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COTTON RESPONSE TO MULTIPLE APPLICATION OF GROWTH INHIBITOR (MEPIQUAT CHLORIDE)

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Stance (mepiquat chloride) is a growth inhibitor which is used to regulate vegetative growth. The objective of this study was to determine the efficacy, optimum dose and time of its application. The experiment was designed in Randomized Complete Block Design with seven treatments and three replications. T_1 was control, T_2, T_4 and T_6 (250 ml ha^{-1} at 45th, 60th and 75th day of emergence respectively) and T_3, T_5 and T_7 (500 ml ha^{-1} at 45th, 60th and 75th day of emergence respectively) were evaluated. The yield was maximum in T_7 (500ml ha^{-1} at 75th day of emergence). While T7 (500ml ha^{-1} at 75th day of emergence) and T6 (250ml ha^{-1} at 75th day of emergence) were at par with each other. Plant height was minimum in T_3 (500ml ha^{-1} at 60th day of emergence) but it had no effect on yield.

Keywords: Cotton (*Gossypium hirsutum* L.), mepiquat chloride**,** vegetative growth, arid climate

INTRODUCTION

Cotton (*Gossypium hirsutum* L.) is currently grown in Pakistan on an area of about 3.1 million hectares with production of approximately 11.7 million bales in Pakistan (Anonymous, 2006-07). Pakistan is the fourth largest cotton producer in the world with production of 2.26 million metric tons (Anonymous, 2006-07). The growth and development of crop plants can usually be characterized by a period of vegetative growth followed by a reproductive growth. But under Thal conditions, more number of irrigations leads to more vegetative growth of cotton crop, which delay the reproductive stage. During these periods of growth, photosynthetic products are partitioned into various plant parts. The degree to which plants distribute *photosynthates* between vegetative and reproductive structures determines the growth rate and yield of many economically important crops (Brown, 1984). The cotton (*Gossypium spp*.) plant is somewhat unique by having a perennial nature and indeterminate growth pattern. Ramifications of this growth habit are that vegetative higher and reproductive growth occurs at the same time on the cotton plant and thus compete for photosynthetic products (Brown, 1984). Higher vegetative tendencies in cotton have been shown to lead to losses in reproductive structures (squares, flowers, and bolls) (Gausman *et al*., 1979; York, 1983b; Fletcher *et al.,* 1994). The loss of reproductive structures (carbohydrate sinks) can shift energy from reproductive to vegetative portions of the plant, resulting in a rapid propagation of main stem growth (Mauney, 1986).

Mepiquat chloride MC is a plant growth regulator that has been used in cotton production as a management tool in controlling vegetative growth. Mepiquat chloride is a gibberellic acid suppressant that is absorbed by the green portions of the plant and serves to reduce cell elongation, thus offering the potential of decreasing leaf area and restricting additional plant height increases (York, 1983a; Kerby, 1985). MC has also been found for enhancing earliness with regards to fruiting development (York, 1983b; Kerby, 1985). MC is used as a growth retarder and it reduces plant height, number of nodes, branch length and leaf area (Iqbal *et al*., 2004). Much research has been done to determine optimum rates and MC application time for cotton production (Kerby, 1985; McConnell *et al*., 1992; Boman and Westerman, 1994).

The effect of mepiquat chloride on seed cotton yield is inconsistent. Some have observed increase in yield, some have observed decrease in yield and some has observed no effect on yield. The yield is related to environmental factors like rainfall and temperature (Iqbal *et al*., 2004). The time and rate of MC is also important. If it is applied early and in less concentration it would give more lint yield as compared to late and high dose application (Kerby, 1998). High temperature also increases the vegetative growth (Yeates *et al.*, 2002). In Southern Punjab (Pakistan) farmers sow

cotton end of May to end of June. Temperature is high during these two months so due to high temperature there is more vegetative growth, which ultimately reduces the no. of bolls per plant which results in fewer yields (Iqbal *et al*., 2004). Mepiquat chloride (MC) is used to solve the problem of more vegetative growth but optimum time and dose for the application of (MC) is the problem. In Southern Punjab (Pakistan) there is less research on this aspect.

To solve this problem two years study was conducted at adaptive research farm Karor and in farmer's field at 2007 and 2008. The main objective of this study was to determine the optimum time for the application of MC and to study that how the application of different doses at different times affects the plant height, no. of branches per plant, no. of bolls per plant and yield.

