PGR-IV Increased Cotton Yield by Affecting Various Fruiting Parameters

K. Kosmidou, L. Bouza, S. Papadopoulou, I. Grigoriadis, A. Karagounis, G. Konstantinidis, K. Patsialis and V. Svidridou
Hellenic Cotton Board (Central and Regional Offices), 150, Syngrou Av., 17671 Athens, Greece.

ABSTRACT

The effect of the plant growth regulator PGR-IV on cotton (Gossypium hirsutum) was evaluated in field experiments in up to eight locations, for three years (1995-97) in Greece. Seedcotton yields were increased by up to 20 % in most locations, compared to the control. The mean yield increase in all locations and years was 4.9%. This was correlated with increases in boll retention, number of sympodia with two bolls and total boll number per plant. Late PGR-IV applications had no significant effect on seedcotton yield, compared to the PGR-IV treatment with three applications. No effect was found in plant height and fiber quality parameters. It is concluded that PGR-IV can increase seedcotton yield by affecting plant performance.

Introduction

Controlling cotton plant growth and enhancing yield through the use of plant growth regulators (PGRs) has been the subject of much research. The last two decades many compounds have been developed and tested with variable results. PGR-IV is a relatively new multi-entity plant growth regulator, consisted mainly of gibberellic acid, indole butyric acid and a fermentation broth. It is reported to improve the growth and yield of cotton (Kosmidou *et al.*, 1997a; Kosmidou *et al.*, 1997b; Oosterhuis, 1994a; Oosterhuis, 1994b; Oosterhuis and Zhao, 1994; Oosterhuis and Janes, 1994). In previous research in Greece (Kosmidou *et al.*, 1997b) PGR-IV was tested in three different treatments on cotton (*Gossypium hirsutum* L.), in field experiments in many locations. PGR-IV was found to increase yield numerically in most locations and in some, the differences were statistically significant. There were indications that PGR-IV could increase nitrogen uptake by the plants, total number of bolls and boll retention in first and second positions. The objective of the present work was the further evaluation of the best of these treatment (Kosmidou *et al.*, 1997b), in order to adapt its use to the growth requirements of cotton in the environmental conditions of Greece.

Material and Methods

Field experiments were planted for three consecutive years (1995-1997), in randomized complete block designs with five replications in up to eight locations in Greece. Treatments consisted of an untreated control and PGR-IV in three sprays (73 ml/ha in furrow, 146 ml/ha at pinhead square and 292 ml/ha at first flower). The third year, a third treatment was added, with only one late PGR-IV spray, consisted of 450 ml/ha at 10 days after first flower.

Planting was with a 4-row machine at 0.97-cm spacing. 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 sympodial bolls, number of sympodia with two bolls and boll retention were measured using COTMAP (Bourland and Watson, 1990). Boll weight, lint % and fiber technological characteristics were measured on samples of 30 open bolls per plot per harvesting, with HVI and with classical laboratory instruments (Stelometer, Pressley, Micronaire).

Results and Discussion

Effect of PGR-IV on seedcotton yield

Seedcotton yield (Table 1) was significantly increased by PGR-IV in four experiments out of a total of nineteen. Numerical yield increases occurred in eight other experiments. When the mean yield in each location for the 3 years was calculated (Fig. 1), higher yield due to PGR-IV occurred in seven out of the eight total locations. In cumulative data per location (mean 1995-97), PGR-IV treatment of three sprays gave higher yields than the control at six of the eight areas of experimentation. Yield increase in two of them was significant. The other two areas gave equal yields to control.

Cumulative data per year show that in 1995 and 1997, PGR-IV performed better, especially in 1995, while in 1996 the effect was negligible in most locations (Fig. 2). This can be attributed to differences on weather conditions affecting PGR-IV performance, causing inconsistent yield responses. Livingston and Parker (1994) also reported inconsistent PGR-IV yield

responses that were attributed to differences in cultivars and weather conditions. The single, late PGR-IV application in 1997 gave no significant differentiation in response in most experiments compared to three PGR-IV applications (Table 1).

