Irrigation Scheduling on Long and Short Staple Cotton Safford Agricultural Center, 1989

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ABSTRACT

Two irrigation scheduling trials were performed in 1989, one for short staple and one for long staple. Yields in the trials were very good with the best treatments yielding over 1700 and 1600 pounds of lint per acre for DP 90 and S-6, respectively. The treatment using Infrared thermometry was the best overall treatment in the short-staple trial, with the highest yield, the highest percent first pick, the shortest plants, the lowest water use and the highest water use efficiency. The two computer methods were very close to the IR treatment in yield and percent first pick, but grew taller plants with more water and were not as efficient with their water use. The trial on long staple cotton was encouraging in that reasonable yields were obtained using short-staple parameters. The computer model using AZMET data yielded significantly lower than the other treatments, indicating that we need to refine the evapotranspiration crop coefficients.

INTRODUCTION

The research on scheduling irrigation on short staple cotton is an ongoing project until the proper crop coefficients are derived that will allow the computer accurately to predict the crop's water needs. In last year's research (1), the Erie model using historical weather data produced the highest yield but came in last in water use efficiency. The checkbook method, which used the AZMET weather data, came in second in yield and had a slightly better water use efficiency, but it was noted that there was a need for improvements of its crop coefficients. Likewise, it was noted that the yield for the IR thermometry could perhaps be improved by lowering its critical level slightly and hopefully not lower its water use efficiency too much. Thus, work was needed to refine the work of past years.

Computer irrigation scheduling on long staple cotton had not been done in the past and crop coefficients are not available. Similarly, base lines for using IR thermometry for irrigation scheduling are not available for the higher deserts in Arizona. The first step is to try a model and then see what modifications are needed to make it work. This experiment was set up to use the same parameters as for scheduling short staple cotton, and then to measure the water used by the cotton plants in order to improve the model for subsequent research.

MATERIALS AND METHODS

These experiments were performed at the Safford Agricultural Center in Graham County at an elevation of 2950 feet above sea level. Small plot techniques were applied with multiple replications.
Crop History for Short Staple Cotton

Soil type: Pima clay loam
Previous crop: Wheat
Planting Date: 17 April 1989
Planting Rate: 25 pounds per acre in 36" rows
Herbicide: Trillin and Cotton Pro
Fertilizer: 300 lbs/ac 16-20-0 preplant, 200 lb/ac Urea 16 June
Irrigation: Watered up and furrow irrigated as called for by the scheduling technique.

Insecticides: 5 applications of pyrethroids (malathion was added to the 2nd application of pyrethroid)
Harvest: First pick: 26 October
Second pick: 17 November
Heat units during the season (86/55): ca. 3800
Plot size: Six 36-inch rows wide by 200 feet long
Replications: Four
Treatments:
1. Check, visual observations and soil checks by the farm manager.
2. Erie method, driven by historical evapo-transpiration data.
3. Checkbook method, driven by AZMET data
4. Infrared thermometry, using 2.7 - 3.0 (.27 - .3 CWSI) as the critical level.

Crop History for Long Staple Cotton

Soil type: Pima silty clay loam
Previous crop: Wheat
Planting Date: 12 April 1989
Planting Rate: 25 pounds per acre in 36" rows
Herbicide: Trillin and Cotton Pro
Fertilizer: 220 lbs of urea preplant and 200 lbs of urea on 16 Jun
Irrigation: Watered up and furrow irrigated as called for by the scheduling technique.
Insecticides: 5 applications of pyrethroids (malathion was added to the 2nd application of pyrethroid)
Harvest: First pick: 23 October
Second pick: 7 November
Heat units during the season (86/55): ca. 3800
Plot size: 6 - 36 inch rows wide by 200 feet long
Replications: Three
Treatments:
1. Erie method, driven by historical evapo-transpiration data.
2. Checkbook method, driven by AZMET data
3. Infrared thermometry, using 2.7 - 3.0 (.27 - .3 CWSI) as the critical level.

Well water was used for all irrigations so the water source variable would not affect the results. The well water had approximately 1600 ppm soluble salts. Each plot was divided into three subplots where different levels of PIX were applied over each irrigation treatment. The results of that study will be presented in a subsequent report.

RESULTS AND DISCUSSION

Table 1. Yields, crop characteristics, water use and efficiency on short staple cotton by treatment, Safford Agricultural Center, 1989.

Treatment	Lint Yield (lbs/ac)	Percent 1st Pk	Plant Height (inches)	Water Used (ac in)	Water use Efficiency (# lnt/ac in)
IR	1713 a	91.0 a	33.0 b	36.5	46.9
Erie	1700 a	88.7 ab	38.7 a	43.2	39.4
Checkbook	1699 a	89.3 ab	37.0 a	43.5	39.0
Check	1665 a	87.0 b	34.8 b	39.9	41.8

From Table 1 it can be seen that the yields are not significantly different and that they are all high. The IR treatment that was the highest yielder also had the highest percent first pick, the smallest plant and the least water used. Everything was right for this treatment this year. From Figure 1, one can follow the irrigations

throughout the season. Note that in the early part of the season, up through boll load, the IR treatment called for about the same amount of water as the other treatments, but after 75 days it dropped behind the others and stayed parallel to them. Figure 2 shows the plant growth with time and correlates well with the water applied shown in Figure 1.

