

Cotton Irrigation Scheduling, Safford Agricultural Center, 1988

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ABSTRACT

Cotton was grown using historical evapotranspiration data in the Erie method, a checkbook method using real-time AZMET weather data, an infrared thermometer, and a farm manager to schedule irrigations. Yields of 4 bales per acre were recorded with no significant differences between the scheduling methods. Differences were seen in the plant growth and maturity. More refining will be done in subsequent investigations.

INTRODUCTION

In 1986 a computer model was set up to predict the water use of cotton at the Safford Agricultural Center (1). Yields of 2.5 bales per acre were achieved and the model was considered successful, even though some discrepancies were seen between the calculated and measured soil moistures. In 1987, an additional computer model was added to the study that included real-time weather data generated by the new AZMET weather station; two other treatments were scheduled by infrared thermometry, and by the farm manager's observations (2). That year, 3-bale yields were seen and the farm manager's treatment came in with a significantly higher yield than the other treatments. We were confident about our methods, but some of our parameters were not well enough refined. Another attempt would be necessary to get our AZMET data to accurately predict cotton water use and to choose another critical level for the infrared water-stress index.

MATERIALS AND METHODS

Four methods were used to schedule irrigations in the 1988 season:

- 1) Visual observations and soil checks by the farm manager.
- 2) The Erie (3) method, driven by historical evapo-tranpiration data; the method was essentially the same as that used in 1986.
- 3) A checkbook method, developed by the fifth author, using a modified Penman equation and AZMET information.
- 4) Infrared thermometry (IR), using a stress index of 3 (approximately the same as 0.3 on the Crop Water Stress Index (CWSI)). A Scheduler was provided by Standard Oil, Engineered Materials Company.

The experiment was carried out on a dead-level, Grabe clay-loam soil. There were 6 200-foot rows per plot and 4 replicates per treatment. The treatments were irrigated with well water--which had approximately 1,600 ppm soluble salts--using 2-inch syphon tubes.

Delta Pine 90 short-staple cotton was grown; because of adverse weather, the initial planting did not have a good stand so it was replanted and watered on 9 May 1988. The field was planted to pinto beans in 1987, 300 pounds per acre of 16-20-0 was applied preplant and another 50 units of nitrogen was side dressed on 11 July. Trifluralin and prometryne were used for weed control.

A sister experiment was carried out at the Maricopa Agricultural Center under the direction of the third author (4).

RESULTS AND DISCUSSION

Table 1. Yields, crop characteristics and water use efficiency by treatment at the Safford Agricultural Center, 1988.

Treatment	Lint Yield (lbs/ac)	Percent 1st pk	Percent Lint	Plant Height (in)	Water Used (in)	Water Use Efficiency (# lint/ac in)
Check	1,939 a*	88.8 a	35.9 ab	33.4 b	33.9	57.2
Erie	2,093 a	74.9 b	35.4 b	42.3 a	41.1	50.9
Checkbook	2,003 a	87.0 a	36.1 a	31.6 b	36.5	54.9
IR Therm.	1,992 a	89.5 a	36.1 a	35.5 b	33.5	59.5

* Values in a column that are followed by the same letter are not significantly different at the 5% level using the Student-Newman-Keul's test.

Table 1 indicates that all the yields were excellent with no significant differences between them. The Erie method, which ended up with the highest yield, had a first-pick yield that was significantly lower than the other treatments. That was shown by a significantly lower percent first pick. The column on plant heights and Figure 1 show that the Erie method produced taller plants--bordering on rankness--than the other treatments. More irrigation water was used by the Erie and checkbook methods, which lowered the water use efficiency compared with the other two methods.

Table 2. Fiber quality characteristics by treatment at the Safford Agricultural Center, 1988.

Treatment	Grade	Staple	Mic	Strength	Uniformity
Check	41 a*	37.5 a	41.5 a	30.25 a	81.25 a
Erie	41+a	37.5 a	42 a	28.25 a	80.75 a
Checkbook	41+a	37.5 a	43.3 a	29.25 a	82.25 a
IR Therm.	41+a	36.8 a	43.5 a	28.25 a	82.5 a

* Values in a column that are followed by the same letter are not significantly different at the 5% level using the Student-Newman-Keul's test.

