

Effect of Irrigation Termination Date On Defoliation And Yield of Upland Cotton For Short-Season Production

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ABSTRACT

A field study was conducted at the Maricopa Agricultural Center to determine the influence of plant water stress on the effectiveness of defoliant and yield of short season cotton. Irrigation termination dates of 11, 18 and 24 August were used to achieve different levels of water stress at the time defoliant was applied (1 September). Irrigation termination dates had little effect on the response of cotton to defoliant. Def-6 at the lowest rate tested, 0.75 lbs a.i./A, was less effective in defoliating cotton with a 24 August irrigation termination date than cotton terminated earlier. Dropp resulted in higher defoliation percentages and 30% fewer unopened bolls at harvest than Def-6. Although the irrigation termination dates provided a range of CWSI values at the time of chemical termination, no clear relationship was found between CWSI values and defoliation percentages. Short season cotton (149 days) produced 3.2 bales of lint/A compared to 4.4 bales for a full-season crop (208 days).

INTRODUCTION

Interest in the use of a short-season production system has increased in Arizona in recent years. An area of concern for growers in the management of cotton for short-season production is defoliation. For short-season production, defoliation must be done in late August or early September when conditions are favorable for vegetative growth and foliage is often very dense. This means that multiple applications of defoliant may be required to prepare the crop for harvest satisfactorily.

Although the use of chemicals as conditioners for defoliation has been studied extensively, little research has been done on the management of irrigation to condition the cotton plant for defoliation. Managing the date of the termination irrigation to stress plants at harvest appears to be an important factor in preparing for defoliation. The objective of this study was to determine the effect of plant water stress at the time of defoliation on the effectiveness of defoliant and yield of short season cotton.

MATERIALS AND METHODS

Seed of DPL 90 cotton was planted on 5 April 1989 in moist soil at the Maricopa Agricultural Center. The planting received a total of 180 lbs of N/A preplant and during the season. Three irrigation treatments to provide different levels of plant stress were established at the end of the season by using different irrigation termination dates. Irrigation treatments were as follows:

<u>Treatment</u>	<u>Irrigation Schedule</u>	<u>Days From Final Irrigation to Defoliation</u>	<u>% Depletion of Available Soil Water</u>
I ₁	11 Aug.	21	80
I ₂	11 Aug. & 18 Aug.	14	60
I ₃	11 Aug. & 24 Aug.	8	38
I ₄	11 Aug. & 24 Aug. & 15 Sep.	--	--

The I₄ treatment was included in the test to represent a full season cotton crop and was not chemically terminated until 30 October.

Soil water content in each irrigation treatment was measured weekly with a neutron moisture probe to a depth of 6 feet after the termination irrigation and on the date defoliant were applied. Canopy temperatures were measured with a hand-held infrared thermometer, and vapor pressure deficits were determined with an aspirated psychrometer. This information was used to determine the Crop Water Stress Index (CWSI) for cotton in each irrigation treatment at the time defoliant were applied. Cumulative yield data were collected weekly from 17 August through 28 September to measure the effect of irrigation treatments on earliness. On each date open cotton was hand-picked in subplots of each irrigation treatment.

Twelve defoliation treatments as shown in Table 1 were established as subplots in each of the irrigation treatment (I₁ - I₃) plots. Prep was applied on 24 August and defoliant were applied on 1 September by a Hi-Boy sprayer using 5 nozzles per row. The total volume of spray was 25 GPA. The maximum air temperature was 104° F on the day defoliant were applied and averaged 98° F for the three days following application. Defoliation treatment plots were 4 rows wide by 30 feet long. Unopened bolls were counted in all defoliation treatment plots 14 days after defoliant were applied. Experimental design was a splitplot with four replications. On 16 September, all plots received an application of Dropp + Def-6 to prepare the planting for mechanical harvest. The cotton from 30 feet of the center 2 rows per plot was harvested by machine on 2 October from I₁ - I₃ plots and on 15 November from I₄ plots.

