

2002 Evaluation of a Twin-Line Cotton Production System in Graham County

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Abstract

A series of studies were conducted around the southeastern region of the state during the 2002 cotton growing season to evaluate the effects of a twin-line (TL) planting configuration on fiber quality and lint yield. Two of the three studies were conducted on grower cooperator fields with large block comparisons or demonstrations of TL versus single-line (SL) configurations. Fiber quality was essentially the same for both demonstration locations. Yield differences were observed in both locations with the Graham County location experiencing a 130 lb lint yield decrease in the TL plots. The Cochise County location experienced a 328 lb lint yield increase in the TL plots. The third study was a split plot within a randomized complete block design with planting configuration (TL or SL) as the main effect and variety as the sub-unit effect. . No significant differences were detected in the main effect, sub effect or the interaction with respect to yield. Trends were observed however, indicating less difference between the TL and SL with respect to yield for varieties with a more columnar growth pattern. Fiber quality results indicated no significant differences among any of the treatments

Introduction

Agricultural producers have seen the cotton industry suffer through extremely difficult times of late. With rising costs of production and a continued depressed market for cotton it has been very difficult for growers to remain profitable. Along with the depressed price many Arizona growers have had discounts applied to their crop due to fiber quality problems mainly as a result of high fiber micronaire. In light of these circumstances growers are interested in techniques that will allow them to decrease their costs of production and help improve their margin of profitability.

There has been a considerable amount of research in other parts of the cotton belt investigating different configurations of plant population and stand geometry. Research conducted in California has indicated increased profitability in a TL cotton production system. Cotton is planted in a TL configuration on top of the bed with a seven-inch spacing. Results have shown modest yield increases of 5 to 8% and a decrease in production costs from \$40 to \$60 per acre. Results from other research conducted in Arizona during 2001 (Husman et al., 2001) indicate trends in decreased micronaire values in the TL production systems when compared to the traditional single line production. Previous research done at this site showed that planting two seed lines on a bed can produce yields in excess of those produced with a single seed line, where columnar-type plants are grown (Clark and Carpenter, 2001)

One of the major benefits observed in recent years (Husman et. al., 2001 and Husman et al., 2002) with the TL production system has been a significant decrease in fiber micronaire in the TL system when compared to traditional SL systems. This is not a significant factor for growers in the upper Gila River valley since elevated micronaire has not been a problem. However, this technology may benefit growers in this region from the perspective of stand geometry. The target plant population is between 60,000 to 100,000 plants per acre. In many cases growers in this valley will have plant populations that exceed that target in a SL configuration. Higher seeding rates are typically used to ensure a proper stand due to cooler conditions that are often experienced at planting in this valley. A TL production setting may provide the ability to take the already high population and "spread it out" to allow for less in-row competition.

Materials and Methods

Demonstration Projects

Two separate demonstration projects were established on grower-cooperator fields. One was located in Graham County in Safford and the other was located in Cochise County near Kansas Settlement. Both were randomized complete block designs with two treatments (TL and SL) and 4 replications.

Graham County

In Graham County, plots consisted of 24, 36-inch rows extending the full length of the irrigation run of 1250 feet. Plots were planted on April 23rd using the Monosem planter configured to plant a double line of seed 7 inches apart on a 36 inch bed. The SL plots were planted with the grower's John Deere precision air planter. Plots were harvested on October 14th harvesting the center 8 rows out of each block and weighing with a boll buggy equipped with load cells. Sub samples of seed cotton were obtained for percent lint estimates. Lint samples were then submitted to the Phoenix classing office for fiber quality analysis.

Cochise County

In Cochise County plots consisted of 16, 30-inch rows extending the full length of the irrigation run of 800 feet. Plots were planted on April 22nd. TL plots were planted with a modified International Harvester plate planter that was configured to plant a double line of seed 6 inches apart on 30 inch beds. The SL plots were planter with grower's John Deere precision air planter. Plots were harvested on November 7th harvesting the entire 16 rows of each block and weighed with a boll buggy equipped with load cells. Sub samples of seed cotton were obtained for percent lint estimates. Lint samples were then submitted to the Phoenix classing office for fiber quality analysis.

Experiment Station Project

A research study was established at the Safford Agricultural Center to evaluate the effects of planting configuration (TL or SL) on different varieties with respect to lint yield and fiber quality. This experiments was designed as a split-plot within a randomized complete block design with planting configuration as the main effects and variety as the sub-unit effect. Three varieties were selected for evaluation based on their growth habit. Deltapine DP655BR (columnar), Stoneville ST4892BR (semi-cluster), and Fiber Max FM989BR (bush-type) were planted in both the TL and SL configurations on April 23rd. The entire 4 row plot was harvested and weighed using a boll buggy equipped with load cells. Subsamples were also collected for percent lint and fiber quality measurements.

Lint yield results were analyzed statistically in accordance to procedures outlined by Gomez and Gomez (1984) and the SAS Institute (SAS, 1999).

