

**COTTON RESEARCH ANNUAL REPORT**  
**Alabama Cotton Commission/Cotton Incorporated**

**QUARTER ENDING:** December 31, 2006 (4th Quarter, Annual Report)

**PROJECT TITLE:** "COTTON SYSTEMS RESEARCH: EVALUATING HERBICIDE TECHNOLOGIES, TILLAGE SYSTEMS, AND ROW SPACINGS"

**AGREEMENT NUMBER:** 05-602AL

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**PERFORMING INSTITUTION:** USDA-ARS NSDL, Auburn, AL and Auburn University, Auburn, AL

**PROJECT OBJECTIVE:**

Evaluate the effects of two tillage systems, two row spacings and three cotton varieties on yield, fiber quality, soil moisture, weed management, and economic returns.

**PLAN OF WORK:**

Cotton varieties, tillage systems, and row spacings were implemented at the Field Crops Unit of the E.V. Smith Research and Extension Center near Shorter, AL. Treatments arranged in a split-split-plot design with 4 replications were:

Cotton Varieties

1. Conventional cotton – FM966®
2. RoundUp Ready – FM960 RR®
3. Liberty Link – FM966 LL®

Tillage Systems

1. Conventional tillage (fall chisel/disk, spring disk/level) with in-row subsoiling
2. No-tillage (fall paratilling)

Row Spacings

1. 40-inch
2. 15-inch

**REPORT:**

This experiment was initiated in the fall of 2003 at the E.V. Smith Research Center, Field Crops Unit near Shorter, AL on a Compass sandy loam (coarse-loamy, siliceous, subactive, thermic Plinthic Paleudults). The experiment remained in the same location for three years with no re-randomization of the treatments. The experimental area utilized for this study contained conventional tillage and conservation tillage plots that were originally established over 15 years ago. These plots allowed a comparison of treatments among mature tillage systems and eliminated any concern associated with transition effects into conservation tillage.

The experimental design contained a split-split plot treatment restriction in a randomized complete block design with four replicates. The main plots consisted of row spacings (15-inch vs 40-inch row spacing), the subplots

were varieties represented by different herbicide technologies (conventional variety - FM966®, glyphosate tolerant variety - FM960 RR®, and a glufosinate tolerant variety - FM966 LL®), and the sub-subplots were tillage systems (conventional and conservation tillage). A rye cover crop was drilled across the experimental area each fall at 90 lb ac<sup>-1</sup>. All plots were paratilled (complete disruption) immediately following the cover crop planting operation to eliminate any subsurface soil compaction with the exception of fall 2003. During the first year of the study, no deep tillage was performed in any of the plots, and only surface tillage associated with the conventional tillage plots was performed where appropriate. Surface tillage in the conventional tillage plots consisted of multiple spring disk operations and level. In the conservation tillage plots, no additional tillage was performed after the fall paratill operation. Typical spring in-row subsoiling prior to planting could not be administered to standard row (40-inch) cotton, because it would create a potential bias against 15-inch cotton.

In early spring, 20-30 lb N ac<sup>-1</sup>, as NH<sub>4</sub>NO<sub>3</sub>, was applied to the cover crop to enhance biomass production. Biomass samples were collected from each plot approximately 3 weeks before anticipated planting date and immediately preceding chemical termination. The average biomass production across the experimental site was 3520, 3060, and 4470 lb ac<sup>-1</sup> for 2004, 2005, and 2006, respectively. All plots received 42 lb N ac<sup>-1</sup> as a starter in the form of NH<sub>4</sub>NO<sub>3</sub>, prior to planting. An additional 60 lb N ac<sup>-1</sup> was sidedressed as urea-ammonium nitrate (UAN). All cotton varieties were Cruiser® treated and planted with an in-furrow application of Temik® (5 lb/A) and Terraclor® (10 lb/ac). All plots were planted on May 25, 2004, May 17, 2005, and May 17, 2006, respectively. The 15-inch cotton was planted with a precision drill at 105,000 plants/A, while the 40-inch cotton utilized an air planter at 80,000 plants/A. Prowl® (32 oz/A) was applied pre-emergence to all conventional tillage plots and conventional varieties immediately following planting. Two over-the-top applications of Roundup Weathermax® (23 oz/A), Ignite® (32 oz/A), and Staple® (1.2 oz/A) were applied to corresponding herbicide tolerant and conventional varieties at the 2- and 4-leaf stages. A layby application of Envoke® (0.15 oz/A) or Staple® (1.2 oz/A), depending on the year, was applied to all 15-inch cotton, while a layby application of Caparol® (32 oz/A) and MSMA® (42.6 oz/A) was applied on the same day to the 40-inch cotton. Each year, all cotton in the experiment was defoliated with Def 6® (1 pt/A), Prep (1.5 pt/A), and Dropp® (0.2 lb/A). Unfortunately, access to a 15-inch spindle picker was not feasible, but cotton from two 2-m<sup>2</sup> sections within each plot was hand-harvested on October 4, 2004, October 11, 2005, and October 11, 2006, respectively. A sub-sample of seed cotton from each plot was ginned in a 20-saw tabletop micro-gin to determine ginning percentage. Lint yields were determined by weighting lint and seed collected from each plot and multiplying corresponding seed cotton by the ginning percentage of each plot. The values obtained from a tabletop gin can be used for comparative purposes but may not necessarily coincide with values obtained by a grower from a full-scale gin. Values obtained for lint percentage and quality will likely be above typical averages, but any differences between treatments should be detectable. Initial plant populations were recorded approximately 3 weeks after planting by counting all the plants from 3 equal areas within each plot. Whole plant biomass (1 m<sup>2</sup>) samples were collected from each plot during 1<sup>st</sup> square and mid-bloom.

