Reducing Energy Use in Cotton Production

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Higher energy costs and potential future shortages have motivated the evaluation of more energy efficient cotton production methods. Where deep wells supply the water, eighty percent of the energy used in irrigated cotton production may be required for pumping (Larson and Fangmeier, 1977). Tillage operations, particularly plowing and subsoiling, also require substantial amounts of energy. Research was initiated in 1975 to simultaneously evaluate more efficient irrigation methods and reduced tillage practices.

Tillage and irrigation practices have been compared on a ten acre plot at the Marana Experiment Farm since 1975. In 1975 and 1976 four treatments of 12 rows each were replicated four times with rows extending the full length of the field which was approximately 600 feet. Rows of this length could not be irrigated uniformly, however, and yield data obtained was not reliable. In 1977 the field was divided into 12 blocks with four treatments in each block. Each treatment again consisted of 12 rows, but only 175 feet long. Gated pipe was employed to supply water to the blocks and meters were installed in the gated pipe to obtain an accurate measurement of the amount of water used. This system minimized the effect of nonuniform soil and uneven furrow slopes. Identical pest control and harvesting methods were used for all treatments. The treatments are described in Table 1.

Results of 1977 and 1978 field trials are shown in Table 2. In 1977, every furrow irrigation treatments had the highest yields and the double row treatment had much lower yields. Yields were generally lower in 1978, perhaps due to the later planting date. The highest yields were obtained with chisel-list tillage and alternate space surface irrigation, treatment C. Again in 1978, the double row treatment had the lowest yields.

Minimum irrigation water use was a primary goal of the research. Irrigation water applications are shown in Table 3. More water was used with every space irrigation during both years. Water applications were lower in 1978 because of the later planting date and greater rainfall. Less water was applied to the treatments irrigated only from alternate spaces, but treatment C received less water in 1977 while treatment D received the least amount in 1978.

The ratios of cotton yields to irrigation quantities provide a particularly interesting comparison, Table 4. In 1977, these ratios were 26.9 and 26.2 for treatments A and B, irrigated from every row space. The ratios were a somewhat higher 28.2 for double row treatment D and a much higher 35.4 for treatment C, which was chiseled and irrigated from alternate spaces. Lower water use in 1978 resulted in higher yield to water use ratios. Again the ratios were lower for the treatments irrigated from every row space; 32.0 for treatment A, 29.0 for B. The highest ratio, 47.6, was computed for treatment C, with a somewhat lower 46.1 ratio calculated for double row treatment D.

Summary

Treatments using chisel-list tillage and surface irrigation from alternate row spaces produced the highest yields per unit energy input in 1977 and 1978. Average yields were also highest with these practices in 1978. Yields were generally lower in the double row treatment, perhaps due to difficulties in obtaining stand establishment and adequate watering. Field trials will be continued in 1979 to obtain more experience with practices using reduced tillage and modified irrigation practices.

References

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Table 1. Cultural Practices Compared in Marana Field Trials

Treatment A	Conventional tillage*, 40-inch row spacing, every row space irrigation
Treatment B	Chisel-list tillage**, 40-inch row spacing, every row space irrigation
Treatment C	Chisel-list tillage, 40-inch row spacing, irrigation furrow in alternate row spaces
Treatment D	Chisel-list tillage, alternate 40- and 50-inch row spacing, irrigation furrow only in 40-inch row spaces, 2 rows 6 inches apart planted on each side of bed

*Conventional: chop stalks, disk, plow, disk, list, mulch, plant, de-cap

**Chisel-list: chop stalks, chisel, disk, list, plant, de-cap

Table 2. Average Lint Cotton Yields, lb/acre

Practices	1977	1978
A. Conventional tillage, every row space irrigation	1024	895
B. Chisel-list, every row space irrigation	1024	892
C. Chisel-list, alternate row space irrigation	969	980
D. Chisel-list, alternate row space irrigation, double rows on wide bed	813	851

Table 3. Irrigation Water Applied, Including Pre-Planting Irrigation, Inches.

Practices	1977	1978
A. Conventional tillage, every row space irrigation	38.0	26.2
B. Chisel-list, every row space irrigation	39.0	28.6
C. Chisel-list, alternate row space irrigation	27.3	19.2
D. Chisel-list, alternate row space irrigation, double rows on wide bed	28.7	17.4

Useful rainfall was 1.8 inches in 1977, 5.1 inches in 1978.

Table 4. Ratio of Lint Cotton Yield to Irrigation Quantity, lb/inch.

Practices	1977	1978
A. Conventional tillage, every row space irrigation	26.9	32.0
B. Chisel-list, every row space irrigation	26.2	29.0
C. Chisel-list, alternate row space irrigation	35.4	47.6
D. Chisel-list, alternate row space irrigation, double rows on wide bed	28.2	46.1