BENEFITS OF UNIFORM ROW SPACING IN A COTTON-CORN CONSERVATION SYSTEM

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Abstract

Recommendations to obtain maximum yields of cotton (*Gossypium hirsutum* L.) and corn (*Zea mays* L.) often don't occur with the same row spacing due to different crop's needs and available equipment. However, many producers in the South are now rotating these two crops and are faced with the dilemma of either choosing unequal row spacing for each crop or growing both crops using uniform row spacing. An experiment was conducted at the E.V. Smith Research Center in South-Central Alabama on a Coastal Plain soil to determine the effect of uniform row spacing for a cotton-corn rotation system. Row spacing in this region is typically 36 in. for cotton and 30 in. for corn. Our treatments consisted of using these row spacings for each crop or using a standard row spacing of 36 in. for both crops. Because in-row subsoiling is also commonly practiced in this region, we also included this tillage practice in our production system. In-row subsoiling was conducted at three different times: (1) biennially before corn planting, (2) biennially before cotton planting, or (3) annually before both corn and cotton planting. A fourth control treatment with no in-row subsoiling was also evaluated. Results after two years of the study indicate that, contrary to popular belief, maximum yields of corn were obtained with the uniform row spacing of 36 in. instead of the narrower row spacing of 30 in. It was also noted that when similar row spacing was used, in-row subsoiling conducted prior to the cotton crop provided maximum cotton yields with no decrease in corn yield the following year. Controlled traffic combined with uniform row spacing of 36 in. produced maximum yields of both crops as well as decreased energy use associated with reduced annual in-row subsoiling.

Introduction

Crop rotations are an important part of every conservation system. However, different crops have varying needs and much of the data for their growth was obtained in a monoculture. When these crops are integrated into a conservation system that minimizes surface disturbance, tillage practices may need to be further examined to choose the best solutions for both crops.

Soil compaction in the Southeastern region of the United States is extremely prevalent and routinely reduces crop yields unless in-row subsoiling is annually conducted. The causes of soil compaction that have been identified are vehicle traffic, cropping systems, and natural variability (Raper, 2005). If we could reduce or eliminate the largest contribution to soil compaction in our soils (vehicle traffic), perhaps we could achieve a more sustainable and economical production system that wouldn't require the expensive annual in-row subsoiling operation. Because we can't eliminate vehicles from our fields, perhaps we could reduce their presence by implementing controlled traffic systems where the tire tracks are maintained in the same locations throughout the growing seasons. Additionally, maintaining uniform row spacings from year to year could result in reduced soil compaction and improved soil condition. Controlled traffic could be achieved by using GPS technology that allows rows to be placed over previous rows with great precision. Benefits associated with in-row subsoiling might last beyond one growing season and increase root growth in subsequent crops.

Therefore, an experiment was conducted to determine the impacts of crop rotations, tillage systems, and row spacings on a cotton-corn conservation production system.

Methods and Materials

In 2006, an experiment was initiated at the E.V. Smith Research Station in Shorter, AL (85°:53'50" W, 32°:25'22" N) to evaluate the effects of crop rotation, row spacing, and tillage practices on corn and cotton production systems. Soils at the site are mostly in the Compass series and are coarse-loamy, siliceous, subactive, thermic Plinthic

Paleudults. The conservation system included a cover crop system which was crimson clover (*Trifolium incarnatum* L.) prior to corn and rye (*Secale cereale* L.) prior to cotton.

A dryland corn-cotton rotation was established at the site in the spring of 2007 with corn being planted on the eastern half of the plots either in 30 or 36 in. rows and cotton being planted on the western half of the plots in 36 in. rows. In 2008, the crops were rotated with cotton being planted on 36 in. rows in the previous corn plots and corn being planted either in 30 or 36 in. rows following the cotton in 36 in. rows. Plant populations were maintained at similar levels in both row spacings with cotton being planted with 45,000 seeds/ac and corn with 28,000 seeds/ac.

Additionally, four in-row subsoiling treatments were arranged within the experiment: (1) annual, (2) spring prior to corn, (3) spring prior to cotton, and (4) none. All of the plots were managed with conservation systems which used no surface tillage. The total number of plots in the experiment were 64 which were composed of 2 crops (corn and cotton) x 2 row spacings (30 in. and 36 in. corn) x 4 tillage treatments x 4 replications. Figure 1 illustrates how the row spacings were arranged with the first pass (center of tractor) of the cotton (2008) being positioned directly over the first pass (center of tractor) of corn (2007).