All response variables were analyzed using the MIXED procedure (Littell et al., 2006) and the LSMEANS PDIF option to distinguish between treatment means (release 9.1; SAS Institute Inc.; Cary, NC). Data were analyzed with rep, year, variety, spacing, tillage, and the interactions among year, variety, spacing, and tillage as fixed effects in the model, while replication X variety and replication X variety X spacing were considered random. Treatment differences were considered significant if  $P \leq 0.05$ .

### **Plant Populations**

A three-way interaction was observed between Year X Spacing X Tillage ( $Pr > F = 0.0434$ ) (Fig. 1). Higher plant populations were generally measured for the 15-inch cotton, regardless of the tillage system. Across the three significant conventional tillage comparisons and the one no-tillage comparison, 15-inch cotton plant populations were 22% higher than 40-inch cotton plant populations. However, due to differences between the drill for 15-inch cotton and traditional planter units utilized for 40-inch cotton, initial seeding rates were 35% higher for the 15-inch cotton. The high seed costs associated with using a drill in 15-inch cotton production will require a significant yield increase to offset this key production expense. However, other cost savings, such as benefits associated with weed suppression should also be considered.

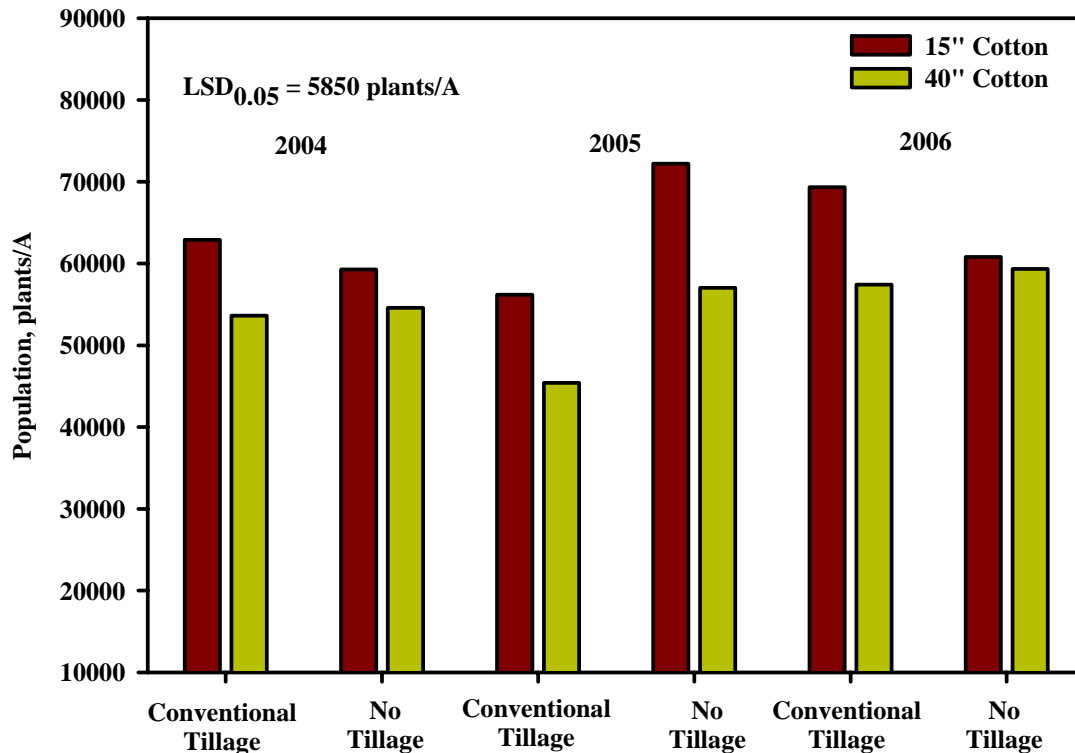


Figure 1. Plant populations measured across 15-inch and 40-inch cotton within conventional and no-tillage systems during the 2004-2006 growing seasons at the Field Crops Unit of the E.V. Smith Research Center near Shorter, AL.

### Lint Yields

Lint yields were influenced by year as indicated by three interactions that included year. A Year X Spacing interaction ( $Pr > F = 0.0127$ ) indicated that 2005 produced superior lint yields compared to the other two growing seasons (Fig. 2A). However, within growing seasons, 15-inch cotton yields were equivalent to 40-inch cotton yields. The increase in seed costs associated with 15-inch cotton may require an additional yield increase for growers to justify the additional costs. A Year X Variety interaction ( $Pr > F = 0.0150$ ) also showed that 2005 produced the best yields, but the conventional and glyphosate-tolerant variety produced higher yields compared to the glufosinate-tolerant variety (Fig. 2B). In 2005, conventional cotton produced 12% greater yields, while glyphosate-tolerant cotton produced 13% greater yields compared to glufosinate-tolerant cotton. In 2006, glyphosate-tolerant cotton was superior to both conventional and glufosinate-tolerant cotton by 29%. No lint yield differences were observed between varieties in 2004. A Year X Tillage interaction ( $Pr > F = 0.0005$ ) highlighted a 21% yield increase for conventional tillage cotton compared to no-tillage cotton during the 2004 growing season (Fig. 2C). However, this yield increase can be attributed to the lack of deep tillage during the first year of the experiment. Typically, Coastal Plain soils require some form of deep tillage to eliminate subsurface soil compaction, which will enhance root growth and subsequent nutrient and water uptake.

