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

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Introduction

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

On-Farm Cotton Variety Evaluations

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

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

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

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

Collins & Whitaker, 2013

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

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

Agronomic Irrigation Research

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

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

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

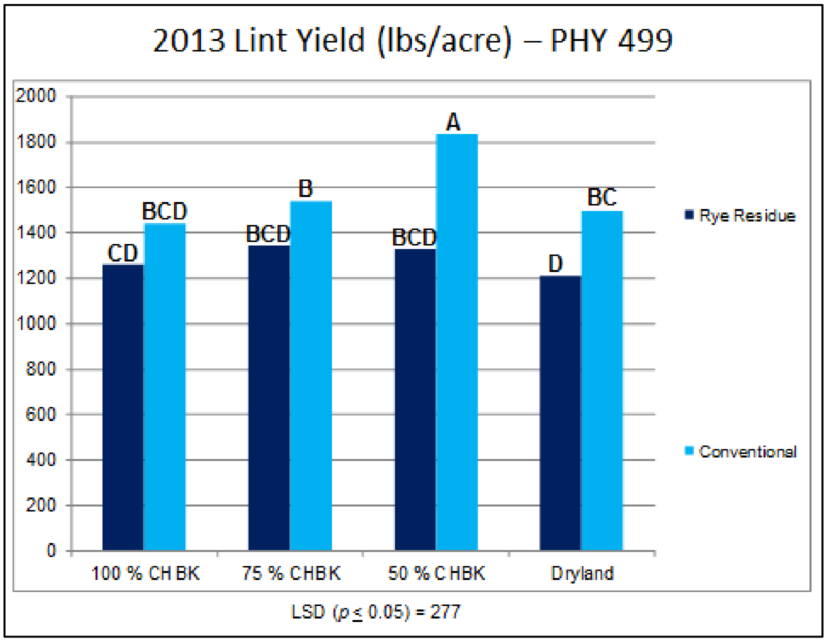

Figure 2. Lint Yield Response of PHY 499 to Various Irrigation Regimes in Conventional and Heavy Rye Residue Tillage Systems

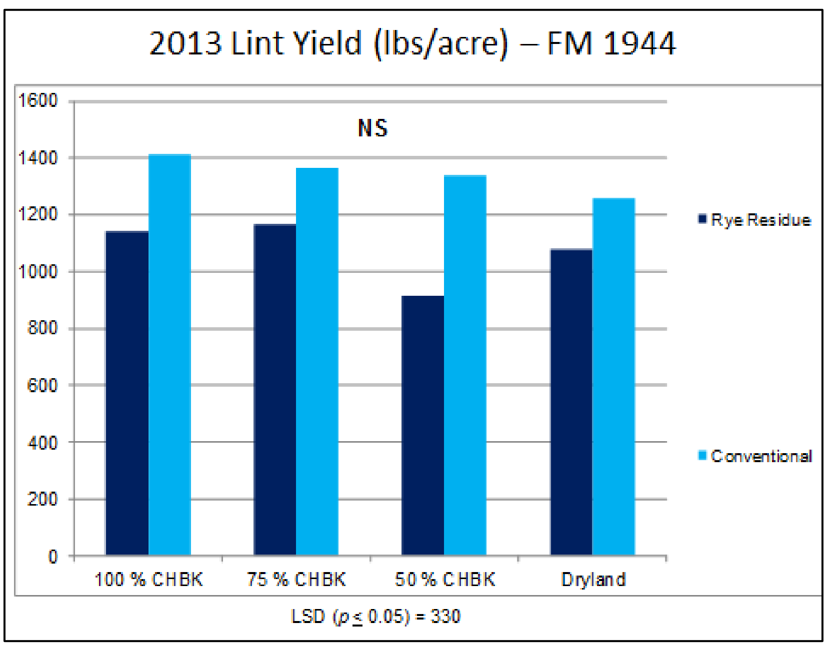

Figure 3. Lint Yield Response of FM 1944 to Various Irrigation Regimes in Conventional and Heavy Rye Residue Tillage Systems