+ Values are composites of values from the 4 reps; 1 out of the 4 reps had a grade of 31. No significant differences were seen in the fiber characteristics between treatments.

Figure 1 shows the growth of the cotton plants in each treatment. The growth curves were together up to about 70 days, after which the Erie method pulled away from the other treatments. PIX was applied at 65 days, causing a flattening of the growth curve at that point for all treatments other than the Erie method. Figure 2 shows the amount and timing of the irrigations and rainfall.

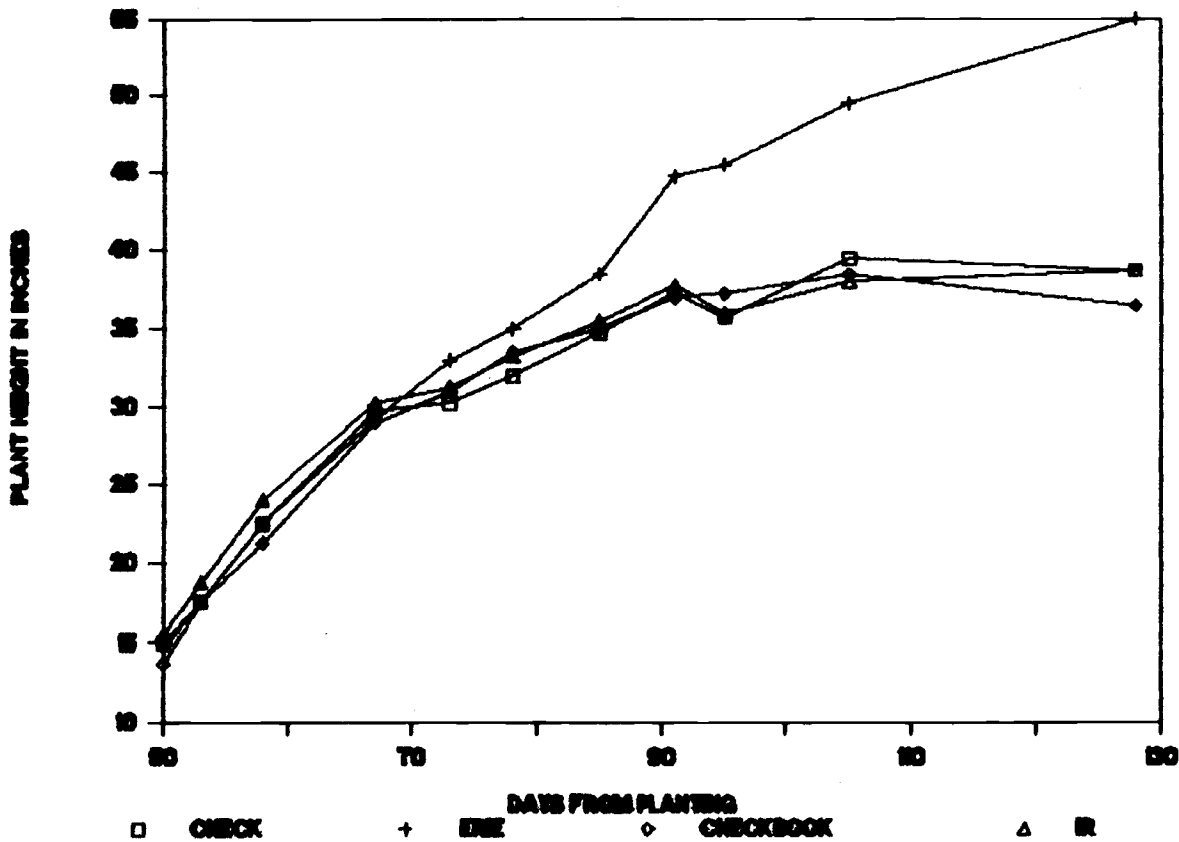


Figure 1. Cotton Growth with Time for each Irrigation Treatment.