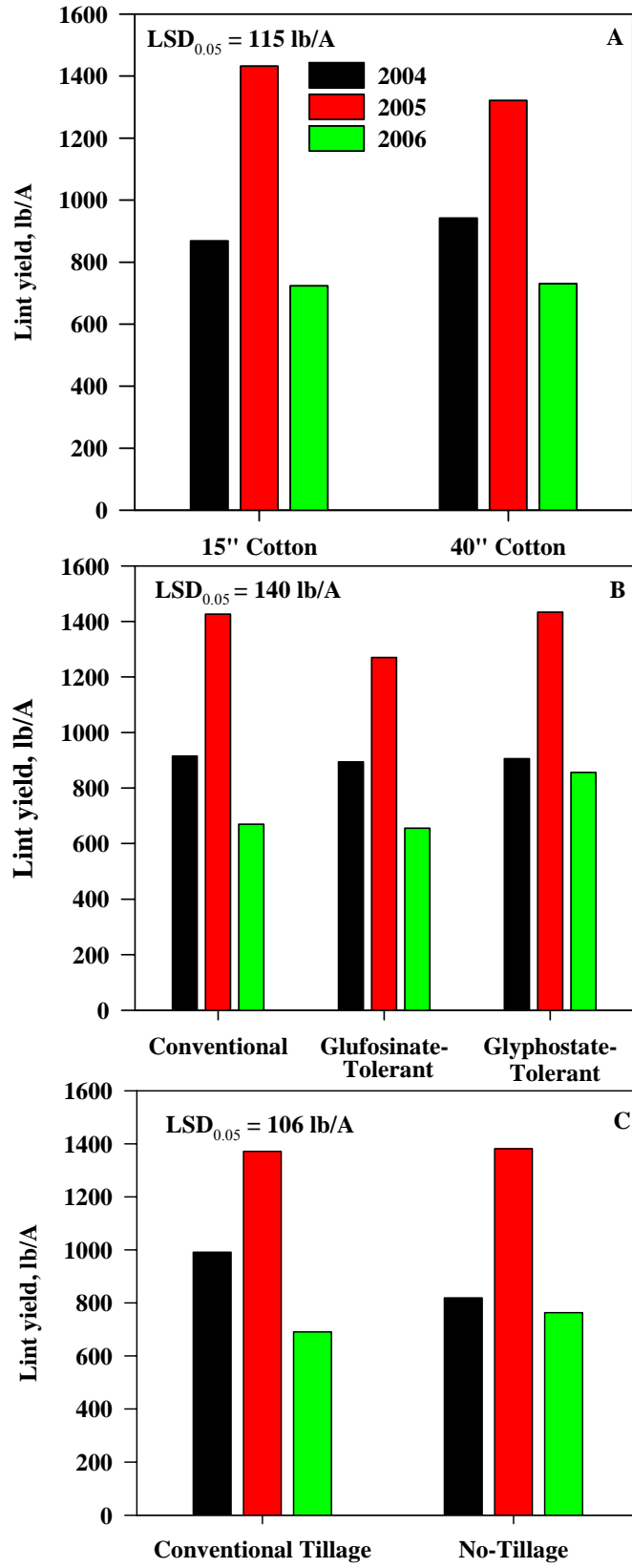


Figure 2. Lint yields measured during the 2004-2006 growing seasons across row spacings (A), cotton varieties (B), and tillage systems (C) at the Field Crops Unit of the E.V. Smith Research Center near Shorter, AL.

### 1<sup>st</sup> Square Plant Biomass

Three interactions were also observed for early season plant biomass measured at 1<sup>st</sup> square. A Year X Spacing interaction ( $Pr > F = <0.0001$ ) indicated that 15-inch cotton produced larger plants at 1<sup>st</sup> square the first two growing seasons, however no difference was observed the last year (Fig. 3A). The 15-inch cotton produced 51% and 17% heavier plants at 1<sup>st</sup> square compared to 40-inch cotton during 2004 and 2005, respectively. The 2004 40-inch cotton also produced less plant biomass than 40-inch cotton produced in 2005 or any 15-inch cotton produced in 2004 or 2005. A Year X Tillage interaction ( $Pr > F = <0.0001$ ) showed conflicting results that depended on the growing season (Fig. 3B). In 2004, plant biomass measured at 1<sup>st</sup> square was lower from no-tillage plots, but as with the yields, that can be attributed to the lack of deep tillage. The biomass observed in the no-tillage plots for the 2004 growing season were also lower than plant biomass measured during the 2005 growing season. In 2005, the best growing season of the experiment, plant biomass was 16% greater in the no-tillage plots. In 2006, a very dry growing season, no differences were observed, but no-tillage plant biomass was numerically lower. A