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DETERMINING THE OPTIMUM TIMING FOR THE FINAL DRIP IRRIGATION ON COTTON BASED ON CROP MONITORING: WEST TEXAS

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Abstract

Interest is growing in expanding the use of the heat unit (HU) calculations of COTMAN to assist in end-of-season recommendations such as irrigation termination. Current recommendations in subsurface drip irrigated cotton are inadequate to determine the optimum timing to stop irrigation. This study was conducted to determine if crop based recommendations could be used for timing the final irrigation in subsurface drip irrigated cotton in West Texas. Treatments were made by shutting off the drip irrigation in an 8 acre zone at approximately 400, 550 and 700 Heat Units (HU) after cutout, based on 5 nodes above white flower (NAWF). Evaluations included percent open boll, nodes above cracked boll (NACB) and yield.

The three timings for irrigation termination did not affect crop maturity as measured by percent open. Only the earliest measurement of NACB revealed any difference in maturity with the 400 HU treatment having fewer NACB.

Shutting off the water early did not negatively affect yield. In fact, the 400 HU treatment had the highest final yield. However, final yield data did not make since due to the 550 HU treatment having the lowest yield.

No differences were detected between the treatments for lint and seed weights.

No advantage was gained by watering subsurface drip irrigated cotton beyond the point of 400 HU past cutout. This subject needs further investigation. Additional studies need to be conducted on when irrigation should cease in drip irrigated cotton that include the measurement of other factors in addition to HU accumulation since cutout.

Introduction

COTMAN has been under evaluation in Texas as a management tool for several years and is being incorporated as one of the tools in cotton production. Much of the research has focused on end-of-season management decisions, especially insecticide terminations.

Interest is now growing in expanding the use of COTMAN to assist in other end-of-season recommendations. Growers are expanding the use of irrigation in west Texas, especially with the development of LEPA (Low Energy Precision Application) and subsurface drip irrigation systems. Water costs are a major input and any savings by increasing efficiency or limiting additional water inputs will accrue to the grower immediately. Current recommendations in subsurface drip irrigated cotton, concerning the timing of the final irrigation, are based on a variety of factors ranging from an educated guess involving firmness of bolls, percent open bolls and soil moisture considerations. Other methods for terminating irrigation on drip irrigated cotton relies on the calendar and not on the maturity of the crop.

A recommendation that relates final irrigation to physiological cutout should provide a more reliable measure and fit with other management tactics such as insecticide termination and defoliation. This study was the second year of a trial designed to determine if the rules of COTMAN could be used to determine the final irrigation in subsurface drip irrigated cotton in West Texas. In 2002, a trial indicated that drastic yield reductions will result from early termination of irrigation. In 2003, the study attempted to refine the timing for irrigation termination.

Materials and Methods

The study was conducted in a growers field near St. Lawrence, Texas. The field had a drip irrigation system designed for small plot trials. The design was a randomized complete block with four replications. Each plot was 40 feet long and 6 rows wide.

The variety FiberMax 832 was planted on 10 May 2003 in 40-inch rows. Pre-plant irrigation was applied in the amount of 4.4 inches. In-season irrigation began on 12 July 2003. The plots were watered for 24 hours every three days.

The field reached 5 nodes above white flower (NAWF) on 8 August. The first treatment was begun on 28 August with 418 Heat Units (HU) accumulated since cutout and a total of 5.48 inches of water applied. Water was shutoff for the second treatment on 8 September with 586 accumulated since cutout. On 19 September, water was shutoff of the third treatment. HU accumulation was 720 HU since cutout. The treatments will be referred to as the 400 HU, 550 HU and 700 HU treatments, respectively.

Harvest was taken on four dates from 10 feet of row from each plot. Percent open and nodes above cracked boll (NACB) observations were made on adjacent rows. At the final harvest, 100 boll samples were taken on adjacent rows to each of the harvest locations to determine boll characteristics. All harvest samples were ginned at the Lubbock Research and Extension Center.

