Effect of Four Growth Regulators – Cytokin, Cytoplex, Atonic and PHCA – on Cotton Fruiting Pattern, Yield and Quality

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ABSTRACT

The effect of four plant growth regulators (PGRs) on crop performance, fruiting pattern, yield and fiber quality in cotton (Gossypium hirsutum L.) was evaluated in field experiments for two years in Greece. All four PGRs (Cytokin, Cytoplex, PHCA and Atonic) increased seedcotton yield and differences were related to effects on plant growth and development. Number of sympodia with 2 bolls and total boll number increased significantly in the Cytokin and Cytoplex treated plants, while Atonic and PHCA had a lesser effect. All PGRs increased boll retention, either at first or at second position. Lint quality was not affected by PGRs, although in some experiments positive effects were found in fiber maturity and strength. It is concluded that the four PGRs have the potential to control plant growth and enhance yield.

Introduction

PGRs have been widely used in cotton, to control growth and enhance yield. The last decade many new compounds have been developed and tested in cotton, and some of them were very promising. However, the lack of understanding of the underlying mechanism of the chemicals and the influencing parameters such as environmental and crop conditions, as well as other factors, result some times in variable and inconsistent results.

In 1994, a cooperative research project started in the countries participating the Working Group - 3 (WG-3) on Plant Growth Regulators of the Inter-Regional Research Network on Cotton (Mediterranean and Middle-East countries and the University of Arkansas, USA). The aim was to evaluate the effect of selected new PGRs (PGR-IV, PHCA and Cytokin at the first year, added with Cytoplex and Atonic the next years) at sites within each member country, on the growth and yield of cotton. The results of 1994 in Greece showed positive effects, such as increases on yield, petiole nitrate nitrogen content and fiber maturity (Kosmidou *et al.*, 1997), but they needed further verification. In the present work, results from field experiments in 6 locations for two years, concerning Cytokin, Cytoplex, PHCA and Atonic are presented.

Material and Methods

Field experiments were planted in 6 different locations in Greece for two consecutive years (1995, 1996). Treatments consisted of an untreated control and four PGR's, applied at the company's recommended rates and timing (Table 1). The experimental design was a randomized complete block with six replications.

Planting performed by a 4 row 0.97 cm apart machine. Plot size was 8 rows by 20 m. Preplant fertilizer consisted of N:P:K at 50-80-80 kg/ha, plus 50 kg/ha N side-dressed at mid-squaring.

Irrigation, weed and insect control measures were according to Hellenic Cotton Board recommendations. The fruiting pattern, plant height, total number of bolls, number of main stem nodes, number of first sympodium, number of sympodia with two bolls and boll retention were measured using COTMAP (Bourland and Watson 1990).

In samples of 30 open bolls per plot per harvesting, boll weight, lint % and fiber technological characteristics were measured, with HVI as well as with classical laboratory instruments (stelometer, Pressley, micronaire).

Technological characteristics were measured on HVI instruments in the Textile Technology Research Centre of the Hellenic Cotton Board in Thessaloniki.

Results and Discussion

Effect of PGRs on seedcotton yield

Table 2 shows that seedcotton yield was increased significantly at 0.05 level due to Cytokin in 4 experiments, PHCA in 3, Cytoplex and Atonic in one out of eleven experiments in total. Moreover, numerical yield increases occurred in other experiments additionally to the above, as follows: in 6 experiments by Atonic and in five experiments by PHCA and Cytoplex. Mean seedcotton yield in all experiments for the two years, shown in Fig. 1, increased 5.3% by Atonic, 5% by Cytokin and Cytoplex and 4.9 by PHCA.

Effect of PGRs on plant growth and fruiting pattern

Statistical analysis of data on plant height showed that in 1995, Cytokin reduced it significantly in two locations (Thessaloniki and Karditsa), and Cytoplex,

Proceedings of the World Cotton Research Conference-2. Athens, Greece, September 6-12, 1998. pp.617-620.

Atonic and PHCA in one location (Thessaloniki). A general trend of height reduction was observed (Table 3). Data indicate that the tested PGRs controlled plant height, but not in all locations.

