irrigation scheduling is the process of determining how much water to apply and when to apply it. The objective of this study was to assess the impact of predawn water potential plant-based scheduling methods on agronomic productivity and economic return in comparison to traditional methods and dryland production.

2013 was a wet growing season with season-long rainfall. There was no statistical difference in yield among the treatments. 2014 was the complete opposite of 2013. July and August were dry. In 2014, T1 (using the UGA checkbook method) and T2 (using a plant-based trigger at -0.5 MPa) were the highest yielding treatments and were significantly higher than the other treatments.

There was no relationship between treatment and Color grade in 2013 or 2014. High micronaire was a problem in 2013, but there was no relationship between treatment and micronaire. There was a treatment effect on micronaire in 2014. There was no relationship between treatment and staple length, length uniformity and fiber strength in either year of the study.

In 2013, there was no statistical difference in net return between T2, T3, T4 or T5. T1 (using the UGA checkbook method) had the lowest net return and was statistically different from all plant-based treatments. In 2014, the highest net return was from treatment T2 (using a plant-based trigger of -0.5 MPa). T2 was not statistically different than T1 (using the UGA checkbook) but both T2 and T1 were statistically different than the other three treatments.

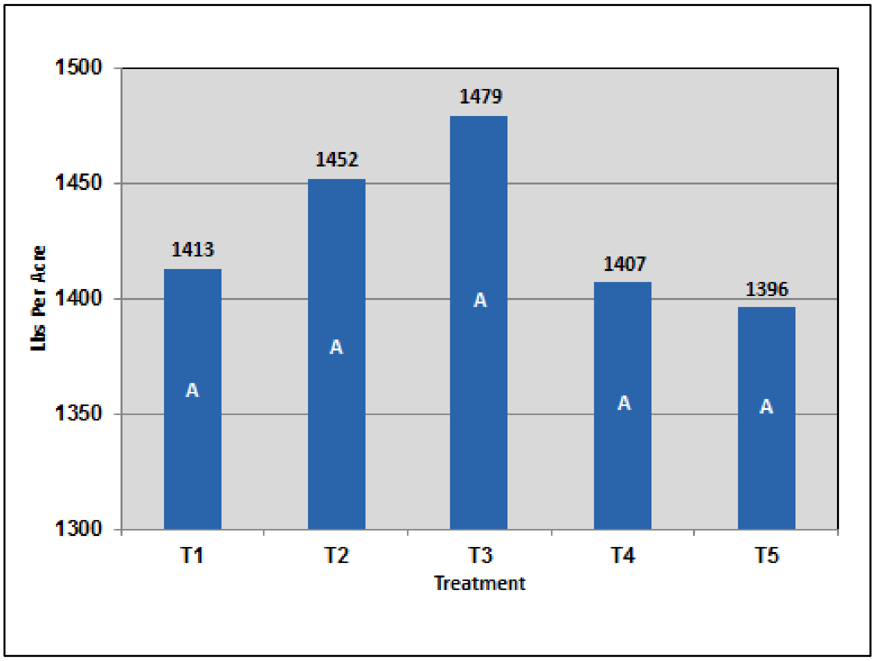

Figure 1. Average Yield Per Acre by Treatment, 2013. Average of Two Varieties. T2-T4 are Plant-Based Irrigation Triggers Based on Predawn Leaf Water Potential. Treatments With the Same Letter are Not Statistically Different at the 95 Percent Level. T1= UGA Checkbook, T2 = -0.5 MPa, T3 = -0.7 MPa, T4 = -0.9 MPa, T5 = Non-Irrigated

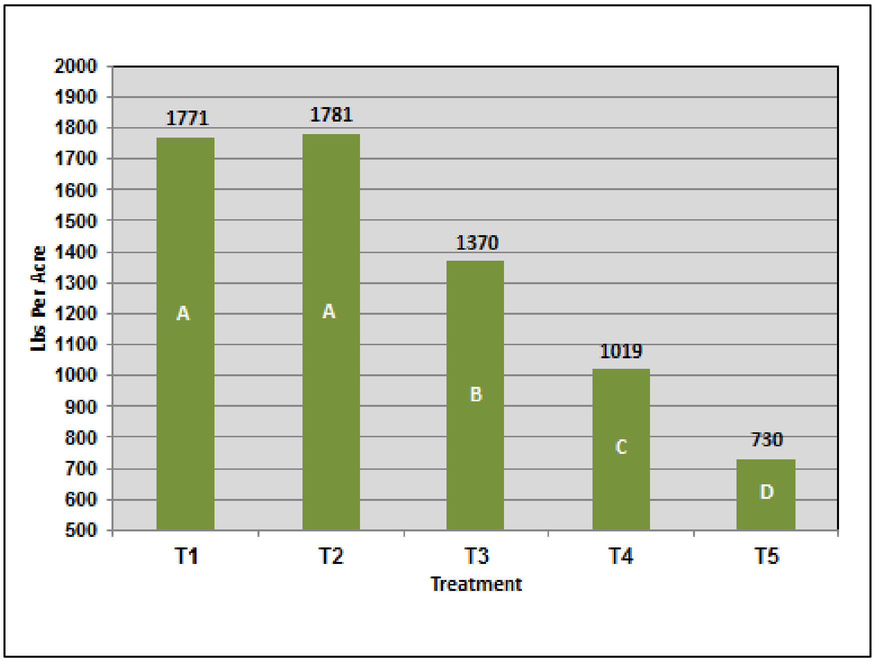

Figure 2. Average Yield Per Acre by Treatment, 2014. Average of Two Varieties. T2-T4 are Plant-Based Irrigation Triggers Based on Predawn Leaf Water Potential. Treatments With the Same Letter are Not Statistically Different at the 95 Percent Level. T1= UGA Checkbook, T2 = -0.5 MPa, T3 = -0.7 MPa, T4 = -0.9 MPa, T5 = Non-Irrigated

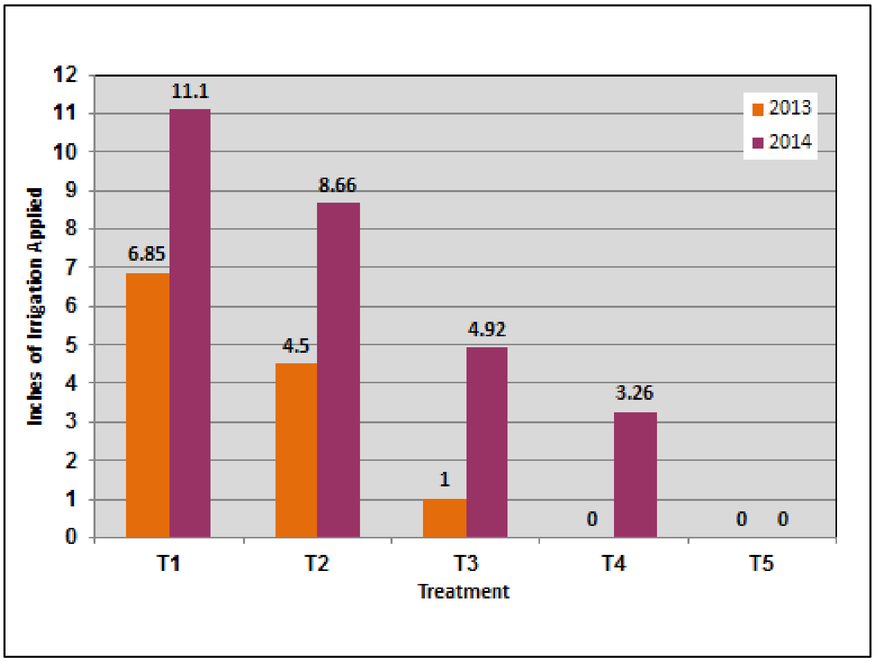

Figure 3. Irrigation Applied by Treatment in 2013 and 2014. T2-T4 are Plant-Based Irrigation Triggers Based on Predawn Leaf Water Potential. T1= UGA Checkbook, T2 = -0.5 MPa, T3 = -0.7 MPa, T4 = -0.9 MPa, T5 = Non-Irrigated. Rainfall received was 26.35 inches in 2013 and 10.63 inches in 2014.

Table 1. Irrigation Applied By Treatment By Year

	2013 Irrigation Applied[1]		2014 Irrigation Applied[1]	
Treatment	**Actual SSDI**	**Est Equiv OVH[2]**	**Actual SSDI**	**Est Equiv OVH[2]**
T1	6.85	8.46	11.10	13.70
T2	4.50	5.56	8.66	10.69
T3	1.00	1.23	4.92	6.07
T4	0.00	0.00	3.26	4.02
T5	0.00	0.00	0.00	0.00

1/ Inches per acre.

2/ Inches applied using SSDI divided by 0.81 or multiplied by 1.2346

Table 2. Yield, Price, Irrigation Cost and Net Returns by Treatment, 2013 and 2014.

Treatment		2013					2014					2-Yr
		Yield[1]	Price[2]	VC[3]	Net[4]		Yield[1]	Price[2]	VC[3]	Net[4]		Avg[5]
T1		1,413	76.00	$102.54	$971[b]		1,771	65.24	$161.02	$994[a]		$983
T2		1,452	77.95	$67.36	$1,064[a]		1,781	65.43	$125.62	$1,040[a]		$1,052
T3		1,479	77.36	$14.97	$1,129[a]		1,370	65.42	$71.37	$825[b]		$977
T4		1,407	76.25	$0.00	$1,073[a]		1,019	63.29	$47.29	$598[c]		$835
T5		1,396	77.42	$0.00	$1,081[a]		730	62.83	$0.00	$459[d]		$770

1/ Average of two varieties—PHY 499 WRF and FM 1944 GLB2.

2/ Cents per pound. Base price of 75.63 cents/pound for November 2013 and 60.70 cents/pound for November 2014, adjusted for fiber quality. Average price for the two varieties.

3/ Variable costs of irrigation application—$12.12 per acre-inch in 2013 and $11.75 per acre-inch in 2014.

4/ Yield per acre times price per pound, minus irrigation variable cost. Net returns followed by the same letter are not statistically different at the 95 percent level.

5/ Average net return of 2013 and 2014.

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References

Ameglio, T., Archer, P., Cohen, M., Valancogne, C., Daudet, F. A., Dayau, S., & Cruiziat, P. (1999). Significance and limits in the use of predawn leaf water potential for tree irrigation. *Plant and Soil, 207*, 155-167.

Amosson, S., Almas, L., Girase, J., Kenny, N., Guerrero, B., Vimlesh, K., & Marek, T. (2011). *Economics of irrigation systems* (B-6113). College Station, TX: Texas AgriLIfe Extension Service.

Collins, G. (Ed.). (2014). *2014 Georgia cotton production guide* (CSS-14-01). Tifton, GA: University of Georgia College of Agricultural and Environmental Sciences.

Gardner, F. P., Pearce, R. B., & Mitchell, R. L. (1985). *Physiology of crop plants.* Ames, IA: Iowa State University Press.

Grimes, D., & Yamada, H. (1982). Relation of cotton growth and yield to minimum leaf water potential. *Crop Science, 22*(1), 134-39.

Jones, H. G. (2004). Irrigation scheduling: Advantages and pitfalls of plant-based methods. *Journal of Experimental Botany, 55*(407), 2427-2436.

Shurley, D., & Smith, A. (2013). *Cotton- strip-till, irrigated: 2013 estimated per acre costs and returns, south and east Georgia*. Retrieved from: http://www.caes.uga.edu/departments/agecon/extension/budgets/cotton/index.html

Smith, A. R., Smith, N. B., & Shurley, W. D. (2013). *Crop comparison tool: Summary of south Georgia crop enterprise estimates, 2013.* Retrieved from: http://www.caes.uga.edu/departments/agecon/extension/budgets/cct/index.html

Smith, A. R., Smith, N. B., & Shurley, W. D. (2014). *Crop comparison tool: Summary of south Georgia crop enterprise estimates, 2014*. Retrieved from: http://www.caes.uga.edu/departments/agecon/extension/budgets/cct/index.html

U.S. Department of Agriculture, Agricultural Marketing Service, Cotton and Tobacco Program. (2013). *Cotton price statistics (Mp_cn820)*, 95(4).

U.S. Department of Agriculture, Agricultural Marketing Service, Cotton and Tobacco Program. (2014). *Cotton price statistics (Mp_cn820)*, 96(4).

2014 COTTON OVT VARIETY TRIALS

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Introduction

The University of Georgia's 2014 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 104-6, January 2015.

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 John D. Gassett, Program Director, Cotton OVT, Griffin, GA, along with Henry Jordan Jr., Research Professional III, Griffin, GA; Dustin Dunn, Research Professional III, Tifton, GA; J. LaDon Day, Department of Crop and Soil Sciences Griffin, GA; and Anton Coy, Senior Agricultural Specialist, Tifton, GA. The OVT is split into released variety and strain trials with placement of varieties or strains into the particular trial chosen by its owner. Trials are separated by maturity. Irrigated OVT trials are conducted at Bainbridge, Midville, Plains, and Tifton, while dryland OVTs are conducted at Athens, Midville, Plains, and Tifton, thus varieties placed into the OVT are included in eight trials per year, giving a fair size data set with which to evaluate variety performance. The strains trials are irrigated and conducted at Midville, Plains, and Tifton. Trials consist of four replicated, randomized complete block designs. An accepted, common, management system is employed at each location for agronomic and pest management, but transgenic cultivars are not produced according to their intended pest management system(s). 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 microgin at Tifton for processing. All fiber samples were submitted to the USDA Classing Office in Macon, GA, for HVI analyses. Trials were picked with a state-of-the-art harvest system composed of an International IH 1822 picker fitted with weigh baskets and suspended from load cells. This system allows one person to harvest yield trials, whereas the established bag-and-weigh approach required eight people or more. The electronic weigh system allowed for timely harvest of yield trials. Data from all trials and combined analyses over locations and years are reported as soon as fiber data are available from the test lab in Adobe pdf and Excel formats on the UGA Cotton Team Website maintained at www.ugacotton.com. Also, the data is available at the Statewide Variety Testing Website: www.swvt.uga.edu.

Results and Discussion

For the second year in a row, Georgia agronomic producers in 2014 were fortunate to have adequate soil moisture for planting combined with an abundance of rainfall. Prolonged and periodic precipitation events lead to spring plantings being delayed for many farmers in Georgia. Cooler than normal temperatures early in the planting season resulted in low soil temperatures and slowed germination for many crops. Irrigation needs did increase for much of the state in June, July, and August.

Seasonal rainfall amounts recorded at the five test locations in Georgia during 2014 are listed in the table below. Athens and Plains were the only two locations out of five that did not receive the normal amount of rainfall. Attapulgus, Midville, and Tifton received 17-25 percent more rainfall than normal.

Crop maturity progressed below the five-year average and harvest conditions were hampered due to wet weather conditions in 2014. Cotton producers seeded 1.38 million acres in Georgia, a 1% increase from last year.

Georgia state average cotton yield for 2014 was of 876 lbs/acre this year was a 3% increase from 2013. Total production was 2.57 million bales—11% more than 2013.

Among varieties in the Dryland Earlier Maturity Trials, DP 0912 B2RF, NG 1511 B2RF, PHY 333 WRF, PHY 339 WRF, PHY 444 WRF, PHY 487 WRF, PHY 499 WRF, and ST 4946GLB2 stand out as varieties with high yield and relative yield stability in the dryland trials averaged over four locations (Table 1). There were also 14 other varieties above average in yield (Table 1). When summarized over two years and four locations, PHY 333 WRF was the top performer, while 12 other varieties were above average (Table 2).

Among the best performing earlier maturing varieties produced under irrigation, PHY 333 WRF, PHY 427 GLB2, PHY 499 WRF, and ST 4946GLB2 were the top highest in yield when averaged over locations (Table 3). Fifteen 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). Five 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 CG 3787 B2RF, PHY 333 WRF, PHY 499 WRF, and ST 4946GLB2 (Table 5). An additional 12 varieties were above average in yield (Table 5). Averaged over locations and years, PHY 499 WRF was the front runner along with three other varieties that yielded above average lint (Table 6).

Under irrigation, there were seven varieties in the top significant group of the standard later maturing trials averaged over locations with DP 1252 B2RF, DP 1454NR B2RF, NG 1511 B2RF, MON 14R1455B2R2, MON 14R1456B2R2, PHY 333 WRF, PHY 495 W3RF, PHY 499 WRF, ST 4946GLB2, and ST 6182GLT among the top 10 yielding varieties (Table 7). Fourteen other varieties were above average in lint yield (Table7). Averaged over locations and two years, CG 3787 B2RF, DP 1252 B2RF, DP 1454NR B2RF, NG 1511 B2RF, MON 13R352BR2, PHY 499 WRF, and PX 554010 WRF were the significant front runners, while one other variety was above average in yield (Table 8).

The Earlier Maturity and Later Maturity Strains Trials (OST) portend improved varieties for crop seasons 2015 and beyond (Tables 9). Varieties from Dow, All-Tex, and Georgia were high yielding performers among standard earlier and later maturing entries in the strains trial (Table 9).

For percent lint yield, the total seed cotton from replicated plots of the 2014 Irrigated Early and Later Maturity 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 the USDA Classing Office in Macon, GA, for HVI analysis processing, and results 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, 2014

	Lint Yield[a]									
Variety	Athens	Midville	Plains	Tifton	4-Loc. Average	Lint	Unif. Index	Length	Strength	Mic.
	lb/acre					%	%	in	g/tex	units
NG 1511 B2RF	1242 [7]	**2031** [1]	**696** [2]	**1611** [2]	**1395** [1]	43.6	83.1	1.11	30.5	4.6
PHY 333 WRF	**1266** [5]	**1942** [2]	**738** [1]	1532 [11]	**1369** [2]	44.0	83.3	1.15	30.2	4.3
PHY 499 WRF	**1396** [3]	1853 [4]	543 [9]	**1580** [6]	**1343** [3]	43.8	83.1	1.11	31.6	4.6
PHY 444 WRF	**1448** [1]	1815 [5]	492 [17]	**1583** [5]	**1335** [4]	44.3	83.4	1.23	31.4	3.9
DP 0912 B2RF	1050 [20]	1812 [6]	553 [8]	**1790** [1]	**1301** [5]	41.7	82.4	1.09	29.6	4.7
PHY 487 WRF	**1432** [2]	1704 [12]	469 [20]	1557 [8]	**1290** [6]	42.0	82.0	1.10	29.2	4.5
ST 4946GLB2	**1282** [4]	1882 [3]	568 [6]	1329 [23]	**1265** [7]	41.6	82.8	1.15	31.2	4.5
PHY 339 WRF	1214 [9]	1770 [7]	475 [19]	**1599** [3]	**1264** [8]	42.1	83.3	1.17	30.9	4.1
SSG UA 222	1171 [11]	1759 [9]	536 [12]	1556 [9]	1256 [9]	42.1	82.9	1.17	31.0	4.3
BX 5115GLT	1195 [10]	1638 [15]	576 [5]	**1594** [4]	1251 [10]	42.0	81.9	1.13	31.0	4.3
DP 1133 B2RF	1077 [17]	1735 [10]	556 [7]	1536 [10]	1226 [11]	44.5	83.8	1.15	31.3	4.8
ST 4747GLB2	1083 [16]	1762 [8]	**642** [3]	1414 [16]	1225 [12]	42.0	82.3	1.18	29.2	4.3
PHY 427 WRF	1227 [8]	1573 [22]	535 [13]	1506 [12]	1210 [13]	40.8	82.3	1.13	29.9	4.1
ST 5032GLT	**1262** [6]	1576 [21]	399 [25]	**1570** [7]	1202 [14]	39.8	82.5	1.19	31.4	4.0
DP 1321 B2RF	1107 [14]	1670 [14]	586 [4]	1438 [14]	1200 [15]	42.5	83.2	1.15	31.1	4.7
GA 2010074	1059 [19]	1707 [11]	420 [24]	1431 [15]	1154 [16]	40.7	83.2	1.17	32.0	4.7
DP 1137 B2RF	1162 [13]	1547 [23]	501 [16]	1374 [19]	1146 [17]	42.7	82.5	1.11	28.8	4.6
BRS 335	1063 [18]	1524 [24]	491 [18]	1463 [13]	1135 [18T]	40.6	82.8	1.14	30.7	4.3
MON 12R224B2R2	1168 [12]	1672 [13]	537 [11]	1164 [25]	1135 [18T]	41.0	83.0	1.16	29.2	4.3
SSG HQ 210 CT	1085 [15]	1589 [18]	446 [23]	1352 [20]	1118 [19]	39.1	82.2	1.11	31.2	4.6
SSG CT Linwood	1013 [22]	1590 [17]	538 [10]	1159 [26]	1075 [20]	41.5	82.9	1.10	31.6	5.1
GA 2009037	850 [24]	1581 [20]	454 [22]	1405 [17]	1072 [21]	41.3	82.0	1.16	31.1	4.5
GA 2009100	770 [26]	1631 [16]	530 [14]	1300 [24]	1058 [22]	39.0	83.1	1.16	33.0	5.0
DG 2355 B2RF	985 [23]	1363 [26]	511 [15]	1343 [21]	1051 [23]	38.9	82.4	1.13	29.8	4.3
BRS 293	830 [25]	1583 [19]	367 [27]	1334 [22]	1029 [24]	40.7	82.5	1.11	32.2	4.7
GA 2010102	1016 [21]	1490 [25]	384 [26]	1152 [27]	1011 [25]	39.3	83.5	1.16	35.1	4.9
BRS 286	676 [27]	1348 [27]	456 [21]	1392 [18]	968 [26]	40.4	81.7	1.11	31.1	4.6
Average	1116	1672	518	1447	1188	41.6	82.7	1.14	30.9	4.5
LSD 0.10	202	138	124	232	134	0.8	0.8	0.02	1.0	0.2
CV %	15.4	7.0	20.4	13.6	12.8	2.4	1.1	1.80	4.0	4.6

[a] Superscripts indicate ranking at that location.