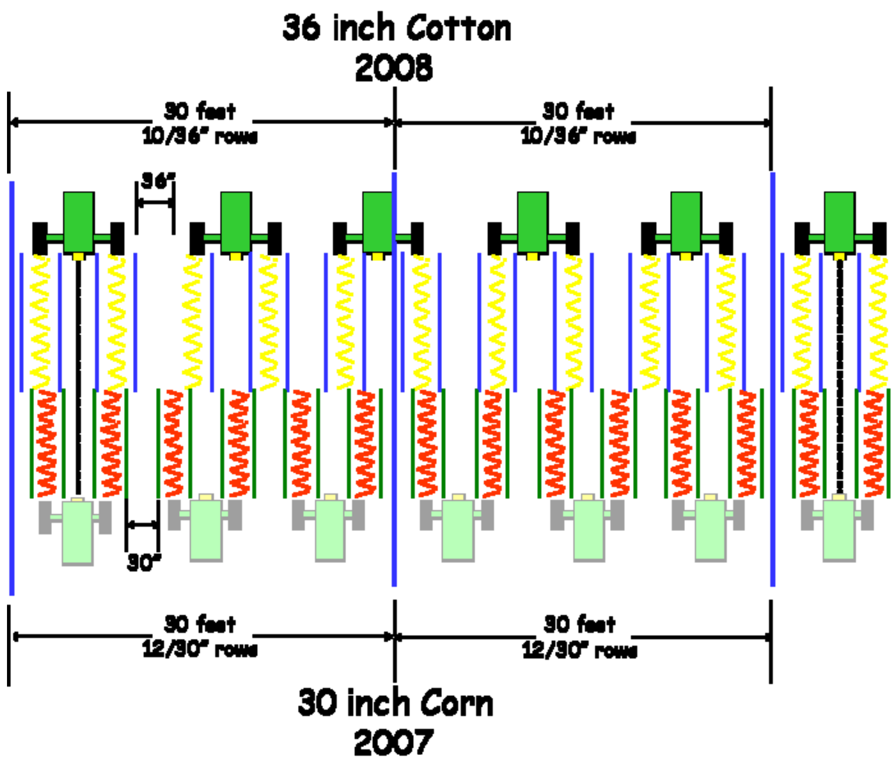

Figure 1. Row spacings layout showing 30 in. corn spacings (bottom) and 36 in. cotton spacing (top).

All in-row subsoiling operations were conducted prior to planting with a KMC (Kelly Manufacturing Company, Tifton, GA) ripper bedder to an approximate depth of 16 in. Subsoiling and planting operations were conducted with a Trimble AgGPS Autopilot® automatic steering system (Trimble, Sunnvale, CA) which was capable of inch-level precision.

Soil strength measurements were obtained with the multiple-probe soil cone penetrometer system in the fall of the year at the after harvesting of the cash crop (Raper et al., 1999). This machine acquired three sets of soil strength measurements across the row from which cone index values were calculated (ASAE Standards, 2004a; ASAE Standards, 2004b).

Statistical analyses were performed on the split-plot experiment with row spacing as the main plots and the four different tillage treatments as the subplots. The split-plot experiment was analyzed with the appropriate ANOVA model using SAS. A predetermined significance level of $P \leq 0.10$ was selected and Fisher's least-significant-difference test (LSD) was used for mean separation.

Results and Discussion

Due to space limitations, discussion will be limited to significant main effects of the cone index measurements.

During the 2007 growing season, no differences in crop yield were found nor were they expected as the benefits from controlled traffic would not be apparent until the second growing season. In 2008, the corn yield showed a significant interaction between row spacing and tillage treatment (Fig. 2) with the highest yields occurring in the 36 in. rows with the in-row subsoiling treatment being conducted prior to the previous cotton crop. Not statistically different were the 36 in. corn following annual in-row subsoiling, 36 in. corn following in-row subsoiling conducted prior to corn, and 30 in. corn following in-row subsoiling conducted prior to corn. These results were interesting and surprising as highest yields for this region are commonly thought to occur with the narrow row spacing of 30 in. However, using controlled traffic with conservation systems and maintaining the rows in the same location (as well as the benefits from in-row subsoiling) increased corn yields with the 36 in. rows significantly. Additionally, no loss in benefits was found by in-row subsoiling almost 1 year previously before the cotton crop.

