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Effects of Mepiquate Chloride on Growth, Fruiting and Yielding Performances of Field-Grown Cotton

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ABSTRACT

The effects of Mepiquat chloride (Pix) on the performances of 58 cotton plots were studied during 1994 and 1995 at Chaibadan district, Lop Buri Province. Pix application at early blooming reduced significantly vegetative growth (node production, inter-node length) during the reproductive period and shortened the crop duration. Over all plots the average seed-cotton yield was not improved by Pix despite significant changes in boll distribution pattern and boll-size. Large variation in yield response existed between plots. The response depended on the rate of increase in internode length prior to Pix application together with fruit retention of the first fruiting branches.
Key words : cotton (*Gossypium hirsutum*), Pix, plant monitoring

INTRODUCTION

Excessive vegetative growth in cotton often occurs in humid tropics environment such as in Thailand. In this country, sowing at the beginning of the rainy season (mid-May to mid-June) is a way to maximize plant growth while escaping from maximum peaks of population of Jassids and cotton bollworms (Castella, 1994). However, in many cases, early sowing leads to excessive vegetative growth resulting in inefficient control of insect pests.

Mepiquat chloride (1,1-dimethylpiperi-dinium chloride) is a plant growth regulator which has been reported to reduce vegetative development (Kerby, 1985; Stuart *et al.*, 1984) by reducing stem elongation and leaf size (Cathey and Luckett, 1980; Mc Carty *et al.*, 1985). However its effect on seed-cotton yield varies according to plant status at time of application (Follin 1979, Dippenaar *et al.*, 1990, Constable 1994). This study carried out in farmers conditions aimed at evaluating the effects of mepiquat chloride on growth, fruiting and yield of Thai cotton cultivars SSR60 in relation to plant growth and plant structure.

MATERIAL AND METHODS

General design

Study was carried out during two years at the cotton growing area of Chaibadan District, Lop Buri Province. 20 and 38 farm plots cultivated with cultivars SSR60 (Sri Sumrong 60),were selected during 1994 and 1995 growing season respectively. After emergence, an area of 11 rows x 10 m with uniform plant stand was selected within the plot.

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The plots were managed by the farmers excepted at early blooming when researchers asked farmers to apply Pix (Mepiquate chloride, BASF) at the rate of 1.2 $l.ha^{-1}$ on half the observation area (5 rows x 10 m). The row adjacent to the treated row was used as a border row and the remained five rows were used as control.

Plant observations

Twenty plants per treatment (Pix, control) were randomly selected within the observation area for insects scouting and plant mapping. This crop monitoring was performed every week throughout the growing season. During plant mapping the following data were recorded : plant height, position of the last mainstem node (defined as last node whose axillary leaf was unfolded), position of the last squaring node (defined as the uppermost sympodium whose substending leaf of the first fruiting site (P1) is unfolded), position of the uppermost white flower on P1 fruiting site and % survival of fruits located on P1 sites of the mainstem sympodia.

At maturity, bolls of all plants of the observation-area (border row not included) were harvested for seed-cotton yield and yield components determination. Between five to eight harvests were carried out. Seed-cotton yields (fresh weight and dry weight) as well as the number of bolls was recorded at each harvest. At final harvest, a complete mapping of plants selected for weekly mapping was carried out in order to describe boll distribution and survival among all fruiting sites. Dry weight of stems (remaining leaves not included) and carpels were measured for an evaluation of the harvest index.

Data analysis

Farm plots were considered as blocks (20 or 38 blocks) for analyzing the effects of Pix on plant growth, boll distribution and yield components. Yield response to Pix according to plant status at application was studied with data from plots displaying at least 10% difference (positive or negative) in yield between control and treated plants.

RESULTS AND DISCUSSION

Effects on plant growth, fruiting and seed-cotton production

As shown in Table 1, Pix application significantly reduced the final plant height by shortening internode length (height to node ratio). The total number of nodes was also reduced with Pix, especially in 1994. After first flower, the decline of the number of Nodes Above White Flower (NAWF) generally observed on cotton (Oosterhuis *et al.*, 1993) was accelerated by Pix as indicated by the difference in time to reach NAWF = 5 (Table 1). This was in agreement with an early slow-down in node production after Pix application. As a result, time to 50% harvested yield (i.e earliness) was shortened by 6 to 8 days with Pix application. Such effects are reported to be consistent responses of the crop to Pix (Hake *et al.*, 1991).

Final yield of Pix treatment was not significantly different from that of the control in both years (Table 1). However, there were significant changes in yield components. Plants treated with Pix produced less bolls (especially in 1994) but with a bigger average boll-size. Contribution of fruiting positions and vegetative branches to the final boll-load were not affected by Pix treatment. In contrast, the distribution of boll along the mainstem nodes showed marked differences. The last productive node as well as the most productive node of plants treated with Pix were recorded on lower nodes than in the control (Table 1). Shift of boll distribution towards lower nodes has been well described by Kirby *et al.*,

Table 1 Effects of Pix application on plant growth, plant structure and yielding performances in farmers-managed cotton (Chaibadan District, Lop Buri Province)

	1994 (20 plots)		1995 (38 plots)	
	Control	Pix	Control	Pix
Final plant height (cm)	138	111*	153	133*
Mainstem nodes	31.1	29*	26	25.5
Height to node ratio (cm)	4.43	3.82*	5.81	5.14*
Days to 50% harvested yield	134	126*	128	122*
Days to NAWF = 5 (1)	88	79*	79	74*
Node with maximum bolls	10.2	9.2*	12.1	10
Last productive node (2)	19.7	17.8*	23	20.5*
% bolls on P1 sites	28.6	28.3	19.7	21.1
% retention P1 fruits, nodes 1-5	71	69	67	68
% bolls on vegetative	15.5	17.8	36.9	33.3
Seed-cotton ($g.m^{-2}$)	232	236	233	235
$Bolls.m^{-2}$	51.5	44.5*	48.7	45.9
Average boll size (g.)	4.71	5.22*	4.79	5.19*
Harvest index	0.41	0.44	0.42	0.43

