FIELD EVALUATION OF PLANT GROWTH REGULATORS

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RESEARCH PROBLEM

Cotton (*Gossypium hirsutum* L.) is a perennial with an indeterminate growth habit and is very responsive to changes in the environment. This has led to the need to manipulate plant growth, while maximizing yield, using plant growth regulators (PGRs). In the past two decades many new plant growth regulator (PGR) compounds have been developed and tested on field-grown crops. The objective of this study was to evaluate the effect of foliar application of the plant growth regulator ATONIK on the growth and yield of field-grown cotton.

BACKGROUND INFORMATION

Field evaluation of available PGRs has been routinely conducted at the University of Arkansas for the past twenty years (e.g., Urwiler et al., 1989; Oosterhuis et al., 1996; Zhao and Oosterhuis, 2001). Research has been directed towards determining the effect of PGRs on growth and yield (Oosterhuis and Zhao, 1997, 1998), investigating the physiological effects and underlying mechanisms of PGRs (Guo et al., 1994), and studying the effects of PGRs under stress conditions, i.e. drought, flooding or shade (Zhao and Oosterhuis, 1998). These studies improve our understanding of how individual PGRs work and assist with recommendations regarding the use of PGRs in current cotton production systems in Arkansas.

RESEARCH DESCRIPTION

Two field experiments were planted into a Calloway silt loam soil at the Delta Branch Station in Clarkedale, Arkansas, on 9 May 2001. Fertilizer, weed, and insect control measures were according to Cooperative Extension Service recommendations.

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Plots consisted of four rows 15 m long with 0.9 m between rows and 3 plants per foot in-row spacing. Plots were furrow-irrigated as needed throughout the growing season.

Atonik Rate Study

Treatments consisted of an untreated control and Atonik at four rates; 2.5, 5.0, 10, and 20 oz/acre, applied at matchhead square (29 June) and one week after first flower (19 July). Foliar spray applications were made with a CO_2 backpack sprayer calibrated to deliver 10 gallons solution/acre. The adjuvant Penetrator Plus (Helena Chemicals, Memphis, TN) was used at 0.5% v/v. The experimental design was a Latin Square with five replications. The cotton cultivar Suregrow 747 was planted on 5 May 2001. Physiological measurements were also made to understand the mode of action but the results will not be reported here. Petiole nutrients were recorded at 5 and 10 days after each Atonik application time. At maturity, boll weight and boll number were recorded by hand picking a one-meter length of row in the center two rows of each plot. Fiber quality was also determined from the hand-picked seedcotton samples, and final yield was determined by mechanically harvesting the center two rows of each plot.

Mepiquat Chloride and Atonik Combination

Treatments consisted of (1) an untreated control, (2) mepiquat chloride applied at matchhead square (MHS) at 8 oz/acre and at first flower at 16 oz/acre, (3) mepiquat chloride at MHS (8 oz/acre) plus Atonik at 5 oz/acre, and (4) mepiquat chloride at MHS (8 oz/acre) plus Atonik at 10 oz/acre. The experimental design was a randomized complete block with five replications. The cultivar used was DPL 33B. At harvest (3 October), yield and components of yield were recorded.

RESULTS

Lint Yield

In the Atonik Rate Study there were no significant differences (P=0.05) between treatments for yield or components of yield (Table 1) although there was a *trend* for Atonik to increase yields (i.e., 4.3% compared to the control). There was also no real difference in fiber quality between treatments (Table 2). Furthermore, petiole nutrient status was not different between treatments (Table 3) at first flower plus 10 days. There was no significant difference in lint yield between treatments in the Mepiquat Chloride plus Atonik trial (Table 4), although again, there was a slight trend (P=0.07) for Atonik to increase yields (i.e., by 6.3%).

PRACTICAL APPLICATION

The primary objective of this study was to evaluate Atonik under field conditions for effect on growth and yield. In the two trials, Atonik did not significantly increase yields. However, the 2001 growing season was favorable for cotton and in general, spray applications of PGRs (and foliar fertilizers, see Coker et al., 2002) did not have a statistically significant affect on yield in our studies. Generally, over the past ten years, our studies have shown a large year-to-year variability in growth and yield response, with most PGRs performing inconsistently and showing little or no significant increase in yield.

