DETERMINING THE OPTIMAL TIMING FOR THE FINAL IRRIGATION ON ARKANSAS COTTON

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RESEARCH PROBLEM

Irrigation termination recommendations for cotton tend to key on first open boll, a better indicator of the maturity of the first fruit than the whole crop. The studies reported here are part of a multi-state project whose overall objective is to develop crop-based recommendations for timing the final irrigation on cotton as grown in a range of typical field environments. This report describes the studies conducted in Arkansas in 2001.

BACKGROUND INFORMATION

Cotton growers across the Cotton Belt are adopting COTMAN, a COTton MANagement system developed at the University of Arkansas used to monitor crop development and aid in making end-of-season decisions (Danforth and O'Leary, 1998). The later-season portion of the system is based on monitoring the number of nodes above the uppermost first-position white flower (NAWF) on a plant. Bourland et al. (1992) found that a first-position white flower five nodes below the plant terminal represented the last effective flower population. Based on their findings, NAWF=5 is generally accepted as physiological cutout.

The COTMAN system uses a target development curve (TDC) as a reference to compare with actual crop development. The TDC has flowering beginning at 60 days after planting (DAP) and NAWF=5 at 80 DAP. Comparisons of actual crop development to the TDC provide an indication of the maturity of the crop. Early-season stress often results in first flower at a relatively low NAWF value and physiological cutout occurring in less than 80 DAP (Bourland et al., 199?). Currently, research-based deci-

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sion guides have been developed to aid in identifying the last effective boll population and determining dates for safe termination of insect control and the application of defoliants based on physiological cutout. Another area of cotton production that may benefit from COTMAN is the decision of when to stop irrigating the crop. A recommendation that relates the timing of the final irrigation to physiological cutout should fit the needs of the crop and follows the approach taken with other management recommendations.

RESEARCH DESCRIPTION

Five irrigation termination studies were conducted in Arkansas during the 2001 growing season. Cotton was planted on 38-inch rows and furrow irrigated. With the exception of irrigation termination, cultural practices followed Cooperative Extension Service (CES) recommendations. Seedcotton weights were determined with an instrumented boll buggy and an assumed gin turnout of 35% was used to calculate lint yield. NAWF data were collected weekly from early flower until NAWF<5. Information about the crops in each study is included in Table 1. For each site, the first termination treatment was targeted for approximately NAWF=5 (physiological cutout). An additional treatment was terminated with each subsequent irrigation. Fiber samples were submitted to Cotton Incorporated for high-volume instrument (HVI) analyses.

Northeast Arkansas

Three studies were conducted in Mississippi County in northeast Arkansas. One study was on the University of Arkansas Northeast Research and Extension Center (NEREC) at Keiser, on a field containing areas of Sharkey silty clay and Sharkey-Steele complex soils. Irrigation plots consisted of 4 rows approximately 800 ft long, with 4 buffer rows between plots, and seedcotton weights were obtained from all 4 rows for two harvests. A second study was on Field 89 of Wildy Farms near Manila, with areas of Routon-Dundee-Crevasse complex and Amagon sandy loam soils. Irrigation plots consisted of 18 rows approximately 1200 ft long and seedcotton weights were determined from the center 12 rows for two harvests. A third study was on Field 78 of Wildy Farms, with Routon-Dundee-Crevasse complex soils. Irrigation plots consisted of 18 rows approximately 1300 ft long and seedcotton weights were determined from the center 4 rows for one harvest.

Southeast Arkansas

Two studies were conducted in Desha County in southeast Arkansas on the Steve Stevens Farm near Rohwer. One experiment was on E Pond field on a Hebert silt loam. Irrigation plots consisted of 12 or 16 rows approximately 1000 ft long and seedcotton weights were determined from the center 4 rows for one harvest. The

second experiment was on Barrett field on a Rilla silt loam. Irrigation plots consisted of 16 rows approximately 500 ft long and seedcotton weights were determined from the center 8 rows for one harvest.

RESULTS

Northeast Arkansas

Even though two cultivars and three planting dates were used, all three fields reached NAWF=5 on 95 DAP, 15 days later than the 80 DAP for the COTMAN TDC (Table 1). However, none of the crops appeared to have suffered any early-season stress, with each having a relatively high NAWF at first flower (~9, data not included). Final irrigations ranged from 27 July (3 days or 70 DD60 before NAWF=5 at NEREC) to 4 September (32 days or 609 DD60 after NAWF=5 at Wildy 89) (Table 2). At Wildy 89 and Wildy 78, a 0.5-inch rain occurred on 8 August, one day after irrigation. Therefore, 8 August was considered the "effective" irrigation date. While each of the crops tended to have the lowest yield associated with the earliest final irrigation, the irrigation termination effect was significant for yield only at Wildy 89, and there were no significant differences among the four latest termination treatments (≥11 days or 220 DD60 after NAWF=5) in that study (Table 3). At NEREC and Wildy 89 it was possible to make two harvests, allowing percent first harvest to be used to indicate earliness. For both crops, the earliest crops (i.e., highest percent first harvest) were associated with the earliest final irrigation. Fiber quality was not affected. These findings are consistent with the results reported by Vories et al. (2001) for northeast Arkansas in 2000.

Southeast Arkansas

Even though the planting dates were similar, the fields reached NAWF=5 on 86 and 101 DAP for Stevens E Pond and Stevens Barrett, respectively (Table 1). The late date for Stevens Barrett resulted from early-season stress that delayed fruiting. The relatively low yields (Table 3) were probably affected by the early stress. A 5-inch rain occurred at Stevens Farm on 29 August, about the time the treatments were to begin being implemented on Stevens Barrett field. For the purposes of the experiment, the rainfall was considered the effective final irrigation for one treatment (21 days or 426 DD60 after NAWF=5, Table 2), even though the time required for drying out from that much rain would be much greater than is typical after irrigation. Another portion of the field was irrigated on 13 September (36 days or 673 DD60 after NAWF=5). Neither the yield difference nor fiber quality differences were significant at Stevens Barrett (Table 3).