At the end of the season, just before second pick, ten plants in an unpicked row in the plot were mapped. The data from this mapping are shown in Table 2.

Table 2. Plant Mapping at the End of the Season on Short Staple Cotton Irrigation Trial at the Safford Agricultural Center, 1989.

Treatment	Node 1		Node 2		Both Nodes			
	% FS*	% Open	% FS	% Open	FS	% FS	Fruit	% Open
IR	58	100	61	100	186	59	90	100
Erie	51	100	75	100	143	52	61	100
Checkbook	59	100	70	100	154	60	85	100
Check	56	100	63	100	161	57	81	100

* FS = Fruiting Sites, the % FS is the percent of the fruiting sites that were filled with any fruiting structure, from square to open boll. Fruit are actual harvestable bolls.

The number of fruiting sites and fruit (per 10 plants) correlated quite well with the plant heights, with the shorter plants having more fruiting sites and fruit. Beyond that, it is difficult to make any correlations between Tables 1 and 2.

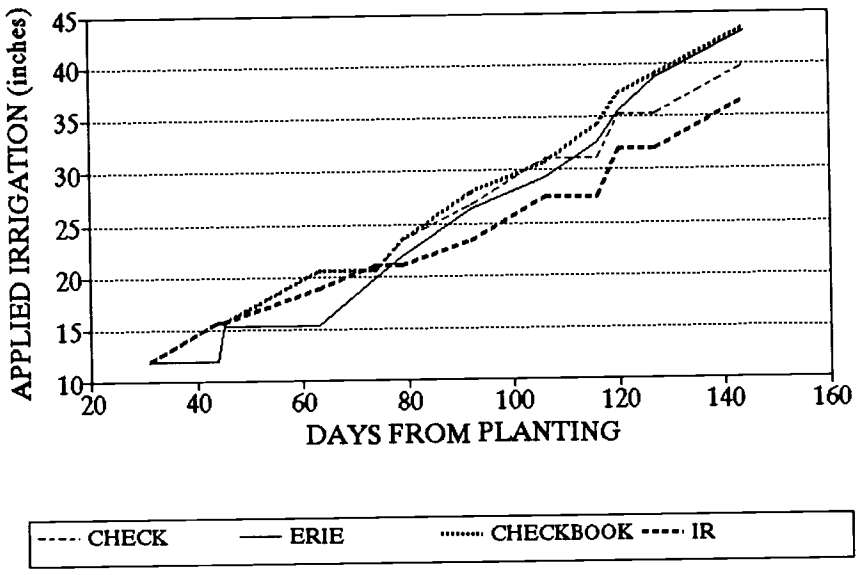


Figure 1. Applied irrigation water in inches for the treatments on short staple cotton on the Safford Agricultural Center, 1989.

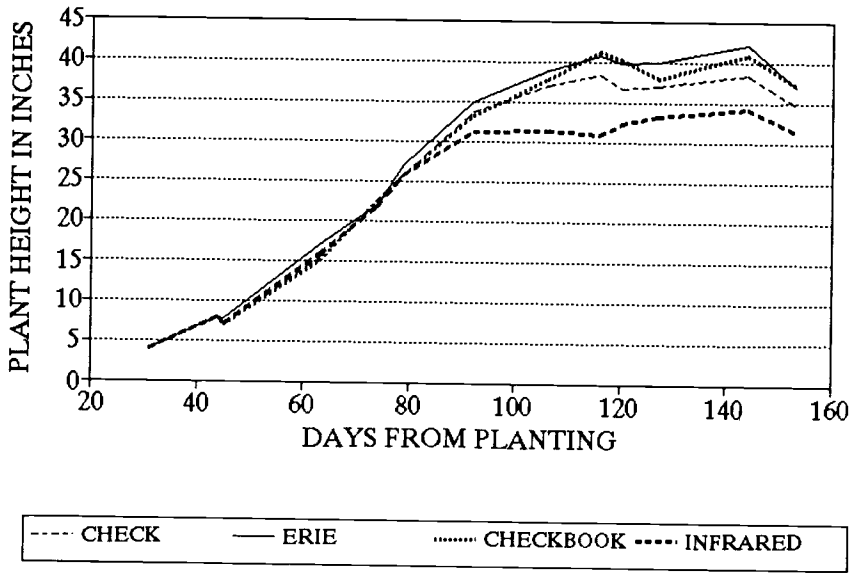


Figure 2. Plant height throughout the growing season by treatment on short staple cotton on the Safford Agricultural Center, 1989.

Table 3. Yields, crop characteristics, water use and efficiency on long staple cotton by treatment, Safford Agricultural Center, 1989.