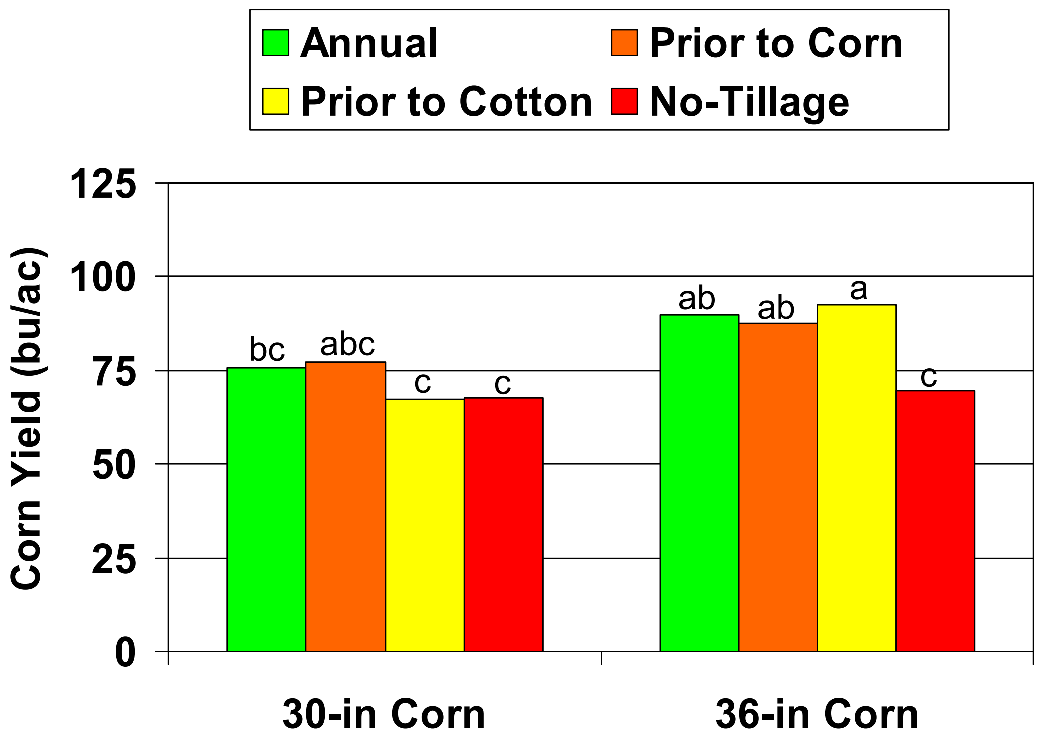

Figure 2. Corn yield in 2008 showing the effects of annual in-row subsoiling, no tillage, or in-row subsoiling prior to corn or cotton. Letters indicate statistical significance ($LSD_{0.10}$).

Cotton yields in 2008 were only affected by tillage treatments (Fig. 3) with the highest yields occurring with annual in-row subsoiling or with in-row subsoiling conducted just prior to the cotton crop (with both row spacings). No-tillage and in-row subsoiling conducted prior to the previous corn crop both produced lower yields. These results indicate that cotton is more sensitive to soil compaction and requires in-row subsoiling conducted just prior to establishment while corn was more tolerant and had the highest yields with the same in-row subsoiling treatment also conducted prior to the cotton crop.

