

## Effect of Mepiquat chloride and boron on irrigated cotton (*Gossypium hirsutum*) in Turkey

OZGUL GORMUS

Department of Field Crops, Faculty of Agriculture, Cukurova University, Adana, Turkey 01330

Received : May 2005

### ABSTRACT

A field study was conducted from 2003 to 2004 to evaluate effects of foliar application of Mepiquat chloride and boron on growth and yield of upland cotton (*Gossypium hirsutum* L.). Mepiquat chloride @ 0.15 litre/ha significantly reduced plant height, number of main stem nodes and nodes to first fruiting branch compared to the control. Plants treated with Mepiquat chloride at first flowering and 2 weeks after first flower stage and boron @ 0.15 litre/ha at first flowering and 4 weeks after first flowering resulted in significantly highest number of open bolls and seed-cotton yield. All foliar B applications applied either at 2 weeks and 4 weeks after first flower resulted in similar but higher yields than the control. Neither Mepiquat chloride nor B affected gin turnout.

**Key words :** Boll weight, Boron, Cotton, Plant height, Main stem nodes, Yield

Foliar application of Mepiquat chloride, a plant growth regulator, is an accepted cultural practice for controlling rank vegetative growth of cotton (Kerby, 1985). Although it has been the most successful and widely used plant-growth regulator to control cotton plant size in cotton production, cotton yield responses to it have been variable and inconsistent. Oosterhuis and Robertson (2000) reported an average yield increase of 22.4 kg/ha with application of Mepiquat chloride. Boron requirement of cotton crop is high during flowering and boll development. Gormus (2005) reported significant response to foliar B treatment over the control on clay soil having 0.40 mg/kg B concentration in Adana, Turkey. Research concerning the combined effect of B and plant-growth regulators on cotton is limited. The present study was conducted to evaluate effects of foliar application of Mepiquat chloride and B fertilizer on cotton growth and yield.

### MATERIALS AND METHODS

The field experiment was conducted at the Cukurova University research fields in Adana (161 m, 37°02 N, 35°18 E). Turkey, in 2003 and 2004. Cotton 'Suregrow 125' was planted on 16 May 2003 and on 6 May 2004 and grown under irrigated conditions. The soil type was clay with pH 7.7, sand 17.9%, silt 39.4%, clay 42.8%, with cation-exchange capacity of 23.9 meq/100 g, CaCO<sub>3</sub> 27.8% and salt 0.05%. Four weeks prior to planting, 60 kg N and 70 kg P/ha were broadcast applied. At 60 days after planting, 60 kg N/ha was side-dressed. Recommended and weed control were followed. Plots consisted

of 6 rows spaced 80 cm apart. Plant-to-plant spacing was 20 cm to maintain an optimum plant population of 62,500/ha. Mepiquat chloride treatments included: (i) an untreated control, (ii) 2 applications of 0.5 litre/ha first made at first flower (FF) stage and (iii) at FF and 2 weeks after first flower (2 WAFF) stage. Foliar application of B included : (i) an untreated control, (ii) 3 applications of 0.15 litre/ha of B, with first application at first flower stage, (iii) the 2 weeks after first flower stage (2 WAFF), and (iv) application 4 weeks after first flower stage (4 WAFF). The B treatments were applied to foliage as Bortace-150 (ethanolamine polyborat, 10.9%), made with CO<sub>2</sub> backpack sprayer calibrated to deliver 150.g fertilizer material with 100 litres/ha water for each hectare to be treated. The experiment was laid out in randomized split-plot design with 3 replications. The whole-plot factor was Mepiquat chloride, and the split-plot factor represented foliar B fertilization. Average hot-water-soluble B levels averaged over 2 years, in the top 20 cm soil profile, was 0.38 mg/kg. Prior to any fertilization, soil nutrient concentrations including N, P, K, Ca, Mg, Mn, Cu, and Zn were determined to be adequate each year. Leaf area was determined from a leaf subsample using a model LI-3100 area meter. At the end of season, plant height, number of main stem nodes, number of first fruiting node, and number of open bolls/plant were recorded on 20 plants in each plot. Thirty bolls were harvested from the middle 3 rows of each plot, weighed, and ginned to determine boll weight (g/boll) and gain turnout (%).

