Comparison of Early Season and Mid-Season Applied Plant Growth Regulators on DPL 5415 Cotton

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Abstract

Several plant growth regulators were applied to DPL 5415 cotton to evaluate effectiveness on cotton lint yield. Growth regulators applied in small amounts over multiple applications early in the growing season reduced yields compared with the check, while a single application applied at full-bloom slightly increased lint yields. High night time temperatures from late July into early September were detrimental for cotton production. Increased squaring of early season applications compared with the check may have resulted in reduced yields due to increased stress from temperatures and/or nutrient availability. Increased stress in the early treated (more fruit) plots may have had greater fruit abscission.

Introduction

Commercially marketed and available hormone based plant growth regulator (PGRs) products are increasing in number and complexity on an annual basis. Most growers are familiar with the plant growth regulator PIX™ (active ingredient = mepiquat chloride), which is not hormonal and functions as an anti-gibberellic acid growth regulator. Growers and most university personnel are less knowledgable about hormonal plant growth regulators.

Hormone based plant growth regulators are generally defined by the hormone they contain. These hormone classes are gibberellins, auxins, abcissic acids, cytokinins and ethylenes. Growth promotion PGRs for cotton usually come from the gibberellin and cytokinin classes. Gibberellins have the unique ability to among plant hormones to stimulate extensive growth of intact plants (Salibury and Ross, 1978) while cytokinins are used to promote increased rooting and flowering/ fruit set. A number of hormones exist in each of the classes, especially in the cytokinin class, which is known to have at least 28 (with some estimates of more than 100 different hormones). Many commercial products contain multiple hormones of the same class or several hormones from multiple classes.

Arizona field testing of hormone based PGRs in the past several years has provided varying responses. In two studies by Nelson and Hart (1993, 1994) examining multiple applications of PGR IV (a product containing gibberellic acid and the auxin indolebutyric acid) on Pima and upland cotton, no significant effect on lint yield was found. Hood (1993) found that the product Cytokin (containing cytokinins) significantly increased lint yield of DPL 5415 cotton when compared to Pix or Pix/Cytokin combinations during 1992, but slightly reduced yields compared to the check in 1993 (Hood 1995). Clark and Carpenter (1994) reported a 102 lb/acre increase in lint for DPL 90 and a 201 lb/acre increase in lint for Pima S-6 for X-Cyto compared to the untreated check, while Cytokin reduced DPL 90 lint yields but slightly increased Pima S-6 yields. Clark and Carpenter (1995) found that PGR IV significantly reduced seed cotton yield for DPL 90 upland cotton as all treatments in the study had reduced yields compared with the check, but all treatments applied to long staple Pima S-6 cotton increased seed cotton yields.

This study was conducted to compare various hormone based PGRs and to determine if timing of application (early vs. peak bloom) and/or application methodology (once vs. multiple) affected yield response of DPL 5415 cotton.

Methods and Materials

A field of DPL 5415, planted May 3rd, 1995 by Rolanco Farms on the Colorado River Indian Tribes Reservation south of Poston, AZ, was used for this study. Treatments were replicated four times with a randomized complete block design. Plots were each 1.175 acres in size, consisting of 24 rows (40 inch spacing) by field length (640 ft). Treatments were applied with a Hague sprayer calibrated to apply 40.8 gpa to treated area with a single 8006 nozzle over the row. All treatments were applied early in the morning (6-9:30 a.m.) to maximize uptake by plants and while temperatures were cool to minimize evaporation.

Early season treatments were initiated at pinhead square (May 31, 452 HUAP), with treatments approximately every two weeks thereafter through June (June 15 = 812 HUAP, and June 30 =1173 HUAP). Two ounces of material were applied on May 31, and 4 oz. on each of the June dates, for a total of 10 ounces of product per treated acre. A single 10 ounce/acre treatment of Triggrr and Cytokin was applied on July 27 (1896 HUAP, approximatley peak bloom) so comparisons could be made of material effectiveness when applied in split applications early in the crop season with a mid-season application.

Treatments and rates of product per acre were as follows:

	May 31	June 15	June 30	July 27
Triggrr	2 oz pH = 5.4	4 oz	4 oz	
Cytokin	2 oz pH = 5.4	4 oz	4 oz	
Cytoplex	2 oz pH = 3.1	4 oz	4 oz	
Sunburst	2 oz pH = 8.9	4 oz	4 oz	
Triggrr				10 oz
Cytokin				10 oz
	All treatments with exception of Sunburst had NU-Film-P added at rate of 4 oz/treated acre as surfactant. Water buffered with sulfuric acid.	Treatment (all) pH was 5.5. 4 oz/treated acre of NU-Film-P was added as surfactant with exception of Sunburst.	4 oz/treated acre of NU-Film-P added as surfactant with exception of Sunburst. pH= 6.0	pH = 7.0. 4 oz per acre of First Choice added as surfactant.

Plots were sampled on June 30 Five plants/plot were evaluated for height, number of nodes, and square retention. Only one replicate was sampled on this date however.

Petioles were collected from plants in plots from all replicates shortly after the midbloom treatment application to determine effects, if any, on plant nutrient concentrations. Twentyfive petioles were collected from each plot.

Cconcentrations of nitrate and phosphorus were determined in the laboratory by Stanworth Crop Consulting (Blythe, CA) on August 1 and 10. Plant height measurements were also obtained on August 1st. Data were analyzed for statistical differences.

Fields were harvested October 25. Attempts to utilize a scale for cotton weights from individual plots were unsuccessful. Cotton from all replicates was then consolidated for each treatment in separate modules, ginned, weighed, baled and analyzed for quality by Modern Ginning Company (Blythe, CA).