All data was analyzed in ARM 6. The percent open data was transformed by using the arcsin of the square root of the percent.

Results and Discussion

Maturity was measured by observing percent open bolls and NACB. At no time during harvest time was statistical differences found in percent open (Table 1). And differences in NACB were found only at the first harvest date (Table 2). In the 2002 trial, shutting off the water early tended to hasten maturity (Biles, et al, 2002).

Harvest was accomplished by hand pulling bolls that were open sufficiently to insert the index finger into the top of the boll. The four harvest dates were 11, 19 and 26 September and 2 October.

The accumulated yields were analyzed by adding the lint together from each of the harvest dates. Beginning at the second harvest date, lint yields began to show differences (Table 3). No statistical differences were found for the accumulated lint of the first three harvest dates. The final yields were statistically different but unexplainable as the treatments watered most and least had more lint than the 550 HU treatment.

One hundred bolls were harvest to determine the lint and seed weight per boll. No statistical differences were detected for either lint weight per 100 bolls or seed weight per 100 bolls. (Table 5).

Conclusions

No distinct differences were found between the treatments. This contrasted with the 2002 study, in that lint yields were impacted severely by shutting the irrigation water off at 300 HU after cutout, additional watering tended to delay crop maturity, increase lint per boll and seed weight.

The differences between the studies could be the result of several factors. First, the optimal timing for irrigation termination might be between 300 and 400 HU after 5 NAWF. Second, different watering schemes will have different optimal timings for irrigation termination. Third, year to year variations in the weather may impact the optimum timing. Other factors may also be involved such as soil moisture in the root zone and boll maturity at various levels in the canopy. In order to more effectively understand the proper end of season water management additional studies need to be conducted.

Acknowledgments

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References

Biles, Stephen, Chris Sansone and Billy Warrick. 2002 Determining the Optimum Timing for the Final Drip Irrigation on Cotton Based on Crop Monitoring: West Texas. 2002 Proceedings Beltwide Cotton Conferences, January 7-10, 2003. Nashville, TN. National Cotton Council, Memphis TN.

Vories, Earl, Jeremy Greene, Steve Hague, Bobby Phipps, Lyle Pringle, William Robertson, Phil Tacker, and Tina Teague. 2002. Determining the Optimum Timing for the Final Irrigation on Mid-South Cotton. 2002 Proceedings Beltwide Cotton Conferences, January 7-10, 2003. Nashville, TN. National Cotton Council, Memphis TN.

Table 1. Percent open bolls of the various subsurface drip irrigation termination treatments.

Treatment	11 September	19 September	26 September	2 October
400 HU	29.0	59.3	77.4	87.1
550 HU	27.8	53.4	71.9	81.3
700 HU	17.0	43.3	65.9	84.2
p-value	0.0818	0.4123	0.4947	0.1874

Data was transformed using the arcsin square root of the percent for analysis. Data shown is the untransformed data.

Table 2. Nodes Above Cracked Boll for the various subsurface drip irrigation termination treatments.

Treatment	11 September	19 September	26 September	2 October
400 HU	5.9 b*	2.4	1.7	0.8
550 HU	6.9 ab	3.3	1.7	1.6
700 HU	7.8 a	3.6	2.4	1.2
p-value	0.0165	0.4050	0.5297	0.2951

*Means followed by same letter are not significantly different (= 0.05).

Table 3. Accumulated lint yields of the individual harvest dates of the various subsurface drip irrigation termination treatments.

Treatment	11 September	19 September	26 September	2 October
400 HU	375	800	958	1075 a*
550 HU	329	713	858	945 c
700 HU	298	632	866	1031 b
p-value	0.7417	0.3348	0.3586	0.0022

*Means followed by same letter are not significantly different (= 0.05).

Table 4. Lint and Seed Weight per 100 bolls of the various subsurface drip irrigation termination treatments.

Treatment	Lint Weight per 100 Bolls (g)	Seed Weight per 100 Bolls (g)
400 HU	180	277
550 HU	198	284
700 HU	199	296
p-value	0.4378	0.4333