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

Table 2. Two-Year Summary of Dryland Earlier Maturity Cotton Varieties at Four Locations[a], 2013-2014

Variety	Lint Yield	Lint	Uniformity Index	Length	Strength	Micronaire
	lb/acre	%	%	inches	g/tex	units
PHY 333 WRF	**1599**	44.8	83.9	1.17	30.9	4.3
PHY 499 WRF	**1571**	44.7	83.5	1.13	32.1	4.7
PHY 444 WRF	**1562**	44.6	83.8	1.24	31.6	3.8
PHY 487 WRF	**1532**	43.1	82.6	1.12	29.8	4.5
NG 1511 B2RF	1525	44.3	83.6	1.13	30.9	4.7
ST 4946GLB2	1485	42.4	83.0	1.14	31.3	4.6
PHY 399 WRF	1468	42.8	83.7	1.18	31.0	4.3
DP 0912 B2RF	1451	42.0	82.9	1.11	30.2	4.7
SSG AU 222	1444	42.7	83.4	1.18	30.8	4.4
PHY 427 WRF	1414	41.4	82.9	1.15	30.7	4.1
SSG HQ 210 CT	1392	40.5	82.4	1.11	31.0	4.6
DP 1321 B2RF	1381	43.4	83.6	1.14	31.0	4.8
GA 2009037	1347	42.0	82.3	1.17	31.2	4.6
SSG CT Linwood	1293	42.5	83.5	1.12	32.7	5.0
GA 2009100	1282	41.5	83.8	1.18	33.3	4.6
Average	1450	42.9	83.3	1.15	31.2	4.5
LSD 0.10	68	0.4	0.6	0.01	0.8	0.1
CV%	11.3	2.4	1.2	2.0	4.2	4.8

[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, 2014, Irrigated

	Lint Yield[a]									
Variety	Bainbridge	Midville	Plains	Tifton	4-Loc. Average	Lint	Unif. Index	Length	Strength	Mic.
	---------------------------- lb/acre ----------------------------					%	%	in	g/tex	units
ST 4946GLB2	**1541** [4]	**2597** [1]	**1925** [2]	**1912** [2T]	**1994** [1]	42.1	83.1	1.16	31.1	4.3
PHY 499 WRF	1268 [12]	**2406** [2]	**1852** [8T]	**1869** [3]	**1849** [2T]	43.4	83.4	1.14	31.5	4.5
PHY 333 WRF	**1583** [3]	2269 [9]	**1846** [9]	1697 [13]	**1849** [2T]	42.4	83.0	1.16	30.1	4.1
PHY 427 WRF	**1679** [1]	2087 [20]	**1909** [4]	1618 [21]	**1823** [3]	41.0	83.6	1.16	30.7	4.2
ST 4747GLB2	1278 [11]	2328 [6]	**1931** [1]	1683 [16]	1805 [4]	41.9	82.6	1.20	30.5	4.3
PHY 444 WRF	1284 [10]	2355 [5]	**1887** [5]	1691 [14]	1804 [5]	44.0	84.0	1.22	32.0	3.7
DP 1133 B2RF	1481 [5]	2093 [18]	**1852** [8T]	1768 [9]	1799 [6]	43.0	83.5	1.17	31.6	4.4
ST 5032GLT	1140 [17]	2299 [7]	**1813** [11]	**1912** [2T]	1791 [7]	41.3	82.1	1.18	31.1	3.8
DP 0912 B2RF	1164 [16]	**2400** [3]	**1782** [13]	**1774** [8]	1780 [8]	41.3	83.1	1.12	30.0	4.7
ST 5115GLT	1334 [9]	2248 [10]	**1915** [3]	1609 [22]	1776 [9]	41.6	82.1	1.15	30.7	3.9
SSG UA 222	1208 [15]	2374 [4]	**1866** [6]	1636 [19]	1771 [10]	42.0	83.4	1.19	30.9	4.1
DP 1321 B2RF	1357 [8]	2178 [13]	**1800** [12]	1720 [11]	1764 [11]	42.2	83.9	1.16	30.8	4.4
NG 1511 B2RF	1380 [6]	2089 [19]	**1855** [7]	1678 [17]	1750 [12]	43.0	82.9	1.15	30.6	4.3
DP 1137 B2RF	1367 [7]	2167 [15]	**1822** [10]	1630 [20]	1747 [13]	42.2	82.7	1.14	29.5	4.5
PHY 487 WRF	**1637** [2]	2100 [17]	**1757** [14]	1462 [25]	1739 [14]	41.9	82.3	1.14	30.5	4.1
PHY 339 WRF	1260 [13]	2184 [12]	1662 [16]	**1780** [6]	1722 [15]	41.8	82.8	1.19	30.6	4.1
SSG HQ 210 CT	1218 [14]	1924 [23]	1646 [18]	**1989** [1]	1694 [16]	40.7	82.7	1.14	31.5	4.3
MON 12R224B2R2	1035 [21]	2202 [11]	1675 [15]	**1785** [5]	1674 [17]	41.9	83.5	1.17	30.5	3.9
GA 2010102	1103 [18]	2166 [16]	1628 [19]	1733 [10]	1658 [18]	40.6	83.7	1.18	33.5	4.4
GA 2009037	1067 [20]	2291 [8]	1625 [20]	1479 [24]	1616 [19]	42.2	82.7	1.16	32.5	4.4
BRS 335	893 [23]	2050 [21]	1658 [17]	1641 [18]	1560 [20]	40.6	82.6	1.16	32.1	3.9
GA 2010074	876 [24]	2171 [14]	1503 [23]	1687 [15]	1559 [21]	41.5	83.4	1.18	31.0	4.4
DG 2355 B2RF	1010 [22]	1892 [25]	1522 [21]	**1777** [7]	1550 [22]	40.0	82.7	1.17	31.3	4.0
GA 2009100	872 [25]	2040 [22]	1410 [25]	1700 [12]	1505 [23]	40.1	83.0	1.15	32.1	4.5
SSG CT Linwood	1079 [19]	1906 [24]	1472 [24]	1391 [26]	1462 [24]	41.1	83.3	1.13	31.5	4.6
BRS 286	834 [26]	1631 [27]	1514 [22]	**1791** [4]	1442 [25]	40.6	82.7	1.14	31.8	4.4
BRS 293	738 [27]	1733 [26]	1346 [26]	1540 [23]	1339 [26]	40.5	82.8	1.14	31.5	4.3
Average	1211	2155	1721	1702	1697	41.7	83.0	1.16	31.2	4.2
LSD 0.10	246	205	187	218	178	1.5	0.6	0.02	1.4	0.2
CV %	17.3	8.1	9.3	10.9	10.8	2.1	1.0	2.00	4.0	6.3

[a] Superscripts indicate ranking at that location.

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

Table 4. Two-Year Summary of Earlier Maturity Cotton Varieties at Four Locations[a], 2013-2014, Irrigated

Variety	Lint Yield	Lint	Uniformity Index	Length	Strength	Micronaire
	lb/acre	%	%	inches	g/tex	units
PHY 499 WRF	**1871**	43.6	83.4	1.15	31.4	4.7
PHY 444 WRF	**1849**	43.6	84.0	1.24	31.7	3.8
PHY 333 WRF	**1822**	42.6	83.5	1.18	30.6	4.3
PHY 487 WRF	**1809**	42.0	82.5	1.14	30.1	4.3
ST 4946GLB2	1797	41.6	83.3	1.16	31.1	4.6
NG 1511 B2RF	1750	44.0	83.6	1.16	31.2	4.6
DP 0912 B2RF	1729	41.0	83.3	1.13	30.2	4.9
DP 1321 B2RF	1729	42.1	83.8	1.17	30.5	4.6
SSG AU 222	1729	41.9	83.7	1.20	30.8	4.4
PHY 427 WRF	1710	40.8	83.3	1.15	30.5	4.3
SSG HQ 210 CT	1706	40.9	82.6	1.14	31.3	4.6
PHY 399 WRF	1705	41.8	83.2	1.19	30.4	4.2
GA 2009037	1656	41.5	82.8	1.18	31.8	4.5
GA 2009100	1591	41.0	83.5	1.19	32.8	4.4
SSG CT Linwood	1475	41.1	83.3	1.14	32.0	4.8
Average	1729	42.0	83.3	1.17	31.1	4.5
LSD 0.10	67	0.5	0.5	0.02	0.7	0.1
CV %	9.4	2.8	1.1	2.3	3.9	5.3

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

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

Table 5. Yield Summary of Dryland Later Maturity Cotton Varieties, 2014

	Lint Yield[a]									
Variety	Athens	Midville	Plains	Tifton	4-Loc. Average	Lint	Unif. Index	Length	Strength	Mic.
	lb/acre					%	%	in	g/tex	units
PHY 333 WRF	**1423** [2]	**1950** [1]	**561** [10]	**2175** [1]	**1527** [1]	43.2	83.2	1.18	30.1	4.1
ST 4946GLB2	**1355** [5]	**1929** [2]	**615** [5]	**2055** [2T]	**1488** [2]	41.6	83.3	1.15	31.6	4.4
PHY 499 WRF	**1471** [1]	**1867** [3]	426 [24]	**2055** [2T]	**1455** [3]	43.9	83.4	1.13	32.4	4.7
CG 3787 B2RF	1183 [14]	1758 [4]	**643** [3]	**2044** [4]	**1407** [4]	44.2	83.1	1.15	29.5	4.6
PHY 495 W3RF	**1282** [7]	1707 [7]	477 [21]	1958 [5]	1356 [5]	43.2	83.6	1.12	32.0	4.4
NG 1511 B2RF	1102 [19]	1697 [8]	**664** [1]	1909 [6]	1343 [6]	43.2	82.7	1.13	30.1	4.6
ST 4747GLB2	1235 [9]	1718 [5]	523 [12]	1881 [8]	1339 [7]	41.1	81.8	1.19	29.7	4.3
GA 2010076	1196 [13]	1597 [13]	511 [15]	**2047** [3]	1337 [8]	40.5	83.4	1.18	32.7	4.6
PX 554010 WRF	1198 [12]	1563 [17]	**654** [2]	1874 [9]	1322 [9]	43.9	82.7	1.12	30.3	4.2
PX554063WRF	**1342** [6]	1651 [10]	**616** [4]	1671 [25]	1320 [10]	43.6	83.7	1.17	32.1	4.3
ST 6448GLB2	**1409** [3]	1576 [16]	346 [29]	1868 [10]	1300 [11]	40.9	82.0	1.19	29.9	4.4
DP 1454NR B2RF	1208 [11]	1553 [18]	518 [13]	1889 [7]	1292 [12]	43.3	82.1	1.11	29.4	4.7
MON 14R1456B2R2	**1402** [4]	1494 [20]	**571** [8]	1668 [26]	1284 [13]	43.9	82.9	1.13	32.2	4.9
GA 2010019	1144 [16]	1469 [23]	**575** [7]	1849 [13]	1259 [14]	41.5	83.0	1.15	30.8	4.4
PHY 575 WRF	1104 [18]	1642 [11]	495 [18]	1764 [17T]	1251 [15]	40.4	83.5	1.17	30.5	4.2
DP 1050 B2RF	1026 [22]	1590 [15]	512 [14]	1866 [11]	1248 [16]	44.0	83.5	1.15	28.9	4.6
ST 5289GLT	1234 [10]	1551 [19]	481 [19]	1714 [22]	1245 [17]	41.7	82.3	1.13	29.8	4.5
DP 1137 B2RF	1014 [24]	1629 [12]	531 [11]	1773 [15]	1237 [18]	42.9	82.7	1.13	28.5	4.7
MON 14R1455B2R2	1120 [17]	1593 [14]	496 [17]	1700 [23]	1227 [19]	44.1	82.9	1.14	32.1	4.6
BX 1536GLT	945 [25]	1661 [9]	442 [23]	1852 [12]	1225 [20]	41.3	83.3	1.15	32.5	4.1
DG 2610 B2RF	1049 [21]	1480 [22]	480 [20]	1841 [14]	1213 [21]	43.0	83.2	1.15	29.1	4.5
MON 13R352B2R2	1156 [15]	1492 [21]	468 [22]	1697 [24]	1204 [22]	45.0	82.5	1.15	31.6	4.5
BX 1535GLT	1272 [8]	1393 [27]	376 [28]	1764 [17T]	1201 [23]	40.5	82.9	1.19	33.3	4.4
GA 230	1015 [23]	1400 [26]	**578** [6]	1734 [20]	1182 [24T]	39.4	82.8	1.23	31.2	4.2
DP 1252 B2RF	1055 [20]	1448 [24]	507 [16]	1720 [21]	1182 [24T]	45.2	84.0	1.15	29.9	4.7
ST 6182GLT	786 [28]	1714 [6]	417 [25]	1771 [16]	1172 [25]	47.7	82.7	1.15	29.7	4.7
NG 5315 B2RF	896 [27]	1426 [25]	**567** [9]	1666 [27]	1139 [26]	43.7	83.1	1.14	28.6	4.4
GA 2009100	937 [26]	1286 [28]	397 [26]	1742 [18]	1090 [27]	38.7	82.5	1.17	32.3	4.8
BRS 269	679 [29]	1215 [29]	381 [27]	1738 [19]	1003 [28]	39.9	83.0	1.17	32.6	4.6
Average	1146	1588	511	1837	1271	42.6	83.0	1.15	30.8	4.5
LSD 0.10	194	168	108	216	137	0.9	0.9	0.20	0.9	0.2
CV %	14.4	9.0	18.0	10.0	11.8	1.8	1.2	1.97	3.4	3.9

[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], 2013-2014

Variety	Lint Yield	Lint	Uniformity Index	Length	Strength	Micronaire
	lb/acre	%	%	inches	g/tex	units
PHY 499 WRF	**1561**	44.7	83.9	1.14	32.2	4.7
ST 4747GLB2	**1550**	42.9	82.6	1.20	30.5	4.4
PX 554010 WRF	**1516**	44.9	83.6	1.14	30.7	4.3
NG 1511 B2RF	**1503**	44.3	83.3	1.14	30.5	4.7
CG 3787 B2RF	1487	44.9	84.0	1.17	29.9	4.6
ST 6448GLB2	1455	42.1	82.8	1.20	30.6	4.4
MON 13R352B2R2	1431	45.4	83.4	1.18	32.0	4.5
PHY 575 WRF	1421	42.0	83.7	1.20	30.4	4.2
DP 1050 B2RF	1385	44.9	83.6	1.16	29.3	4.6
DP 1454NR B2RF	1385	44.1	82.7	1.13	30.4	4.8
DP 1137 B2RF	1380	44.0	83.4	1.14	29.0	4.7
DP 1252 B2RF	1348	45.0	83.7	1.15	29.4	4.8
DG 2610 B2RF	1301	43.6	83.6	1.16	29.5	4.5
NG 5315 B2RF	1290	44.5	83.7	1.15	28.9	4.6
GA 230	1288	41.2	83.2	1.23	31.6	4.3
Average	1420	43.9	83.4	1.17	30.3	4.5
LSD 0.10	62	0.4	0.6	0.01	0.7	0.1
CV%	10.6	2.2	1.1	1.8	3.7	4.4

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

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

Table 7. Yield Summary of Later Maturity Cotton Varieties, 2014, Irrigated

	Lint Yield[a]									
Variety	Bainbridge	Midville	Plains	Tifton	4-Loc. Average	Lint	Unif. Index	Length	Strength	Mic.
	------ lb/acre ------					%	%	in	g/tex	units
MON 14R1456B2R2	**2141** [1]	**2559** [1]	1769 [13]	**1800** [1]	**2067** [1]	44.1	83.6	1.17	32.2	4.7
DP 1454NR B2RF	**2087** [2]	2287 [4]	1839 [9]	**1621** [20]	**1959** [2]	43.4	82.8	1.13	30.0	4.5
PHY 333 WRF	1754 [10]	2238 [7]	**2052** [1]	**1627** [17]	**1918** [3]	43.2	83.3	1.18	30.5	4.2
NG 1511 B2RF	1799 [7]	2273 [5]	**1898** [6]	**1687** [9]	**1914** [4]	43.8	83.4	1.15	30.9	4.5
ST 6182GLT	1671 [13]	2206 [12]	**1924** [3T]	**1776** [2]	**1894** [5]	46.5	83.0	1.16	29.7	4.2
ST 4946GLB2	1520 [17]	**2401** [3]	**1955** [2]	**1686** [10]	**1891** [6]	42.2	83.3	1.16	31.7	4.3
PHY 499 WRF	**1916** [5]	2203 [13T]	**1871** [7]	**1545** [26]	**1884** [7]	42.7	83.6	1.16	31.1	4.3
MON 14R1455B2R2	**1923** [4]	2219 [9]	1843 [8]	**1547** [25]	**1883** [8]	44.2	83.2	1.18	32.1	4.5
DP 1252 B2RF	**1992** [3]	2128 [20]	1656 [19]	**1632** [16]	**1852** [9]	45.6	83.5	1.15	29.2	4.6
PHY 495 W3RF	1599 [15]	**2420** [2]	**1909** [5]	**1474** [29]	**1851** [10]	43.0	83.3	1.14	32.3	4.3
CG 3787 B2RF	1767 [8]	2036 [25]	1831 [11]	**1757** [3]	1848 [11]	43.7	83.5	1.16	29.1	4.4
DG 2610 B2RF	1869 [6]	1945 [27]	1828 [12]	**1708** [7]	1837 [12]	43.2	83.8	1.17	29.5	4.3
ST 4747GLB2	1607 [14]	2231 [8]	1833 [10]	**1607** [23]	1819 [13]	41.8	82.3	1.20	29.7	4.2
PX554063WRF	1346 [22]	2244 [6]	**1913** [4]	**1718** [5]	1805 [14]	43.6	83.4	1.18	32.1	3.9
MON 13R352B2R2	1757 [9]	2107 [22]	1616 [22]	**1638** [15]	1779 [15]	44.8	83.4	1.19	32.5	4.3
DP 1137 B2RF	1578 [16]	2193 [14]	1689 [17]	**1613** [22]	1768 [16]	43.4	83.2	1.15	29.1	4.4
PX 554010 WRF	1213 [24]	2207 [11]	**1924** [3T]	**1653** [13]	1749 [17]	43.2	83.8	1.17	31.0	4.2
ST 5289GLT	1370 [20]	2140 [18]	1687 [18]	**1731** [4]	1732 [18T]	42.2	82.3	1.14	30.0	4.2
PHY 575 WRF	1473 [18]	2091 [23]	1722 [16]	**1641** [14]	1732 [18T]	41.3	83.1	1.19	30.8	4.1
DP 1050 B2RF	1730 [11]	2163 [16]	1362 [27]	**1623** [19]	1719 [19]	44.3	83.0	1.15	29.5	4.2
NG 5315 B2RF	1724 [12]	2061 [24]	1463 [26]	**1624** [18]	1718 [20]	43.5	83.5	1.16	30.0	4.3
GA 2010076	1357 [21]	2215 [10]	1729 [15]	**1533** [28]	1708 [21]	40.5	83.0	1.19	31.7	4.5
ST 6448GLB2	1384 [19]	2134 [19]	1617 [21]	**1667** [12]	1700 [22]	41.9	83.0	1.20	30.6	4.1
GA 2010019	1022 [27]	2203 [13T]	1767 [14]	**1677** [11]	1667 [23]	41.7	82.6	1.15	31.0	4.1
BX 1535GLT	1313 [23]	2184 [15]	1521 [25]	**1550** [24]	1642 [24]	40.4	83.0	1.21	32.8	4.0
GA 2009100	1165 [25]	2143 [17]	1619 [20]	**1541** [27]	1617 [25]	38.9	83.3	1.19	32.6	4.4
BX 1536GLT	1028 [26]	2113 [21]	1574 [23]	**1702** [8]	1604 [26]	41.9	83.4	1.15	31.6	4.0
GA 230	919 [28]	2019 [26]	1533 [24]	**1710** [6]	1545 [27]	40.6	83.8	1.20	31.2	4.1
BRS 269	883 [29]	1759 [28]	1336 [28]	**1615** [21]	1398 [28]	40.1	83.2	1.18	32.7	4.4
Average	1549	2177	1734	1645	1776	42.7	83.2	1.17	30.9	4.3
LSD 0.10	261	178	181	N.S.[1]	218	1.3	0.8	0.02	0.9	0.2
CV %	14.3	6.9	8.9	11.8	10.3	2.2	1.0	2.20	4.3	4.9

[a] Superscripts indicate ranking at that location.

1/ F-test indicated no statistical differences at the alpha = 0.10 probability level; therefore, 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 8. Two-Year Summary of Later Maturity Cotton Varieties at Four Locations[a], 2013-2014, Irrigated

Variety	Lint Yield	Lint	Uniformity Index	Length	Strength	Micronaire
	lb/acre	%	%	inches	g/tex	units
DP 1454NR B2RF	**1853**	42.9	83.0	1.14	30.3	4.7
DP 1252 B2RF	**1832**	45.0	84.0	1.16	29.1	4.8
CG 3787 B2RF	**1829**	43.9	83.8	1.17	29.4	4.6
MON 13R352BR2	**1819**	44.2	83.6	1.21	32.5	4.4
NG 1511 B2RF	**1819**	43.9	83.6	1.15	30.9	4.7
PHY 499 WRF	**1809**	43.0	84.1	1.17	31.5	4.6
PX 554010 WRF	**1805**	44.1	83.9	1.17	30.8	4.2
ST 4747GLB2	1776	41.9	82.9	1.21	30.2	4.3
DP 1137 B2RF	1748	43.2	83.6	1.16	29.5	4.5
PHY 575 WRF	1742	40.8	83.7	1.22	30.9	4.2
DP 1050 B2RF	1732	44.3	83.7	1.17	28.9	4.5
DG 2610 B2RF	1727	43.5	84.1	1.18	29.6	4.5
ST 6448GLB2	1696	41.1	83.6	1.22	30.7	4.4
NG 5315 B2RF	1682	43.6	84.0	1.18	29.7	4.5
GA 230	1558	40.2	83.7	1.23	31.1	4.2
Average	1762	43.0	83.7	1.18	30.3	4.5
LSD 0.10	66	0.4	0.5	0.02	0.7	0.1
CV %	9.1	2.5	0.9	2.2	4.1	4.4

[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 9. Yield Summary of Cotton Strains, 2014, Irrigated

Variety	Lint Yield[a] Midville	Plains	Tifton	3-Loc. Average	Lint	Unif. Index	Length	Strength	Mic.
	---------- lb/acre ----------				%	%	inches	g/tex	units
PX559001WRF	2506 [2]	**1535** [3]	**2241** [1]	**2094** [1]	46.3	82.9	1.15	32.0	4.4
GA 2011124	2477 [3]	**1526** [4]	**2171** [3]	**2058** [2]	45.9	83.1	1.13	30.7	4.9
PX453915WRF	2408 [6]	**1462** [8]	**2189** [2]	**2020** [3]	41.5	84.3	1.21	32.1	4.1
PX3003-14WRF	2465 [4]	**1588** [1]	1989 [7]	**2014** [4]	43.3	82.7	1.14	29.8	4.4
PX559006WRF	2427 [5]	**1497** [7]	1976 [8]	**1967** [5]	43.3	82.7	1.16	30.7	4.1
DG CT14515	**2757** [1]	1313 [10]	1767 [12]	**1946** [6]	45.3	83.0	1.17	31.7	4.3
PX453318WRF	2239 [10]	**1500** [6]	**2083** [5]	**1940** [7]	43.8	83.8	1.16	29.6	4.5
PX565215WRF	2262 [9]	**1586** [2]	1970 [9]	**1939** [8]	43.5	84.1	1.19	31.7	4.1
GA 2011158	2403 [7]	**1439** [9]	1960 [10]	**1934** [9]	43.1	83.9	1.15	31.1	4.7
GA 2012031	2172 [12]	**1505** [5]	**2070** [6]	**1916** [10]	45.3	83.6	1.15	30.7	4.4
GA 2011004	2263 [8]	1245 [12]	**2162** [4]	**1890** [11]	46.0	84.3	1.19	30.6	4.7
GA 2012073	2224 [11]	1269 [11]	1784 [11]	**1759** [12]	43.3	84.1	1.19	33.0	4.5
Average	2384	1455	2030	1956	44.2	83.5	1.17	31.1	4.4
LSD 0.10	186	179	218	N.S.[1]	1.7	0.8	0.02	1.1	0.2
CV %	6.5	10.2	10.9	8.6	2.4	0.9	1.55	4.1	4.4

[a] Superscripts indicate ranking at that location.
1/ F-test indicated no statistical differences at the alpha = 0.10 probability level; therefore, 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 10. Tifton, Georgia:
Earlier Maturity Cotton Variety Performance, 2014, Irrigated

Variety	Lint Yield	Lint*	Uniformity Index*	Length*	Strength*	Micronaire*
	lb/acre	%	%	inches	g/tex	units
SSG HQ 210 CT	**1989**	43.3	84.0	1.22	31.0	4.3
ST 5032GLT	**1912**	42.3	81.9	1.15	29.2	4.5
ST 4946GLB2	**1912**	40.2	82.9	1.20	30.3	4.5
PHY 499 WRF	**1869**	41.3	83.2	1.13	30.7	4.8
BRS 286	**1791**	40.8	82.5	1.16	30.4	4.5
MON 12R224B2R2	**1785**	43.1	84.1	1.16	29.6	4.4
PHY 339 WRF	**1780**	41.3	82.7	1.18	29.4	4.5
DG 2355 B2RF	**1777**	42.1	82.9	1.19	30.0	4.5
DP 0912 B2RF	**1774**	40.1	83.3	1.16	30.6	5.0
DP 1133 B2RF	1768	40.5	83.6	1.18	30.0	4.5
GA 2010102	1733	41.6	83.1	1.16	29.3	4.5
DP 1321 B2RF	1720	41.2	82.8	1.19	28.8	4.4
GA 2009100	1700	42.5	82.9	1.14	29.7	4.8
PHY 333 WRF	1697	39.7	82.5	1.17	30.7	4.2
PHY 444 WRF	1691	42.9	83.5	1.19	30.2	4.3
GA 2010074	1687	40.6	83.1	1.19	30.3	4.5
ST 4747GLB2	1683	40.7	82.9	1.19	30.0	4.7
NG 1511 B2RF	1678	39.9	82.9	1.22	29.5	4.3
BRS 335	1641	40.2	82.3	1.14	29.9	4.3
SSG UA 222	1636	41.7	83.6	1.17	30.6	4.7
DP 1137 B2RF	1630	39.0	82.2	1.15	32.3	4.9
PHY 427 WRF	1618	39.0	84.0	1.17	31.7	4.5
ST 5115GLT	1609	39.8	82.2	1.17	29.8	4.2
BRS 293	1540	39.7	81.9	1.14	29.9	4.5
GA 2009037	1479	41.8	82.2	1.16	32.2	4.6
PHY 487 WRF	1462	39.9	82.7	1.16	30.4	4.2
SSG CT Linwood	1391	40.2	83.1	1.14	30.8	4.9
Average	1702	40.9	82.9	1.17	30.2	4.5
LSD 0.10	218	1.2	N.S.[1]	N.S.	N.S.	N.S.
CV %	10.9	2.4	1.0	2.8	5.4	7.2

* Percent lint fractions were determined from plot seed cotton ginned in the Micro-Gin located on the UGA Tifton Campus. A lint sample was sent to the USDA classing office in Macon, GA, for quality testing.