Weather conditions in Adana were generally considered

good for cotton growth and yield during 2003 and 2004. Unusual cool temperatures through the end of April, and abundant rainfall in the beginning of May delayed planting in 2003.

## RESULTS AND DISCUSSION

Combined analysis of variance across 2003 and 2004 revealed that main effects associated with Mepiquat chloride and foliar boron application were significant with respect to plant height, seed-cotton yield, and number of open bolls. There was a significant interaction between Mepiquat chloride and B for number of open bolls, leaf-area index, and gin turnout. Year  $\times$  Mepiquat chloride interactions were significant for plant height, number of open bolls, and main stem nodes, and year  $\times$  B application interactions were significant for plant height and number of open bolls. Year  $\times$  Mepiquat chloride  $\times$  B applications interactions were not significant for all measured characters. Statistical differences were not found in the experimental plots for all treatments for gin turnout.

Mepiquat chloride and B treatments reduced the plant height compared with the control. Control plants were taller, had greater number of main stem nodes than plants treated with Mepiquat chloride and B. Mepiquat chloride treatment applied at 2 weeks after first flower reduced the plant height by 21.7 cm compared with the control (Table 1) by reducing rate of node production. Year  $\times$  Mepiquat chloride and year  $\times$  B interactions were significant ( $P \leq 0.05$ ) for plant height. Shortest plants were noted from cotton receiving application of Mepiquat chloride 2 weeks after first flower in 2004. Boron application applied at first flower stage resulted in shortest plants in 2004. Of the 4 B treatments, application at 4 weeks after first flower resulted shortest plants. The number of main stem nodes and first fruiting nodes differed among treatments. When compared to the control plants, applications significantly

reduced number of main stem and first fruiting nodes (Table 1). Number of main stem and first fruiting nodes were significantly decreased by Mepiquat chloride applied at 2 weeks after first flower. Year  $\times$  Mepiquat chloride interaction was significant ( $P \leq 0.01$ ) for number of main stem nodes/plant. Highest number of main stem nodes came from untreated Mepiquat chloride control in 2003. Number of main stem nodes was not affected by B treatments. Differences in number of first fruiting node could not be noted for B applications (Table 1).

There were no statistical differences for the leaf-area index between Mepiquat chloride treatments, although Mepiquat chloride treated plants had smaller leaf-area index compared with the control plants (Table 1). Boron application applied at first flower stage resulted in higher leaf-area index, which was not significantly different from the untreated control. Boron-treated plants at first flower stage exhibited significantly lower leaf-area index. Mepiquat chloride  $\times$  B interaction was significant for leaf-area index. Plants untreated with Mepiquat chloride and B exhibited significantly higher leaf-area index (Table 2).

Mepiquat chloride-treated plants produced more bolls than the control. Its treatment, 2 weeks after first flower, increased the average of bolls by 14.1% over the untreated control. The only B treatment for which cotton plants produced more bolls was its application while 4 weeks after flower stage. Two other treatments resulted in similar values with the untreated control (Table 1) Mepiquat chloride  $\times$  B, year  $\times$  MC, and year  $\times$  B interactions were significant for number of open bolls. The highest number of open bolls were recorded by spraying of Mepiquat chloride (2 WAFF) in combination with B (4 WAFF) (Table 2).