MATERIALS AND METHODS

The field experiments were conducted during 2007-2008 and 2008-2009 at Adaptive Research Farm (A.R. Farm) Karor and at farmer's field in district Layyah. Two different doses (250 ml ha^{-1} and 500 ml ha^{-1}) of Stance (mepiquat chloride) at 45^{th}, 60^{th} and 75^{th} day of emergence were tried in randomized complete block design with seven treatments, T1 was control and two different doses (250 ml ha^{-1} and 500 ml ha^{-1}) of Stance (mepiquat chloride) at 45^{th}, 60^{th} and 75^{th} day of emergence in remaining 6 treatments were used. The seed was taken from Punjab Seed Corporation and CIM- 496 was the test variety. For both years crop was planted during last week of April with hand cotton drill. After emergence of seedlings, crop was thinned before first irrigation each year. Single super phosphate and sulphate of potash were applied uniformly as per recommendations of department of agriculture Punjab (production plan 2007-2008) at the time of sowing. Urea fertilizer was applied in two equal splits, half at 40-45 days after sowing and remaining half at 60-65 days after sowing in all experimental fields. Weeds were controlled with the application of pre-emergence herbicides and different cultural practices. During crop season, insects/pests were kept below threshold level with appropriate multiple applications of insecticides at all sites according to insects/pests. Any other cultural/agronomic practices were kept uniform and constant for all experimental sites. At maturity, yields were ascertained manually for individual plots at appropriate intervals. The yield data were calculated on hectare basis and analyzed statistically by using analysis of variance technique. Least significance test (LSD) was used to compare the treatment means at 5 percent probability.

Treatments: The trials comprised of seven treatments viz; T_1 = Control, T_2= 250 ml ha^{-1} at 45^{th} days of emergence, T_3= 500 ml ha^{-1} at 45^{th} days of emergence, T_4= 250 ml ha^{-1} at 60^{th} days of emergence, T_5= 500 ml ha^{-1} at 60^{th} days of emergence, T_6= 250 ml ha^{-1} at 75^{th} days of emergence, T_7= 500 ml ha^{-1} at 75^{th} days of emergence

RESULTS AND DISCUSSION

Plant height (cm): Data of plant height in (Table 1) revealed that the comparison means of treatments were significant statistically. The minimum plant height was observed in T_3 (500 ml at 45^{th} day of emergence) but during 2008 T_2 (250 ml ha^{-1} at 45^{th} days of emergence) and T_3 (500 ml ha^{-1} at 45^{th} days of emergence) were non significant while all other treatments trends were the same as in 2007. The results of reduction of plant height are similar to those of Pettigrew and Jhonson (2005).

During 2007 the data of the same parameter for farmer's field trial depicted that T_2 (250 ml ha^{-1} at 45^{th} days of emergence) and T_3 (500 ml ha^{-1} at 45^{th} days of emergence) were similar but different from other treatments in the trial. Same trend of results was also reported by Nichols *et al.* (2003).

Number of branches per plant: Number of braches per plant at A.R. Farm (Table 2) showed that in all treatments application of mepiquat chloride had reduced the number of braches per plant. T_3 (500 ml ha^{-1} at 45^{th} day of emergence) has given significant results to control and to T_4 (250 ml ha^{-1} at 60^{th} day of emergence). Remaining treatments are non significant with each other and to T_3 (500 ml ha^{-1} at 45^{th} days of emergence). At A.R. Farm the numbers of braches per plant are minimum in T_3 (500 ml/ha at 45^{th} days of emergence) but it has no significant difference to control (Table 2).

Number of braches per plant at Farmer's Field (Table 2) showed that number of braches per plant wee minimum in T_3 (500 ml ha^{-1} at 45^{th} days of emergence) and it is highly significant. At Farmers Field (Table 2, during 2008) again T_3 (500 ml ha^{-1} at 45^{th} days of emergence) is highly significant to all other treatments; numbers of braches per plant are minimum in this treatment. T_2 (250 ml ha^{-1} at 45^{th} days of emergence) is also significant. Nichols *et al.* (2003) reported it results that the application of mepiquat chloride reduced vegetative growth.

Table 1. Effect of Stance (mepiquat chloride) on plant height (cm) of cotton.

	A.R. Farm		Farmer Field	
Treatments	**2007**	**2008**	**2007**	**2008**
T1	148.2 a	148.6 a	138.8 a	144.2 a
T2	123.0 f	124.1 f	113.3 e	128.4 cd
T3	120.0 g	121.6 f	112.8 e	118.7 e
T4	134.7 c	138.4 c	126.4 c	132.4 c
T5	131.8 d	134.0 d	123.3 cd	125.3 d
T6	140.8 b	144.0 b	132.9 b	137.8 b
T7	128.2 e	128.1 e	120.2 d	124.3 d
LSD value	**1.188**	**2.958**	**3.733**	**4.251**

Mean sharing the same letter are not significantly different from each other.

Table 2. Effect of Stance (mepiquat chloride) on number of branches per plant in cotton.