1/ F-test indicated no statistical differences at the alpha = 0.10 probability level; therefore, 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: May 6, 2014.
Harvested: October 13, 2014.
Seeding Rate: 4 seeds/foot in 36" rows.
Soil Type: Tifton sandy loam.
Soil Test: P = Medium, K = Medium, and pH = 6.5.
Fertilization: 18 lb N, 36 lb P_2O_5, and 108 lb K_2O/acre. Sidedress: 75 lb N and 30 lb K_2O/acre.
Previous Crop: Peanuts.
Management: Disked, subsoiled, and bedded; Reflex, Cotoran, and Prowl used for weed control; Orthene, Bidrin, and Blackhawk used for insect control.

(Gibbs Farm, Tifton)	May	June	July	Aug.	Sept.
Irrigation (in):	0.50	1.25	1.25	2.25	0.75
Rainfall (in):	6.10	2.96	2.82	3.38	5.93

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

Table11. Tifton, Georgia:
Later Maturity Cotton Variety Performance, 2014, Irrigated

Variety	Lint Yield	Lint*	Uniformity Index*	Length*	Strength*	Micronaire*
	lb/acre	%	%	inches	g/tex	units
DP 1558NR BWRF	**1800**	43.3	82.9	1.16	30.7	4.9
ST 6182GLT	**1776**	43.7	82.9	1.15	29.3	4.3
CG 3787 B2RF	**1757**	43.1	82.9	1.16	27.2	4.5
ST 5289GLT	**1731**	42.6	82.4	1.14	28.7	4.4
PX554063WRF	**1718**	43.9	82.8	1.17	30.7	4.2
GA 230	**1710**	41.7	84.0	1.15	30.5	4.4
DG 2610 B2RF	**1708**	42.6	82.7	1.15	28.1	4.6
BX 1536GLT	**1702**	41.3	81.6	1.17	29.5	4.4
NG 1511 B2RF	**1687**	43.3	82.5	1.14	28.7	4.4
ST 4946GLB2	**1686**	40.8	83.5	1.16	30.8	4.6
GA 2010019	**1677**	39.7	82.1	1.15	29.5	4.3
ST 6448GLB2	**1667**	43.4	81.2	1.14	30.4	4.1
PX 554010 WRF	**1653**	41.1	82.2	1.17	29.8	4.5
PHY 575 WRF	**1641**	43.4	82.4	1.16	28.8	4.4
DP 1555 B2RF	**1638**	42.0	82.3	1.19	30.5	4.2
DP 1252 B2RF	**1632**	45.2	82.1	1.13	27.9	4.6
PHY 333 WRF	**1627**	40.5	81.8	1.17	30.8	4.4
NG 5315 B2RF	**1624**	43.2	82.5	1.17	28.8	4.5
DP 1050 B2RF	**1623**	43.0	81.1	1.14	28.8	4.2
DP 1454NR B2RF	**1621**	41.9	82.7	1.13	29.0	4.3
BRS 269	**1615**	41.7	82.8	1.18	30.6	4.8
DP 1137 B2RF	**1613**	41.4	82.7	1.16	27.9	4.4
ST 4747GLB2	**1607**	40.2	81.5	1.17	29.7	4.0
BX 1535GLT	**1550**	39.4	82.1	1.20	31.3	4.1
MON 14R1455B2R2	**1547**	42.2	81.7	1.16	29.1	4.3
PHY 499 WRF	**1545**	39.4	82.8	1.19	29.7	4.2
GA 2009100	**1541**	38.8	82.4	1.20	30.7	4.4
GA 2010076	**1533**	40.1	82.3	1.19	31.1	4.4
PHY 495 W3RF	**1474**	40.3	81.8	1.16	30.7	4.7
Average	1645	41.8	82.3	1.16	29.6	4.4
LSD 0.10	N.S.[1]	1.7	N.S.	N.S.	N.S.	N.S.
CV %	11.8	3.5	1.2	2.7	5.1	6.7

* Percent lint fractions were determined from plot seed cotton ginned in the Micro-Gin located on the UGA Tifton Campus. A lint sample was sent to the USDA classing office in Macon, GA, for quality testing.

1/ F-test indicated no statistical differences at the alpha = 0.10 probability level; therefore, 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: May 6, 2014.
Harvested: October 13, 2014.
Seeding Rate: 4 seeds/foot in 36" rows.
Soil Type: Tifton sandy loam.
Soil Test: P = Medium, K = Medium, and pH = 6.5.
Fertilization: 18 lb N, 36 lb P_2O_5, and 108 lb K_2O/acre. Sidedress: 75 lb N and 30 lb K_2O/acre.
Previous Crop: Peanuts.
Management: Disked, subsoiled, and bedded; Reflex, Cotoran, and Prowl used for weed control; Orthene, Bidrin, and Blackhawk used for insect control.

(Gibbs Farm, Tifton)	May	June	July	Aug.	Sept.
Irrigation (in):	0.50	1.25	1.25	2.25	0.75
Rainfall (in):	6.10	2.96	2.82	3.38	5.93

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

THE EFFECT OF DELTA-12 FATTY ACID DESATURASE (FAD) GENE EXPRESSION ON SEEDLING VIGOR UNDER COOL TEMPERATURES

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Introduction

Seedling vigor is an important characteristic for ensuring uniform and healthy stand establishment, and in some instances, poor seedling vigor and stand establishment can negatively impact yield or force growers to make the costly decision to replant (Collins and Whitaker, 2012; Snider et al., 2014; Wanjura et al., 1969). Vigorous early season plant growth 1) maximizes light interception, 2) improves competitiveness with weedy species, and 3) lessens the long-term damage that can be caused by early-season insect herbivory. Given the well-established relationship between temperature and cotton development, it is not surprising that below optimum temperature conditions during the early growing season will slow growth and development, and if temperatures are cool enough, result in chilling injury in cotton (Kratsch and Wise, 2000; Wise et al., 1983).

One plant characteristic that influences tolerance to either high or low temperatures is the level of membrane fluidity. That is, chilling-sensitive species, like cotton, tend to have poor membrane fluidity at low temperatures, resulting in a number of negative physiological consequences. The level of fatty acid saturation in plant cell membranes will influence membrane fluidity in much the same way that fatty acid saturation determines whether fats used for cooking purposes are a liquid (canola oil, olive oil, etc.) or a solid (lard, butter, etc.) at room temperature. Membrane fluidity and tolerance to cool, early season temperatures could potentially be improved in cotton if fatty acids were less saturated during the seedling stage.

The delta-12 fatty acid desaturase (FAD2) is an enzyme in plants that accomplishes fatty acid desaturation, specifically to create omega-6 polyunsaturated fatty acids. Consequently, the current study sought to assess whether transgenic cotton lines overexpressing a cotton isoform of the delta-12 fatty acid desaturase (FAD2-4; Zhang et al., 2009) would exhibit greater seedling vigor than their parent genotype under cool temperatures imposed under controlled environment conditions. Thus the main objective of the current study was to assess the response of leaf area, plant fresh weight, and plant height three weeks after planting under cool (20/15C) and optimal (30/20C) day/night temperature conditions for one parental line (Coker 312) and six different third-generation transgenic lines of Upland cotton.

Materials and Methods

Seeds of Coker 312 (the parental line; L1) and six FAD2-4 transgenic lines (L2 through L7) were grown for three weeks in two large Conviron walk-in controlled environment chambers (model CG72) at the Georgia Envirotron at the University of Georgia Griffin Campus. From planting until the end of the three-week growth period, chamber temperatures were maintained at a 30/20 ± 0.5C day/night temperature regime (optimal growth temperature regime for cotton) or a 20/15 ± 0.5C day/night temperature regime (sub-optimal temperature regime). Light intensity for both temperature regimes in the chambers was maintained equal throughout the growth period (~700 µmol m^{-2} s^{-1} photosynthetically active radiation). Seeds were planted at a 2.5 cm depth in 1 liter pots filled with Pro-Mix growth medium and watered to capacity every two days. Pots were spaced 15 cm apart and the experimental design was a completely randomized design with seven lines and five replications of each.

Following three weeks of growth at each temperature regime, a number of different measures of seedling vigor were obtained. For brevity, only three parameters are discussed in the current report: leaf area per plant, plant fresh weight, and plant height. Plant height was measured in cm; whole plants were then cut at the base, and fresh weight was measured immediately following excision; all leaves were then cut from the plant, and a LI-3100 leaf area meter (Li-Cor; Lincoln, NE) was used to quantify total leaf area per plant.

To assess the importance of FAD2-4 overexpression on seedling vigor under cool conditions, relative to the vigor of the parent line (Coker 312), the effect of genotype (L1 through L7) on leaf area, fresh weight, and plant height at three weeks past planting was assessed using a one-way analysis of variance (ANOVA) at each temperature regime. Post-hoc analysis was conducted using Fisher's LSD ($\alpha = 0.05$).

Results and Discussion

When leaf area is assessed for all lines under optimal temperature conditions, no significant genotype effect is observed ($P < 0.05$; Figure 1). Under cool conditions (20/15C), two notable trends are observed: 1) leaf area development is substantially reduced under cool temperature conditions relative to optimal temperature conditions and 2) genotype strongly influences leaf area development under cool temperatures. Specifically, L4 produced significantly greater leaf area than the parent line (L1) under the cool temperature regime.

Under optimal conditions, plant fresh weight is significantly affected by genotype, where L3 and L6 produced the lowest plant fresh weight. L5 produced the greatest fresh weight and was not statistically different than L1, L2, L4, or L7. Under cool temperatures, L1-L3 produced the lowest plant fresh weight, whereas L4-L7 produced the greatest plant fresh weight. Similar to leaf area per plant, plant height demonstrated no significant cultivar effects under optimal conditions, but a significant cultivar effect under cool temperatures was observed. Specifically, L4 plants were the tallest plants measured under cool temperatures and were not statistically different than L5 through L7. L4, L5, L6, and L7 were all taller than the parental line under the 20/15C temperature regime.

Our findings indicate that multiple FAD2-4 overexpressing lines assessed demonstrated promise for improving seedling vigor under cool conditions, relative to Coker 312. Specifically, L4 demonstrated greater seedling vigor than the parental line in all parameters measured under the 20/15C temperature regime. Importantly, with the exception of L3 for plant fresh weight, all FAD2-4 transgenic lines perform similarly to Coker 312 under optimal temperature conditions, indicating no negative impacts of fatty acid desaturase over expression under optimal conditions. Thus, fatty acid desaturation appears to be a promising approach for improving seedling vigor under cool temperature conditions while not negatively impacting performance under optimal growth temperatures. The genotypes assessed in the current study are currently being evaluated in the field using planting date to expose all lines to cool early-season temperatures.

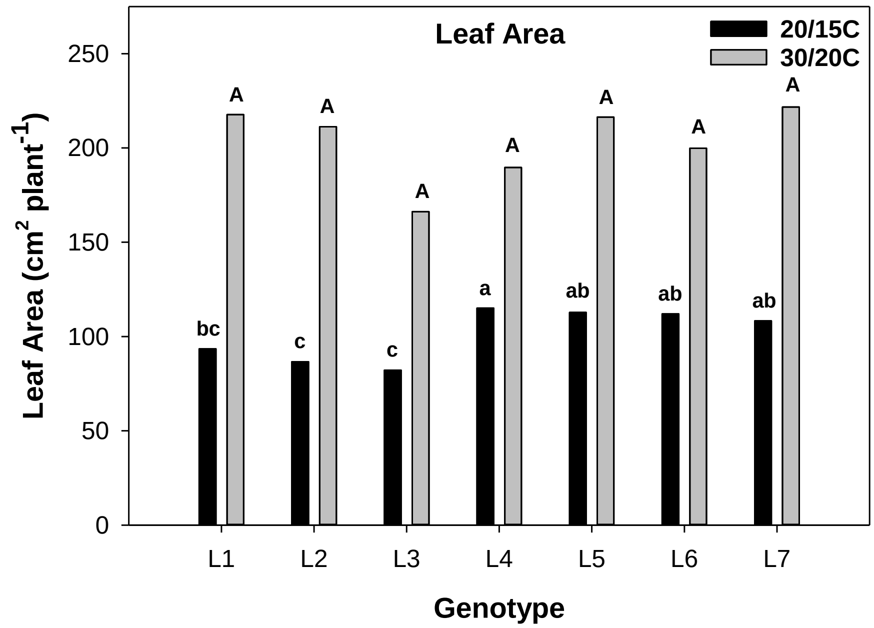

Figure 1. Average leaf area per plant for seven cotton genotypes (lines). L1 is the parent line (Coker 312), and L2 through L7 are third-generation transgenic lines engineered to overexpress fatty acid desaturase (FAD), which should improve seedling vigor under cool temperatures. Each column represents the mean leaf area of five plants. Columns not sharing a common letter within a given temperature regime are statistically different.

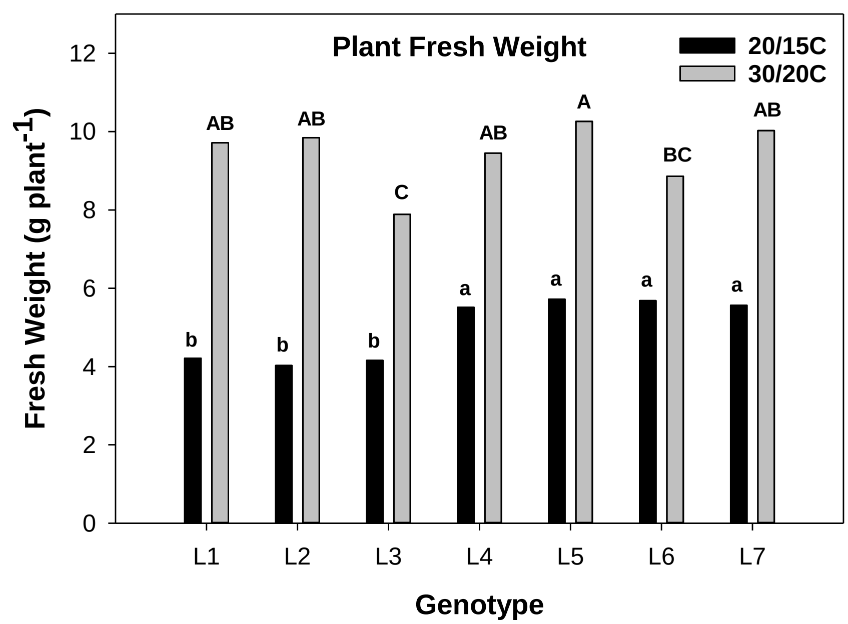

Figure 2. Average fresh weight per plant for seven cotton genotypes (lines). L1 is the parent line (Coker 312), and L2 through L7 are third-generation transgenic lines engineered to overexpress fatty acid desaturase (FAD), which should improve seedling vigor under cool temperatures. Each column represents the mean fresh weight of five plants. Columns sharing a common letter within a given temperature regime are not statistically different.

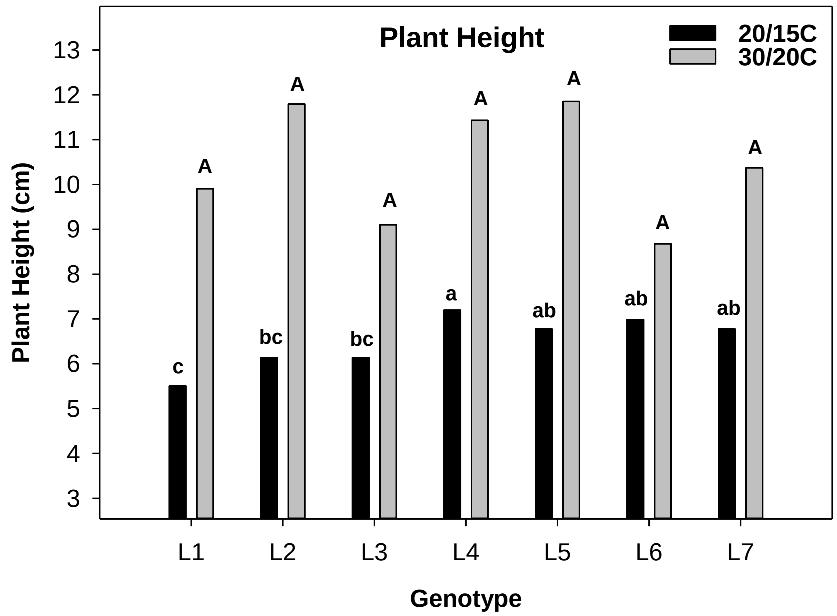

Figure 3. Average height per plant for seven cotton genotypes (lines). L1 is the parent line (Coker 312), and L2 through L7 are third-generation transgenic lines engineered to overexpress fatty acid desaturase (FAD), which should improve seedling vigor under cool temperatures. Each column represents the mean height of five plants, and columns not sharing a common letter within a given temperature regime are statistically different.

Acknowledgement

The authors would like to thank, the Georgia Cotton Commission, Cotton Incorporated, and the University of Georgia for support of this project.

References

Collins, G. D., & Whitaker, J. (2012). The 2011 crop year in review. In G.D. Collins, C. Li, & D. Shurley (Eds.), *Cotton research-Extension report–2011*. Tifton, GA: Univ. of Georgia.

Kratsch, H. A., & Wise, R. R. (2000). The ultrastructure of chilling stress. *Plant, Cell & Environment, 23*(4), 337-350.

Snider, J. L., Collins, G. D., Whitaker, J., Chapman, K. D., Horn, P., & Grey, T. L. (2014). Seed size and oil content are key determinants of seedling vigor in Gossypium hirsutum. *Journal of Cotton Science, 18*, 1-9.

Wanjura, D. F., Hudspeth, E. B., Jr., & Bilbro, J. D., Jr. (1969). Emergence time, seed quality, and planting depth effects on yield and survival of cotton (Gossypium hirsutum L.). *Agronomy Journal, 61*(1), 63-65.

Wise, R. R., McWilliam, J. R., & Naylor, A. W. (1983). A comparative study of low-temperature-induced ultrastructural alterations of three species with differing chilling sensitivities. *Plant, Cell & Environment, 6*(7), 525-535.

Zhang, D., Pirtle, I. L., Park, S. J., Nampaisansuk, M., Neogi, P., Wanjie, S. W., . . . Chapman, K. D. (2009). Identification and expression of a new delta-12 fatty acid desaturase (FAD2-4) gene in upland cotton and its functional expression in yeast and Arabidopsis thaliana plants. *Plant Physiology and Biochemistry, 47*(6), 462-471.

THE EFFECT OF IRRIGATION DELIVERY METHOD ON LINT YIELD IN TWO YEARS WITH CONTRASTING WATER AVAILABILITY

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Introduction

Overhead (OVHD) sprinkler irrigation is the primary irrigation method used by Georgia cotton growers. Although a fairly significant number of cotton acres in the state of Georgia are also produced under dryland (rain fed) conditions, OVHD irrigation improves yield in dry years and provides security during sporadic drought events that are common during a typical cotton growing season. Despite the obvious benefits of OVHD, subsurface drip irrigation (SSDI) has been touted as a means to improve water use efficiency and increase or maintain yields in cotton production systems (Whitaker et al., 2008) relative to OVHD-irrigated cotton. Cotton irrigated with OVHD irrigation has also been shown to cause limited boll retention near the base of the plant, which can delay crop maturity (Ritchie et al., 2009). This could potentially be problematic when adversely cool fall weather limits the time frame during which normal crop maturation is allowed to occur. Furthermore, sprinkler-induced pollen rupture and associated fruit loss has been shown to limit yield in some instances (Burke, 2003), and slight yield improvements for SSDI cotton versus OVHD cotton have been observed previously (Whitaker et al., 2008). Because cotton cultivars are continuously changing, and an analysis of yield response to irrigation delivery method has not been reported in recent years for a cultivar in widespread use in Georgia, the goal was to characterize lint yield response of the cotton cultivar *Gossypium hirsutum* cv. Phytogen (PHY) 499 WRF (a widely utilized commercially available cultivar) to SSDI, OVHD, and dryland conditions during an atypically wet year (2013) and a year characterized by drought (2014).

Materials and Methods

The cotton cultivar PHY 499 WRF was planted at the CM Stripling Irrigation Research Park near Camilla, GA, on 6 May in 2013 and on 3 June in 2014 and was managed according to practices outlined by University of Georgia Cooperative Extension with respect to fertility, plant growth regulator application, weed control, and insect control. Seed were planted at a 1-inch depth at a rate of three seed per row ft. Row spacing was 36 inches. Irrigation treatments were arranged using a randomized block design. Three irrigation treatments were utilized: 1) **OVHD**: irrigation water was applied according to the University of Georgia Checkbook Method via overhead sprinkler irrigation using a center-pivot irrigation system; 2) **SSDI**: irrigation water was applied according to the University of Georgia Checkbook Method via subsurface drip tape positioned at a 12-inch depth in alternating row middles; and 3) **DRY:** No supplemental irrigation was applied beyond stand establishment. Plot sizes were six rows in width and 40 feet in length.

To characterize each year with respect to water availability, rainfall data were obtained from a weather station immediately adjacent to the research field. Table 1 provides rainfall and irrigation amounts during the irrigation treatment period for all treatments for both study years. Following defoliation, the two center rows of each plot were harvested using a two-row spindle picker and seedcotton weight was obtained on-site from each plot. Seedcotton samples were transported to the University of Georgia microgin in Tifton, where gin turnout was determined. Plot lint yield was extrapolated to lbs/acre. The effect of irrigation treatment on lint yield was analyzed using a mixed effects ANOVA, where block was a random effect and irrigation treatment was a fixed effect. Post-hoc analysis was conducted using Fisher's LSD ($\alpha = 0.05$).

Results and Discussion

Table 1 shows the substantial difference in rainfall between the 2013 and 2014 growing seasons. Total rainfall received during the 2013 growing season (26 inches) was 8 inches in excess of the total water required by a cotton crop in Georgia during a typical growing season (18 inches; Bednarz et al., 2002). In contrast, 2014 rainfall amounts (13.7 inches) were 4.3 inches below the 18-inch requirement to maximize lint yields.

