Weed Control Efficacy and Lint Yield of Herbicide Resistant Cotton Technologies Under Different Tillage Systems and Row Spacing .

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Introduction

Producers utilizing conventional cotton varieties and conventional tillage systems were highly reliant on soil applied preplant incorporated (PPI) or preemergence (PRE) and postemergence (POST) directed spray applied herbicides to achieve adequate weed control; however, due to POST over-the top application ease and control of diverse weed flora by glyphosate and glufosinate used in herbicide resistant cotton varieties, producers have reduced use of these weed control options. Further, the increased adoption of conservation tillage system has reduced the use of preplant incorporated (PPI) and preemergence (PRE) herbicides. However, the decisions related to herbicide resistant technologies may be influenced by a grower's tillage system. Complex economics are also involved in choosing varieties and subsequent herbicide systems.

Traditionally, cotton had been grown in 90 to 100 cm spaced rows; however, an alternative narrow row production system of 37.5 cm is being adopted by limited numbers of cotton growers. Potential advantages associated with this system are moisture conservation and weed suppression due to the faster canopy closure. Jost and Cothren (2000) reported a yield increase for cotton grown in narrow rows during a dry growing season, while Boquet (2005) reported no significant yield advantage for narrow row cotton production. Nevertheless, there is little knowledge about the performance of narrow row cotton production across herbicide technologies and tillage systems. Thus, an experiment was undertaken to compare three cotton varieties with different herbicide technologies, planted in standard 100 cm and 37.5 cm row patterns in both conventional and conservation tillage systems.

Materials and Methods

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 experimental design consisted of a split-split plot treatment restriction in a randomized complete block design with four replicates. The main plots consisted of row spacings (37.5 cm vs 100 cm 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).

The 37.5 cm cotton was planted with a precision drill at 105,000 plants/A, while the 100 cm cotton utilized an air planter at 80,000 plants/A. Pendimethalin (0.91 kg a.i. Ha^{-1}) was applied pre-emergence to all conventional tillage plots and conventional varieties immediately following planting. Two POST over-the-top applications of Glyphosate (1.1 kg a.i. Ha^{-1}), Glufosinate (0.47 kg a.i. Ha^{-1}), and Pyrithiobac (0.032 kg a.i. Ha^{-1}) were applied to corresponding herbicide tolerant and conventional varieties at the 2- and 4-leaf stages. A last application (LAYBY) of Trifloxysulfuron (0.01 kg a.i. Ha^{-1}) or Pyrithiobac (0.032 kg a.i. Ha^{-1}), depending on the year, was applied to all 37.5 cm cotton, while a LAYBY application of Prometryn (0.45 kg a.i. Ha^{-1}) and MSMA (0.595 kg a.i. Ha^{-1}) was applied on the same day to the 100 cm cotton. Cotton was hand-harvested from two $2m^2$ sections within each plot on October 4, 2004, October 11, 2005, and October 11, 2006, respectively. Lint yields were determined by weighing seed cotton collected from each plot and multiplying seed cotton by the corresponding ginning percentage of each plot.

All response variables were analyzed using the MIXED procedure (Littell et al., 2006) and the LSMEANS PDIFF 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 by variety and replication by variety by spacing were considered random.

Results and Discussion

Weed Control

The weed control efficacy of HR technologies was comparable and both the glyphosate-tolerant and the glufosinate-tolerant technologies were significantly better than conventional herbicide system. Two way interactions were observed, between herbicide technology & tillage system, herbicide technology & spacing, and tillage system & spacing. In the herbicide technology & tillage system interaction (Fig. 1, A & B), significant improvement in weed control was reported with use of the conventional herbicide system in which Palmer amaranth, coffee senna, smallflower morningglory and sicklepod control was higher under the conservation tillage system. The weed control in glyphosate and glufosinate tolerant technologies was not influenced by the tillage systems. In the herbicide technology and spacing interaction (Fig. 1, C & D), the glufosinate tolerant technology (FM966 LL®) at 100 cm spacing gave better control of coffee senna and sicklepod than the glyphosate tolerant technology (FM960 RR®). However, at 37.5 cm spacing, the glyphosate system provided better control of coffee senna and sicklepod. In the tillage system and spacing interaction, the conventional tillage system and 100 cm spacing provided better Palmer amaranth, yellow nutsedge, smallflower morningglory and sicklepod control than at the 37.5 cm spacing. Under the conservation tillage system, narrow spacing did not prove as a significant aid in enhancing the weed control efficacy.

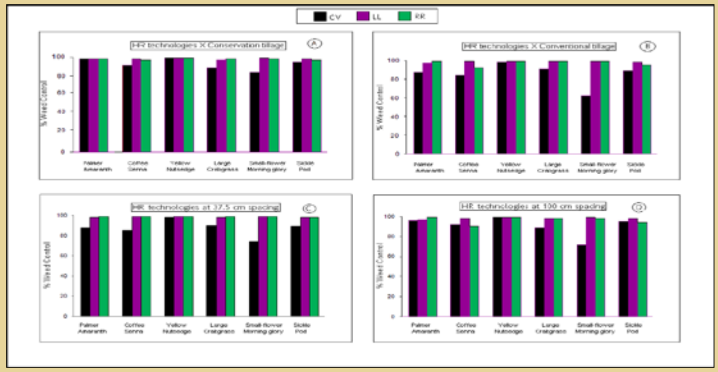

Figure 1. Weed control efficacy as affected by tillage systems, HR technologies and row spacing.

Lint Yield

- Higher lint yields were obtained during the year 2005 as compared to the other two growing seasons. However, within growing seasons, 37.5 cm cotton yields were similar to 100 cm cotton yields (Fig. 2A).
- In 2005, conventional cotton produced 12% greater yields, while glyphosate-tolerant cotton produced 13% greater yields compared to glufosinate-tolerant cotton (Fig. 2B). In 2006, glyphosate-tolerant cotton was superior to both conventional and glufosinate-tolerant cotton by 29%. There were no remarkable yield differences during 2004 among different HR technologies.
- A year X tillage interaction ($Pr > F = 0.0005$) documented a 21% yield increase for conventional tillage cotton compared to no-tillage cotton during the 2004 growing season (Fig. 2C). While in 2005, similar yields were obtained under both the tillage systems. In 2006, conservation tillage recorded a slight yield advantage over the conventional tillage. This hints that 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 (Busscher et al., 1988; Schwab et al., 2002).

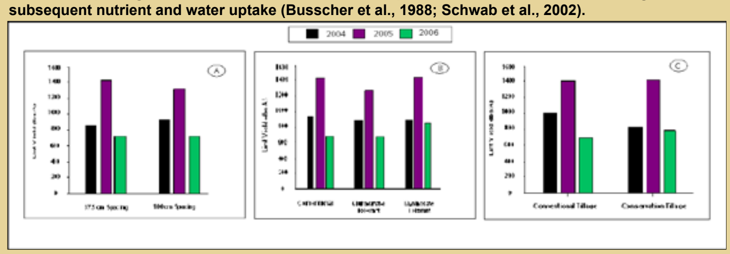

Figure 2. Cotton lint yield in relation to tillage systems, herbicide resistant technologies and row spacing

Conclusions

- Both the glyphosate and glufosinate herbicide resistant technologies were equally good in weed control but notably better than conventional technology under conventional tillage.
- The 37.5 cm spaced cotton lint yields were similar to that of 100 cm spaced cotton.
- Lint yields were influenced more by the growing season than row spacing, cotton varieties, or tillage systems

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