

CROP MANAGEMENT

Effect of Irrigation Termination Date on Defoliation and Yield of Upland Cotton

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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 defoliants and yield of cotton. Irrigation termination dates of 12 August, 24 August, and 8 September were used to achieve different levels of plant water stress at the time defoliants were applied (22 September). The defoliants tested performed well on cotton, which had termination irrigations in August. Def 6 was not as effective as other defoliants in defoliating plants with an 8 September termination irrigation, unless used in combination with Prep. Cotton with an 8 September termination irrigation produced lint yields 9% higher than cotton with August irrigation termination dates.

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. That means that multiple applications of defoliants may be required to satisfactorily prepare the crop for harvest.

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 irrigation termination 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 defoliants and yield of short-season cotton.

MATERIALS AND METHODS

Seed of DPL 90 cotton was planted on 31 March 1988 in moist soil at the Maricopa Agricultural Center. Cold weather at planting time delayed emergence and slowed early-season growth. Later in the season (27 July) a rain and hail storm caused a 20 to 25% reduction in leaf area and damaged some squares and bolls. The planting received a total of 200 lbs of N/A preplant and during the season.

Three irrigation treatments to provide different levels of plant water stress were established at the end of the season by using different irrigation termination dates. Irrigation treatments were as follows:

Treatment	Irrigation schedule (Aug. & Sept.)	Days from final irrigation to defoliation
I ₁	12 Aug.	41
I ₂	12 Aug. & 24 Aug.	29
I ₃	12 Aug. & 24 Aug. & 8 Sept.	14

Soil water content in each irrigation treatment was measured weekly with a neutron moisture probe to a depth of six feet after the termination irrigation and on the date defoliant was applied. Canopy temperatures were measured with a hand held infrared thermometer and vapor pressure deficits were determined with an aspirated psychrometer. The information was used to determine the crop water stress index (CWSI) for cotton in each irrigation treatment at the time defoliant was applied. Computation of the CWSI has not been completed and will be reported at a later date. 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.

Ten defoliation treatments as shown in Table 1 were established as subplots in each of the irrigation treatment plots. The experimental design was a split plot with 4 replications. Prep was applied on 15 September and defoliant was applied on 22 September by a Hi-Boy sprayer using 5 nozzles per row. The total volume of spray was 25 GPA. The maximum air temperature on the day defoliant was applied was 83°F but the average maximum for the week after defoliation was 95°F. Defoliation treatment plots were 4 rows wide by 30 feet long. Unopened bolls were counted in all defoliation treatment plots 14 days after defoliant was applied. The cotton from 30 feet of the center 2 rows per plot was harvested by machine on 15 October.

RESULTS AND DISCUSSION

Hail damage and other problems delayed maturity of cotton in the test and prevented the production of a short-season crop, as was desired. Irrigation termination dates and the date of defoliation were delayed to better conform to crop maturity.

Lint yields were low in August and early September for all irrigation treatments (Table 2). Final yield was 9% higher for cotton that had an 8 September irrigation termination date (I₃ treatment) compared to cotton with August irrigation termination dates (Table 2). The I₃ treatment also had the highest number of unopened bolls remaining 14 days after chemical termination.

Defoliant used in the test all performed well on cotton that had termination irrigations in August (Table 3). At the time defoliant was applied, cotton plants in the I₁ and I₂ treatments (12 and 24 August irrigation termination dates, respectively) had light green foliage and many of the older leaves had abscised, while plants in the I₃ treatment were dark green and had dense foliage. Even without chemical defoliation, cotton in the I₁ treatment was 42% defoliated by 6 October compared to 11% for the I₃ treatment (Table 3). As expected, there were large differences between irrigation treatments in water remaining in the soil at the time defoliant was applied. Nearly 90% of the available soil water in the top three feet had been depleted in the I₁ and I₂ treatments compared to only 53% in the I₃ treatment.

There were no significant differences among defoliant leaf drop percentages for the I₁ and I₂ treatments (Table 3). Def 6 was not as effective as other defoliant in defoliating the green, dense foliage on plants in the I₃ treatment. However, when Def 6 was used in combination with Prep, defoliation was similar to that of the other defoliant. Prep used alone did not significantly promote leaf drop and there was no advantage to using Prep in combination with other defoliant when the termination irrigation was in August. Defoliation treatments did not influence the number of unopened bolls remaining 14 days after chemical termination.

Table 1. Description of defoliation treatments.

Treatment	Chemical	Appl. Rate (lbs a.i./A)
1	Control	
2	Prep	0.50
3	Dropp	0.20
4	Prep + Dropp	0.50 + 0.20
5	Def 6	1.88
6	Prep + Def 6	0.50 + 1.88
7	Gramoxone + Def 6	0.08 + 0.75
8	Prep + Gramoxone + Def 6	0.50 + 0.08 + 0.75
9	Ginstar**	0.15
10	Prep + Ginstar	0.50 + 0.15

* Prep and defoliant in treatments 2-8 were applied with 0.5 pints X-77/A.

** Ginstar is a new harvest-aid product of the Nor-Am Chemical Company.

Table 2. Effect of irrigation treatments on cumulative and final lint yield and unopened bolls remaining after chemical termination.

Irrigation treatment	Cumulative yield				Final yield 15 Oct.	Unopened bolls* (bolls/ft)
	17 Aug.	31 Aug.	14 Sept.	28 Sept.		
	-----lbs/A-----					
I ₁	82a**	441a	894a	1110a	1210b	2.2b
I ₂	71a	393a	824a	1095a	1188b	3.4ab
I ₃	77a	369a	860a	1185a	1312a	4.4a

* Unopened bolls were counted on 6 October, 14 days after application of defoliant.

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

Table 3. Effect of irrigation and defoliation treatments on percentage leaf drop of DPL 90 cotton 14 days after chemical termination.

Defoliation treatment*	Irrigation treatments		
	I ₁	I ₂	I ₃
Control	42	35	11
Prep	53	26	17
Dropp	77	73	71
Prep + Dropp	78	74	70
Def 6	75	73	45
Prep + Def 6	78	80	73
Gramoxone + Def 6	80	75	69
Prep + Gramoxone + Def 6	81	83	63
Ginstar	80	77	72
Prep + Ginstar	83	81	74
LSD (0.05)**	12	12	12

* Prep was applied on 15 September and defoliant were applied on 22 September.

** LSD (0.05)=17 for comparing defoliation treatment means at different irrigation treatments.