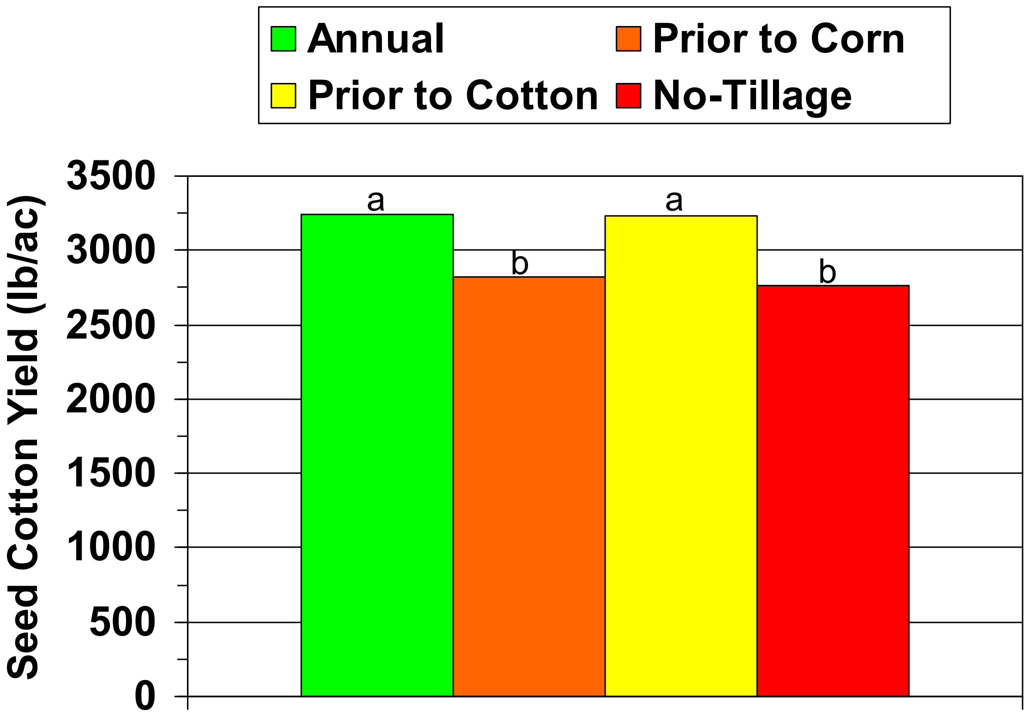

Figure 3. Cotton yield in 2008 showing the effects of annual in-row subsoiling, no tillage, or in-row subsoiling prior to corn or cotton. Letters indicate statistical significance ($LSD_{0.10}$).

The soil strength data provide further evidence of the benefits of in-row subsoiling conducted just prior to cotton establishment. Figure 4 shows the loosened row middles where the cotton roots are actively growing. Note the absence of intense soil compaction with the soil being loosened where the cotton roots are growing. Now compare this soil condition to the soil condition resulting from in-row subsoiling conducted the previous year before the corn crop (Fig. 5). Intense soil compaction is shown near the row middles of the previous corn crop, probably resulting from vehicle traffic being conducted the previous growing season. Note especially the last cotton row which was placed near a previous corn row middle with the roots attempting to grow in a compacted region. However, both soil conditions are superior to the no-tillage treatment where no deep tillage has been conducted throughout the period of the experiment (Fig. 6). In these plots, uniform compaction is prevalent throughout the entire growing region where row spacings are non-uniform.

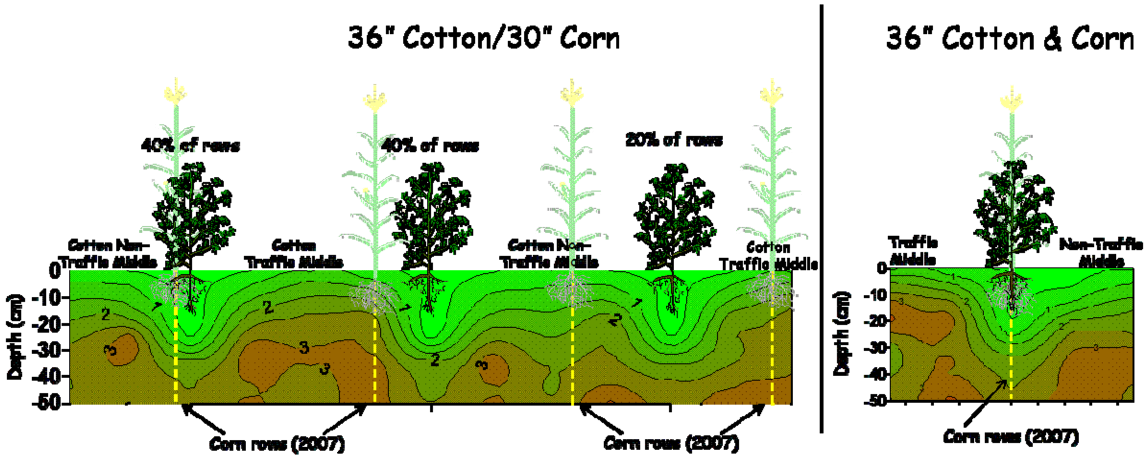

Figure 4. Cone index iso-profiles (MPa) for in-row subsoiling treatments conducted prior to cotton planting across the growing zone showing differences that were caused by vehicle traffic and in-row subsoiling for different row spacings (left) and similar row spacings (right).

