Effect of Plant Nitrogen Status and Growth Regulators on Earliness, Effectiveness of Defoliants, and Yield of Upland Cotton

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ABSTRACT

A field study was conducted at the Maricopa Agricultural Center to determine the effect of nitrogen fertility level and growth regulators on earliness, yield of cotton, and effectiveness of defoliants. Nitrogen application rates of 80, 120 and 160 lbs N/A did not influence lint yields or the response of cotton to growth regulators. The growth regulator Pix tended to promote earliness but did not affect final yield. The defoliants tested achieved good leaf drop results independent of the plant nitrogen status. Petiole nitrate-N content at the time of defoliation (4 October) did not correlate well with the response of cotton to defoliation treatments.

INTRODUCTION

Recently there has been interest in Arizona in the use of a short-season production system for cotton. The short-season system referred to here is a 135- to 150-day season with an approximate 15 August irrigation termination date. That production system has several advantages over full-season production such as: 1) it requires reduced irrigation and insecticide inputs; 2) it can act as a method of population suppression of pink bollworms and other insects by reducing the over-wintering generation; and 3) it can result in improved lint quality.

The main disadvantage of the short-season system is that growers face a loss of yield from the elimination of the late-season top crop. To offset that loss, the short-season crop should be managed to maximize the production of early bolls. One method of promoting earliness is through the use of growth-regulating chemicals. Growth regulators have potential as a means of manipulating growth to increase the production of early bolls as well as controlling plant growth and reducing production inputs.

Another area of concern for growers in the management of cotton for short-season production is defoliation. For short-season production, the crop must be defoliated in late August or early September when conditions are favorable for vegetative growth and foliage is often very dense. Limited information is available concerning the management of nitrogen fertility to condition the cotton plant for defoliation, particularly for early termination. The objective of this research was to determine the effect of the nitrogen fertility level and early-season growth regulator treatments on earliness, the effectiveness of defoliants, and the yield of short-season cotton. An important aspect of the work was to evaluate the use of petiole- nitrate monitoring as a guide to defoliant selection and time of application.

MATERIALS AND METHODS

Seeds of the cultivar DPL 90 were planted on 1 April 1988 in moist soil at the Maricopa Agricultural Center. Cold weather at planting time delayed emergence and resulted in very slow growth after emergence. On 27 July the planting was severely damaged by a rain and hail storm. At that time, a 30 to 35% leaf area reduction occurred along with some loss of squares and main stem terminals.

The plot area did not receive preplant N fertilizer. A crop of sweet sudan was grown without N fertilizer in the plot area in the summer of 1987 and removed from the field at the end of the season to lower the residual N content of the soil. The N application rates used for cotton were 80, 120, and 160 lbs N/A. The N fertilizer was sidedressed on plots on 22 May, 16 June, and 1 July. Soil samples were collected before planting to determine the residual soil N present. The nitrate content of cotton petioles was monitored throughout the season for N treatment plots. At the time defoliants were applied, petioles were collected from all defoliation plots and analyzed for nitrate-nitrogen content.

Within each of the N treatment plots, 4 growth regulator treatments were established as follows:

1- Control
2- XE-1019 at .01 lbs a.i./A at 14 June (prebloom) and 24 June (first bloom)
3- XE-1019 at .05 lbs a.i./A at 24 June (first bloom)
4- Pix at .04 lbs a.i./A at 1 July (early bloom)

XE-1019, a product of Chevron Chemical Company, modifies plant architecture and may promote earliness. The cotton plants were approximately 15-, 22-, and 26-inches in height on 14 June, 24 June, and 1 July, respectively. The XE-1019 treatments were applied by a ground rig sprayer with 2 nozzles per row directed at the base of the cotton plants' main stems. Pix was applied as a foliar spray by a ground rig sprayer. To measure earliness, cumulative yield data were collected for growth regulator plots. Open cotton was hand picked in subplots in each growth regulator plot weekly from 12 August through 7 October. Plant heights were measured in each plot on 1 August and 21 October.