Effect of PGR-IV on plant growth and development

In this study, plant height and boll weight were not affected significantly by PGR-IV treatments (Table 2). There are reports of increased boll size due to PGR-IV (Hickey and Athins, 1992; Livingstone and Parker, 1994), but in other reports no significant effects were found (Oosterhuis and Zhao, 1994; Weir *et al.*, 1994). It seems that the final number of bolls per plant and the crop and environment conditions that are correlated with boll size can influence the mean boll weight.

The node of first sympodium was not influenced by PGR-IV (Table 3) except in one location where the decrease was about a half node. Total number of bolls per plant was slightly increased by the three PGR-IV sprays in 1995 and 1997 (Fig. 3, Table 3), but there were no differences in 1996. The boll number increase significantly in one location only in 1995. The late application PGR-IV did not increase boll number/plant. Boll retention was increased in the second boll position (up to 20% higher), indicating that the PGR-IV treated plants had the ability to load more bolls than the control (Fig. 4, Table 3). This increase can be correlated with the higher number of bolls (Fig. 3) and with the higher boll retention in the second position (Table 3), explaining the yield increases reported above. Increased boll retention was reported in the second fruiting position (Robertson and Cothren, 1993). Increases in total boll retention, especially at the first fruiting position, have also been reported (Livingston and Parker, 1994); Weir *et al.* 1994).

The number of sympodia with two bolls (cumulative data) was increased slightly, the difference being significant in two locations (Table 3). This is correlated with the increased boll retention at the second fruiting position.

Lint percentage and fiber quality

The mean lint percent and fiber quality in all locations in all years were not influenced by PGR-IV (Table 2). Within experiments, numerical increases were found in micronaire in five locations and in fiber strength in four locations. Micronaire increases due to PGR-IV was found in some but not all experiments in 1994 (Kosmidou *et al.*, 1994b). Similar results have been reported (Robertson and Cothren, 1993), but other reports show no significant PGR-IV effects on fiber quality (Livingston *et al.*, 1992; Livingston and Parker, 1994).

In conclusion, these results show that PGR-IV has potentiality to increase seedcotton yield in Greece, by influencing cotton plant fruiting parameters.

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Table 1. Seedcotton yield (Kg/ha) in 8 locations for 3 years in Greece. Data followed by * are significantly higher than control. Data followed by + are numerically higher than control.

Locations	Karditsa			Volos			Larisa			Lamia		
Year	*1995*	*1996*	*1997*	*1995*	*1996*	*1997*	*1995*	*1996*	*1997*	*1995*	*1996*	*1997*
Treatment												
Control	3582	2816	2880	3843	3844	3828	3125	4340	3369	3320	3405	2143
PGR-IV (3 sprays)	4032 *	3392 *	3008 +	4153 +	3831	3499	3210 +	4275	3770 +	3200	3650 +	1989
PGR-IV (1 late spray)	-	-	3190 +	-	-	3580	-	-	3400 +	-	-	2070
LSD (0.05)	332	402	NS	NS	NS	NS	NS	NS	NS	NS	NS	NS
Locations		Veria			Thessaloniki			Serres			Komotini	
Year	*1995*	*1996*	*1997*	*1995*	*1996*	*1997*	*1995*	*1996*	*1997*	*1995*	*1996*	*1997*
Treatment												
Control	4340	-	4008	2524	2520	2464	-	-	3765	-	-	2790
PGR-IV (3 sprays)	4255	-	4256 +	3028 *	2440	2350	-	-	3780 +	-	-	3258 **
PGR-IV (1 late spray)	-	-	4080 +	-	-	2710 +	-	-	3940 +	-	-	3020 *
LSD (0.05)	NS	-	NS	483	NS	NS	-	-	NS	-	-	217

Table 2. Plant height, boll weight, lint % and fiber technological characteristics (data 1995-97).