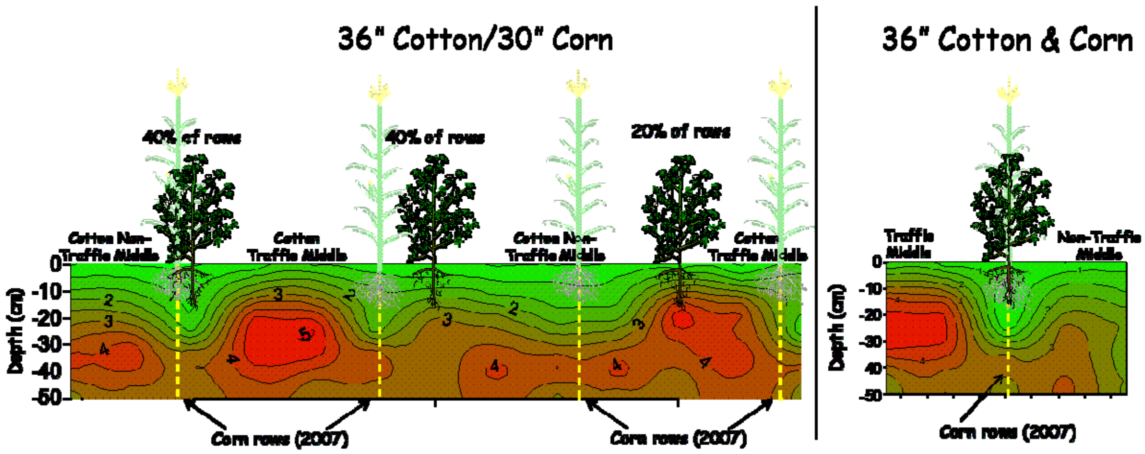

Figure 5. Cone index iso-profiles (MPa) for in-row subsoiling treatments conducted prior to corn planting across the growing zone showing differences that were caused by vehicle traffic and in-row subsoiling for different row spacings (left) and similar row spacings (right).

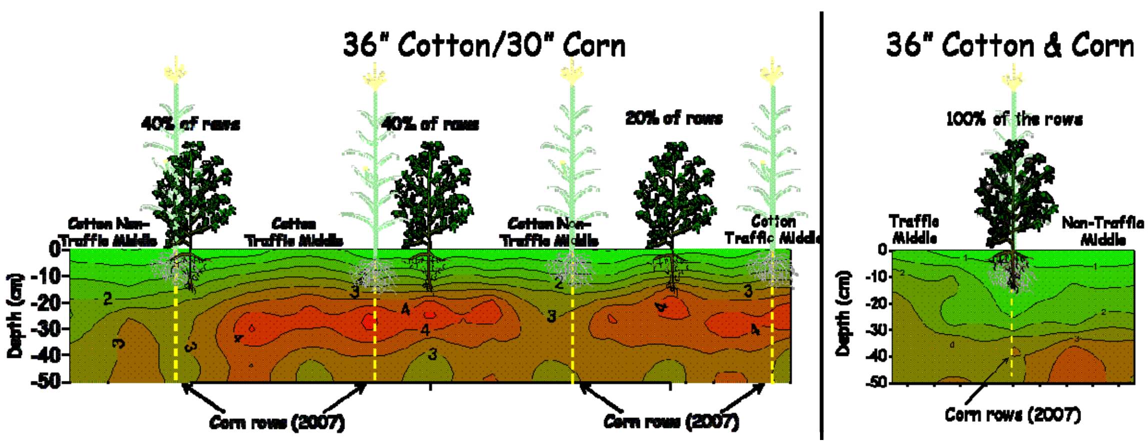

Figure 6. Cone index iso-profiles (MPa) for no tillage treatments across the growing zone showing differences that were caused by vehicle traffic and in-row subsoiling for different row spacings (left) and similar row spacings (right).

Conclusions

1. Highest corn yields were found in the 36 in. rows which differs from the commonly held belief that increased corn yields are obtained in our region with narrower row spacings of 30 in.
2. Corn yields were not found to suffer from in-row subsoiling conducted almost a year previously before the cotton crop.
3. Cotton yields were found to benefit from in-row subsoiling conducted just prior to planting.
4. Soil strength information verified that intense soil compaction was found beneath a portion of the rows in the cotton plots that had previously been under the previous corn crop's trafficked row middles.

Disclaimer

The use of trade names or company names does not imply endorsement by USDA-ARS.

References

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