Four defoliation treatments were established as subplots in each growth regulator plot as follows:

1- Control
2- Prep + Def 6 at 0.50 and 1.88 lbs. a.i./A
3- Prep + Dropp at 0.50 and 0.20 lbs. a.i./A
4- Prep + Gramoxone + Def 6 at 0.50, 0.80 and 0.75 lbs a.i./A

Prep was applied 23 September by a ground rig sprayer using 30 gallons of water per acre as a carrier. Defoliant chemicals were applied on 4 October with a Hi-Boy sprayer using 5 nozzles per row traveling at 1.5 mph. The total volume of spray was 25 GPA. Prep and all defoliants were applied with 0.5 pints X-77 per acre. Defoliation treatment plots were 4 rows wide by 25 feet long. The final irrigation for this planting was 16 September. Experimental design for this test was a split-split plot with 4 replications. Main plots were N treatments, subplots were growth regulator treatments and sub-subplots were defoliation treatments. The cotton from 25 feet of the center 2 rows in each defoliation plot was harvested by machine on 21 October.

RESULTS AND DISCUSSION

Although the cotton planted for the test was intended to be grown as a short-season crop with chemical termination in early September, that was not possible. The cold weather early in the season, hail damage in July, and other problems delayed the maturity of the crop and the plants were not defoliated until 4 October. The effect of those problems on maturity of the crop can be seen in the sequential harvest data collected in August and early September (Table 1). However, even though the results are not for a short-season crop as intended, the information is appropriate for full-season production.

Nitrogen fertility treatments had no effect on lint yields at the end of the season. However, the lowest N treatment tended to result in earlier yields. Plant height for the 80 lbs N/A treatment (46 inches) was significantly lower than that of the higher N treatments (average of 53 inches) at final harvest. Nitrogen treatments had no effect on the response of cotton to growth regulator treatments.

Lint yields were significantly influenced by growth regulator treatments. Pix tended to promote earliness as shown by sequential harvest data, but yield differences between Pix and the control were statistically significant

only for the 26 August and 7 October harvests (Table 1). In the test, XE-1019 delayed maturity but did not reduce final yields. Plant height was reduced by Pix and that reduction occurred at all N fertility levels (Table 2).

As expected, defoliation treatments had no effect on lint yields. There were significant differences among the defoliants tested in percentage leaf drop; however, the differences were small and were observed only at 7 days after application (Table 3).

Nitrogen treatments did not significantly influence the effectiveness of defoliation treatments. Average leaf drop obtained at the 80, 120, and 160 lbs N/A fertility levels was 85, 82, and 81%, respectively, at 14 days after termination. In addition, no clear relationship was found between petiole nitrate content and defoliation. One possible explanation for the poor correlation between plant N status and defoliation was that petiole nitrate levels were relatively low for all N treatments at the end of the season. Petiole nitrate-nitrogen content averaged 400, 900, and 1,300 ppm for the 80, 120, and 160 lbs N/A fertility levels, respectively.

Table 1. Effect of growth regulators on cumulative lint yield of DPL 90 cotton.

Treatment	Appl. rate	Cumulative Yield 12 Aug.	26 Aug.	9 Sept.	23 Sept.	7 Oct	Final Harvest 21 Oct.
	(lbs.a.i./A)	lbs/A					
Control	------	28a*	313b	842a	1153ab	1343b	1446ab
XE-1019	.01+.01	19b	185c	712b	1081b	1275b	1395b
XE-1019	.05	10b	182c	592b	1038b	1285b	1420b
Pix	.04	30a	381a	939a	1236a	1460a	1574a

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

Table 2. Effect of growth regulators on plant height of DPL 90 cotton.

Treatment	Appl. rate	1 Aug.	21 Oct.
	(lbs. a.i./A)	inches	
Control	-------	47a*	54a
XE-1019	.01+.01	45a	52a
XE-1019	.05	46a	51a
Pix	.04	42b	47b

* 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 defoliation treatments on leaf drop of DPL 90 cotton.

Treatment	Days After Application	
	7	14
	----------%----------	
Control	20c*	40b
Prep + Def 6	71a	85a
Prep + Dropp	65b	83a
Prep + Gramoxone + Def 6	67ab	81a

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