Not surprisingly, lint yield response to irrigation treatment differed with year. For example, during 2013, there was no response to irrigation treatment due to the high rainfall amounts experienced during the season. However, for the relatively dry 2014 season, lint yield was strongly impacted by irrigation treatment (Figure 2; $P < 0.0001$). SSDI produced the highest lint yield at 1,837 lbs/acre; OVHD produced the second highest yield at 1,250 lbs per acre; DRY produced the lowest yields at 722 lbs per acre. This response to irrigation is similar to a report by Whitaker et al. (2008), although the increase in yield with SSDI compared with OVHD was much larger in the current study.

It is important to note, however, that the same plant growth regulator management strategy was used for all irrigation treatments to prevent the introduction of a confounding factor. Rank growth was observed for OVHD and SSDI-irrigated plots. Interestingly, plots irrigated via OVHD were substantially taller than those irrigated via SSDI, bolls were set at higher positions on the plant, and crop maturity was delayed (as estimated using % open boll). Poor boll retention on lower nodes and delayed crop maturity have been reported previously (Ritchie et al., 2009) for OVHD relative to SSDI.

Although the cause of these phenomena are relatively unexplored, it is interesting to speculate that sprinkler induced fruit abscission due to pollen rupture (Burke, 2003) may increase carbohydrate partitioning to vegetative growth. Thus, in the current study, the combined effects of delayed maturation, later planting date (3 June), and rank growth exhibited in OVHD irrigated cotton likely limited the time frame during which bolls at higher positions on the plant were allowed to develop.

It should be noted, however, that OVHD produced yields that were 73% higher than DRY, emphasizing the importance of irrigation, via any method, in improving yields under drought conditions and minimizing the risks associated with cotton production in Georgia.

Table 1. Cumulative Amount of Water Supplied to the Cotton Crop

Treatment	Irrigation 2013	Irrigation 2014	Rainfall 2013	Rainfall 2014	Total 2013	Total 2014
			--- Inches ---			
SSDI	6.9	11.8	26	13.7	32.9	25.5
OVHD	6.9	11.8	26	13.7	32.9	25.5
Dryland	0	0	26	13.7	26	13.7

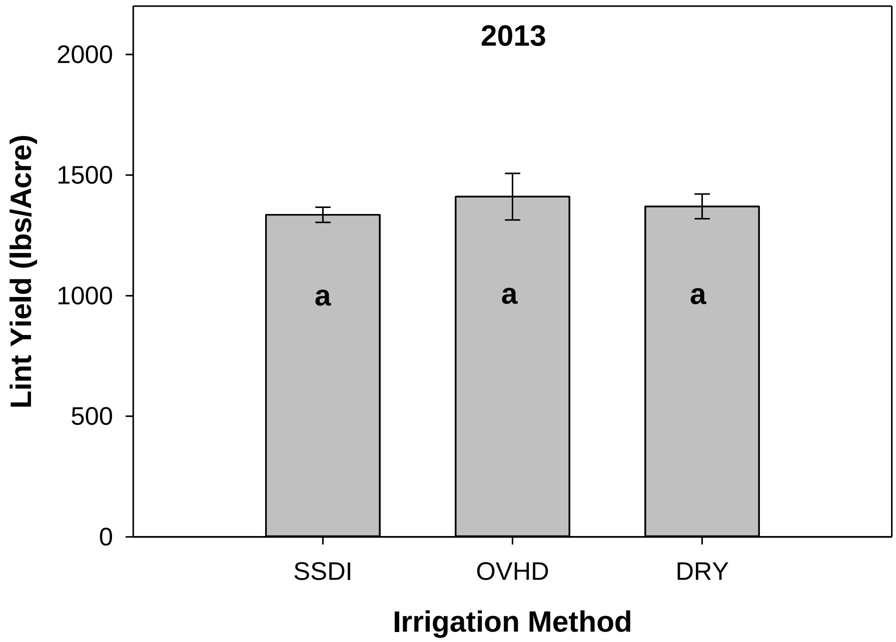

Figure 1. Average lint yield for *Gossypium hirsutum* cv. PHY 499 WRF under three different irrigation methods during the 2013 growing season: subsurface drip irrigation (SSDI), overhead sprinkler irrigation (OVHD), and dryland (DRY). SSDI and OVHD received the same amount of water during the growing season according to the University of Georgia Cooperative Extension “Checkbook” approach. This ensured that plants in both the SSDI and OVHD treatments were well watered. Columns are means and standard errors (n = 3 for OVHD and 4 for SSDI).

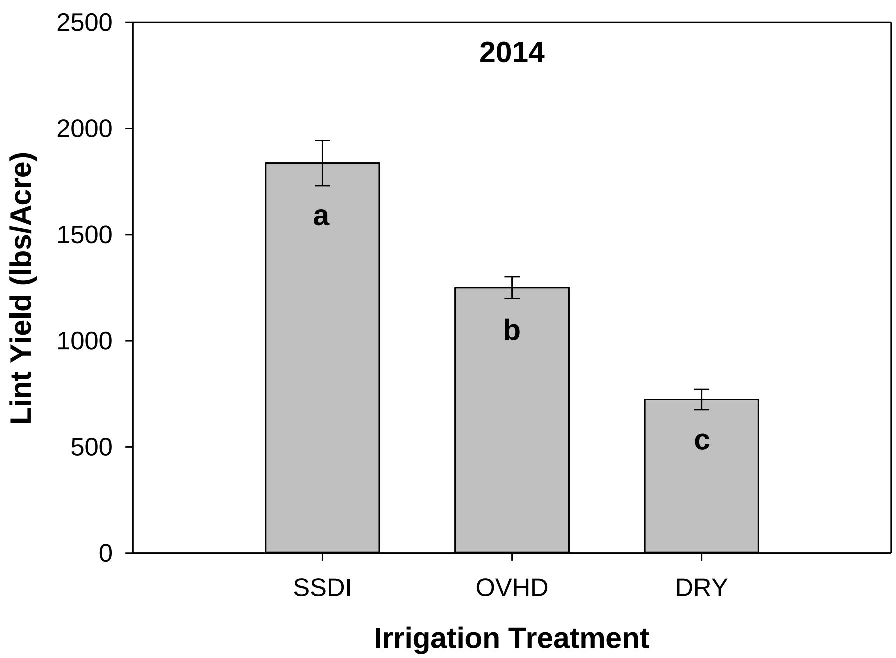

Figure 2. Average lint yield for *Gossypium hirsutum* cv. PHY 499 WRF under three different irrigation methods during the 2014 growing season: subsurface drip irrigation (SSDI), overhead sprinkler irrigation (OVHD), and dryland (DRY). SSDI and OVHD received the same amount of water during the growing season according to the University of Georgia Cooperative Extension Service “Checkbook” approach. This ensured that plants in both the SSDI and OVHD treatments were well watered. Columns are means and standard errors (n = 3 for OVHD and 4 for SSDI)

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The authors would like to thank, the Georgia Cotton Commission, Cotton Incorporated, and the University of Georgia for support of this project.

References

Bednarz, C., Ritchie, G., Hook, J., Yager, R., Cromer, S., Cook, D., & Griner, I. (2002). Cotton crop water use and irrigation scheduling. In A. S. Culpepper (Ed.), *Georgia cotton research and Extension report* (pp. 61-64). Athens, GA: University of Georgia.

Burke, J. J. (2003). Sprinkler-induced flower losses and yield reductions in cotton (Gossypium hirsutum L). *Agronomy Journal, 95*(3), 709-714.

Ritchie, G. L., Whitaker, J. R., Bednarz, C. W., & Hook, J.E. (2009). Subsurface drip and overhead irrigation: A comparison of plant boll distribution in upland cotton. *Agronomy Journal, 101*(6), 1336-1334.

Whitaker, J. R., Ritchie, G. L., Bednarz, C. W., & Mills, C. L. (2008). Cotton subsurface drip and overhead irrigation efficiency, maturity, yield, and quality. *Agronomy Journal, 100*(6), 1763-1768.

PHOTOSYNTHETIC RESPONSE OF TWO COMMERCIAL COTTON CULTIVARS TO IMPOSED DROUGHT USING PREDAWN LEAF WATER POTENTIAL AS AN IRRIGATION TRIGGER

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Introduction

Cotton producers in southern Georgia typically adopt a rainfall budget or more commonly a checkbook approach to irrigation scheduling, where water lost to evapotranspiration is replaced by balancing rainfall with supplemental irrigation. With increased interest in resource conservation, many irrigation-scheduling methods based on estimates of crop water status have been proposed. Previous research on cotton indicates that direct measurements of plant water status before sunrise are strong indicators of midday leaf metabolic trends (Chastain et al., 2014; Snider et al., 2014). In these studies, low predawn leaf water potentials in dryland, relative to fully irrigated cotton were observed. When these differences were detected, dryland treatments typically had lower photosynthetic rates. Carbon loss mechanisms, such as respiration and photorespiration were also shown to increase. All cultivars responded similarly to drought stress. In the current study, we were interested in assessing the feasibility of using predawn leaf water potential as an irrigation trigger to induce a range of water-deficit stress. In addition, it was our objective to determine if differences in physiological response to drought stress existed between two different, commercially available cotton cultivars.

Methods

To evaluate the photosynthetic response of two common cultivars [PHY 499 WRF (Dow AgroSciences) and FM 1944 GLB2 (Bayer CropScience)] to water deficit, experiments were conducted at C.M. Stripling Irrigation Research Park near Camilla, Georgia (31°16'55.5"N, 84°17'39.9"W), in 2014. Soil type was classified as Lucy loamy sand (loamy, kaolinitic, thermic Arenic Kandiudults). A common rye cover crop was established and treated with glyphosate prior to planting. Seeds were planted on 2 June 2014, at a 36 in. inter-row spacing and at a rate of four seeds ft^{-1} under a strip-till system with a common rye cover crop. To ensure proper stand establishment, plots were irrigated at 1.0 in. per $week^{-1}$, via overhead sprinklers. Fertilization and pest management practices were conducted according to University of Georgia Cooperative Extension cotton production recommendations. Climactic data were provided by the Georgia Automated Environmental Monitoring Network (www.georgiaweather.net) weather station located at the C.M. Stripling Irrigation Research Park, near Camilla, GA. Field observations were conducted on 10 July, 26 July, and 08 Aug. 2014, both during a predawn (0400-0600 h) and midday (1200-1300 h) time window; hereafter referred to as predawn and midday, respectively.

To provide a range of water deficit conditions, cotton plants were grown under five distinct irrigation regimes (Treatments 1 through 5; T1-5). Treatment 1 was irrigated according to University of Georgia Cooperative Extension "Checkbook Recommendations" (Collins et al., 2014). Treatment 5 was grown with no supplemental irrigation beyond the four-leaf stage (referred to as T5 or dryland). Treatments 2-4 consisted of three distinct plant-based irrigation triggers (-0.5, -0.7, and -0.9 MPa, respectively), as determined by predawn leaf water potential (Ψ_{PD}). The Ψ_{PD} was determined by excising the uppermost, fully expanded leaf of one plant per plot, immediately sealing the leaf petiole within the adjustable compression gasket of a Scholander pressure chamber. Positive pressure was then applied until xylem sap reached the cut surface of the petiole. When the average leaf water potential of a treatment reached its respective threshold, one-third of the weekly water prescribed by the Checkbook was then applied via subsurface drip tape at ~12 in. below the soil surface (Netafilm, Fresno, CA)

Single leaf gas exchange was performed using a LI-COR 6400 Portable Photosynthesis System (LI-COR, Lincoln, NE) on the uppermost, fully expanded leaf both predawn (400-600 h) and midday (1200-1400 h) on 10 and 26 July and 8 Aug. 2015. Flow rate was set to 500 µmol s^{-1}, and CO_2 was maintained at 400 ppm. Carbon dioxide exchange rates were logged when rates reached a steady state (< 0.2 µmol m^{-2} s^{-1}). Midday dark respiration rates were estimated according to Valentini et al. (1995).

Plots were arranged according to a split plot, randomized complete block design. Statistical analysis was conducted using JMP 11. Data were analyzed by two-way analysis of variance. Each sample date was analyzed separately. Factors were as follows: whole plot factor = irrigation treatment and split plot factor = cultivar. Post-hoc differences were determined using Fisher's LSD ($\alpha = 0.05$)

Results and Discussion

Early in the growing season (pre-bloom; 10 July), predawn leaf water potentials were similar for all irrigation treatments (between -0.45 and -0.6 MPa). Consequently, no observable effect of irrigation treatment was observed and cultivars responded similarly (Figures 1 A, D, and G). Later in the growing season (during first flower), a drought event lasting approximately 26 days resulted in greater separation amongst irrigation treatments. Specifically, on 26 July T4-5 leaf water potentials (-0.56 MPa) were ~17% lower than T1-2 (-0.47MPa), with T3 forming an intermediate between the two. This decrease in plant water status resulted in decreased midday photosynthetic rates for T3-5, relative to T1-2 (Figures 1 B and E). Interestingly, a cultivar effect was observed on this date, with FM 1944 performing slightly better overall than PHY 499 (~5%). However, no cultivar by treatment interaction was observed. Respiration was shown to increase under water deficit, similar to that reported by Chastain et al. (2014). Specifically, Treatments 3-5 respiration rates were ~35% higher than T1-2 (Figure 1 H). Late in the growing season (during peak bloom; 8 Aug.), treatment differences became more pronounced; however, treatment separation was similar to the previous sample date. Specifically, treatments with the highest leaf water potentials (T1-2, -0.65 MPa) had the highest photosynthetic rates. Treatment 3 (-0.88 MPa) and T4-5 (-1.06 MPa) photosynthetic rates were ~52 and 82% lower than T1-2, respectively. No cultivar effect or two way interaction was observed for this date. No irrigation effect on midday respiration was observed.

This study produced similar photosynthetic and respiratory responses under drought to those reported by Chastain et al. (2014). Evidence was noted for some differences between cultivars. However, there was no supporting data for increased respiration for the 8 Aug. sample date, as drought stress increased. One possible explanation currently under investigation is a confounding effect of leaf expansion and senescence under drought. Typically, when physiological measurements are made, researchers focus on the uppermost, fully expanded leaf. Under drought, low plant water status limits turgor pressure and, thus, slows expansion (Hsiao, 1973). This adds to the difficulty of making comparisons amongst treatments because uppermost, fully expanded leaves likely differ in leaf age as well as water status in a treatment-dependent manner. We are conducting an investigation of the interaction between leaf development and drought stress.

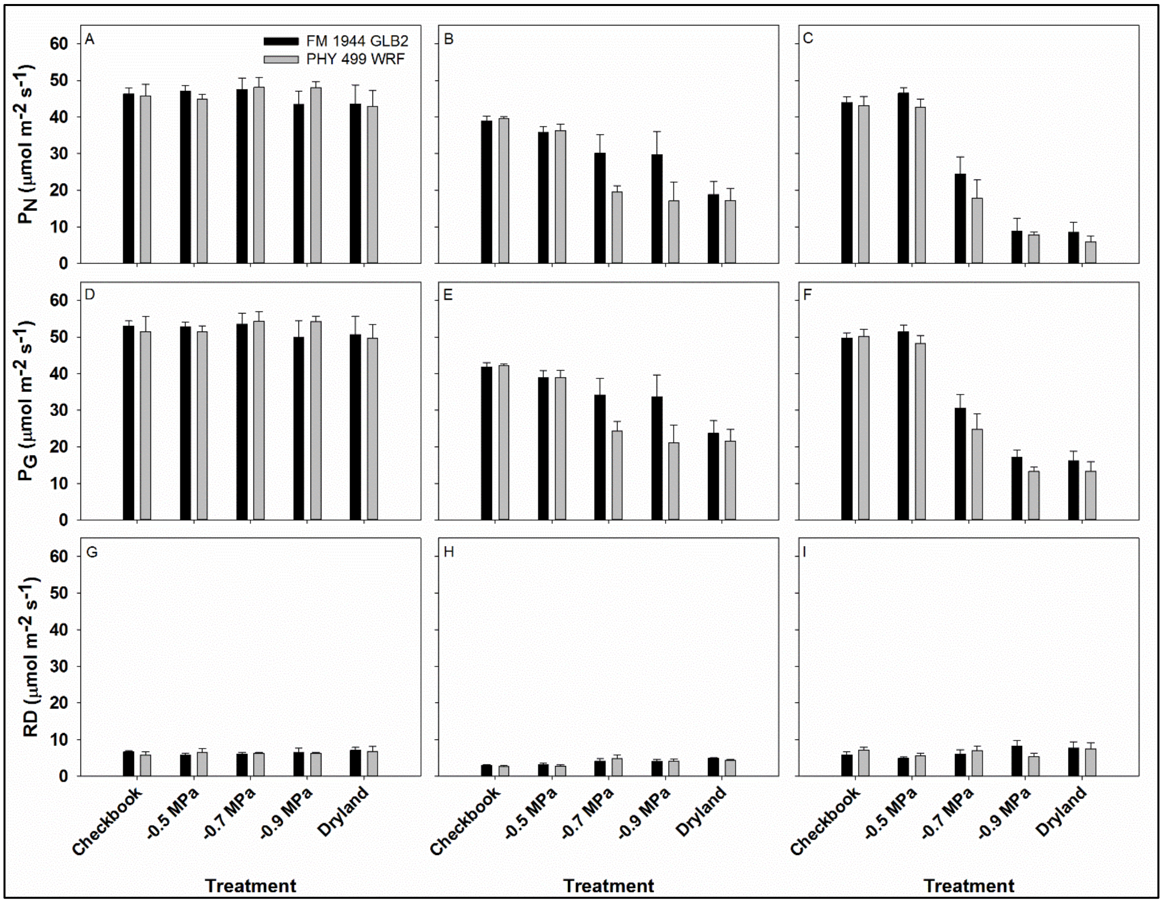

Figure 1. Net photosynthesis (A, B, C), gross photosynthesis (D, E, F), and respiration (G, H, I) for two cultivars on 10 July (left), 26 July (center), and 8 Aug. (right) for 2014. Means ± SE (n = 4).

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References

Chastain, D., Snider, J., Collins, G., Perry, C., Whitaker, J., & Byrd, S. (2014). Water deficit in field-grown Gossypium hirsutum primarily limits net photosynthesis by decreasing stomatal conductance, increasing photorespiration, and increasing the ratio of dark respiration to gross photosynthesis. *Journal of Plant Physiology, 171*(17), 1576-1585.

Collins, G., Whitaker, J., Culpepper, S., Harris, G., Kemerait, B., Perry, C., . . . Porter, W. (2014). *2015 Georgia cotton production guide.* Tifton, GA: University of Georgia Cooperative Extension.

Hsiao, T. (1973). Plant responses to water stress. *Annual Review of Plant Physiology, 24*, 519-570.

Valentini, R., Epron, D., Angelis, P., Matteucci, G., & Dreyer, E. (1995). In situ estimation of net CO2 assimilation, photosynthetic electron flow and photorespiration in Turkey oak (Q. cerris L.) leaves: Diurnal cycles under different levels of water supply. *Plant, Cell & Environment,* 18(6), 631-640.

THE EFFECT OF PRIMED ACCLIMATION IRRIGATION STRATEGIES ON COTTON WATER USE EFFICIENCIES

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Introduction

Important steps for producers after establishing a good plant stand are to promote healthy root development and canopy growth. A type of irrigation management strategy called primed acclimation (PA) aims to limit water availability early in the growing season to promote root development, which potentially helps prepare plants for episodic drought in years with limited water. Recent advances in continuous and remote soil moisture monitoring will allow for a more definitive assessment of 1) the utility of the primed acclimation strategy and 2) the thresholds needed to achieve the maximum benefit from this strategy.

Rowland et al. (2012) have demonstrated this system to be highly effective in peanut production. Guinn et al. (1981) demonstrated water savings without negative impacts on cotton yield (relative to treatments receiving irrigation at the start of squaring) by delaying the first irrigation until two weeks after the first visible square was observed.

To our knowledge, there are no studies currently available that assess the utility of PA in cotton by using variation in early-season soil water potential-based irrigation scheduling thresholds. Plants produced under PA conditions have demonstrated improvement in their water use efficiency (WUE), as well as photosynthesis when compared to non-acclimated plants under drought stress (Flexas et al., 2006; Rowland et al., 2012). Physiological alterations resulting from prior exposure to stresses (one example being histone modification) are often retained by plants the entire growing season (Bruce et al., 2007). The key to the PA approach is to clearly define early-season irrigation thresholds such that the cotton crop is not exposed to yield-limiting drought stress (Perry et al., 2012).

Materials and Methods

Field experiments were conducted at the CM Stripling Irrigation Research Park near Camilla, GA, during 2014. The experiment was a split-block design with four replications. A single commercial cotton cultivar, FiberMax 1944 GLB2, was planted on 19 May in 2014 and managed according to practices outlined by University of Georgia Cooperative Extension with respect to fertility, plant growth regulator application, weed control, and insect control. Seed were planted at a 1 inch depth at a rate of three and a half seed per row ft. with row spacing of 36 inches. Five treatments were utilized including four pre-bloom irrigation triggers:

- **T5** A dryland check with no irrigation applied beyond what was needed for stand establishment. This treatment could not be randomized with the other treatments due to irrigation system limitations.
- **T1** -20cb pre-bloom
- **T2** -40cb pre-bloom
- **T3** -70cb pre-bloom
- **T4** -100cb pre-bloom

The UGA Smart Sensor Array (SSA) utilizing Watermark soil water potential sensors was used to trigger irrigation with these predetermined pre-bloom soil moisture triggers. Upon initiation of flowering, all irrigated treatments were triggered at -35 cb for the remainder of the season. Irrigation was applied via overhead sprinkler irrigation using a variable rate center-pivot irrigation system. Plot sizes were a minimum of eight rows in width and 40 feet in length.

Rainfall data were obtained from a weather station in the vicinity of the experimental area. Table 1 shows rainfall and irrigation amounts during the irrigation treatment period for all treatments in 2014. Following defoliation, rows four and five of each eight-row plot were harvested using a two-row spindle picker. Seedcotton weight was obtained on-site. Seedcotton samples were then sent to the University of Georgia microgin in Tifton for ginning, and lint yield was determined. The effect of irrigation treatment on lint yield was analyzed using a mixed effects ANOVA where block was a random effect and irrigation treatment was a fixed effect. Post-hoc analysis was conducted using Fisher's LSD ($\alpha = 0.05$).

Results and Discussion

Using the higher thresholds of -70 cb or -100 cb saved 0.9 inches of applied irrigation water compared to the lower threshold of -20 cb (Table 1). Irrigation triggered prebloom for T1 was four times greater than the other PA thresholds. All four irrigated treatments resulted in the same irrigation applied postbloom (Figure 1). Even with varying amounts of irrigation water applied pre-bloom, irrigation triggered and applied postbloom were the same (Figure 2).

Rainfall in 2014 (12.6 inches) was 5.4 inches less than the 18-inch amount reported by Bednarz et al. (2002) as needed to maximize lint yields. Irrigation amounts and events were not substantially different applied postbloom even with the reduced prebloom irrigation for PA treatments. Total water received (irrigation plus rainfall) was 17.7 inches for T1 and 17.1 inches for T2.

Lint yields were not significantly different for any of the prebloom triggers (Figure 3). Yields were substantially higher in all irrigation treatments compared to the dryland treatment. Plant mapping parameters indicated no significant differences between irrigated treatments with respect to yield distribution (data not shown).

Observations thus far indicate that PA irrigation strategies could potentially be successfully implemented in cotton production, although additional data is needed to verify these findings.