It has been reported that cytokinin products could give significant increases in boll number and boll retention (Mayeaux et al, 1986; Mayeaux, 1997). In this study, the fruiting pattern in three locations, (COTMAP, Bourland and Watson, 1990), was improved by PGR treatments. Cytokin and Cytoplex significantly increased total number of bolls per plant (Fig. 2) while Cytokin gave the highest number of sympodia with two bolls (Fig. 3). These data are correlated with increased yields. PGR treatments improved boll retention, either at first or second position (Fig. 4). In particular, boll retention at first position was increased 8.3% by Cytokin and 3.8%, 4.5% and 3.5%, by Cytoplex, PHCA and Atonic, respectively. Cytokin and Cytoplex also significantly increased boll retention at second position (14.9 and 4.3% respectively). As it is known, boll retention can be high only if the plant has the ability to supply sufficient nutrients to meet boll demands. Higher root/shoot ratios, i.e. larger root mass and increased root activity for nutrient uptake are beneficial. Increased nitrate uptake due to Cytokin and PHCA was found in our previous work (Kosmidou *et al.*, 1997) and in other research results (Oosterhuis *et al.*, 1995; Oosterhuis and Janes, 1997).

Boll weight and fiber quality

Mean values of boll weight, lint percentage and fiber technological characteristics over all experiments show no differences due to the PGRs tested (Table 4).

Positive significant effects were found in fiber strength caused by Cytoplex in one location (Thessaloniki 1995), while numerical increases were caused by Atonic and Cytoplex in four experiments, by Cytokin in three and PHCA in two experiments. In addition, numerical increases in micronaire values were observed with Atonic in five experiments, Cytoplex in four, PHCA in three and Cytokin in two experiments. Mean values of all experiments show Atonic to be superior in influencing micronaire value. Similar influences on micronaire due to these PGRs were found in previous experiments (Kosmidou *et al*, 1997). These results are not sufficient to conclude that PGRs affect fiber quality.

Conclusions

This study shows that these PGRs could be a useful for enhancing yield and controlling plant growth in cotton in Greece. Yield increases resulting from these PGRs were associated with fruiting pattern alterations, such as total boll number, number of sympodia with two bolls and boll retention.

References

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Table 1. PGRs: time of application and rates.

Treatment	Time of application	Rates
Control	no PGR's	-
Cytoplex	PHS, FF	300ml/ha, 600ml/ha
Cytokin	PHS, FF, FF+2wks	280ml/ha, 560ml/ha, 560ml/ha
PHCA	PHS, FF, FF+2wks	560ml/ha, 1120ml/ha, 1120ml/ha
Atonic *	PHS, FF, FF+2wks	100ml/ha, 200ml/ha, 200ml/ha

* Atonic in Greece contains 1.8% active ingedient instead of 0.6%.

** PHS = pinhead square, FF = first flower, FF+2wks = two weeks after first flower.

Table 2. Seedcotton yield (Kg/ha) in 6 locations in Greece, for two years. Data followed by same letter are not significantly different (Duncan's test).

Location	Thessaloniki		Veria	Larisa		Karditsa		Volos		Lamia	
Treatment	*1996*	*1995*	*1995*	*1996*	*1995*	*1996*	*1995*	*1996*	*1995*	*1996*	*1995*
Control	2520$_{a}$	2524$_{c}$	4340$_{a}$	4340$_{a}$	3125$_{a}$	2816$_{b}$	3582$_{c}$	3844$_{a}$	3843$_{c}$	3405$_{a}$	3320$_{a}$
Cytokin	2440$_{a}$	3276$_{ab}$	4255$_{a}$	4195$_{a}$	3140$_{a}$	3186$_{a}$	3855$_{ab}$	3806$_{a}$	4302$_{ab}$	3475$_{a}$	3520$_{a}$
Cytoplex	2680$_{a}$	3546$_{a}$	4710$_{a}$	4185$_{a}$	2955$_{a}$	2962$_{ab}$	3680$_{bc}$	3925$_{a}$	4180$_{bc}$	3322$_{a}$	3250$_{a}$
PHCA	2560$_{a}$	3412$_{ab}$	4555$_{a}$	4135$_{a}$	3245$_{a}$	2964$_{ab}$	3911$_{ab}$	3789$_{a}$	4163$_{ab}$	3486$_{a}$	3270$_{a}$
Atonic	2760$_{a}$	3048$_{b}$	4410$_{a}$	4345$_{a}$	3115$_{a}$	2992$_{ab}$	3614$_{bc}$	3922$_{a}$	4509$_{bc}$	3781$_{a}$	3300$_{a}$

Table 3. Effect of PGRs on plant height.