Spacing X Tillage interaction ( $Pr > F = 0.0464$ ) illustrated that 15-inch cotton produced 28% more 1<sup>st</sup> square plant biomass than 40-inch cotton averaged across tillage systems (Fig. 3C). The 40-inch conventional tillage cotton also produced 20% greater 1<sup>st</sup> square plant biomass than 40-inch no-tillage cotton. This difference is probably attributed to the lack of deep tillage performed in 2004.

### Mid-Bloom Plant Biomass

Mid-bloom plant biomass was significant across years, row spacings and tillage systems (Table 1). The most mid-bloom plant biomass was measured during the 2005 growing season followed by the 2004 growing season. The lowest mid-bloom plant biomass was recorded in the very dry 2006 growing season. The 2006 mid-bloom plant biomass was 55% and 78% lower than the 2004 and 2005 growing season, respectively. The 40-inch cotton produced 21% less plant biomass at mid-bloom compared to 15-inch cotton, while no-tillage plots produced 14% less plant biomass at mid-bloom when averaged over varieties, row spacings, and all three years of the experiment (Table 1).

Table 1. Mid-bloom plant biomass measured across years, row spacings, and tillage systems during the 2004-2006 growing seasons at the Field Crops Unit of the E.V. Smith Research Center near Shorter, AL.

Variable	Crop year			Row spacing		Tillage system†	
	2004	2005	2006	15"	40"	CT	NT
Mid-bloom plant biomass	3567	7233	1609	4534	3738	4408	3865
Pr > F		< 0.0001		0.0004		0.0007	
LSD <sub>0.05</sub>		374		377		287	

† CT = Conventional tillage; NT = No-tillage.