The large rain came relatively later in the study period on Stevens E Pond, on the day following the final irrigation on the 4th treatment. Therefore, 29 August was considered the effective irrigation date for that treatment (Table 2). Final irrigations ranged from 9 August (20 days or 470 DD60 after NAWF=5) to 29 August (40 days or 890 DD60

after NAWF=5). Yield was significantly affected, with higher yield associated with later irrigation (Table 3). Although the difference between treatments 3 and 4 was not significant, the 29 August rain was likely close enough to the final irrigation on treatment 3 (22 August) to minimize any possible effect. Micronaire was significantly affected, with higher micronaire associated with the later irrigations (Table 3).

PRACTICAL APPLICATION

Only two of the five studies showed significant differences in cotton yield with later irrigation; however, rainfall affected the studies in southeast Arkansas. Where yield differences were significant, the differences for southeast Arkansas (Stevens E Pond) were observed later in the growing season (after 20 days or 470 DD60 after NAWF=5) than for northeast Arkansas (Wildy 89, where no differences were observed later than 11 days or 220 DD60 after NAWF=5). Only two of the studies were harvested twice and in both (NEREC and Wildy 89) there was a significantly lower percent first harvest associated with later irrigation. Very little difference was observed in fiber quality for the different irrigation termination treatments. Micronaire was significantly affected in Stevens E Pond in southeast Arkansas, where micronaire tended to increase with later irrigation. Similar coordinated studies were conducted in Louisiana and Missouri in 2001. In addition to these locations, studies will be conducted in Mississippi and Texas in 2002. Crop-based recommendations should be developed soon by comparing the findings from all of these studies, leading to more efficient use of irrigation water and the energy associated with pumping.

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Table 1. Cultivar and significant dates for each site from the 2001 cotton irrigation termination studies.

Location	Cultivar	Planting date	NAWF=5 Date	NAWF=5 DAP	Harvest
NEREC	Sure-Grow 747	26 Apr	30 Jul	95	21 Sep; 9 Oct
Wildy 89	ST 4892BR	30 Apr	3 Aug	95	26 Sep; 18 Oct
Wildy 78	ST 4892BR	8 May	11 Aug	95	18, 22 Oct
Stevens E pond	DP 451 B/RR	25 Apr	20 Jul	86	28 Sep
Stevens Barrett	ST 4892BR	29 Apr	8 Aug	101	26 Oct

Table 2. Timing of the final irrigation in the 2001 cotton irrigation termination studies.

Treatment	Date	Final irrigation: Days after planting	Final irrigation: Days after NAWF=5[z]	Final irrigation: DD60 after NAWF=5[z]
NEREC				
1	27 Jul	92	-3	-70
2	9 Aug	105	10	234
3	20 Aug	116	21	444
4	30 Aug	126	31	669
Wildy 89				
1	8 Aug[y]	100	5	102
2	14 Aug	106	11	220
3	21 Aug	113	18	334
4	28 Aug	120	25	489
5	4 Sep	127	32	609
Wildy 78				
1	8 Aug[y]	92	-3	-67
2	14 Aug	98	3	52
3	21 Aug	105	10	166
4	28 Aug	112	17	321
5	4 Sep	119	24	441
Stevens E pond				
1	9 Aug	107	20	470
2	15 Aug	113	26	592
3	22 Aug	120	33	735
4	29 Aug[y]	127	40	890
Stevens Barrett				
1	29 Aug	122	21	426
2	13 Sep	137	36	673

[z] Negative values signify that the final irrigation was made before a field-average NAWF=5.
[y] Date changed by one day to account for rain on the day following irrigation.

Table 3. Lint yield, earliness and fiber quality findings from the 2001 cotton irrigation termination studies.

Treatment	Lint yield[z]	% First harvest	Micronaire	Strength	Length
NEREC					
1	1199	88	4.45	26.3	1.15
2	1275	83	4.40	27.1	1.18
3	1268	79	4.38	26.7	1.15
4	1252	78	4.55	26.0	1.16
$LSD_{(0.05)}$	NS	4	4.42	26.3	1.18
Wildy 89[y]					
1	1014	85	4.42	29.1	1.13
2	1110	82	4.58	29.5	1.13
3	1137	79	4.70	29.1	1.16
4	1082	80	4.58	29.4	1.13
5	1116	81	4.65	30.5	1.17
$LSD_{(0.05)}$	67	4	NS	NS	NS
Wildy 78					
1	806	--	4.48	29.5	1.16
2	898	--	4.45	28.6	1.15
3	874	--	4.60	29.2	1.17
4	944	--	4.65	29.4	1.17
5	890	--	4.60	28.7	1.17
$LSD_{(0.05)}$	NS	--	NS	NS	NS
Stevens E pond					
1	958	--	4.48	27.1	1.09
2	986	--	4.38	26.9	1.08
3	1045	--	4.72	26.8	1.07
4	1029	--	4.75	27.4	1.10
$LSD_{(0.05)}$	55	--	0.18	NS	NS
Stevens Barrett					
1	589	--	5.02	29.6	1.13
2	615	--	5.00	29.5	1.14
$LSD_{(0.05)}$	NS	--	NS	NS	NS

[z] Assuming 35% gin turnout.
[y] Fiber-quality samples collected from first of two harvests.