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. The desire to manipulate plant growth, while maximizing yield, has led to interest in plant growth regulators (PGRs). In the past two decades, many new PGR compounds have been developed and tested on field-grown crops. The objective of this study was to evaluate promising new and existing commercially available PGRs for effect on plant growth, maturity, and yield of field-grown cotton in Arkansas.

BACKGROUND INFORMATION

Field evaluation of available PGRs has been routinely conducted at the University of Arkansas for the past 15 years (e.g., Urwiler *et al.*, 1988; Oosterhuis and Janes, 1994; Oosterhuis *et al.*, 1996). Research has been directed towards (a) determining the effect of PGRs on growth and yield (Oosterhuis and Zhao, 1998), (b) investigating the physiological effects and underlying mechanisms of PGRs (Guo *et al.*, 1994), and (c) studying the effects of PGRs under stress conditions, e.g., drought, flooding, or shade (Zhao and Oosterhuis, 1997). These studies promote our understanding of how individual PGRs work and assist with recommendations regarding the use of PGRs in current cotton production systems in Arkansas. This project has been running since 1992, but only the yields from 1997 to 1999 are reported.

RESEARCH DESCRIPTION

A field experiment was planted into a Calloway silt loam soil at the Delta Branch Station in Clarkedale on 11 May 1999 using the cotton cultivar Suregrow 125. Treatments consisted of an untreated control, Early Harvest, PGR-IV, mepiquat chloride and MepPlus (renamed Pix Plus in 1995). Table 1 shows rates and timing of each treatment. Foliar spray applications were made with a CO_2 backpack sprayer calibrated to deliver 10 gal solution/acre. The experimental design was a randomized complete block with six replications. Fertilizer, weed, and insect control measures were according to extension service recommendations. Plots were furrow irrigated as needed throughout the growing season. Measurements were also made to understand the mode of action of these PGRs but the results will not be reported here.

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RESULTS

Lint Yield

There was no significant increase in yield from any of the PGRs tested in 1997, 1998, and 1999 (Table 2). In 1997, mepiquat chloride significantly decreased yield. The effect of PGRs on lint yield from 1992 until 1997 was presented by Oosterhuis and Zhao (1997). Over the past eight years these 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. Only PGR-IV and mepiquat chloride have shown reasonably consistent results. Over the past three years the PGRs tested have shown an effect on yield ranging from–1.2% to +1.5%. This is insignificant (i.e., a +1.5% increase on a two-bale crop would only be about 14 lb lint/acre) and would not warrant the use of the PGRs tested for yield enhancement.

In-furrow Applications of PGRs at Planting

Generally, the use of PGRs such as Early Harvest and PGR-IV, as an in-furrow application at planting have not produced a yield increase at harvest. Earlier studies in the growthroom showed a positive enhancement of root growth and seedling development for PGR-IV either as a seed treatment or an in-furrow application. Results to date indicate that in-furrow applications of PGRs can enhance early seedling growth, but usually with no yield advantage at harvest. These in-furrow PGR treatments were dropped in 1999.

Plant Height

Only the two growth retardants, mepiquat chloride and Pix Plus, consistently and significantly influenced (reduced) plant height (data not shown).

Maturity

Nodes above white flower measurements as an indication of physiological maturity showed that only the mepiquat chloride and Pix Plus treatments were significantly lower (P=0.05) than all other treatments at each sampling date. Plants in the mepiquat chloride and Pix Plus treatments reached physiological cutout (NAWF = 5) approximately 5 days earlier than the untreated control. However, there was not a clear trend toward early cutout or earlier maturity (open boll counts taken at the end of the growing season) between any other PGR and the control.

Mode of Action

Physiological measurements have also been made of the effects of PGRs on growth, dry matter production, photosynthesis, respiration, electrolyte leakage, carbohydrate status, and ^{14}C translocation from the leaf to the boll. The results of these studies help to understand the mode of action of the PGRs concerned but will not be reported here.

PRACTICAL APPLICATION

The primary objective of this study was to evaluate and compare PGRs under field conditions for their effect on growth and yield. In the last 3 years, the PGRs tested did not increase yield and in 1997 mepiquat chloride significantly decreased yield. Generally, over the past 8 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. Over the past 3 years, the PGRs tested have only shown an effect on yield ranging from –1.2% to +1.5% which would not warrant the use of the PGRs tested for yield enhancement.

LITERATURE CITED

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Table 1. Treatments, rates and timing of PGR applications in 1997, 1998 and 1999.

Treatment	Timing	Rate		
		1997	1998	1999
Control	No PGRs added	----	----	----
Mepiquat chloride	PHS, FF	8 oz/acre, 8 oz/acre	3 oz/acre, 6 oz/acre	5 oz/acre, 10 oz/acre
Pix Plus[w]	PHS, FF	8 oz/acre, 8 oz/acre	3 oz/acre, 6 oz/acre	5 oz/acre, 10 oz/acre
PGR-IV	PHS, FF	4 oz/acre, 4 oz/acre	4 oz/acre, 4 oz/acre	4 oz/acre, 4 oz/acre[u]
Early Harvest	IF[z]	2 oz/acre	2 oz/acre	----
Early Harvest	PHS[y], FF[x]	4 oz/acre, 4 oz/acre	4 oz/acre, 4 oz/acre	4 oz/acre, 4 oz/acre[u]

[z] IF = in-furrow at planting.
[y] PHS = pinhead square.
[x] FF = first flower.
[w] Formerly MepPlus.
[u] Applied at first flower and two weeks later.

Table 2. Effects of PGR application on yield of field-grown cotton at Clarkedale, Arkansas from 1997 to 1999.

Treatment	Lint yield			
	1997	1998	1999	Mean
	(lb acre^{-1})			
Control	1083	896	1080	1020
Mepiquat chloride	981	907	1034	974
Pix Plus[z]	1012	922	1087	1007
PGR-IV	1104	860	1063	1009
EH (In-furrow)	1077	905	—[x]	—
LSD $_{(0.05)}$	84	NS	NS	NS

[z] Formerly MepPlus.
[y] NS = not significant (P = 0.05).
[x] Treatment not included.