Table 1. Cumulative Amount of Water Supplied to the Cotton Crop During the 2014 Growing Season From Irrigation Treatment Initiation Until Irrigation Termination (in Inches)

Treatment	Pre-bloom Irrigation	Post-bloom Irrigation	Rainfall	Total
T1 -20cb	1.2	3.9	12.6	17.7
T2 -40cb	0.6	3.9	12.6	17.1
T3 -70cb	0.3	3.9	12.6	16.8
T4 -100 cb	0.3	3.9	12.6	16.8
T5 Dryland	0.0	0.0	12.6	12.6

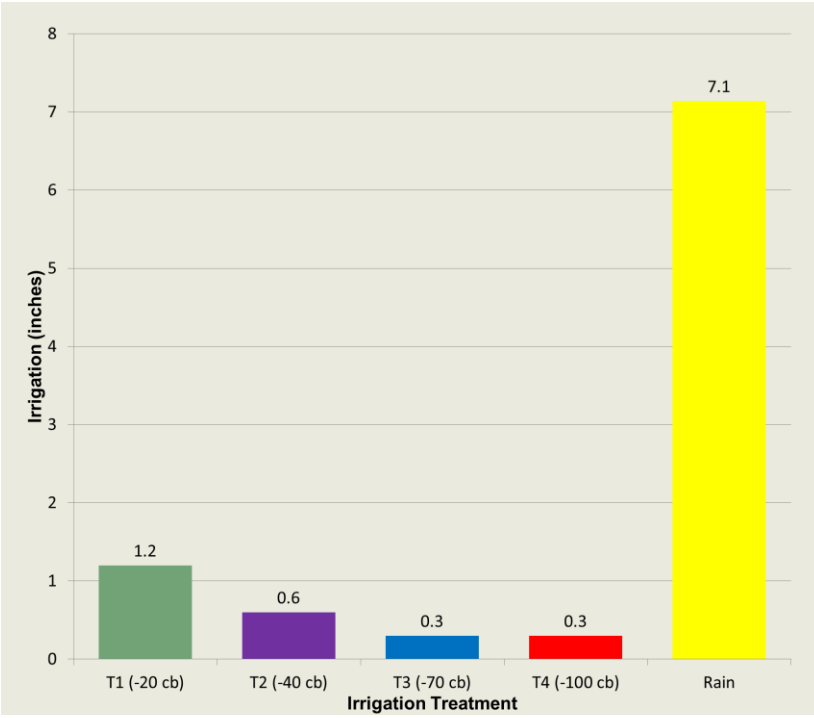

Figure 1. Applied prebloom irrigation for *Gossypium hirsutum* cv. FiberMax 1944 GLB2 under four different irrigation triggers during the 2014 growing season.

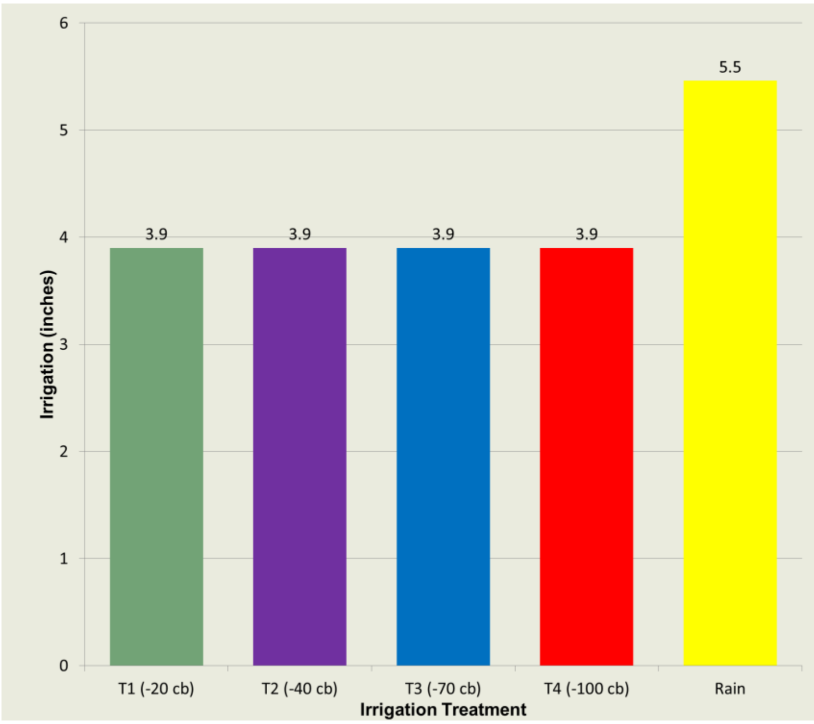

Figure 2. Applied postbloom irrigation for *Gossypium hirsutum* cv. FiberMax 1944 GLB2 under four different irrigation triggers during the 2014 growing season.

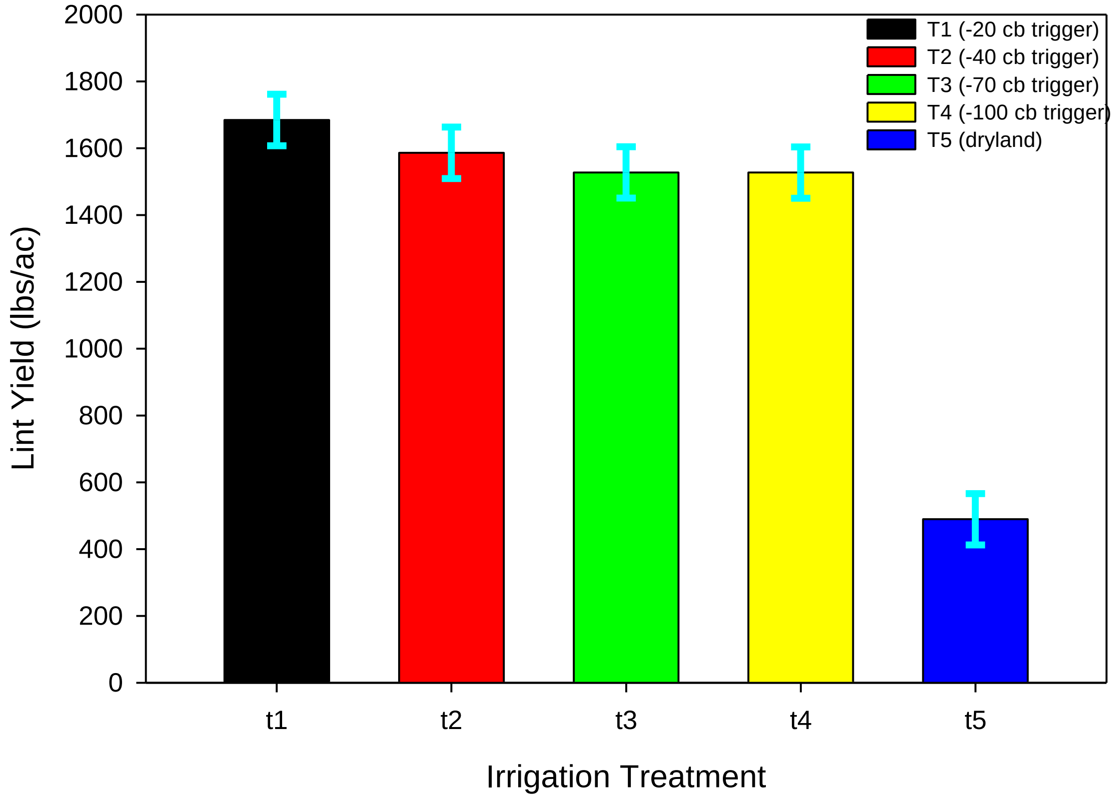

Figure 3. Average lint yield for *Gossypium hirsutum* cv. FiberMax 1944 GLB2 under five different irrigation triggers during the 2014 growing season. Columns are means and standard errors.

Acknowledgements

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References

Bednarz, C., Ritchie, G., Hook, J., Yager, R., Cromer, S., Cook, D., & Griner, I. (2002). Cotton crop water use and irrigation scheduling. In A. S. Culpepper (Ed.), *Georgia cotton research and Extension report* (pp. 61-64). Athens, GA: University of Georgia.

Bruce, T. J. A., Matthes, M. C., Napier, J. A., & Pickett, J. A. (2007). Stressful “memories” of plants: Evidence and possible mechanisms. *Plant Science, 173*(6), 603-608.

Chaves, M. M., Maroco, J. P., & Pereira, J. S. (2003). Understanding plant responses to drought – from genes to the whole plant. *Functional Plant Biology, 30*, 239-264.

Flexas, J., Bota, J., Galmés, J., Medrano, H., & Ribas-Carbó, M. (2006). Keeping a positive carbon balance under adverse conditions: Responses of photosynthesis and respiration to water stress. *Physiologia Plantarum,127*(3), 343-352.

Guinn, G., Mauney, J. R., & Fry, K. E. (1981). Irrigation scheduling and plant population effects on growth, bloom rates, boll abscission, and yield of cotton. *Agronomy Journal, 73*(3), 529-534.

Perry, C. D., & Barnes, E. M. (2012). *Cotton irrigation management for humid regions*. Cotton Incorporated.

Rowland, D. L., Faircloth, W. H., Payton, P., Tissue, D., Jason, T., Ferrell, A., Sorenson, R.B., and Butts, C. L. (2012). Primed acclimation of cultivated peanut (Arachis hypogaea L.) through the use of deficit irrigation timed to crop developmental periods. *Agricultural Water Management, 113*, 85-95. doi:10.1016/j.agwat.2012.06.023

PHYSIOLOGICAL RESPONSES TO PRIMED ACCLIMATION IRRIGATION TREATMENTS: AN INITIAL STUDY

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Introduction

Primed acclimation is a term that is used to describe the imposition of water stress early during the development of a crop in order to induce stress responses that result in increased rooting depth and better utilization of available groundwater later during the season. This approach has been proposed as a means to aid the development of root growth to ensure the crop is better prepared for periods of limited water. Canopy development is considered more sensitive to water deficiencies than rooting development. Thus, early season root development might occur at the expense of early season canopy development. The ability of a plant to change its root distribution to exploit deeper stored soil water may be an important mechanism to avoid drought stress (Benjamin and Nielsen, 2005). Cotton is one of the few crops that respond to water stress well by increasing rooting depth and density, making it an ideal target for water stress studies. However, drought stress in cotton can and will cause reductions in shoot and above ground biomass development, thus it is important to only stress the plants enough to ensure an increase in root development occurs while negligible effects are seen above ground. Pace et al. (1999) reported reductions in shoot to root ratio for plants that were drought stressed. However, after the plants were allowed a recovery period with ample irrigation, the ratio increased to a similar level to non-water stressed plants. Consequently, it is important to characterize the above and below ground responses of cotton to primed acclimation while also directly measuring the stress level experienced by the crop. Primed acclimation irrigation triggers that do not penalize crop growth and yield must be clearly defined. A comprehensive analysis of above-ground and below-ground crop growth responses to primed acclimation is needed.

Objectives

The main objective of this study was to determine primed acclimation effects on crop growth and yield. The secondary objectives were to:

- Quantify biomass development above ground by collecting crop growth parameter data at regular intervals throughout the season.
- Determine the effects of primed acclimation treatment thresholds on end of season cotton lint yield.
- Determine the effects of primed acclimation on rooting development.

Materials and Methods

A site was selected under a variable rate center pivot irrigation system at UGA's Stripling Irrigation Research Park (SIRP) near Camilla, GA. Plots were established in a randomized complete block design and were planted in an arc planting pattern to match the travel pattern of the pivot. FiberMax 1944 GLB2 was the cultivar planted for this study. Five treatments were established and replicated four times (Table 1). Soil moisture sensors were installed in each of the treatments. The soil moisture sensors were the UGA Smart Sensor Array (SSA) system.

The UGA SSA's are a sensor probe with three Irrometer WaterMark sensors installed inline at depths of 12, 18, and 24 inches (Figure 1). Irrigation was triggered based on a weighted average centibar reading from the probe consisting of 50%, 30%, and 20% weight on the 12, 18, and 24 inch deep sensors, respectively. Once the weighted average reached the thresholds listed in Table 1, irrigation was triggered, and an amount of 0.75 inches was applied. This process continued until first bloom, when from then until irrigation termination, all treatments were switched to a weighted average sensor trigger level of 35 centibars.

Beginning at the six-leaf stage, crop growth data was collected. The crop growth data consisted of the number of plants in one yard length of row, the plants from that yard length of row, total weight from the yard length of row, plant height, number of nodes, number of reproductive structures (when relevant), the leaf area index, and the dry biomass weight. The cotton received 12.6 inches of rainfall throughout the season. The supplemental irrigation applied when triggered is shown in Table 2.

MiniRhizotron tubes (Figure 2) were installed in each of the plots. These were installed about the time of canopy closure. Typically the tubes should be installed once a stand is established, but in this case, since it was an initial study, the tubes were installed only to document the differences between treatments and were not used to actually track growth throughout the season. Pictures were collected (Figure 3) on 5 Aug. and 9 Sept.

Once the harvested plants were collected, they were transported back to the lab for further analysis. Once the plants reached the lab, plant height was measured, the number of nodes were counted, and the plants were stripped of all leaves and reproductive structures. The bare stalks were placed into an oven for drying. The leaves and reproductive structures were kept separate; the reproductive structures were counted and placed into an oven for drying. The leaves were processed through a leaf area index meter (LAI). Once each set of leaf samples were processed through the LAI meter, they were placed into the oven. All of the samples were left in the oven for 48 hours. Once the samples were dried, they were removed from the oven and weighed to obtain dry weight. The collected growth parameters were used to calculate crop growth rate, dry matter accumulation, net assimilation rate, and leaf area index.

Results and Discussion

Clear differences were observed throughout the season in the crop growth rate as presented in Figure 4. From Table 2, since the dryland (DL) only received 12.6 inches of rainfall the entire season, this treatment quickly lagged behind in growth rate and even had a few collections that exhibited negative growth. The negative growth occurred during the hottest and driest part of the summer.

The first and second collections did not exhibit major differences between the treatments. As the season progressed, however, differences became evident. The semi-primed (SP), full irrigation (FI), and optimally primed (OP) seemed to grow at a much higher rate than did the DL and full primed (FP). However, during the end of July, the early season limited moisture on both the FP and OP caused the growth rates to increase. This trend quickly changed during the beginning of August when it continued to remain hot and dry through the summer. The FI and SP, which had adequate moisture during the early season, increased their growth rates at the end of the season while the other treatments did not.

Dry matter accumulation (Figure 5) began at a slow rate for all treatments but then picked up along a similar trend for each of the irrigation treatments. The DL treatment reached a peak of growth and then stayed constant for the rest of the season. This is the same trend observed from the growth rate. This means that there was no new growth added to the DL treatment from mid-July until the end of the season. There were no major differences between the other four treatments. The FI and SP treatments had the highest accumulations of dry matter followed by FP and OP. This means that overall the PA treatments at the beginning of the season did have an effect on dry matter accumulation during the growing season and slightly reduced the amount of dry matter produced by the FP and OP treatments.

The net assimilation rate (Figure 6), or the mean rate of increase in total dry weight per unit leaf area, measured over a period of time, represents the excess of the rate of photosynthesis of the leaves over the rate of respiration of the whole plants, both expressed per unit leaf area, had some major differences appear as the season progressed. Until the beginning of July, all treatments responded similarly, however, as the season progressed, the DL treatment dropped off in a very similar manner as it did in the crop growth rate.

Since the net assimilation rate is partially based on crop growth, it exhibited similar trends to the crop growth. The FI and SP treatments had the highest assimilation rate at the end of the season, showing that the adequate soil moisture early in the season had an effect on the end of the season. Just as with the crop growth rate, the lack of soil moisture or induced moisture stress early in the season reduced the net assimilation rate of the FP and OP treatments.

Leaf area index (Figure 7) did not follow any of the previous trends. All of the treatments had a sharp increase in leaf area index from early to mid-June. This is when the crop went through rapid canopy expansion and growth. However, after this time there were constant increases in all of the treatments except for DL. The DL treatment began to decrease in mid-July and continued to do so throughout the rest of the season. Again there was a slight penalty that developed in the OP treatment for having limited water at the beginning of the season. The reduction was not as significant as in some of the other growth parameters.

The reproductive structures on a cotton plant are some of the last structures to develop and that was evident in this study. No reproductive structures (Figure 8) were collected until 8 July. After this point, all of the treatments added a significant amount of structures, the SP treatment most of all. After 23 July, however, the DL treatment began losing reproductive structures. All of the rest of the treatments kept increasing the number of reproductive structures at a high rate until the end of the season except for the OP treatment. OP was consistent with the other treatments until mid-August, at which it actually lost some of its reproductive structures.

Cotton plants typically lose reproductive structures when they are stressed. In this case, the decline of reproductive structures is indicative of one of two things—either sampling error or stress. The reduction of reproductive structures in the DL treatment can be directly attributed to plant stress. However, in the case of the OP treatment, it could be sampling error, but more than likely it is crop stress. This can be verified by checking the other parameters presented in figures 4, 6, and 7. The OP treatment had decreases in all of these parameters, which were unrelated to reproductive structures but could be attributed to early season moisture stress.

Crop yield (Figure 9) is the final judgment of treatment effects. A productive canopy, high growth rate, high leaf area index, and increases in reproductive structures are required to maximize yield.

Lint yield was statistically similar for all of the treatments except for DL. There was a yield penalty for increasing soil tension and decreasing early season irrigation. The penalty was not statistically significant, however. The reduction that was seen in some of the other growth parameters did not have a significant effect on yield. Thus, it can be concluded that plants with early season moisture stress can recover if provided with adequate soil moisture at critical times during the season.

Figure 10 represents rooting pictures from approximately 2.6 feet below the soil surface. In each treatment the picture on the left was captured on 5 Aug., before cutout, and the picture on the right was captured on 9 Sept., after cutout. Initial inspection of these images shows a dry down of all of the roots in both collections; but it appears that the roots in the FP and OP treatments dried down much more than the ones in the FI and SP treatments. Too much early season stress caused these roots to stop growing sooner in the season. As discussed in the above-ground data, higher stress levels typically caused a reduction in growth and development. The same appears to be true in the below-ground data. The DL crop did not develop a substantial rooting system and roots were rarely found deeper than 0.1 ft. Even though the dryland crop performed similar to the irrigated treatments until mid-season the pictures do not show that it was able to develop a definitive rooting system. More in-depth analysis is needed of the rooting systems to determine full treatment effects of primed acclimation on root development.

Summary and Conclusions

Primed acclimation treatments were implemented in a cotton production trial at SIRP near Camilla, GA. There was rain early in the season that prevented treatments from being implemented as early as would be ideal. However, the production season turned very hot and dry. Throughout the entire production season the trial only received 12.6 inches of rainfall. Crop growth parameters indicated that there were no differences between the FI and SP treatments. The FP treatment typically had slightly lower values than the FI and SP treatments. The OP treatment had lower growth rate and net assimilation rate. It was similar to the other irrigated treatments in dry matter accumulation and leaf area index. However, OP did have a reduction in reproductive structures late in the season, which can be attributed to moisture stress early in the season. Lint yield was statistically similar for all four of the irrigated treatments. Statistically similar lint yield is significant because it means early season moisture stress did not have a significant effect on end of season productivity and lint yield. Even though the FP and OP treatments seemed to have slight reductions in some of the in-season crop growth parameters, it did not have an effect on final yield. This means, the adequate irrigation treatments that were implemented beginning at first bloom allowed the plants to recover from early season moisture stress. This also indicated that mid-season irrigation rates and timing are more critical to crop growth, development, and final yield than early season irrigation. The rooting data requires more in-depth analysis but shows promise towards treatment differences in developing sound rooting systems. Corresponding root development pictures coupled with the above ground biomass collections would aid to develop a relationship between above- and below- ground developments throughout the season.

Table 1. Irrigation Treatments and Sensor Reading Thresholds for Triggering Irrigation Events

Irrigation Treatment	Prebloom	First Bloom	Peak Bloom
Full Irrigation (FI)	40 cb	35 cb	35 cb
Semi Primed (SP)	70 cb	35 cb	35 cb
Full Primed (FP)	100 cb	35 cb	35 cb
Optimally Primed (OP)	No Irrigation	35 cb	35 cb
Dryland (DL)			

Table 2. Irrigation Applied to, Rainfall Received by, and Total Water on Each Irrigation Treatment

Irrigation Treatment	Rainfall (in)	Irrigation (in)	Total Water (in)
Full Irrigation (FI)	12.6	6.9	19.5
Semi Primed (SP)	12.6	6.3	18.9
Full Primed (FP)	12.6	6.0	18.6
Optimally Primed (OP)	12.6	6.0	18.6
Dryland (DL)	12.6	0.0	12.6

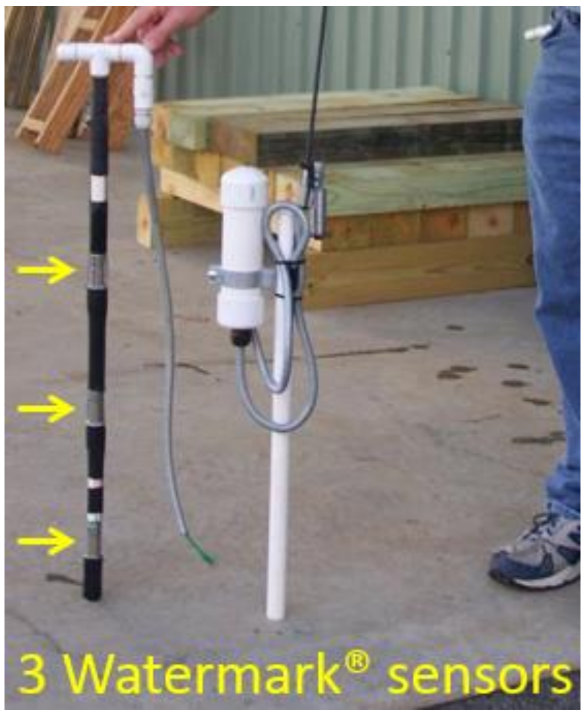

Figure 1. UGA Smart Sensor Array.

Figure 2. MiniRhizotron tubes installed in the cotton production field.

Figure 3. The MiniRhizotron camera (left) and image capture software (right) .

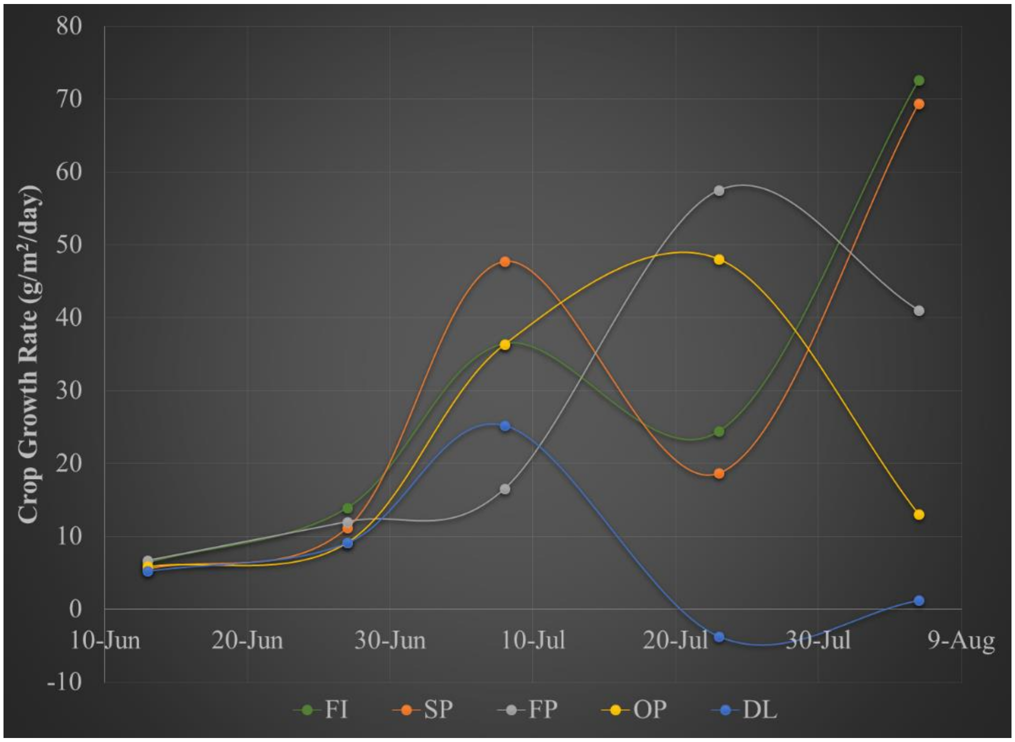

Figure 4. Crop growth rate of the five treatments throughout the growing season.