Mepiquat chloride treatments did not affect boll weight, while boron application resulted in increased boll weights over the untreated control. No significant differences in gin turnout among treatments were noted (Table 1). The

**Table 1.** Growth, yield attributes and seed cotton yield as influenced by Mepiquat chloride and B treatments (averaged over 2003 and 2004)

Treatment	Plant height (cm)	Main-stem nodes/plant	No. of first fruiting node	LAI (m <sup>2</sup> /m <sup>2</sup> )	Bolls/plant	Boll weight (g/boll)	Seed-cotton yield (q/ha)
<i>Mepiquat chloride timing</i>							
Control	94.6	22.8	6.4	0.87	14.2	6.6	16.00
FF	77.9	18.9	5.7	0.78	15.3	6.8	34.16
2 WAFF	72.9	16.4	5.4	0.79	16.2	6.9	40.40
CD (P=0.05)	2.3	0.7	0.2	NS	1.2	NS	0.24
<i>B timing</i>							
Control	85.3	19.7	5.9	0.90	14.4	6.5	32.30
FF	81.0	19.5	5.9	0.71	14.8	6.8	31.60
2 WAFF	81.2	19.1	5.8	0.84	15.0	6.9	34.20
4 WAFF	78.8	19.0	5.6	0.79	16.5	6.8	36.20
CD (P=0.05)	3.1	NS	NS	0.12	1.3	0.3	0.21

Treatment details in materials and methods

Mepiquat chloride B interaction was significant for gin turnout. The highest gin turnouts were obtained with Mepiquat chloride-untreated control and B applications made at 2 weeks and 4 week after first flower stages, followed by Mepiquat chloride application made at first flower stage and B application at first flower stage and 2 weeks after stage flower stage (Table 2).

Mepiquat chloride and B treatments resulted in increased seed-cotton yield over the control (Table 1). Application of Mepiquat chloride at first flower stage and 2 weeks after first flower stage increased the seed-cotton

**Table 2.** Boll number, leaf-area index (LAI) and gin turnout as influenced by Mepiquat chloride and boron treatment interactions (averaged over 2003 and 2004).

Mepiquat chloride	B	Bolls/ plant	LAI (m <sup>2</sup> /m <sup>2</sup> )	Gin turnout (%)
Control	Control	12.9	1.09	39.4
	FF	13.7	0.65	41.2
	2 WAFF	13.8	0.95	42.5
	4 WAFF	14.2	0.76	42.6
FF	Control	14.3	0.89	41.7
	FF	14.6	0.69	42.3
	2 WAFF	15.4	0.78	42.3
	4 WAFF	15.8	0.72	39.3
2 WAFF	Control	15.9	0.71	40.3
	FF	16.3	0.76	40.0
	2 WAFF	17.4	0.81	39.5
	4 WAFF	17.7	0.87	40.4
CD (P=0.05)		2.3	0.22	1.5

Treatment details in Materials and Methods

yield over the untreated control by 8.1 and 14.4 q/ha respectively. There results are contrary to those observed by Zhao and Oosterhuis (2002). Increased yields for Mepiquat chloride and B treatments compared with the control might be associated with improved boll weight and number of bolls. As the soils were low in native B (critical value is between 0.5 and 1.0 mg/kg), the cotton crop responded quite favourably to B fertilization. Mepiquat chloride × B interaction was significant ( $P \leq 0.05$ ) for seed-cotton yield in 2004. Highest seed-cotton yields were obtained from Mepiquat chloride applied at 2 weeks after first flower stage and B applied at 4 weeks after first flower stage, followed by applications of Mepiquat chloride and B made 2 weeks after first flower stage. Among B treatments which resulted in significantly higher yields included the application made at 2 and 4 weeks after first flower stage.

## REFERENCES

- Gorums, O. 2005. Interactive effect of nitrogen and boron on cotton yield and fiber quality. *Turkish Journal of Agriculture and Forestry* **29** : 51–59.
- Kerby, T.A. 1985. Cotton response to mepiquat chloride. *Agronomy Journal* **77** : 907–912.
- Oosterhuis, D.M. and Robertson, W.C. 2000. The use of plant growth regulators and other additives in cotton production. (In) *Proceedings of the 2000 Cotton Research Meeting*, AAFS Special Report 198, pp. 22–32.
- Zhao, D. and Oosterhuis, D.M. 2002. Cotton carbon exchange, nonstructural carbohydrates, and boron distribution in tissues during development of boron deficiency. *Field Crop Research* **78** : 75–87.