Treatment	Plant height - mean of 11 locations (cm)
Control	105.8
Cytokin	102.0
Cytoplex	104.0
PHCA	103.2
Atonic	102.6

Table 4. Effect of PGRs on boll weight, lint percentage and technological fiber characteristics (mean of 6 locations, 1995 and 1996).

Treatment	Boll weight (gr)	Lint %	Micronaire (HVI)	Fiber length 2.5% (HVI)	Uniformity (HVI)	Strength (gr/tex, HVI)
Control	6.22	39.6	3.67	28.5	47.6	23.9
Cytokin	5.98	39.6	3.64	28.4	47.4	23.8
Cytoplex	6.14	39.8	3.65	28.6	47.7	24.0
PHCA	6.08	39.5	3.59	28.4	47.2	23.6
Atonic	6.16	39.6	3.72	28.6	47.5	23.7

Figure 1. Effect of PGRs on seedcotton yield (mean 6 locations, 1995 and 1996).

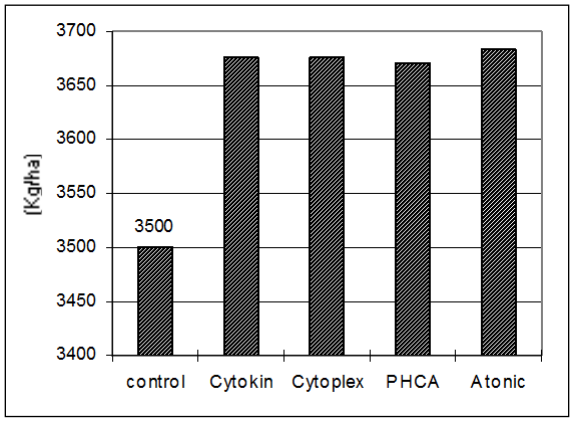

Figure 2. Effect of PGRs on total number of bolls/plant.

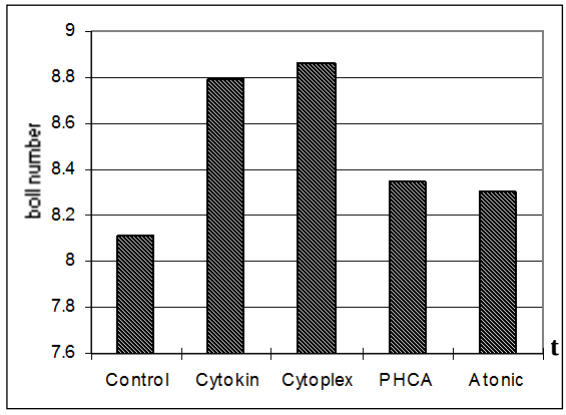

Figure 3. Effect of PGRs on number of sympodia with 2 bolls.

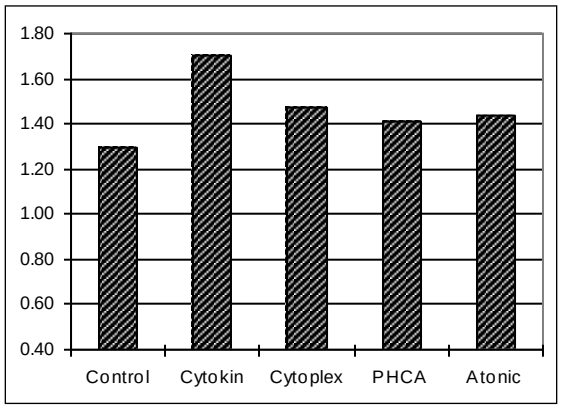

Figure 4. Effect of PGRs on boll retention (1st and 2nd position).