Results and Discussion

Demonstration Projects

Graham County

Lint yield results from the Graham County site were significantly different with the SL configuration producing approximately 130 lbs more lint per acre than the TL configuration (Table 1 and Figure 1). Yield estimates made prior to harvest through boll sampling and plant measurements would have indicated the inverse. The Monosem planter was set to plant two lines approximately 7 inches apart on the top of the bed. At harvest, measurements were taken between the lines and distances as large as 11 inches were observed. Nine inches was a very common distance between the two lines. The condition of the seedbed prepared for this demonstration was not optimum. A level, flat seedbed is critical for precise seed placement and maintenance of the 7 inch spacing between lines. These conditions resulted in a

configuration that was difficult to harvest with a conventional cotton picker. Much of the cotton that was produced on the lower portion of the plant was not harvested in the TL plots resulting in lower yields in the TL plots compared to the SL plots.

Fiber quality data from the Graham County location did not reveal any significant trends in any of the fiber quality parameters when comparing the TL and SL row configurations (Table 2).

Cochise County

Lint yield results in Cochise County were much different from those experienced in Graham County. The TL configuration produced approximately 330 lbs more lint than the SL configuration (Table 1 and Figure 1). Two factors contributed to the success of the TL plots in this study. First, seedbed condition was flat and uniform providing a more stable bed for the TL treatments. Secondly, the planter used for planting this demonstration had the flexibility of placing the double seed line 6 inches apart. Under these conditions, harvesting the TL plots was accomplished in a much more efficient manner when compared to the Graham County site.

At the Cochise County location, no differences were observed in fiber quality characteristics between the two planting configurations. A trend in higher percent lint was observed in the TL plots when compared to the SL plots but was not statistically significant (Table 2).

Experiment Station Project

Analysis of variance performed on the lint yield data revealed no significant difference from the main effect of planting configuration (OSL=0.0889) or the interaction of planting configuration by variety (OSL=0.3776). Sub-unit effects of variety were significant with an OSL of 0.0476. Analysis of variance for lint yield performed for each of the three varieties is presented in Table 3 (Figure 2). Significant differences were observed between TL and SL for Fiber Max FM989BR, which is the bush type variety. The variety with the least difference between the TL and SL is Deltapine DP655BR, which has a columnar growth pattern. A columnar growth pattern facilitates the harvest process using a conventional picker. These results indicate that proper variety selection for a TL production system is critical.

Fiber quality results from the experiment station project did not reveal any significant differences due to either variety or planting configuration (Table 4)

Summary

Results from this series of studies along with other work done in the Gila Valley (Norton et. al., 2002) indicate a potential benefit in the form of modest yield increase exists for a TL production system. Two important factors need to be addressed in attempting to adopt this type of production system. First and most importantly is seedbed preparation. A flat, level seedbed is critical to maintain precise placement of seed to ensure that the crop can be harvested with a conventional picker with a minimum loss of efficiency. The second factor is variety selection. Preliminary results indicate that varieties with a columnar growth pattern will help facilitate the harvesting process reducing the amount of cotton left in the field.

These research projects will be conducted again in the 2003 season in an effort to continue to refine recommendations for TL production in Arizona.

References

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Table 1. Lint yield analysis of variance for the demonstration projects in Graham and Cochise Counties, 2002.

| | Graham | Cochise |
|----------|----------------|---------|
| | Lbs. Lint/Acre | |
| Single | 940 a | 832 b |
| Twin | 813 b | 1141 a* |
| LSD§ | 131 | 182 |
| OSL† | 0.0538 | 0.0182 |
| C.V.(%)‡ | 6.7 | 5.2 |

*Means followed by the same letter are not significantly different according to a Fisher's LSD means comparison test.

§LSD – Least Significant Difference

†OSL – Observed Significance Level

‡C.V. – Coefficient of Variation

Table 2. Fiber quality data for each of the demonstration projects in Graham and Cochise Counties, 2002.

| Treatment | Staple | Micronaire | Strength | Percent Lint | Length | Uniformity |
|----------------|--------|------------|-----------|--------------|--------|------------|
| | 32nds | | grams/tex | | 100ths | |
| Graham County | | | | | | |
| SL | 33.0 | 4.7 | 25.5 | 38.9 | 1.03 | 81.3 |
| TL | 33.0 | 4.6 | 25.7 | 38.1 | 1.03 | 82.0 |
| Cochise County | | | | | | |
| SL | 35.5 | 2.8 | 28.0 | 35.2 | 1.11 | 81.0 |
| TL | 35.0 | 3.0 | 28.2 | 37.0 | 1.09 | 80.0 |

Table 3. Lint yield analysis of variance for the planting configuration by variety experiment, Safford Agricultural Center, 2002.

| | DP655BR | ST4892BR | FM989BR |
|----------|-----------------------------|----------|---------|
| | Lint Yield (lbs. Lint/acre) | | |
| Single | 1563 a* | 1465 a* | 1358 a* |
| Twin | 1432 a | 1277 a | 1150 b |
| LSD§ | NS | NS | 171 |
| OSL† | 0.1715 | 0.1507 | 0.0302 |
| C.V.(%)‡ | 6.9 | 10.1 | 6.0 |

*Means followed by the same letter are not significantly different according to a Fisher's LSD means comparison test.

