COTMAN IRRIGATION TERMINATION STUDIES

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RESEARCH PROBLEM

Irrigation termination decisions are difficult for growers to make. Little guidance is available to help them make these decisions.

BACKGROUND INFORMATION

For years, farmers in Southeast Arkansas have used irrigation to improve and stabilize cotton yields. Currently, approximately 85% of the cotton acreage in Desha County and surrounding areas is irrigated. Recently, growers have used collapsible thin walled Poly-pipe to furrow irrigate most of the irrigated cotton land. Vories *et al.* (1998) gave growers guidance on when to start irrigating, but research-supported guidelines on irrigation termination are not available. The costs associated with irrigation are substantial. But the cost of one or more late-season irrigations is generally not high, since irrigation tubing is in place from earlier irrigations. There are other, indirect costs associated with late-season irrigations, however. Late-season irrigations often delay crop maturity, increasing the risk of weather-related damage. Also, late irrigations extend the period of vulnerability to insect pests and increase the cost of controlling them. A system is needed to help growers optimize irrigation termination to obtain maximum yields while avoiding unnecessary direct and indirect costs.

The COTMAN crop-management tool is becoming more popular with growers in the area. While it was initially used to monitor pre-flowering plant growth and fruiting and as a guide for late-season insecticide termination, it may provide a system for reliably determining the optimum timing for irrigation termination. The BOLLMAN component of the COTMAN system monitors late-season boll development from an easily determined marker of crop physiological development; i.e., node above white flower 5 (NAWF=5), or physiological cutout. From that point in crop development, further crop maturation is described using heat units accumulated above a 60°F base. Our objective in this study was to gather data on how many heat units should be accumulated before irrigation can safely be terminated without decreasing lint yield.

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RESEARCH DESCRIPTION

Research was conducted on four different fields in 1999 on the C.B. Stevens farm near Tillar. SG501 was planted on 3 May 1999 in Fields 1 and 2, and NuCotn 33B was planted on 9 May 1999 in Fields 3 and 4. Study fields were silt loam soils, planted on 38-inch row spacings, and monitored season-long using the SQUAREMAN and BOLLMAN components of COTMAN. All fields were irrigated using standard timing (7-day schedule) until 13 August, when the last irrigations were applied to the test fields and irrigation was terminated on four eight-row plots per field. For comparison, irrigation was continued in four eight-row plots in each field (Table1). All plots ran the length of the test fields. Irrigation was terminated after 493, 493, 467, and 244 heat units accumulated beyond NAWF=5 in irrigation termination plots in Fields 1 through 4, respectively. Plant population data were estimated in each plot at harvest by counting number of plants per 10 row feet and converting to plants per acre. Lint yield was taken by mechanically harvesting the four middle rows from each plot.

RESULTS

Three of the four fields in the study showed a numerical lint yield increase from the additional irrigation (Table 2). The change in lint yield from the additional irrigation(s) ranged from an additional 105 lb/acre in Field 4, in which irrigation was stopped in the termination plots at NAWF=5 + 244 heat units, to a loss of 14 lb/acre in Field 3, in which irrigation was terminated at NAWF=5 + 467 heat units. In three of the test fields, irrigation was terminated at between 450 and 500 heat units beyond NAWF=5. In these fields, one additional irrigation produced an average of only 16 lb/acre more lint than was harvested from the irrigation-terminated plots. At a 5-year average lint price of $0.685/lb (Bryant, personal communication), the value of this added production was approximately $10.96/acre. At an estimated cost of $5.00/additional irrigation (Tacker, personal communication), terminating irrigation at NAWF=5 + 450 to NAWF=5 + 500 heat units, caused a loss of only $5.96/acre. It has been suggested that continued irrigation may delay maturity. If maturity is delayed, the increased probability of one additional insecticide application and/or the increased probability of weather-related loss could easily cost more than was produced by the additional irrigation. These data indicate that the optimum stage of physiological development for irrigation termination was near or slightly above NAWF=5 + 500 heat units on the Stevens Farm in 1999.

PRACTICAL APPLICATION

Soil type, field history, drainage, canopy density, anticipated rainfall, boll rot, and other factors have impacts on irrigation termination decisions. Recommendations on irrigation termination should not be made based on one year's research. However, the 1999 data reported here appear to show promise that heat unit accumulations after NAWF=5 (BOLLMAN) can be used to optimize irrigation termination. Our 1999 data indicated that an appropriate point for irrigation termination in 1999 on the C.B. Stevens farm was NAWF=5 + about 500 heat units. More data in future years will be needed before arriving at a firm recommendation. We plan to continue this and other studies in future years over a wide variety of management schemes and weather conditions to find the earliest point in COTMAN-monitored crop development at which irrigations can be terminated on cotton without losses in lint yield.

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LITERATURE CITED

Vories, E.D., N.P. Tugwell, J.S. McConnell, and R.W. Turner. 1998. Irrigation Management of Cotton. *In:* D.M. Oosterhuis (ed.). Proc. 1998 Cotton Research Meeting and Summaries of Cotton Research in Progress. University of Arkansas Agricultural Experiment Station Research Series 188:125-127.

Table 1. Individual field data.

Field No.	Variety and Planting Date	Heat Units and Date at Irrigation Term.	Number and Date of Extra Irrigations in Control Plots	Date of Harvest
1	SG 501 3 May	NAWF 5 + 493 HU 13 Aug	1 18 Au	1 Oct
2	SG 501 3 May	NAWF 5 + 493 HU 13 Aug	1 18 Aug	1 Oct
3	DP 33B 9 May	NAWF 5 + 467 HU 13 Aug	1 18 Aug	22 Oct
4	DP 33B 9 May	NAWF 5 + 244 HU 13 Aug	2 18 and 25 Aug	22 Oct

Table 2. Stand count, lint yield, and difference in yield between irrigation terminated plots and irrigation continued plots.

Field #	Irrigation Treatment	Stand Count	Lint Yield	Yield Difference
		#/acre	lb/acre	lb/acre
1	NAWF5 + 493 Term. Continued 1X	33014 42643	1034 1074	40
2	NAWF5 + 493 Term. Continued 1X	38516 36797	1025 1046	21
3	NAWF5 + 467 Term. Continued 1X	41955 40924	1009 995	–14
4	NAWF5 + 244 Term. Continued 2X	42987 44363	878 983	105

Table 3. Influence of additional irrigation on lint yield.

Field	Lint Increase or Decrease	Economic Value of Additional Irrigation(s)
	lb/acre	$/acre
1	+40	+$ 21.00
2	+21	+$ 8.65
3	–14	–$ 14.10
4	+105	+$ 58.25