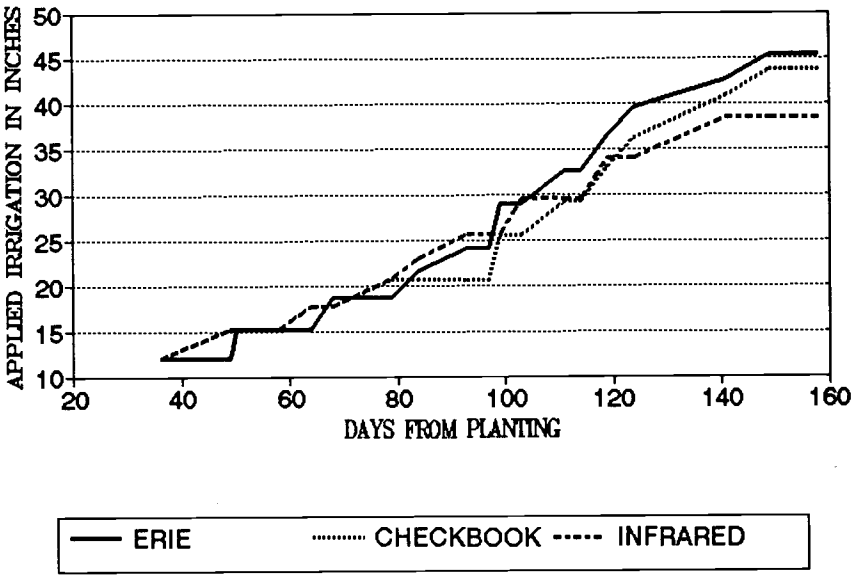
Treatment	Lint Yield (lbs/ac)	Percent 1st Pk	Plant Height (inches)	Water Used (ac in)	Water use Efficiency (# lnt/ac in)
Erie	1608 a	68.4 c	34.0 a	45.4	35.4
IR	1564 a	81.9 a	31.0 b	38.4	40.7
Checkbook	1372 b	73.7 b	34.2 a	43.6	31.5

There were significantly different yields on Table 3, but the Erie method gained its yield in exchange for lateness in maturity as seen by its low percent first pick. Interestingly enough, the plant height and water used was not much different from the checkbook method, but the yields were dramatically different. Figure 3 shows where the difference came. Between 80 and 100 days the checkbook method did not receive water, whereas the Erie method did. The plant growth did not suffer as seen in figure 4, but this was the critical fruit setting period and apparently fruit was lost. The IR method provided a little extra water during the fruiting period and then reduced the water at the end. This resulted in an acceptable yield, early maturity, a reduced plant size and the highest water use efficiency.

Plant mapping was not done on the long-staple irrigation trial.

The encouraging thing about this long-staple irrigation trial was that the scheduling techniques using short-staple parameters fit quite well. Data were taken throughout the growing season to refine the evapo-transpiration crop

coefficients and the IR base line. It is hopeful that this data will be valuable for subsequent irrigation studies.



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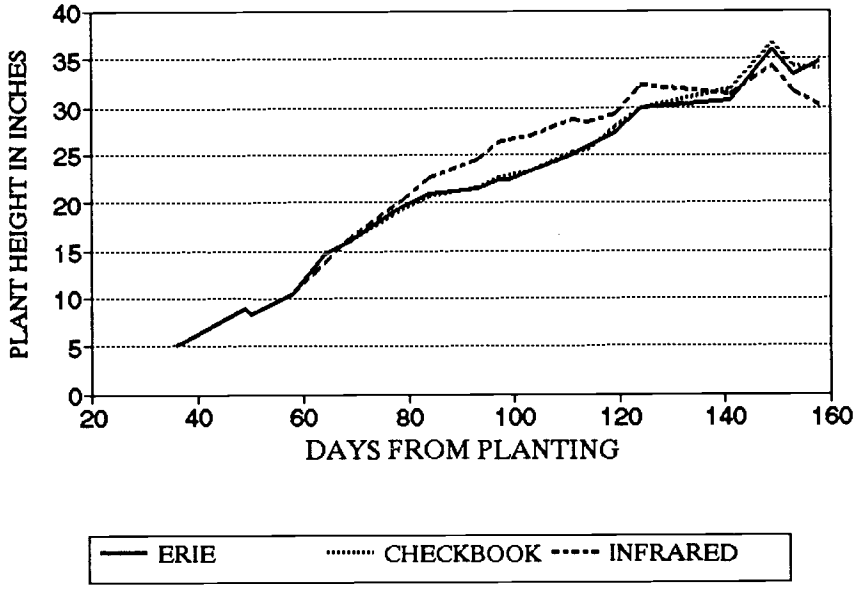

Figure 4. Plant height throughout the growing season by treatment on long staple cotton on the Safford Agricultural Center, 1989.

REFERENCES

1. Clark, L.J., E.W. Carpenter, T. Scherer, D Slack and F. Fox. 1989. Cotton Irrigation Scheduling, Safford Agricultural Center, 1988. Cotton, A College of Agriculture Report, The University of Arizona, Tucson. Series P-77; 159-162.