Results

Effects on early season plant parameters Plant height, numbers of nodes per plant, squares and fruit retention data were collected from the one replicate were evaluated. These data indicate that on June 30, all early treatments had more total squares/plant than the check, although retention at sites 1+2 were for the most part lower than the check, but were very good overall. Height to node ratios were similar, although the lowest ratio was noted in the Triggrr treatment, which had the highest node numbers. Fewest number of nodes and shortest plants were noted in the Sunburst treatment (Table 1).

Petiole analyses and August plant height No statistical differences existed between treatments for plant height or for phorphorous or nitrate concentrations in petioles. Plants treated with Triggrr were shorter than other treatments, and all treatments other than the 10 oz. (July application) Cytokin treatment had shorter plants compared with the check.

Petiole nitrateconcentrations declined by approximately 3300 ppm for the early Triggrr, Cytoplex and both Cytokin treatments, and 2200-2400 ppm for all other treatments from August 1st to 10th. Petiole nitrate on August 10 (2304 HUAP) exceeded 2000 ppm only in the check and the early cytokin treatment, but were approximately 1000 ppm or less for all other treatments with the exception of Sunburst, which was just under 1700. Nitrogen levels below 4000 ppm are considered deficient until late August, although boll load can cause a reduction in petiole nitrate (Pennington and Tucker, 1983). The decline in petiole nitrate concentrations observed from August 1-10 is assumed to be associated with decreased vegetative growth and increased growth or boll load.

From August 1-10, petiole phosphate concentrations decreased by approximately 20% only in the check, decreased slightly in the July application of Triggrr, and increased slightly in all other treatments with the exception of Cytoplex, which increased by 225 ppm (16 % increase). Increased phosphate levels may be due to fruit abscission, resulting in fewer fruiting sites.

Yields and Classification Lint yields from the July applications were slighltly higher than the untreated check, but all early treatments had reduced (0.18-0.4 bales/acre) yields compared with the check (Table 2). Although unable to record data from each replicate for statistical analysis, the data are considered reliable as each treatment harvest acreage yield was 4.7 acres.

Several trends were noted. Each of the four early treatments lowered yield compared to the check (overal reduction = 0.3 bales or 11.5%) , while both July treatments slightly increased lint yields (1.7%). This may have been due to earlier fruit formation that was later abscised due to high August night temperatures for these treatments, while later treatments may have increased fruit production/retention during this period. Previous research had shown that DPL 5415 had yields reduced by 43% under higher night time temperatures (average 3.5° C) compared with a cooler control due to poor fruit retention (Zieher et al., 1994). Temperatures following the July treatment were very warm (Figure 1) with night temperatures only cooling down to 78°F or higher. Little differences existed between the treatments for fiber classification. Differences that were noted between treatments were extremely consistent

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Table 1. Mean nodes per plant, plant height and square retention on June 30th, and petiole analyses for August 1 and 10 of Delta & Pine Land 5415 cotton.

		June 30					August 1			August 10	
					Squares			Means parts per million in petiole			
Treatment	Rate/acre	Nodes	Height (In)	Ht/Node Ratio	Retention % Sites 1,2	Total/ Plant	Plant Ht (in)	NO_3	PO_4	NO_3	PO_4
Triggrr	2,4,4 oz	15.8	18.8	1.19	72.5	28.0	49.5	4,073	1,415	758	1,483
Cytoplex	2,4,4 oz	15.0	18.5	1.23	64.3	20.6	50.0	3,715	1,393	468	1,618
Cytokin	2,4,4 oz	14.8	19.5	1.32	72.3	20.4	51.0	5,143	1,523	2,198	1,560
Sunburst	2,4,4 oz	13.6	18.0	1.32	75.8	16.8	51.3	3,898	1,553	1,668	1,668
Triggrr	10 oz	-----	-----	------	------	------	46.0	3,453	1,690	1,008	1,633
Cytokin	10 oz	-----	-----	------	------	------	53.5	2,695	1,508	843	1,658
Check	----	14.4	18.7	1.30	75.3	15.6	52.3	4,728	2,020	2,463	1,615

No statistical differences exist for means in columns for August 1 or August 10. Data from June 30 represent only one replicate.

Table 2. Lint yields and classification of plant growth regulator treated Delta & Pine Land 5415 cotton.

Treatment	Rate/acre	Yield[1] in bales per acre	Turnout (%)	Color Grade	Length (Inches) 32nds	Length (Inches) 100ths	Micronaire	Strength (g/tex)	Uniformity
Early Season									
Triggrr	2,4,4 oz	2.42	37.8	21	36	111	51	29.6	81
Cytoplex	2,4,4 oz	2.35	37.1	21	35	110	51	28.5	80
Cytokin	2,4,4 oz	2.23	33.3	21	36	113	50	29.9	81
Sunburst	2,4,4 oz	2.20	35.4	21	35	110	50	28.6	81
Averages =		*2.30*	*35.9*	*21*	*35*	*111*	*50*	*29.2*	*81*
Mid-Bloom									
Triggrr	10 oz	2.64	41.7	21	35	110	51	29.0	81
Cytokin	10 oz	2.65	39.5	21	35	110	51	29.4	81
Averages =		*2.645*	*40.6*	*21*	*35*	*110*	*51*	*29.2*	*81*
Check	----	2.60	39.5	21	35	110	50	29.4	81

[1] Reported as 480 lb bales

Note: All bales from the same treatment had identical fiber quality values (turnout and yield not included).

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