§LSD – Least Significant Difference

†OSL – Observed Significance Level

‡C.V. – Coefficient of Variation

Table 4. Fiber quality data for the planting configuration by variety experiment, Safford Agricultural Center, 2002.

| Treatment | Grade | Staple | Micronaire | Strength | Length | Uniformity |
|-----------|-------|--------|------------|-----------|--------|------------|
| | | 32nds | | grams/tex | 100ths | |
| DP655BR | | | | | | |
| SL | 11 | 35.0 | 5.0 | 30.1 | 1.10 | 83.0 |
| TL | 11 | 35.0 | 4.9 | 28.7 | 1.10 | 83.0 |
| ST4892BR | | | | | | |
| SL | 11 | 34.0 | 5.6 | 28.2 | 1.06 | 84.0 |
| TL | 21 | 34.0 | 5.8 | 26.6 | 1.07 | 83.0 |
| FM989BR | | | | | | |
| SL | 21 | 36.0 | 5.0 | 27.4 | 1.11 | 83.0 |
| TL | 11 | 35.0 | 4.9 | 28.2 | 1.09 | 82.0 |

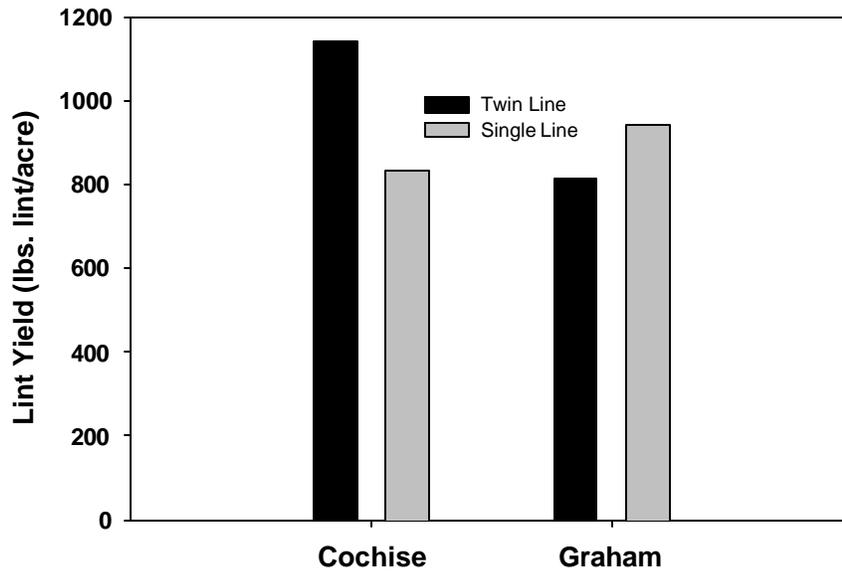


Figure 1. Graphical representation of lint yield results from the demonstration projects in Graham and Cochise Counties, 2002.

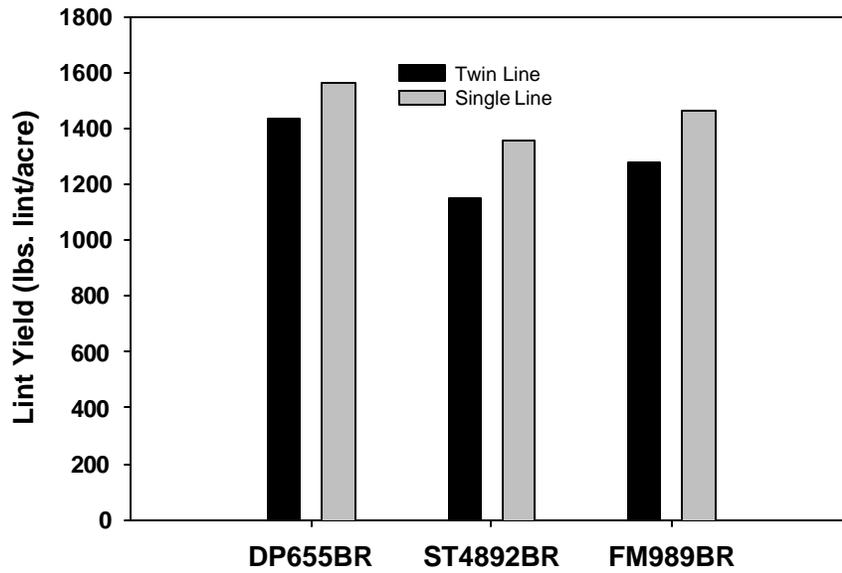


Figure 2. Graphical representation of lint yield results from the planting configuration by variety experiment, Safford Agricultural Center, 2002.