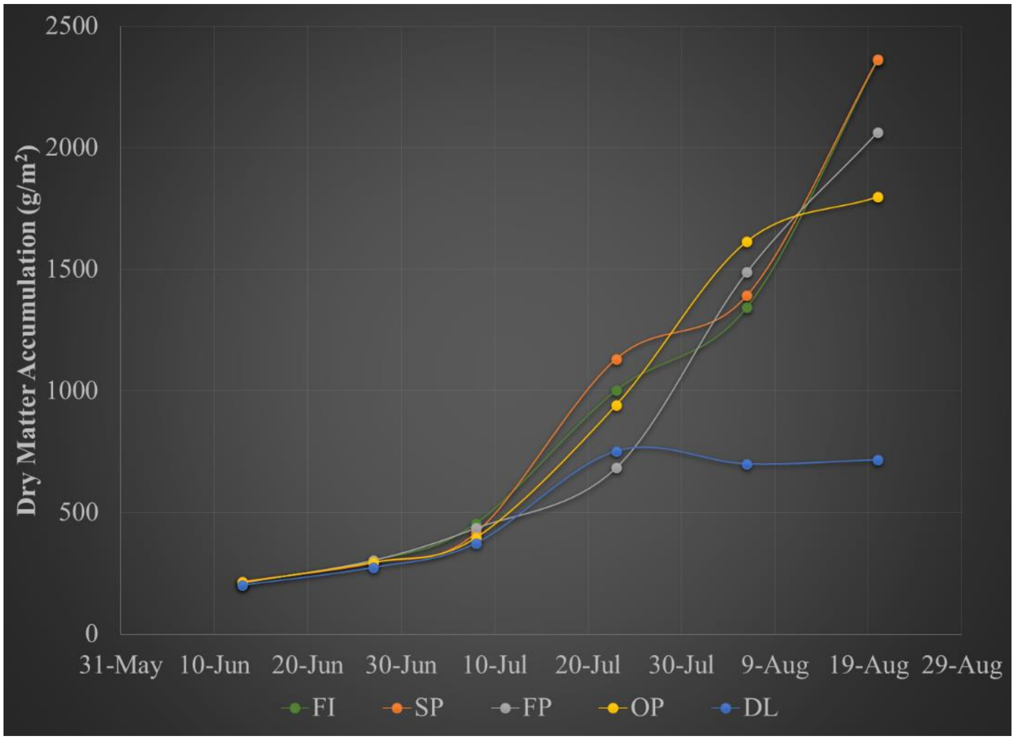

Figure 5. Dry matter accumulation throughout the season for the five PA treatments.

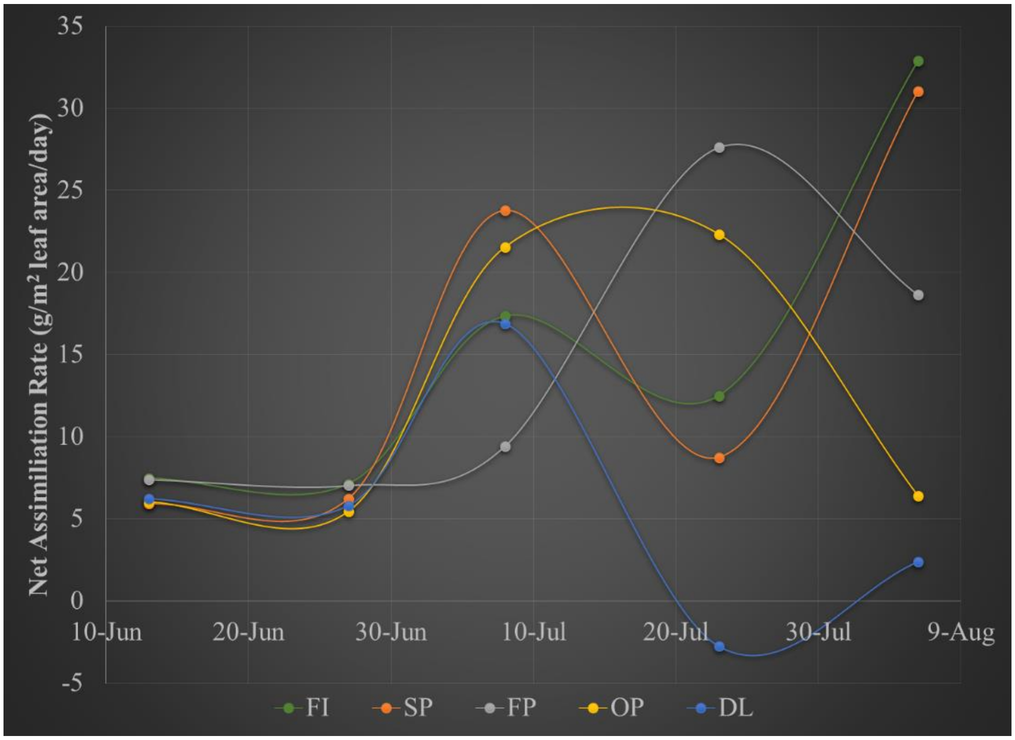

Figure 6. Net assimilation rate for the treatments throughout the season.

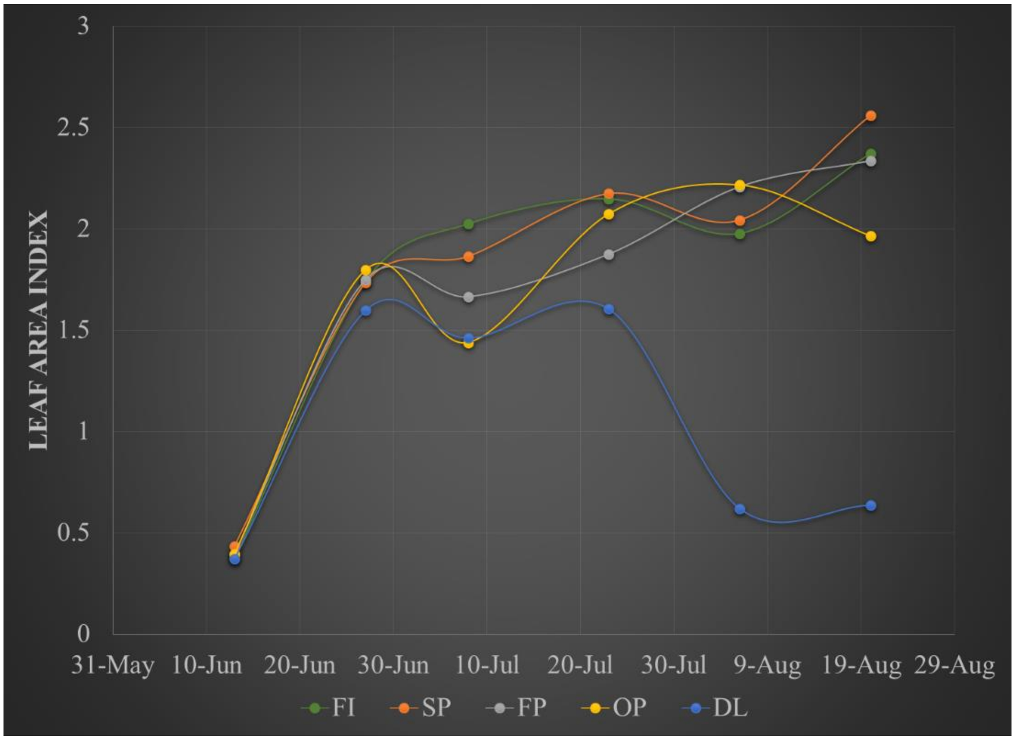

Figure 7. Leaf Area Index for the treatments throughout the season.

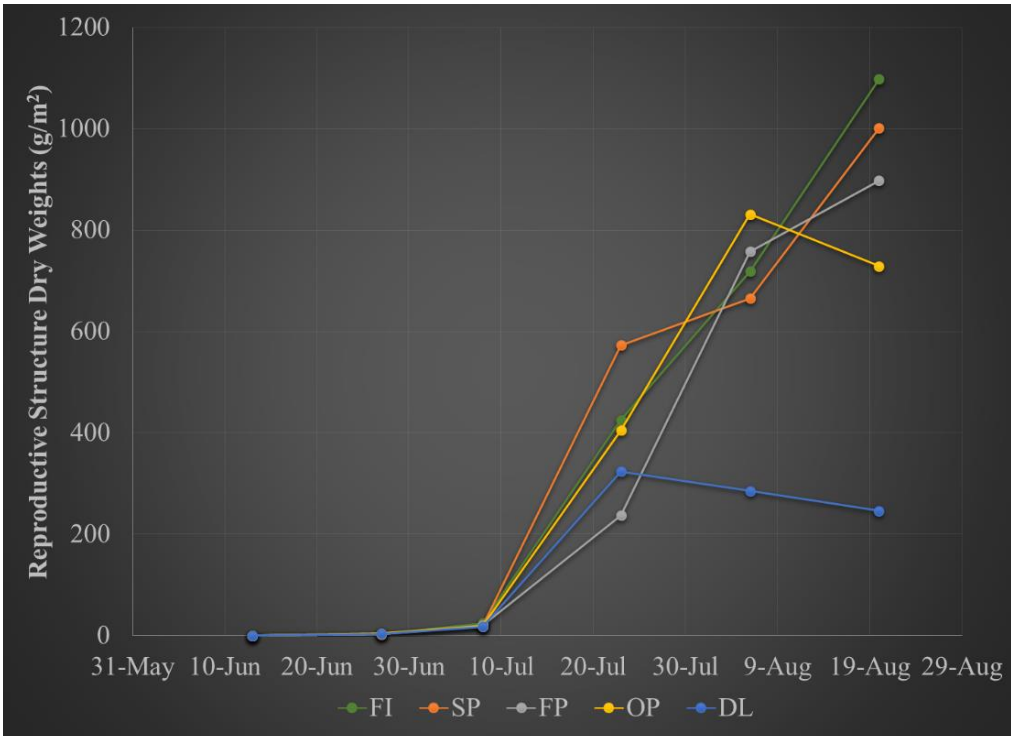

Figure 8. Reproductive structures for the treatments throughout the season.

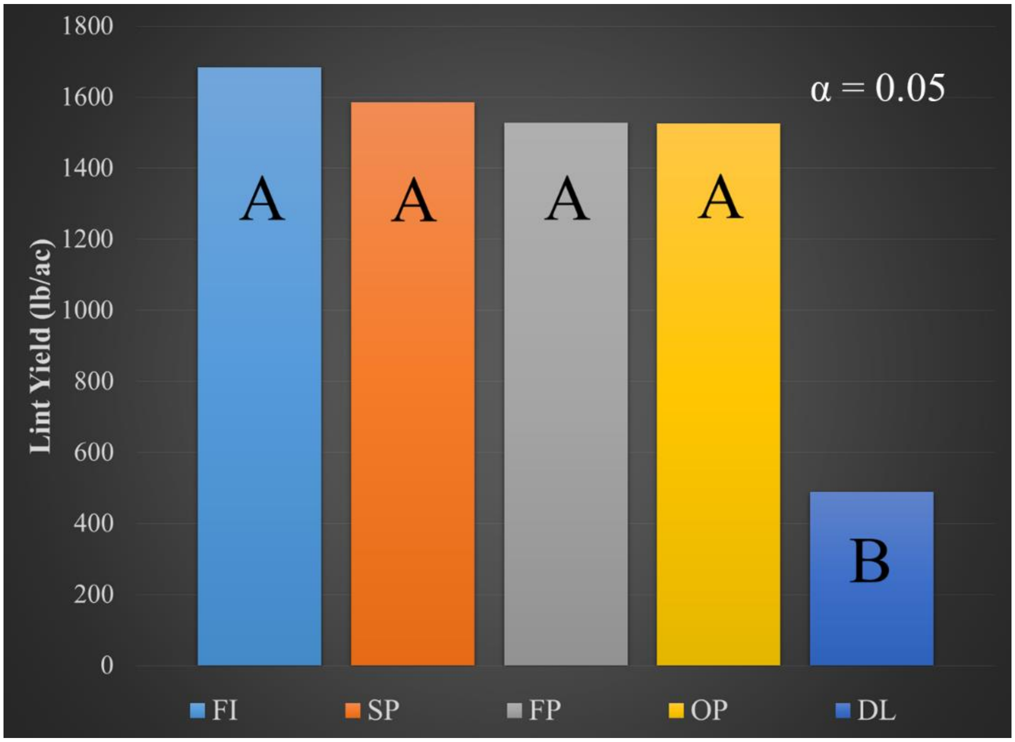

Figure 9. Lint yield for the treatments throughout the season.

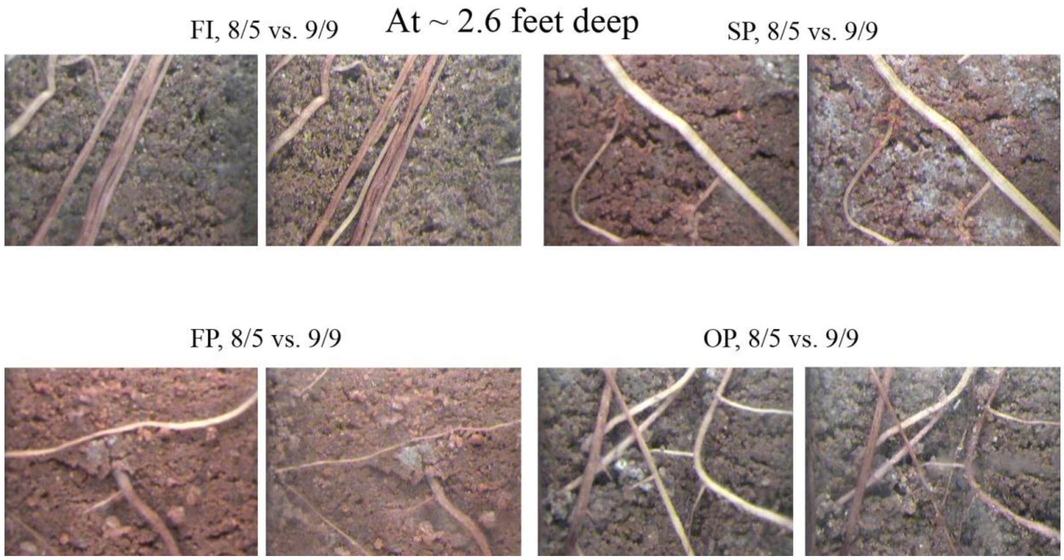

Figure 10. Images of the rooting system of the treatments that received irrigation.

References

Asseng, S., Ritchie, J. T., Smucker, A. J. M., Robertson, M. J. (1998). Root growth and water uptake during water deficit and recovering in wheat. *Plant and Soil. 201*(2), 265-273.

Benjamin, J. G., & Nielsen, D. C. (2006). Water deficit effects on root distribution of soybean, field pea and chickpea. *Field Crops Research, 97*(2-3), 248-253.

Pace, P. F., Cralle, H. T., El-Halawany, S. H. M., Cothern, J. T., & Senseman, S. A. (1999). Drought-induced changes in shoot and root growth of young cotton plants. *Journal of Cotton Science, 3*, 183-187.

IRRIGATION TERMINATION AND FIBER QUALITY: SUBSURFACE DRIP IRRIGATION VERSUS OVERHEAD

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Introduction

The standard practice for irrigated cotton is to terminate irrigation sometime between the first cracked boll and 10 percent open boll. In some cases, this can also be estimated by monitoring the node above white flower (NAWF). Once NAWF is less than five, irrigation termination should be considered (Vories et al., 2002; Multer and Sansone, 2007). Multer and Sansone (2007) conducted a study that used NAWF reaching the five node stage as a trigger point to record accumulated heat units to determine if heat units were a valid method to determine optimum irrigation termination timing. They stated that previous studies indicated that irrigation should be terminated once 400 to 500 heat units are accumulated after the cotton reaches five NAWF.

Studies have shown that additional irrigation after open boll will help to promote boll filling and increase yield over that of crops without the additional irrigation treatments. However, in most cases, in the Southeast the type of irrigation being used on cotton is an overhead sprinkler type of irrigation. Additional water introduced in to the open boll directly on the cotton fiber either via rainfall or via overhead irrigation can promote the degradation of fiber quality. In many cases the plant can still be developing bolls higher on the plant when termination is deemed necessary, and these bolls will typically not develop as fully as those with ample irrigation throughout the season.

Preliminary work done by Multer and Sansone (2007) in 2002 indicated that yield loses can be substantial (up to 200 lbs of lint/acre) if irrigation is ended too soon, and that water costs increase with no yield benefit if irrigation is extended too long. In a study by Vories et al. (2002), only two of eight studies exhibited significant differences in lint yield for extended irrigation. Further, very little difference was observed in fiber quality for the different irrigation termination treatments in the Vories et al. (2002) study. In that study, however, furrow irrigation was the most common type of irrigation used, thus the extra moisture was not introduced into the open cotton bolls via irrigation and should not have had a negative effect on fiber quality. The availability to and adoption of Subsurface Drip Irrigation (SDI) by producers has provided them with the potential to continue irrigation after the crop has reach the first cracked boll or 10 percent open boll.

Even though the irrigation method was not stated, Silvertooth et al. (2006) noted that lint yield and micronaire values consistently increased with later irrigation termination dates. This study was performed at the University of Arizona, Maricopa Agricultural Center. Thus, rainfall is very limited, and typically, irrigation is the only way to produce a crop, and growing conditions are drastically different than in the Southeastern US. It was noted by Silvertooth et al. (2006) that an irrigation treatment imposed just after cutout, which is the recommended irrigation practice in that region, was found to be optimal. This irrigation treatment produced the optimal yield and micronaire relationship and saved 12 inches of water in one year and 19 inches in the next year over the extended irrigation treatment, which was terminated late enough to allow for a second fruit cycle; this irrigation treatment was extended until late September each year.

Most of the previous studies that have been performed on irrigation termination and fiber quality have either been under a different irrigation regime, such as furrow irrigation, or have occurred in a more dry and arid environment than in the Southeast. This study did not focus so much on the exact timing of irrigation termination, but the effects on yield and fiber quality of additional irrigation added to a crop after the deemed optimal or culturally accepted irrigation termination time for the humid Southeast.

Objectives

The main objective of this study was to determine the effects of extending irrigation after first open boll on final yield and fiber quality. The secondary objectives were to:

- Quantify the treatment effects of overhead irrigation versus SDI on cotton yield.
- Determine if there are fiber quality differences that could lead to discounts on cotton with extended irrigation beyond the regional culturally accepted irrigation termination point.
- Gather information that could help producers to decide if it is worth the investment to either use SDI to continue irrigation or if the added yield increase will offset the fiber quality discounts for continued overhead irrigation.

Materials and Methods

A two year study was performed at the Stripling Irrigation Research Park (SIRP) near Camilla, GA. Two varieties (Phytogen 499 and FiberMax 1944) were planted in 2013 and three varieties (Phytogen 499, FiberMax 1944, and DeltaPine 1252) were planted in 2014, all commonly planted in Georgia. The treatments and varieties were planted in randomized strips under half of a 3-acre center pivot irrigation system. In coordination with the pivot irrigation, SDI was previously installed throughout the entire field. The crop was irrigated via SDI throughout the season following the University of Georgia (UGA) Modified Checkbook Method. Once 10 percent open boll was reached, the various irrigation treatments were implemented.

The pivot was divided in half (Figure 1); SDI irrigation was stopped in half of the field and overhead irrigation began and continued at a split applied rate of 1 inch per week until the crop was ready for defoliation. In the other half of the field, SDI continued at split applied weekly rates of 1 inch until the crop was ready for defoliation. Both irrigation treatments, either via overhead sprinkler or SDI, were applied on the same day. Each of the irrigation treatments were irrigated for an additional four weeks and received an additional 4 inches of irrigation beyond standard irrigation termination.

Plots were harvested using a four-row cotton picker with a bagging attachment in the basket of the picker. All of the seed cotton from harvest plots was collected, weighed, ginned at the UGA microgin, and the fiber quality samples sent to the USDA-AMS classing office in Macon, GA, for analysis. SAS JMP was used to run Tukey's LSD's (alpha = 0.05) on the data to determine differences in yield and fiber quality parameters.

Results and Discussion

It should be noted that there were year differences observed in all of the data collected. Most of this can be attributed to weather conditions. 2013 was much cooler and wetter than 2014. Plots at SIRP received 27.3 inches of rainfall during the 2013 season and only received 12.3 inches during the 2014 season. 2014 was wet early but then it turned hot and dry, and the crop did not receive an effective and significant rainfall from mid-June until mid-September.

It was decided to plant three common varieties to Georgia in 2014 to introduce more diversity into the data and provide a better opportunity to delineate varietal effects. However, for a reason that could not be diagnosed, the DeltaPine 1252 variety had very poor emergence issues in this trial (Figure 2).

Eventhough the plant population for the DP 1252 was statistically lower, conversations with agronomists provided information that no differences in yield were prevalent between cotton plant populations of 25,000 plants per acre and 36,000 plants per acre. This is due to the ability of cotton plants to compensate for lack of competition or empty space in the rows. Thus, the data collected from the DP 1252 plots was kept and compiled with the other two varieties.

Figure 3 shows lint turnout (lint weight as a percentage of total seedcotton weight). Across all treatments and averaged for all varieties, turnout ranged from roughly 38% to 42%. In 2013, turnout was highest for dryland. In 2014, turnout was lowest for dryland. For the irrigated treatments in 2013, SDI had slightly higher turnout than overhead (OVH). In 2014, OVD had slightly higher turnout than SDI.

The 2013 dryland turnout was not only higher than both irrigated treatments that year, but also similar to the irrigated treatments in 2014. This is likely due to high rainfall in 2013 compared to 2014. Lint turnout typically should not be affected by extended irrigation unless there are major fiber quality issues or other differences.

In the case of lint turnout, it does not seem that irrigation type or termination has a significant effect. More so, the difference in lint turnout presented is between years and irrigated versus dryland. Thus, additional irrigation added into the cotton bolls by overhead sprinklers did not have an effect on ginning performance of the cotton.

There were no statistical differences in lint yield between the irrigation treatments (Figure 4). The only statistical difference between the treatments was between the dryland crop and the irrigated treatments when the data was averaged over both years (individual data shown in Figure 4). When the data was analyzed individually by treatment independent of year, the only statistical difference was between the 2014 dryland and the rest of the treatments.

In both years there was a slight yield advantage for using SDI versus overhead irrigation after termination. This advantage was not statistically significant, however. In 2013 it appears that the overhead irrigation actually reduced the yield when compared to the dryland treatment. In a very wet year, it is highly recommened that careful consideration be paid to irrigation scheduling and amount applied. Over-watering can cause as much of a yield penalty as underwatering.

Major factors impacting Color grade include weather (specifically rainfall/water on open cotton) and defoliation and harvest timing. Over the two years of the study, extended OVD irrigation resulted in the worse Color grades (Figure 5). SDI resulted in the best Color grades. Color grade was not statistically different among the treatments, however.

HVI Color Grade is a combination of the degree of whiteness in the fiber (+b) and the degree of brightness or reflectance (Rd) in the fiber. Higher +b values (increasing yellowness) and lower Rd (decreasing brightness) values result in a less desirable Color grade. The lower the +b and higher the Rd, the better the Color grade. The lowest +b values were observed with SDI in 2013 and OVD in 2014 (Figure 6). The highest Rd values were observed with SDI in 2013 and OVD in 2013 (Figure 7). For +b, there was a statistical difference between years but no difference among the treatments within a year.