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

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

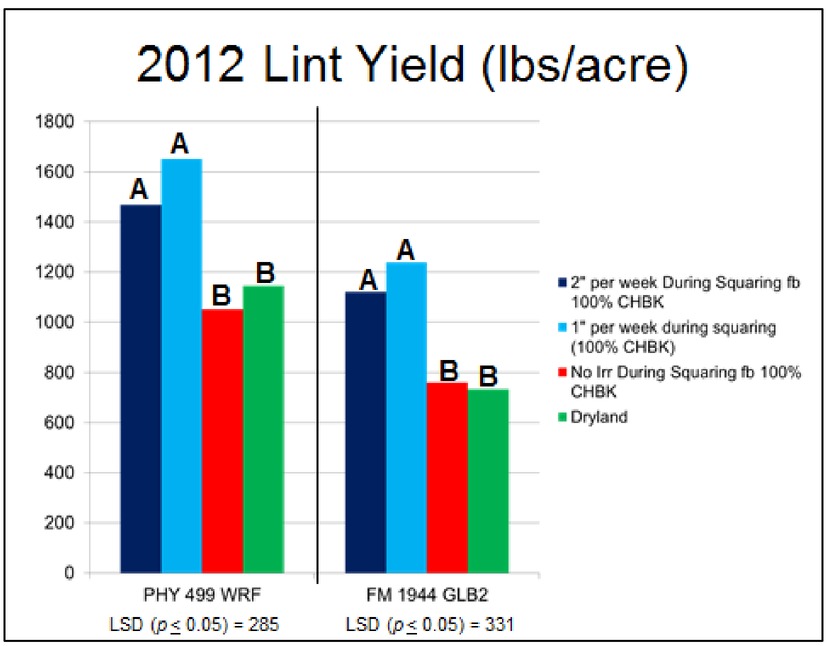

Figure 4. Lint Yield Response of FM 1944 and PHY 499 During 2012 to Normal Irrigation Season Long, No Irrigation During Squaring Followed by Normal Irrigation During Bloom, and Twice the Recommended Irrigation During Squaring.

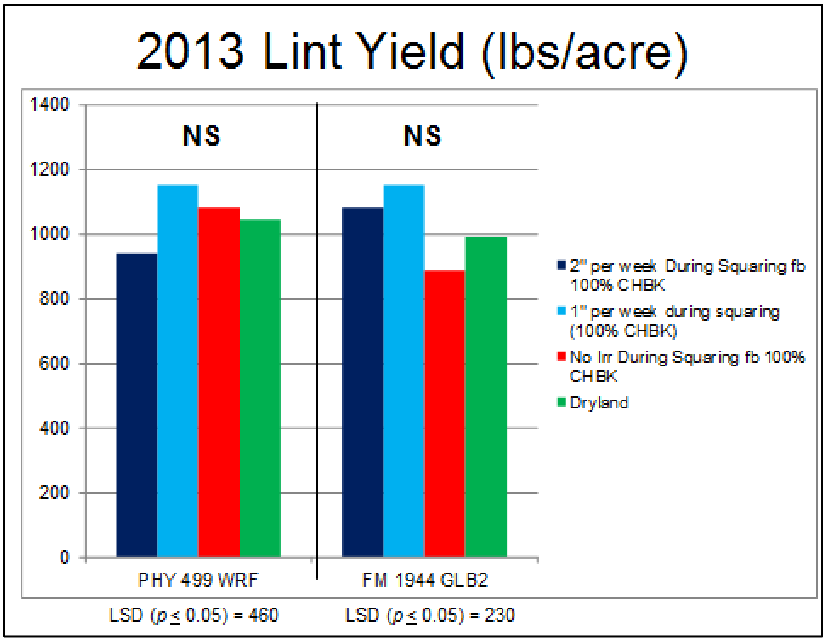

Figure 5. Lint Yield Response of FM 1944 and PHY 499 During 2013 to Normal Irrigation Season Long, No Irrigation During Squaring Followed by Normal Irrigation During Bloom, and Twice the Recommended Irrigation During Squaring.

