EFFECT OF IRRIGATION TIMING ON COTTON YIELD AND EARLINESS

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RESEARCH PROBLEM

State-average yields of irrigated cotton (*Gossypium hirsutum* L.) for 1984 through 1998 averaged 838 lb lint/acre. While there has been a consistent increase above dry-land yields during that period (average of 202 lb lint/acre), many producers believe that the variability in irrigated cotton yield is unacceptably high. Since stabilizing yields is often given as a principle reason for investing in irrigation, and 66% of the 1998 crop was irrigated, variability in irrigated yields is a major concern. The objective of this research was to determine the optimal initiation and termination timing for irrigation of cotton in Arkansas.

BACKGROUND INFORMATION

Water requirements for cotton vary throughout the season, with low use during the vegetative period and needs increasing rapidly during the reproductive growth stage (Fig. 1). The water requirement decreases late in the year as the first bolls mature and air temperatures cool. Current University of Arkansas Cooperative Extension Service (CES) recommendations are to begin monitoring the moisture status of the crop at planting and to maintain well-watered conditions until bolls begin to open. Due to factors such as cultivation, fertilization, and preparing other crops on the farm, the first irrigation in cotton is often applied later than recommended. Of course, the effect of such a delay will depend greatly on the weather conditions. Periods of drought are less likely early in the season, so rainfall will often prevent excessive stress from developing when an early irrigation is missed. It is generally believed that maintaining well-watered conditions until the first bolls open provides sufficient moisture to mature the remaining bolls. However, first open boll (FOB) alone is a poor indicator of the maturity status of the crop, addressing only the first fruit set and not the entire fruiting history. Increased in-season plant monitoring of cotton in recent years has led many producers to ask for an irrigation termination guide better tied to crop status.

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MATERIALS AND METHODS

The cultivar 'Sure-Grow 125' was planted at the University of Arkansas Northeast Research and Extension Center at Keiser on 10 May 1999 at approximately five seeds per foot in 38-inch rows on a Sharkey silty clay (Vertic Haplaquepts). Nitrogen was applied at a rate of 98 lb/acre, split between pre-square (50 lb/acre) and two early flower (24 lb/acre) applications. No other fertilizers were required. University of Arkansas CES recommendations were followed for weed and insect control. The study was designed as a randomized complete block with three replications. Fisher's Least Significant Difference was used to compare treatment means whenever significant (P values ≤0.05) treatment effects were observed. Plots consisted of four 38-inch rows by approximately 600 ft long, with the center two rows harvested. A four-row border area was left between each pair of plots. Five irrigation treatments were used, including no irrigation (NI) (Table 1). Except as noted, plots were watered at a 2-inch estimated soil water deficit (SWD) based on the Cahoon *et al.* (1990) water balance method. Nodes above white flower (NAWF) were counted weekly from 20 plants per plot beginning soon after all plots were flowering. The cotton was harvested twice with a two-row mechanical picker. Seedcotton weights for each plot were determined for the first harvest (14 September) with an instrumented boll buggy and for the second harvest (4 October) with a cotton picker modified for small-plot harvesting.

RESULTS

Little yield difference was observed among the irrigated treatments, with total seedcotton yield highest for the Delay treatment (Fig. 2), even though the estimated SWD reached 3.8 inches by the first irrigation. The NAWF data (Fig. 3) indicated that the Delay treatment was drought-stressed before its first irrigation on 21 July (i.e., the mean values dropped slightly below 5 and then increased after the irrigation). Other studies have shown that the later bolls produced by the increase in NAWF (second growth) will not contribute significantly to yield (Benson *et al.*, 1999); however, no other explanation could be found for the additional yield. Apparently conditions in this study were adequate to allow the crop to compensate for the premature cutout, particularly since the mean NAWF value of 4.9 suggests that many of the individual plants had not yet reached physiological cutout (NAWF=5).

The treatment with the earliest irrigation termination (NAWF=5) was associated with the lowest yield, not significantly different from the yield for the nonirrigated treatment (Fig. 2). Even though a four-row border area was left between each pair of plots, some lateral water movement into the nonirrigated plots may have occurred as a result of the cracking nature of the Vertic soil; therefore the yields reported for the NI treatment should not be considered representative of dryland conditions. The final irrigation for the 5+1Irr treatment was on 3 August (215 DD60 after NAWF=5). There was no significant yield increase associated with the final irrigation before FOB (13 August, 454 DD60 after NAWF=5), even though there was less than 0.5 inch of rain during August.

PRACTICAL APPLICATION

Highest seedcotton yields were observed in this study for the Delay treatment, even though it was the first treatment to reach physiological cutout at NAWF=5. Because the yield response associated with early irrigation is not consistent from year to year, future work will investigate a crop indicator to help determine when early irrigation is needed. There was no significant yield increase associated with the final irrigation before FOB (13 August, 454 DD60 after NAWF=5), even though there was less than 0.5 inch of rain during August. Findings from several similar studies must be compared before new CES recommendations can be developed.

LITERATURE CITED

Benson, N.R., W.C. Robertson, and G.M. Lorenz. 1999. Validation of the insecticide termination component of COTMAN. Proc. Beltwide Cotton Conf., National Cotton Council, Memphis, TN. pp. 1133-1135.