For Rd, the overhead (OVD) treatment had a statistically lower value in 2014, but all other treatments were statistically similar. It is hard to explain this difference, but it did lead to the worse overall color grade of any treatment over the two years. The SDI treatments in both years were higher than the corresponding OVD treatments but not by a statistically significant amount.

The only differences seen in micronaire (Figure 8) can be attributed to year and climatic effects. The mean micronaire for 2013 was 4.95 for all treatments. For 2014, micronaire was lower for the two irrigated treatments with a mean of 4.75 and the dryland treatment at 4.5. These are all still within the acceptable range. Based on the data from the two years, there was a year effect but no effect on micronaire from irrigation type.

Fiber uniformity (Figure 9) was affected by both weather (year) and irrigation treatment. The highest/best fiber uniformity was in the 2013 dryland treatment. Uniformity in the SDI treatments was similar in both years and slightly higher than the OVD treatments. The 2014 dryland treatment had the lowest fiber uniformity.

The data were examined for any differences due to variety. Some fiber quality parameters exhibited varietal differences and some did not (Figure 10). Fiber strength, leaf grade, +b, HVI Length, HVI Trash, and uniformity were all found to have significant differences by variety.

Based on the differences shown in Figure 10, it might be advantageous to explore the data more in-depth to determine if one variety had a better response than another to extended end of season irrigation type. FiberMax 1944, for example, had a much longer fiber length and Phytogen 499 had a much higher uniformity. Such an analysis was not performed for this paper. However, an optimization of variety versus fiber quality parameters versus end of season irrigation type could provide producers with an insight as to which variety to select if they plan to extend irrigation beyond standard termination.

Summary and Conclusions

Irrigation was extended beyond the standard practice in Georgia of terminating somewhere between first cracked boll and 10 percent open boll. The two extended irrigation treatments that were tested were subsurface drip irrigation (SDI) and overhead sprinkler irrigation (OVD). Two varieties were planted and evaluated in 2013 and three in 2014. The main differences observed were due to year (weather) effect. It was much more rainy and cooler in 2013 with 27.3 inches of rainfall, compared to the hotter drier year of 2014 when only 12.3 inches of rainfall were received during the entire production season.

There were year differences only for lint yield. Neither variety nor SDI versus overhead irrigation statistically had an effect on lint yield. Differences were observed in some of the fiber quality parameters but only a few of them were significant independent of variety. Even though some of the fiber quality parameters were not statistically different among treatments, SDI typically did have numerically better fiber quality ratings. This suggests that additional overhead sprinkler irrigation on the crop after there are open bolls can lead to reduction or further degradation of fiber quality.

Statistical analysis of any variety effects showed that strength, leaf grade, +b, length, trash, and uniformity all had significant differences by variety. This would suggest that a more in-depth analysis and potentially an optimization analysis could reveal the best variety to select for each irrigation termination strategy. To fully complete this analysis, however, lint yield and fiber quality data are needed from a treatment where irrigation was fully terminated at the traditional 10 percent open boll period. This would provide a baseline for both yield and fiber quality. The addition of this data set would provide a decision aid tool for producers to aid them in varietal selection for either overhead or SDI, or help them to decide if additional overhead irrigation is worth applying for the additional yield.

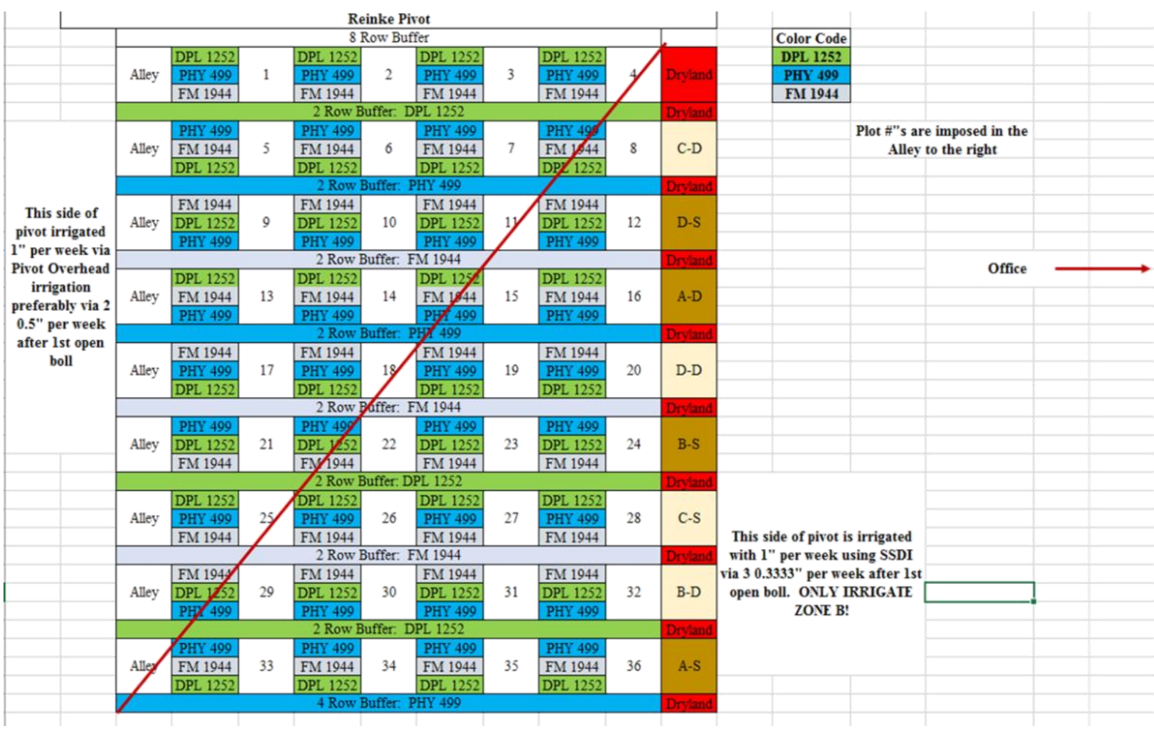

Figure 1. Randomized strips in the split field for the overhead and SDI irrigation treatments.

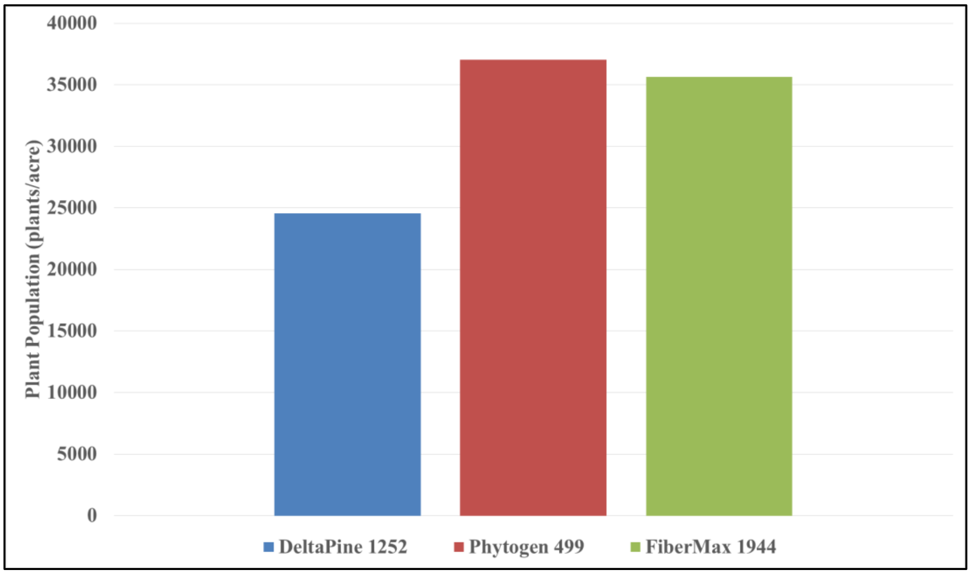

Figure 2. Plant population randomly collected and averaged from plots within the irrigation termination study.

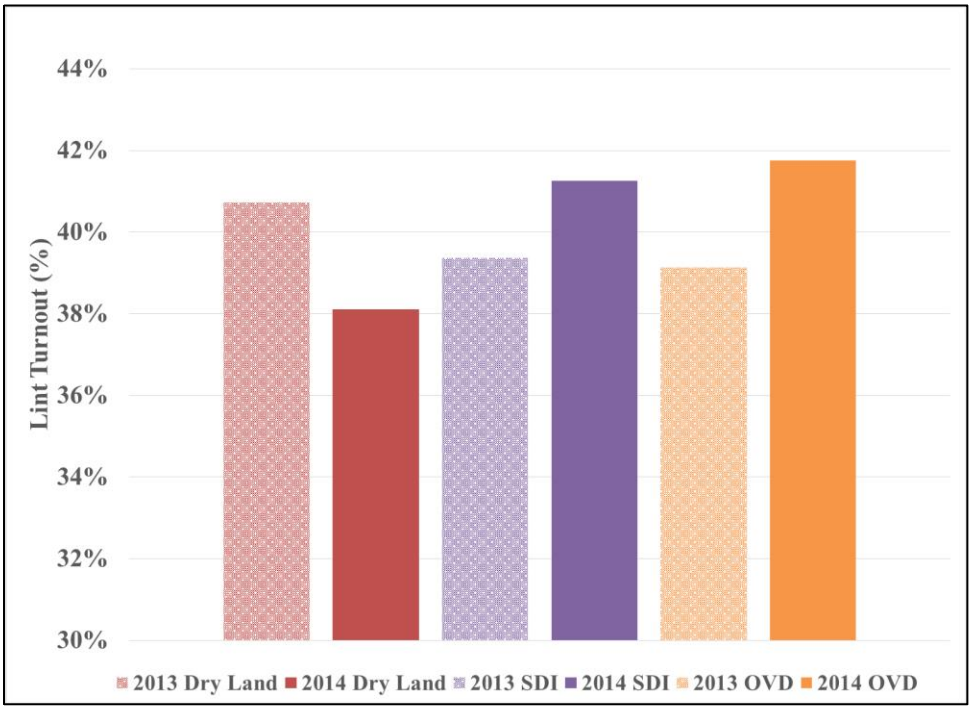

Figure 3. Lint turnout for each of the irrigation termination treatments.

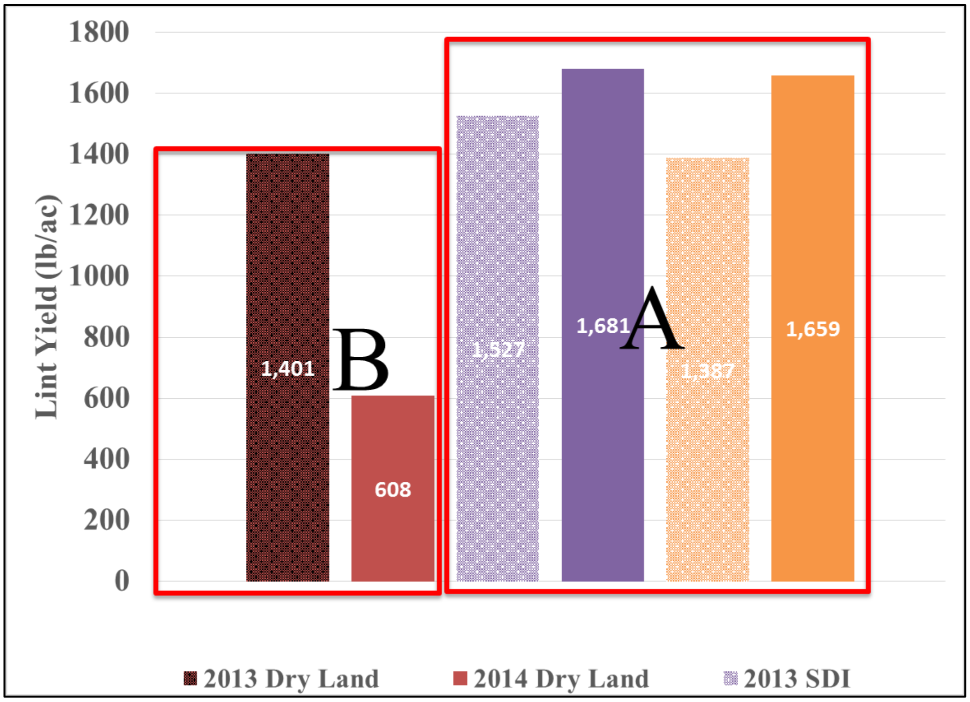

Figure 4. Lint yield for each of the treatments; the only statistical difference was between irrigated and dryland.

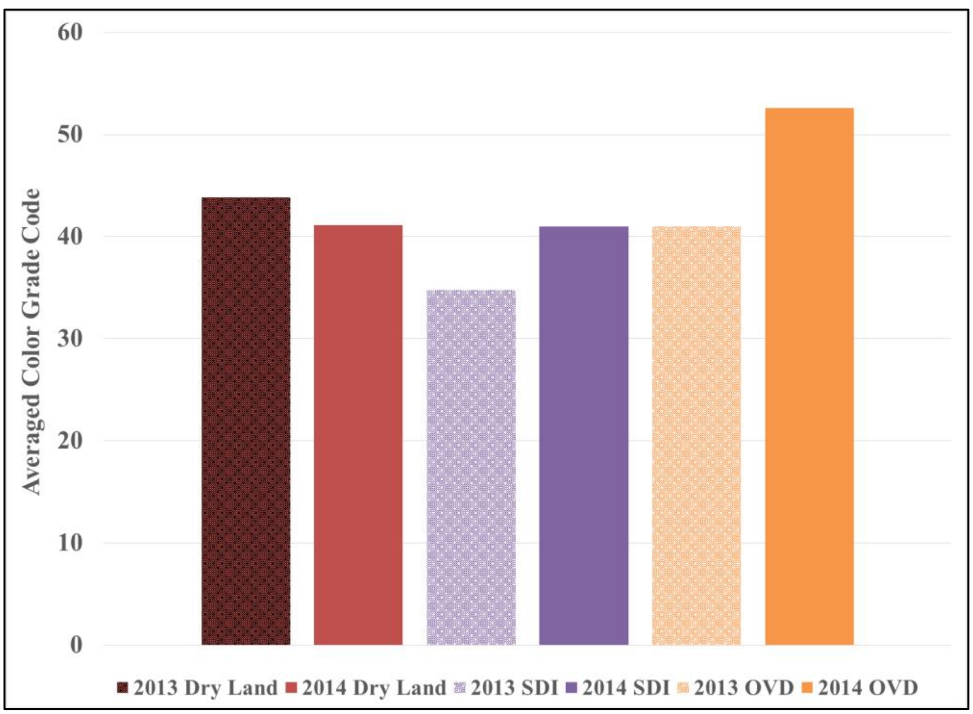

Figure 5. Average Color grade with the SDI having the lowest value.

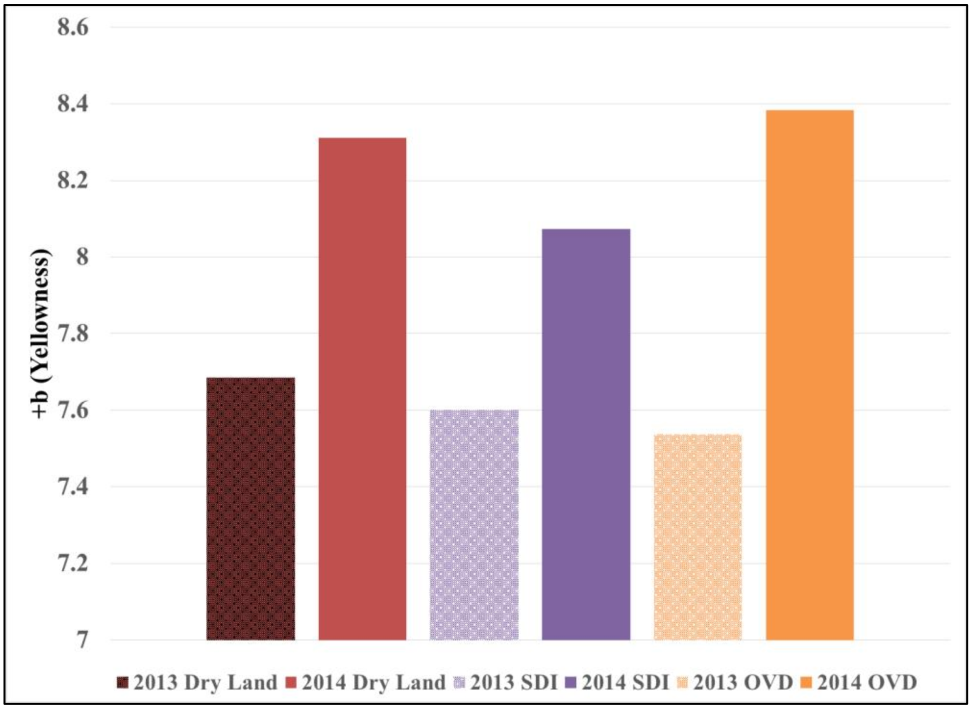

Figure 6. Yellowness data, which only exhibited significant differences for year.

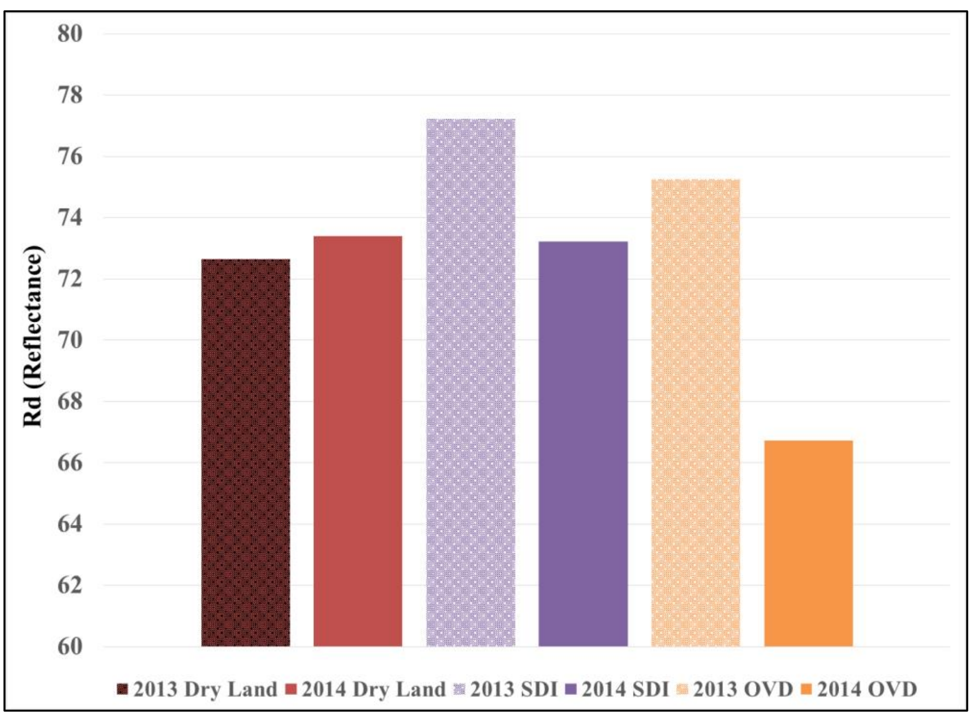

Figure 7. Reflectance data, which only exhibited significant differences for the 2014 OVD treatment.

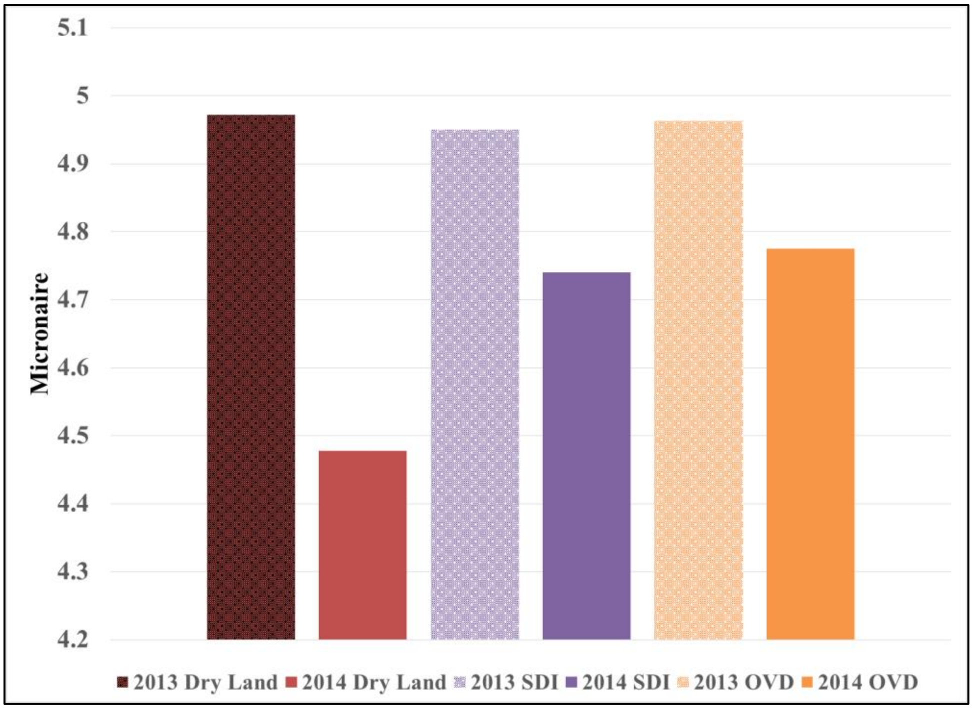

Figure 8. Micronaire data with no difference independent of year and climatic effect.

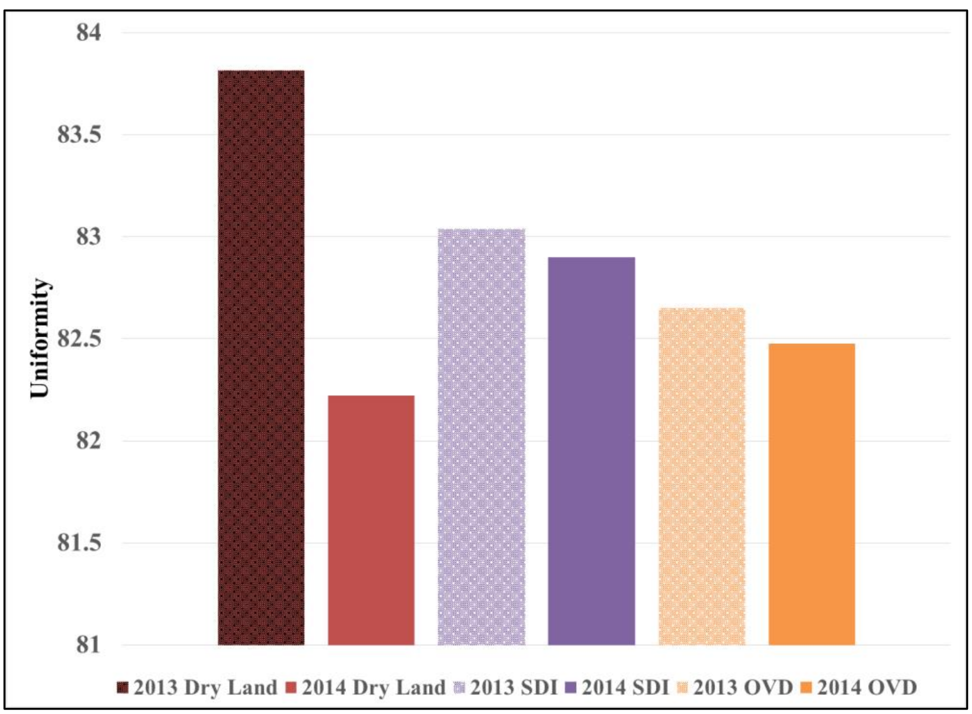

Figure 9. Fiber uniformity; the 2013 dryland had the highest uniformity, and the 2014 dryland had the lowest.