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Table 1. Yield component response of furrow-irrigated, field-grown cotton cv. 'SG 747' to foliar Atonik foliar-applied at matchhead square (MS) and one week after first flower (FF1), Clarkedale, 2001.

	Components of yield			
Treatment	Open bolls	Boll weight	Turnout	Lint
	(# m^{-2})	(g $boll^{-1}$)	(%)	(lb $acre^{-1}$)
Control	100.4 a[z]	3.74 a	36.8 a	1139 a
Atonik - 2.5 oz/A @ MS and FF1	100.0 a	3.92 a	37.8 a	1227 a
Atonik – 5 oz/A @ MS and FF1	94.4 a	3.71 a	37.1 a	1188 a
Atonik – 10 oz/A @ MS and FF1	96.8 a	3.90 a	37.9 a	1221 a
Atonik - 20 oz/A @ MS and FF1	97.0 a	3.98 a	37.8 a	1180 a

[z] Numbers followed by the same letter within a column are not significantly different (P=0.05).

Table 2. Fiber quality (HVI) response of furrow-irrigated, field-grown cotton cv. 'SG 747' to foliar Atonik foliar-applied at matchhead square (MS) and one week after first flower (FF1), Clarkedale, 2001.

	Fiber quality				
Treatment	Micronaire	Strength	Length	Uniformity	Elongation
		(g tex^{-1})	(in)	---------- (%)	----------
Control	3.7 a[z]	30.2 a	1.14 a	83.8 a	7.2 a
Atonik - 2.5 oz/A @ MS and FF1	3.7 ab	31.1 a	1.15 a	83.4 a	7.1 a
Atonik – 5 oz/A @ MS and FF1	3.5 ab	31.1 a	1.15 a	83.6 a	7.1 a
Atonik – 10 oz/A @ MS and FF1	3.7 ab	30.1 a	1.13 a	83.0 a	7.0 a
Atonik - 20 oz/A @ MS and FF1	3.4 b	30.2 a	1.15 a	83.1 a	7.1 a

[z] Numbers followed by the same letter within a column are not significantly different (P=0.05).

Table 3. Petiole nutrient concentrations of field-grown cotton cultivar SG 747 sampled at first flower plus 10 days (FF+10), Clarkedale, Arkansas, 2001.

	Petiole nutrient concentration (FF+10 days)			
Treatment	NO_3-N	P	K	S
	($\mu g\ g^{-1}$)[z]	($\mu g\ g^{-1}$)	($mg\ g^{-1}$)[y]	($\mu g\ g^{-1}$)
Control	4854 a[x]	3702 a	52.4 a	1454 a
Atonik - 2.5 oz/A @ MS and FF1	3886 a	3588 a	51.0 a	1218 b
Atonik - 5 oz/A @ MS and FF1	4682 a	3543 a	52.6 a	1387 ab
Atonik - 10 oz/A @ MS and FF1	3888 a	3533 a	53.6 a	1415 a
Atonik - 20 oz/A @ MS and FF1	4192 a	3520 a	51.4 a	1404 a

[z] Original lab value given as “ppm”.
[y] Original lab value given as “%”.
[x] Numbers followed by the same letter within a column are not significantly (P=0.05) different.

Table 4. Cotton lint yields for Mepiquat chloride and Mepiquat chloride + Atonik treatments at Clarkedale, Arkansas, 2001.

Treatment	Lint yield
	(lb/acre)
Control	1075 a[z]
Mepiquat chloride 8oz/A (MHS) + Mepiquat chloride 16oz/A (Flower)[y]	1102 a
Mepiquat chloride 8ox/A + Atonik 5 oz/A[x]	1143 a[w]
Mepiquat chloride 8oz/A + Atonik 10 oz/A[x]	1142 a[w]

[z] Means followed by the same letter within a column are not significantly different (P=0.05).
[y] Mepiquat chloride was sprayed at 8 oz/acre at matchhead square and 16 oz/acre at early flower.
[x] Treatment combinations were applied at both MHS and early flower intervals.
[w] Mepiquat chloride plus Atonik treatment combinations were significant at the P=0.07 probability level.