Cahoon, J., J. Ferguson, D. Edwards, and P. Tacker. 1990. A microcomputer-based irrigation scheduler for the humid mid-south region. Appl. Eng. Agric. 6:289-295.

Table 1. Irrigation treatments in cotton irrigation study at NEREC, Keiser, AR.

	Initiation		Termination		Total
Treatment	Key	Date	Key	Date[z]	Irrigations
NI	none	--	none	--	0
NAWF=5	2 inch SWD[y]	9 July	NAWF = 5	21 July	2
5+1Irr	2 inch SWD NAWF=5	9 July	one irr. after	3 August	3
FOB	2 inch SWD	9 July	1st Open boll	13 August	4
Delay	one irr. *after* 2 inch SWD	21 July	1st Open boll	13 August	3

[z] Date of final irrigation.
[y] Soil water deficit (SWD) estimated with Irrigation Scheduler program from Cahoon *et al.* (1990).

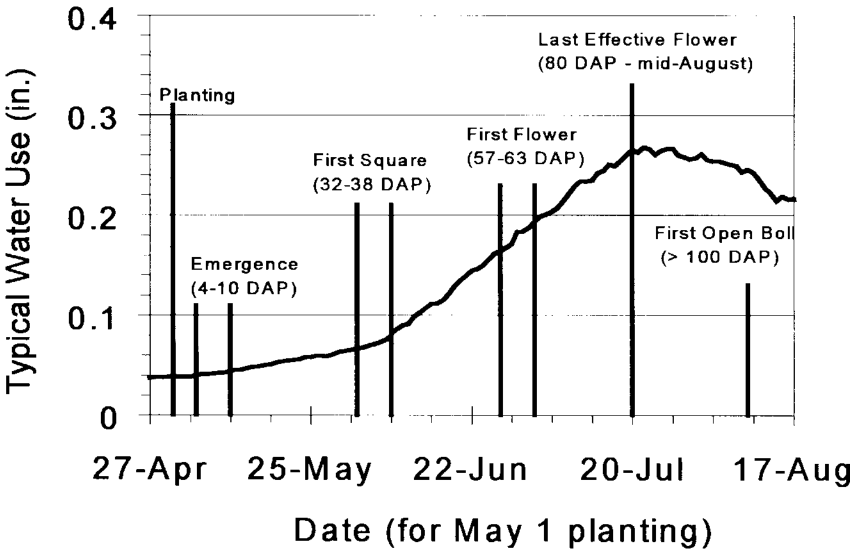

Figure 1. Estimated typical water use for cotton based on 30-year-mean maximum temperatures recorded at the University of Arkansas Northeast Research and Extension Center.

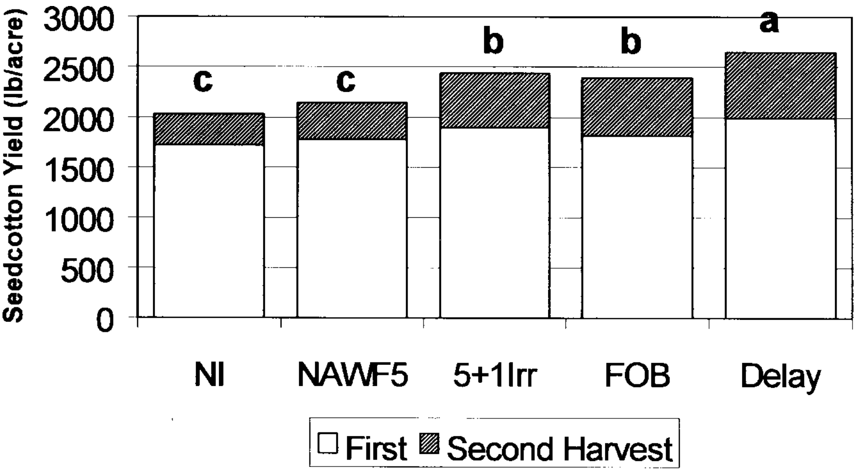

Figure 2. Seedcotton yields from two mechanical harvests of 1999 cotton irrigation study at the University of Arkansas Northeast Research and Extension Center (treatments with the same letter above the column did not differ significantly in total seedcotton yield).

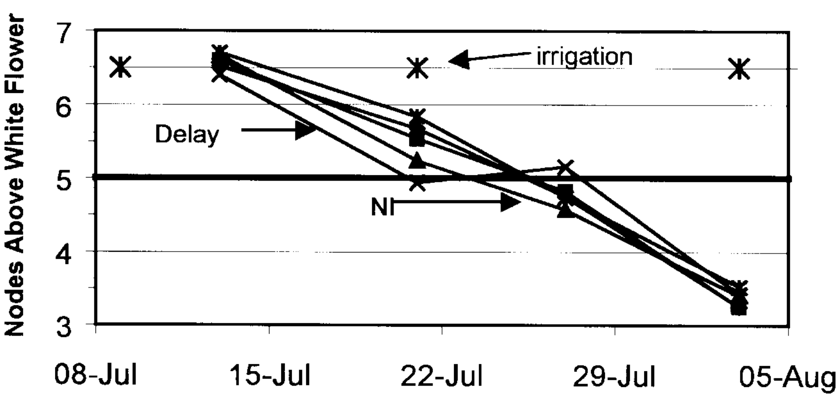

Figure 3. Nodes above white flower observations in 1999 cotton irrigation study at the University of Arkansas Northeast Research and Extension Center.