Evaluation of Potential Risks of Herbicide Drift

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

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

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

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

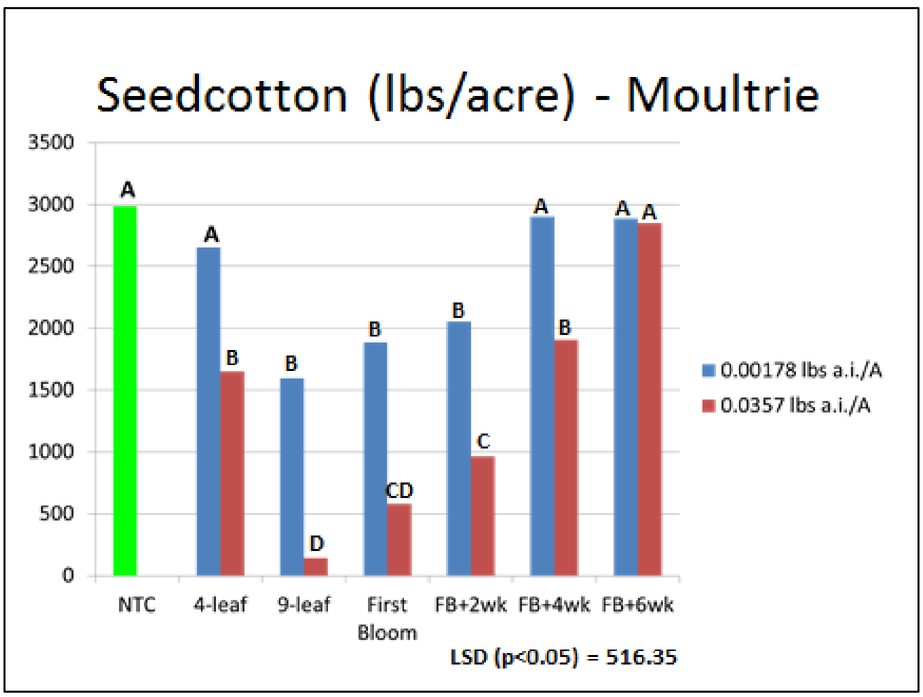

Figure 6. Lint Yield Response to Simulated 2,4-D Drift at Various Growth Stages During 2013 (Moultrie).

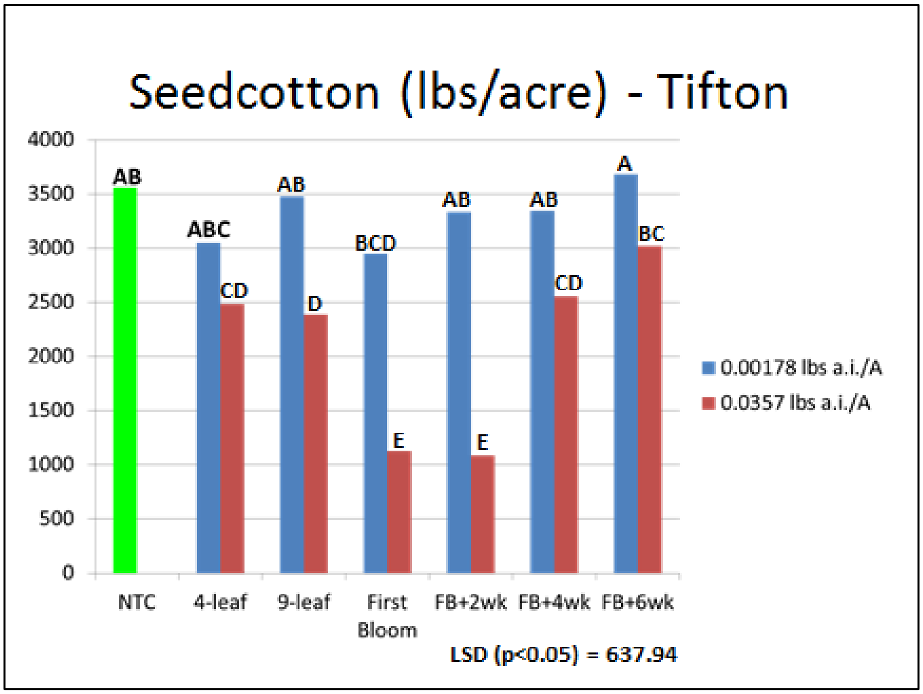

Figure 7. Lint Yield Response to Simulated 2,4-D Drift at Various Growth Stages During 2013 (Tifton).

Acknowledgements

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