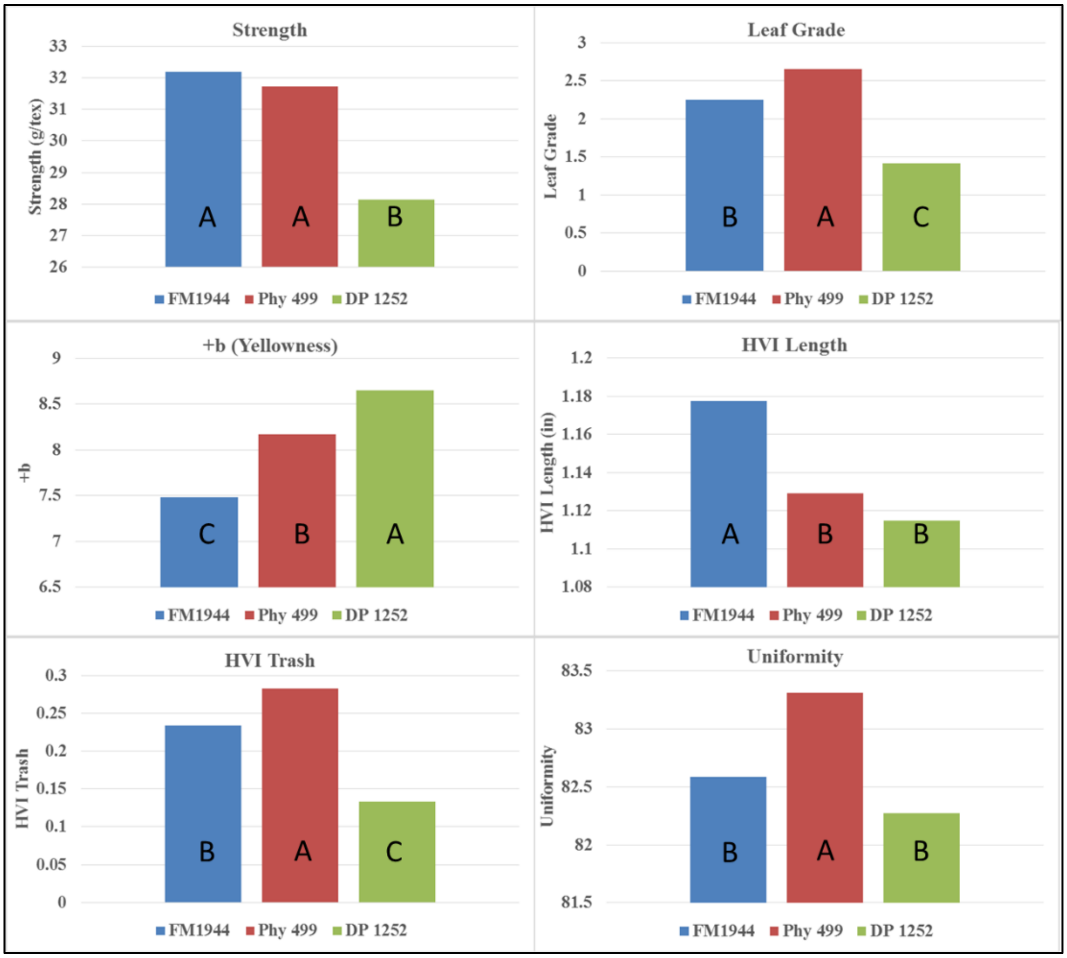

Figure 10. Fiber quality parameters that were found to be statistically different by variety.

References

Multer, W. L., & Sansone, C. G. (2007). Determining the optimum timing for the final drip irrigation on cotton based on crop monitoring: West Texas. *Proceedings of the Beltwide Cotton Conference*, Memphis, TN.

Silvertooth, J. C., Tronstad, R., & Galadima, A. (2006). Evaluation of late season irrigation strategies. *Proceedings of the Beltwide Cotton Conference*, Memphis, TN.

Vories, E., Greene, J., Robertson, W., Teague, T., Phipps, B., & Hague, S. (2002). *Determining the optimal timing for the final irrigation on mid-South cotton. Proceedings of the Beltwide Cotton Conference*, Memphis, TN.

SURFACE RESIDUE MANAGEMENT INFLUENCES USE OF INSECTICIDES FOR CONTROL OF THRIPS AND SHORT-HORNED GRASSHOPPERS IN COTTON

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Objective and Methods

The research objective was to examine the influence of different surface residue management procedures on management of early season cotton pests. Replicated field tests were conducted at the UGA Southeastern Branch Research and Education Center (SEBREC) near Midville and at the UGA Plant Sciences Farm (PSF) near Athens. During fall 2014, rye was planted as a cover crop at the SEBREC and crimson clover was used at the PSF. At the SEBREC, four surface residue management procedures were established in randomized 50 ft blocks. One type of conservation tillage procedure had a glyphosate (1 qt/A) application 21 days before planting to kill the rye cover. The second conservation tillage procedure involved spraying Gramoxone (1 qt/A) + Reflex (16 oz/A) + pendmethalin (20 oz/A) on the rye cover the day after planting. The third conservation tillage regime had the rye incinerated five days before planting. The fourth surface management procedure used conventional plow tillage (disk harrow) of the rye residue at 14 days and one day before planting. The entire field was strip-tilled one day before planting the test.

In the SEBREC test, *Bt* cotton (DPL 1252) was planted on 10 June. The seed had a commercial insecticide seed treatment of Cruiser (thiamethoxam) at 0.35 mg AI/seed. Plots were established as 8 rows x 36 inches wide x 40 ft long with 6 ft alleys in the four different types of tillage blocks. Treatments with planting time insecticide applications included Thimet 20G @ 1# AI/A applied in the seed furrow or Orthene 90S broadcast spray @ 1# AI/A. Four rows of cotton in each treatment were sprayed with Orthene @ 1# AI/A 21 days after planting in conjunction with a broadcast application of glyphosate (1 qt/A) + Warrant (3 pts/A). The timing of the insecticide and herbicide applications was similar to using an insecticide/herbicide tank mix. The insecticide was applied separately to four rows of each plot to minimize spray overlap and drift that was anticipated if four rows were sprayed with the herbicides + Orthene and the adjacent four rows were sprayed with the herbicides only.

The tests were sampled for thrips 14 and 28 days (seven days after the Orthene @ 1# AI/A spray had been applied to four rows of each plot) after planting, and the field was monitored for short-horned grasshopper infestations every one or two weeks by walking 2 x 4 ft wide transits down the middle of each plot while counting all short-horned grasshoppers. Plots were monitored during the season for bollworm, stink bug, and infestations by other pests. Yields were taken at the end of the season in the tests by harvesting the two middle rows of each plot.

In the PSF test, DP 1137 B2RF *Bt* cotton was planted in the crimson clover cover on 22 May, with all treatments using conservation tillage practice. Herbicide treatments were Roundup WeatherMax 5.4 SC @ 0.75# AI/A 14 days before planting or Gramoxone 2 SC @ 0.56# AI/A applied on the day of planting. Herbicide + insecticide treatments at planting time were the above herbicide regimes tank mixed with Orthene @ 1.0# AI/A. Roundup WeatherMax 5.4 SC @ 0.75# AI/A was applied with or without Orthene @ 1.0# AI/A tank mixed with the herbicide. Plots were two rows x 36 inches wide x 20 ft long x 3 ft alleys arranged in a RCBD. Thrips and grasshopper sampling and identification were performed on the same schedule as the SEBREC test.

Results and Discussion

The tests were designed to isolate various surface residue management practices: (1) Roundup burndown several days before planting, (2) Gramoxone burndown at planting time, (3) Incineration of surface residues, and (4) Conventional (plow) tillage, as well as to determine each regime's influence on insect population dynamics. General results that occurred in the tests at the SEBREC and PSF were the following.

1. Seven days prior to planting, short-horned grasshopper populations were significantly higher in all the conservation tillage treatments as compared to plow treatments.

2. None of the planting-time insecticide treatments reduced short-horned grasshopper populations within the four surface residue management regimes.

3. Use of Orthene @ 1# AI/A in a tank-mix with Roundup in a post-emergence application significantly reduced short-horned grasshopper populations in all the surface residue regimes in which it was used.

4. Both Thimet and Orthene @ 1.0 # AI/A used at planting time in conjunction with Cruiser @ 0.35 mg AI/seed treatment reduced thrips (primarily tobacco thrips) populations as compared to plots planted solely with Cruiser @ 0.35 mg/seed.

5. Thrips populations were highest in the plots where the rye had been burned off prior to planting. The numbers were statistically similar to thrips populations in plow tillage treatments. Thrips numbers were significantly less in the two conservation tillage regimes where surface residues remained intact. These trends were similar in most of the insecticide systems that were evaluated within the four surface residue management regimes.

6. Thrips control in the different surface residue regimes followed similar trends with Cruiser + Thimet @ 1# AI/A > Cruiser + Orthene @ 1# AI/A > Cruiser alone. Thrips numbers that were sampled following the Roundup + Orthene @ 1# AI/A applications that were made 21 days after planting were greatly reduced in all surface residue systems as compared to the treatments that received Roundup alone.

7. Yield of cotton was not significantly different among the different surface residue regimes, but trends for increased yield occurred in the treatments that received supplemental insecticides in addition to Cruiser seed treatment.

INTEGRATED MANAGEMENT OF SOUTHERN ROOT-KNOT NEMATODE WITH RESISTANT COTTON VARIETIES AND NEMATICIDES IN APPLING COUNTY, GEORGIA

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Introduction

Southern root-knot nematode (*Meloidogyne incognita*) is the most widespread nematode affecting cotton in Georgia and is a significant problem in Appling County. With the loss of Temik, growers require new options to manage nematodes. This large-plot, on-farm study was conducted with objectives of assessing fumigation with 1,3-dichloropropene (Telone II) and use of multiple varieties, to include Phytogen 367 WRF, which has partial resistance to *M. incognita*.

Appling County lies in the Coastal Plain of southeastern Georgia. Cotton is an important crop for growers in this county, and management of plant-parasitic nematodes is especially important as soils in the county are typically very sandy. *Meloidogyne incognita*, the southern root-knot nematode, is the most important nematode affecting cotton in this region. Growers have historically used aldicarb, Temik 15G, to manage both thrips and nematodes; however, the loss of Temik 15G early in 2011 necessitated additional field trials to determine refined opportunities for control of nematodes in Appling County.

The objective of this study was to compare the performance of a cotton variety with known partial-resistance to the root-knot nematode (PHY 367WRF) to popular varieties without resistance (PHY 375WRF, PHY 499WRF, DP 1050, DP 1048). Additionally, plots planted to each variety and fumigated with Telone II (3 gal/A) were compared to non-fumigated plots. It was hoped that the results from this study would give growers in eastern Georgia a better idea of strategies to integrate nematode resistance and nematicides into their cotton production practices.

Methods

A replicated field trial with two tests was established on the Jeff Deen farm in Appling County, Georgia. The field had a history of losses to *M. incognita*.

The experimental design was a factorial randomized complete block with three replications for both tests. In Test 1, varieties planted were Phytogen 367 WRF, Phytogen 375 WRF, and Phytogen 499 WRF. Seed of each variety was already treated with Avicta (abamectin) seed treatment. The test consisted of 3 replications of each variety with and without the soil being fumigated with Telone II (1,3-dichloropropene, 3 gal/A).

Varieties in Test 2 were DPL 1048 B2RF, DPL 1050 B2RF, and Phytogen 499 WRF. As in Test 1, the seed of each variety was already treated with Avicta and the test consisted of 3 replications of each variety with and without the soil being fumigated with Telone II.

Fumigated plots were done so weeks prior to planting. Both tests and all plots were planted on 14 May 2014 and harvested on 3 Dec. 2014. Data collected included soil sampling to determine nematode populations, end-of-season root-damage ratings, and yield.

Results

From nematode samples collected after harvest it is clear that the populations of root-knot nematodes in the field far exceeded the economic threshold established for Georgia (100 juveniles/100cc soil) (Figures 1and 2) .

Plots fumigated with Telone II had significantly greater early-season growth and vigor. Pre-season fumigation of soil with Telone II (3 gal/A) resulted in a reduction in the populations of *M. incognita* at the end of the season across varieties, to include the "resistant" PHY 367. Such a reduction in end-of-season populations is not often seen, but was very interesting here and will be important to cotton growers in eastern Georgia.

End-of season populations of *M. incognita* were lower where the resistant PHY 367 was planted as opposed to PHY 375 or PHY 499 (Figure 1). The benefits of planting 367 versus 375 or 499 remains (a) reduced galling and (b) reduced nematode populations for the following season.

Most importantly, use of Telone II improved yields for all but one variety in this study (PHY 367). In this study, PHY 499, though not resistant, still out-yielded the more-resistant PHY 367 with and without use of Telone II (Figure 3).

In Test 1, pre-season fumigation with Telone II had season-long impact for the reduction in nematode populations for all varieties. Use of Telone II increased yields by 112, 127, and 12 lbs/A for PHY 499, PHY 375, and PHY 367, respectively.

Impact of Telone II was less obvious here for end-of-season gall ratings, likely because the populations of nematodes were low. In Test 2 (Figure 2), use of Telone II generally reduced both final root gall ratings and final nematode counts for all varieties. Use of Telone II increased yields by 440, 222, and 148 lbs/A for PHY 499, DPL 1050, and DPL 1048, respectively (Figure 4).

Use of resistant variety or Telone II tends to reduce final season nematode populations and damage from the nematodes.

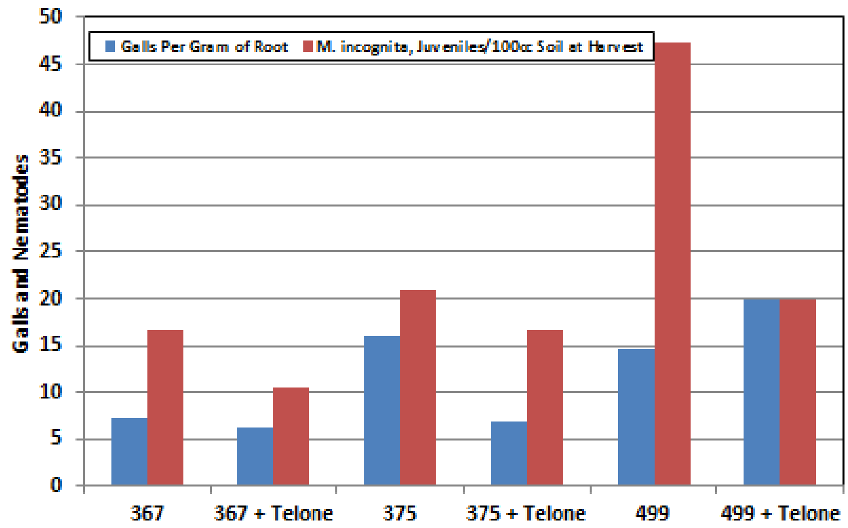

Figure 1. M. incognita, Juveniles/100 cc Soil at Harvest and Galls Per Gram of Root

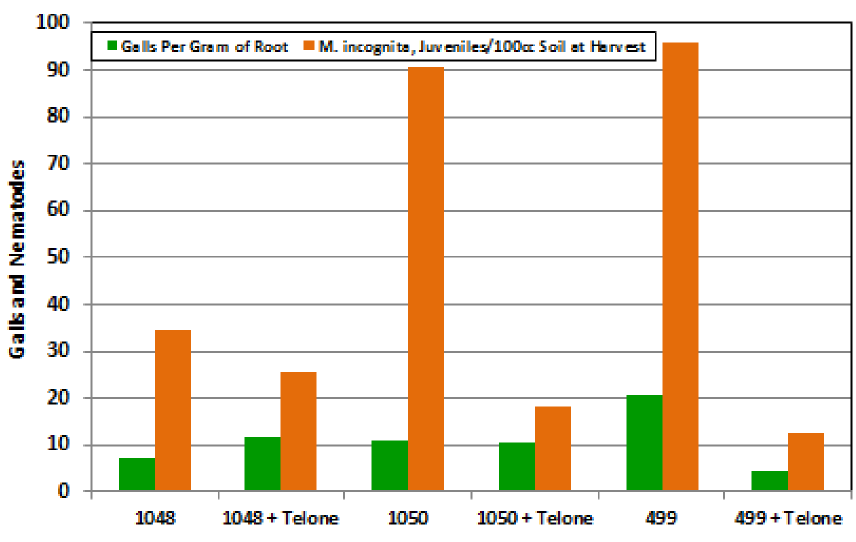

Figure 2. M. incognita, Juveniles/100 cc Soil at Harvest and Galls Per Gram of Root

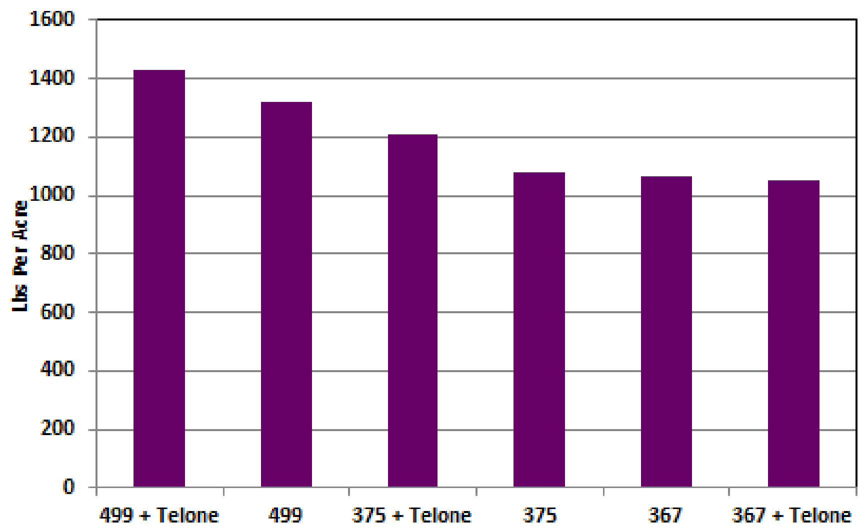

Figure 3. Yield Per Acre by Variety and Treatment

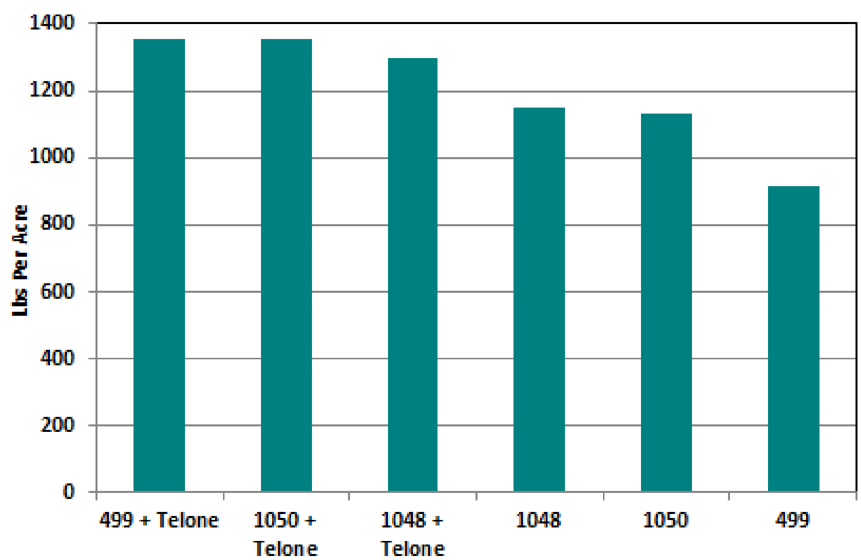

Figure 4. Yield Per Acre by Variety and Treatment

EFFECT OF HEADLINE APPLICATIONS ON TARGET SPOT IN COTTON

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Introduction

Extended periods of wet weather and high humidity often occur during the cotton growing season in Georgia. These conditions, especially in cotton fields with a dense canopy, can lead to development and spread of foliar diseases such as target spot. Target spot is caused by the pathogen *Corynespora cassiicola* and can lead to premature defoliation and potentially reduce yield.

Target spot of cotton was first identified as a possible problem in Georgia in 2005 and has been an issue in many fields during the past few years. Target spot can be identified by its distinct chocolate brown spots on a leaf that frequently demonstrate a pattern of concentric rings. Lesions can also be found on boll bracts and cotton bolls. The affected leaves typically retain their green or green-yellow color, yet ultimately prematurely defoliate.

Symptoms of this disease usually start in the lower canopy where warm temperatures and humid conditions favor development. Progression of symptoms moves up the canopy, affecting progressively younger leaves and fruit. Target spot typically thrives in environments that have a thick crop canopy, often from irrigation or excessive rainfall, and optimum or excessive fertility.

The fungicide Headline (pyraclostrobin) has been used to control target spot in cotton. Headline is a strobilurin type fungicide that can be applied topically to cotton and may provide suppression of target spot. This research investigated cotton response to Headline fungicide applications in areas with high potential for target spot.

Materials and Methods

Research consisted of four tests in east Georgia over two years. Two tests were a large-plot on-farm site in Jenkins County in 2013 and 2014 (eight rows, at least 500 feet long). Two other tests consisted of small-plot sites in 2013 at the University of Georgia Southeast Georgia Research and Education Center in Midville.

PHY 499 WRF was the variety planted in three of the four tests; FM 1944 GLB2 was planted at the Jenkins County test in 2013. In all four tests, the same four treatments were analyzed:

- Not treated with Headline (Untreated)
- Treated with Headline at the first and third week of bloom (1st and 3rd)
- Treated with Headline upon the initial sign of target spot presence (Initial)
- Treated with Headline prior to bloom and at the first and third weeks of bloom (Season-Long)

Each test was a randomized complete block with three replications for both years at the Jenkins County site and four replications at Midville. The different number of replications was due to available research space at each site.

All Headline applications were 6 oz/A. Cotton in all plots was managed similarly except for Headline applications. Plant growth regulators (PGRs) were used to control growth in all locations according to UGA Extension recommendations, except in one Midville site. In this site, no PGRs were used, and cotton was allowed to grow unregulated and ultimately to an excessive height.

All plots were machine harvested and seedcotton samples were sent to the University of Georgia microgin in Tifton for ginning and lint yield determined. Disease ratings and other data were collected throughout the season. Data was analyzed using Proc Mixed in SAS 9.1. Significant effects were separated using Fisher's Protected LSD at P = 0.10.

Results and Discussion

Data were analyzed across locations and significant differences between location and treatments were observed. Therefore, data was analyzed by location. In Jenkins County during 2013 and 2014, fungicide applications had some impact on disease severity and leaf defoliation (data not shown), but no significant differences in lint yield were observed (Table 1). In Midville, where cotton was treated with PGRs as needed to control vegetative growth, all Headline treatments significantly reduced defoliation and disease severity, yet no fungicide treatment significantly improved cotton lint yield. In Midville where no PGRs were used to control growth, a very dense canopy led to a more conducive environment for target spot development. In this location, the two more aggressive Headline treatments reduced defoliation but did not affect disease ratings, and only the season-long treatment significantly increased lint yield over untreated cotton.

Results from this study follow similar work with Headline and management of target spot in cotton. Often, Headline lowered disease severity and leaf defoliation, yet significant differences in yield were less often observed. More work is needed to further understand the effects of fungicides on the management of target spot in cotton.

Table 1. Effect of Headline Fungicide Applications on Lint Yield at the Four Locations

Treatments	Locations				
	Jenkins 2013	Jenkins 2014	Midville 2013 (No PGR)	Midville 2013 (PGR)	Average
Untreated	1243	1484	1495 bc	1726 ab	1486
Initial	1144	1612	1444 c	1669 bc	1464
1^{st} & 3^{rd}	1218	1687	1565 ab	1749 a	1552
Season-long	1107	1618	1667 a	1618 c	1503
P-value	0.23	0.41	0.02	0.05	0.48
LSD (P=0.10)	NS	NS	103	78	NS

Acknowledgements

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