* significant difference, p=0.05, block significance not shown
(1): Nodes Above White Flower, (2): sympodium with at least one harvested boll

(1986). It was analyzed as a result of a better boll retention at lower nodes with Pix, irrespective to better light penetration. In our conditions, light reduction at lower nodes may not be as severe as found in Kirby *et al.*'s experiments because of low plant population (1.2 to 3.6 $plants.m^{-2}$) and no significant difference in boll retention was observed at lower nodes between treatments (Table 1). Pix effects on boll number and distribution was likely to be the result of an early slow-down in node production together with a better derivation of carbohydrates to sustain fruits growth rather than vegetative growth. Differences observed in boll-size and harvest index supported this idea.

Yield responses to Pix according to plant status at application

Twenty three percent of the plots displayed a positive response of at least 10% while a 10% decrease (or more) was recorded in 37% of the plots (Figure 1). The type of response was not yielding dependent (Figure1). Erratic yield response to Pix application have been reported by several authors who showed that plant status prior to application was a major determinant (Follin 1979, Dippenaar *et al.*, 1990, Constable 1994) together with air temperature (Reddy *et al.*, 1990) and growth conditions after the application (Kerby, 1985, Martin, 1994). In our conditions, Pix application was performed by farmers between 53 to 64 Days After Planting (75% of the plots) and

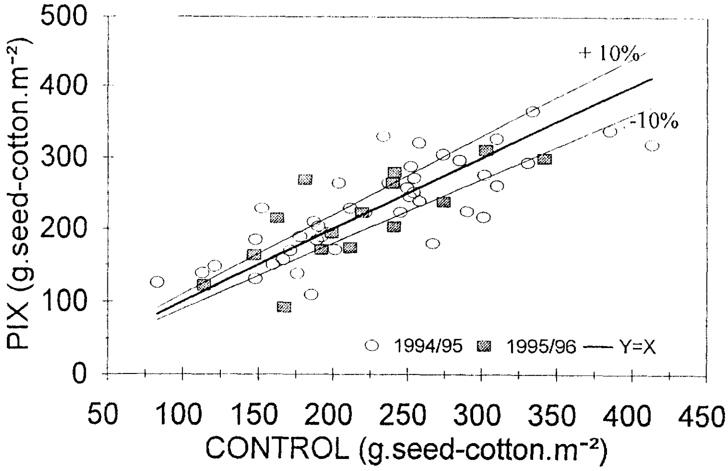

Figure 1 Seed-cotton yield of Pix-treated plants according to seed-cotton yield of the control.

plant status at application varied much between plots.

Time of application as well as plant height, average node length and nodes above white flower prior to application were not relevant indicators of the yield response (data not shown). At the opposite, the rate of increase in internode length (change in plant height / change in node number) during the week prior to application provided a fair prediction (Figure 2). When internode length increased less than 6 cm/node no positive yield response was recorded and yield was reduced dramatically in several plots after Pix application. Conversely positive responses to Pix were recorded when internode length overpassed 6 cm/node, only. In Australia, rate of increase in internode length was also reported to be the most reliable indicator to predict yield response prior to Pix application; significant yield increase being expected when internode length increase at more than 6.5 cm/node (Constable, 1994). However, such criteria is probably insufficient for decision making since negative responses were observed with plots having a high internode increase but a poor retention (< 60%) of P1 fruits on the five first sympodia at time of application (Figure2). In that case, Pix application reduces the possibility of compensatory fruiting of cotton by limiting the production of upper nodes.

CONCLUSION

These results showed that recommendation for Pix application could not be standardized without taking plant structure into consideration. Decision to apply Pix should be based on an evaluation of fruit survival and plant growth rate (increase in internode length) at early blooming. Pix should not be considered only as a way to improve yield. It is also a mean for shaping plant structure and adapting the crop duration to cropping systems constraints.

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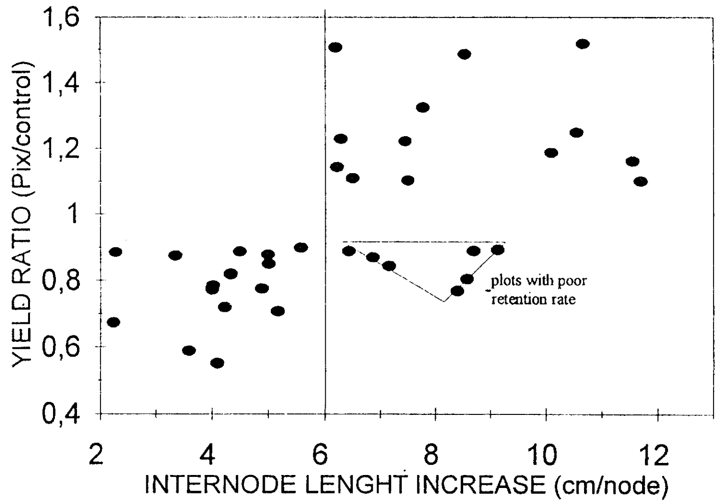

Figure 2 Yield response to Pix application (yield of the treated plot/ yield of the control) according to the rate of increase of internode length prior application.

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