RESULTS AND DISCUSSION

Lint yields averaged 1590 lbs/A for the three irrigation treatments chemically terminated 1 September (Table 2). The lint yield of the I₂ treatment was significantly higher than that of the I₁ treatment, but not the I₃ treatment. Irrigation treatments did not have an influence on the number of unopened bolls remaining 14 days after defoliant were applied or on final plant height.

The irrigation treatments had very little effect on the response of cotton to defoliant (Table 1). The only significant effect of the irrigation treatments was on the performance of Def-6 defoliant. At the lowest application rate, Def-6 was less effective in defoliating cotton in the I₃ treatment than in the I₁ and I₂ treatments.

A statistical analysis of the defoliation treatment data showed that Prep improved defoliation when used as a preconditioning treatment prior to the application of Dropp and Def-6. In addition, Prep reduced by 24% the number of unopened bolls remaining on the cotton at harvest. Dropp resulted in higher defoliation percentages and 30% fewer unopened bolls at harvest than Def-6. Increasing the concentration of Dropp and Def-6 increased the leaf drop percentages in a linear manner and decreased the unopened bolls remaining at harvest. In general, the performance of the defoliant, even at the higher application rates, was inadequate to prepare the cotton for harvest and a second application was necessary. Several factors including the very high air temperatures when defoliant were applied and the vegetative condition of the plants may have reduced the effectiveness of the defoliation treatments.

In order to determine if there were a relationship between plant water stress and the effectiveness of chemical defoliation we obtained CWSI values for each plot at the time defoliant were applied. The I₁, I₂ and I₃ irrigation treatments had average CWSI values of 0.30, 0.15 and 0.10, respectively. Even though the irrigation treatments provided a range of CWSI values, no clear relationship was found between CWSI values and defoliation percentages.

This study was designed to make a comparison of the yields of short season and full season cotton production systems. The short season crop had a 149-day growing season that accumulated 3429 heat units (86/55° F thresholds) while the full-season crop had a 208-day season and 4517 heat units. The short season cotton produced 3.2 bales of lint/A compared to 4.4 bales for the full-season crop.

Table 1. Effect of irrigation and defoliation treatments on leaf drop of DPL 90 cotton grown as a short-season crop.

Defoliation Treatment ¹		Irrigation Treatment		
Chemical	Appl. Rate	I ₁	I ₂	I ₃
	(lbs a.i./A)	----(% leaf drop)----		
Dropp ²	0.10	66	65	63
Dropp	0.20	66	68	68
Dropp	0.30	72	71	73
Prep then Dropp	0.50 + 0.10	68	68	70
Prep then Dropp	0.50 + 0.20	70	79	72
Prep then Dropp	0.50 + 0.30	75	75	78
Def-6	0.75	64	64	55
Def-6	1.13	69	74	69
Def-6	1.50	76	72	70
Prep then Def-6	0.50 + 0.75	70	67	52
Prep then Def-6	0.50 + 1.13	69	68	64
Prep then Def-6	0.50 + 1.50	70	71	68
LSD (0.05) ³		7	7	7

¹ Prep was applied 24 August and defoliant were applied on 1 September. Leaf drop was rated on 15 September.

² Dropp was applied with 0.7 pint crop oil/A and Def-6 was applied with X-77 at 0.3%.

³ LSD (0.05) = 14 for comparing defoliation treatment means at different irrigation treatments.

Table 2. Effect of irrigation treatments on lint yields and unopened bolls at harvest for short-season cotton¹.

Irrigation Treatment	Irrigation Termination Date	Lint Yield	Unopened Bolls	Plant Height
		(lbs/A)	(bolls/ft)	(inches)
I ₁	11 August	1540 b ²	4 a	49 a
I ₂	18 August	1640 a	4 a	52 a
I ₃	24 August	1580 ab	4 a	55 a
Average		1590	4.3	52

¹ Defoliants applied 1 and 15 September.

² Means followed by the same letter are not significantly different at the 0.05 probability level according to Student-Newman-Kuels' Test.