The Erie method received irrigations on the 67th, 74th, and 84th days, which were 1 or 2 more irrigations than the other treatments received in that period of time. That caused the rank growth that the PIX could not suppress. The growth spurt was not accompanied by boll setting as indicated by the low yield at first pick. The delayed frost date in 1988 (16 November) allowed the plants to set a top crop and produce the highest yield, but with the lowest water-use efficiency.

The interactive scheduling methods worked quite well, producing about the same results, keeping the plant in check without undue crop stress. On several occasions the IR thermometry method had visual symptoms of stress in parts of the plots before calling for an irrigation. It might be well to lower the critical threshold level from 3 to 2.8 or 2.7 and evaluate the yield vs. water-use efficiency for a subsequent investigation.

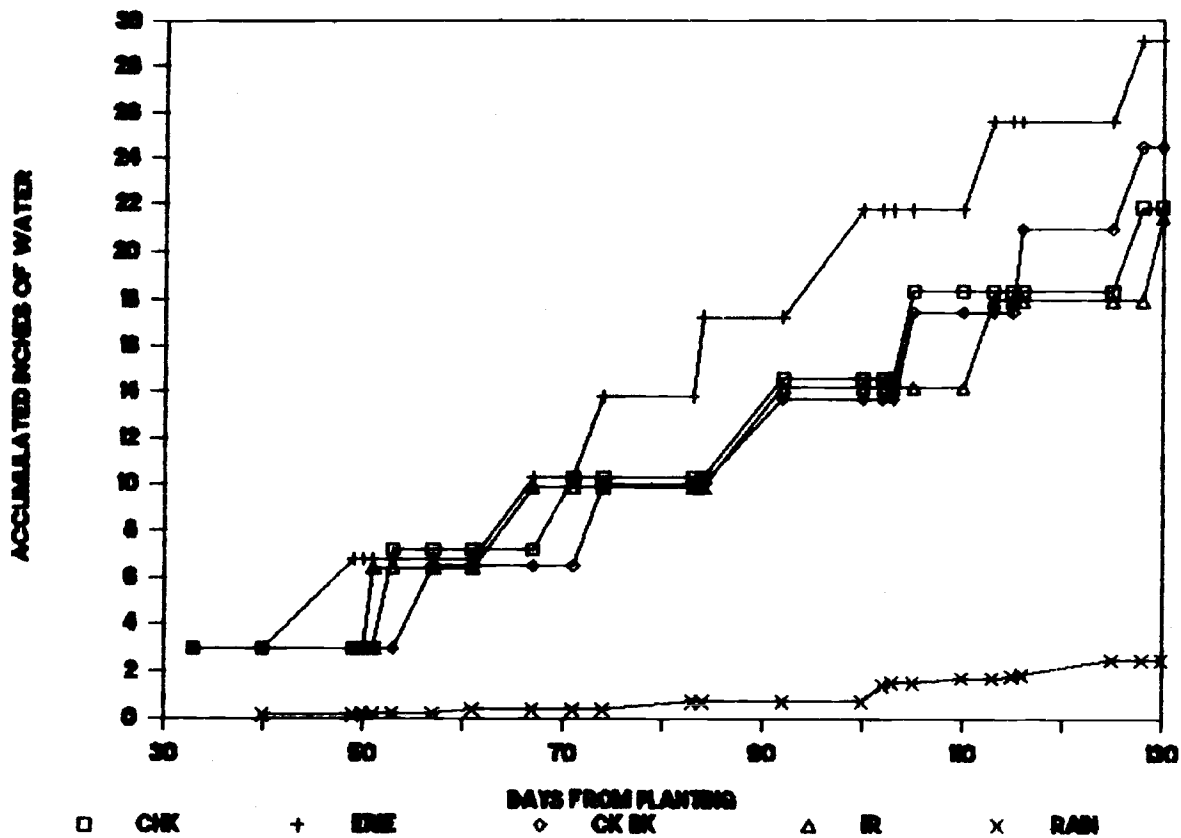


Figure 2. Amounts of irrigation applied by the treatments and rainfall received compared against time.

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