Treatment	Plant height (cm)	Boll weight (gr)	Lint %	Fiber length 2,5% (HVI)	Uniformity (HVI)	Strength (gr/tex, HVI)	Micronaire (HVI)
Control	100.94	6.17	40.3	28.36	47.18	23.72	3.83
PGRIV (3 sprays)	100.39	6.18	40.4	28.47	47.42	23.73	3.87

Table 3. Effect of PGR IV on various fruiting pattern parameters of cotton.

Treatment	Total number of bolls/plant	Node of 1st sympodial node	Number of sympodia with 2 bolls	Boll retention 1st position (%)	Boll retention 2nd position (%)	% bolls 1st & 2nd position
Control	10.5	6.6	1.36	75.15	19.85	84.7
PGRIV (3 sprays)	11.2	6.5	1.47	74.99	23.75	83.8

Figure 1. Effect of PGR-IV on seedcotton yield in 8 locations in Greece (mean 1995-1997).

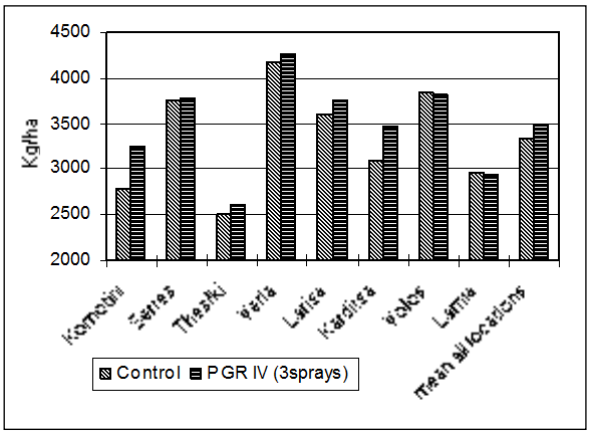

Figure 2. Effect of PGR-IV on seedcotton yield/per year.

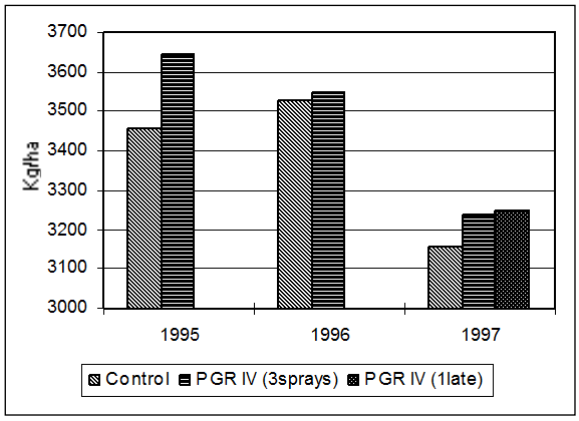

Figure 3. Effect of PGR-IV on total boll number/plant (mean/year).

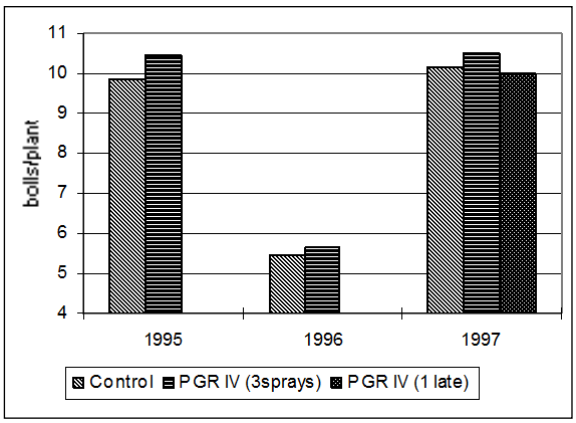

Figure 4. Effect of PRG-IV on boll retention at second position.