### Conclusions

The effects of row spacing, cotton variety, and tillage system were examined across three growing seasons at the Field Crops Unit of the E.V. Smith Research Center near Shorter, AL. The variables examined included plant populations, lint yields, and plant biomass at 1<sup>st</sup> square and mid-bloom. Measured plant populations were generally greater for 15-inch cotton across tillage systems, reflecting a higher seeding rate utilized in the 15-inch cotton. Lint yields were influenced by the growing season more than row spacings, cotton varieties, or tillage systems. The growing season also influenced plant biomass at 1<sup>st</sup> square and mid-bloom, but 15-inch cotton generally produced more plant biomass, while tillage systems showed more erratic effects. Although 15-inch lint yields were equivalent to 40-inch cotton lint yields, an extensive economic analysis is required to account for differing plant populations, technology fees, tillage systems, and herbicide systems to determine if a 15-inch system is more profitable than a traditional cotton system with wider row spacings.

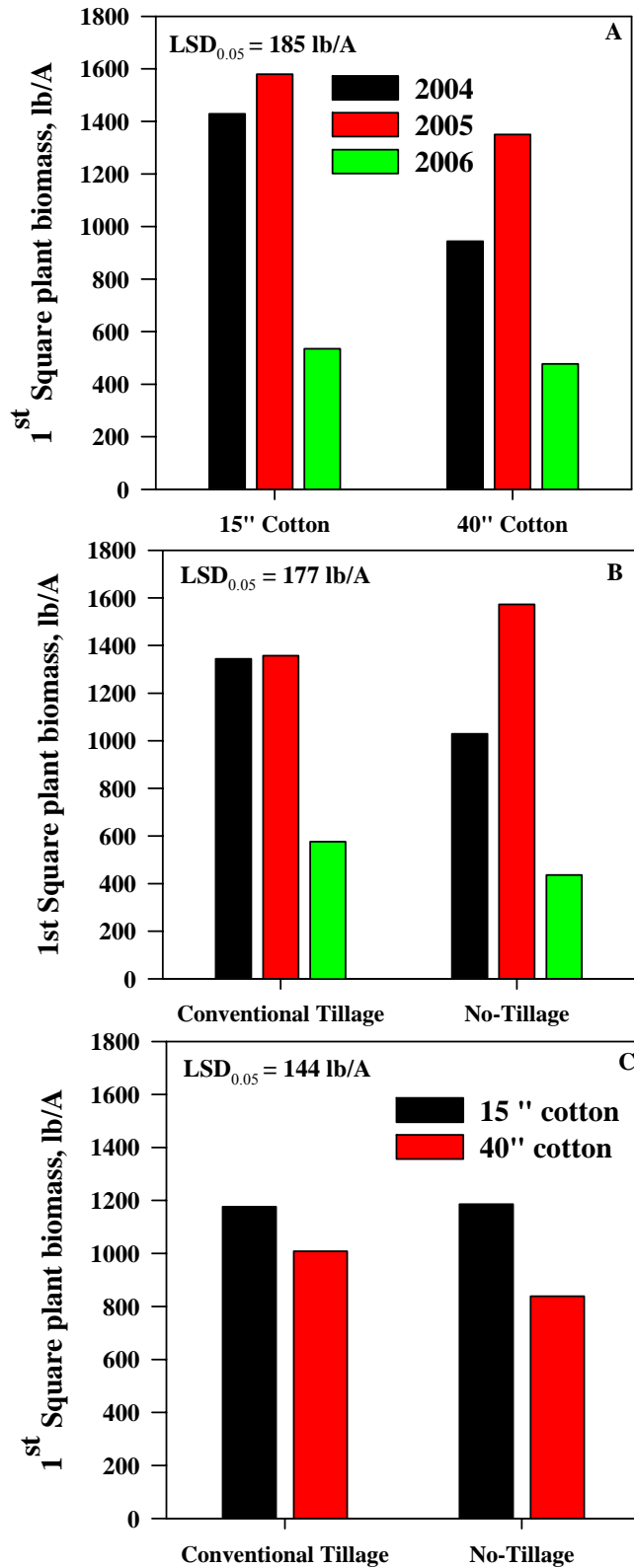


Figure 3. Plant biomass measured at 1<sup>st</sup> square during the 2004-2006 growing seasons across row spacings (A), tillage systems (B), and row spacings and tillage systems (C) at the Field Crops Unit of the E. V. Smith Research Center near Shorter, AL.