	A.R. Farm		Farmer Field	
Treatments	**2007**	**2008**	**2007**	**2008**
T1	17.00 a	16.00 abc	18.00 a	17.17 a
T2	15.33 bc	15.30 bc	14.33 d	15.50 c
T3	15.13 c	14.93 c	13.33 e	14.23 d
T4	16.4 ab	16.69 a	16.67 b	16.54 ab
T5	16.06 abc	15.72 abc	15.67 c	15.56 bc
T6	16.06 abc	16.38 ab	16.33 bc	16.20 abc
T7	16.07 abc	16.72 a	15.67 c	15.83 bc
LSD value	**1.200**	**1.419**	**0.9514**	**0.9905**

Mean sharing the same letter are not significantly different from each other.

Number of bolls per plant: Number of bolls per plant at A.R. Farm (Table 3) showed that all the treatments except T_5 (500 ml ha^{-1} at 60^{th} days of emergence) and T_6 (250 ml ha^{-1} at 75^{th} days of emergence) are significant to control (T_1). T_7 (500 ml ha^{-1} at 75^{th} days of emergence) was significant to all other treatments and had maximum no. of bolls per plant. At A.R. Farm (Table 3, during 2008) the trends of the results were similar; T_7 (500 ml ha^{-1} at 75^{th} days of emergence) was significant to all other treatments and had maximum no. of bolls per plant.

Number of braches per plant at Farmers Field (Table 3) showed that T_7 (500 ml ha^{-1} at 75^{th} days of emergence) is significant to all other treatments and had maximum no. of bolls per plant. At Farmers Field (Table 3) again the results were similar and T_7 (500 ml ha^{-1} at 75^{th} days of emergence) was significant to all other treatments and had maximum no. of bolls per plant.

Yield (kg ha^{-1}): Number of bolls per plant at A.R. Farm (Table 4) showed that T_7 (500 ml ha^{-1} at 75^{th} days of emergence) was significant to all other treatments. It had maximum yield (kg ha^{-1}). T_5 (500 ml/ha at 60^{th} days of emergence) and T_6 (250 ml ha^{-1} at 75^{th} days of emergence) were at par with each other and T_6 (250 ml ha^{-1} at 75^{th} days of emergence) was non significant to control (T_1). At A.R. Farm (Table 4) T_7 (500 ml ha^{-1} at 75^{th} days of emergence) gave maximum yield. T_7 (500 ml ha^{-1} at 75^{th} days of emergence) and T_5 (500 ml ha^{-1} at 60^{th} days of emergence) were at par with each other but T_5 (500 ml ha^{-1} at 60^{th} days of emergence) was non significant to control (T_1).

Yield at Farmers Field (Table 4, during 2007) showed that T_7 (500 ml ha^{-1} at 75^{th} days of emergence) was highly significant to all other treatments and it showed maximum yield. At Farmers Field (Table 4) again T_7 (500 ml ha^{-1} at 75^{th} days of emergence) produced significantly high yield and it was at par with T_6 (250 ml ha^{-1} at 75^{th} days of emergence). Yield response was consistent to higher rates of mepiquat chloride and its application at 75^{th} day of emergence. These results are not similar to that of Siebert and Stewart (2006). According to them the yield response was inconsistent to mepiquat chloride and it was affected by weather conditions. The contradiction may be due to the difference in weather conditions. Such research had been performed under the warm environment where there more number of irrigations are needed to save the cotton crop from drought and scorching winds.

Table 3. Effect of Stance (mepiquat chloride) on number of bolls per plant of cotton.

	A.R. Farm		Farmer Field	
Treatments	**2007**	**2008**	**2007**	**2008**
T1	19.00 b	18.67 b	18.00 b	17.00 b
T2	13.00 d	12.67 d	12.00 d	13.00 d
T3	14.00 d	14.00 d	13.00 d	13.67 d
T4	17.00 c	17.00 c	15.67 c	15.33 c
T5	19.67 b	20.00 b	18.33 b	17.67 b
T6	19.33 b	19.33 b	17.67 b	17.00 b
T7	21.67 a	22.00 a	20.33 a	19.33 a
LSD value	**1.470**	**1.418**	**1.435**	**1.512**

Mean sharing the same letter are not significantly different from each other.

Table 4. Effect of Stance (mepiquat chloride) on yield (kg ha^{-1}) of cotton.

	A.R. Farm		Farmer Field	
Treatments	**2007**	**2008**	**2007**	**2008**
T1	2884.00 c	1397.00 b	2298.00 d	2258.00 bcd
T2	1544.00 f	767.00 d	1612.00 f	1847.00 d
T3	2153.00 e	1041.00 c	1090.00 g	1310.00 e
T4	2246.00 d	1074.00 c	1798.00 e	1972.00 cd
T5	2961.00 b	1471.00 ab	2523.00 b	2341.00 bc
T6	2947.00 bc	1416.00 b	2432.00 c	2607.00 ab
T7	3181.00 a	1528.00 a	2651.00 a	2943.00 a
LSD value	**70.69**	**79.55**	**98.92**	**455.4**

Mean sharing the same letter are not significantly different from each other.

CONCLUSION

The development of reproductive time sites from excessive vegetative growth of cotton was promising by application Mepiquat chloride @ 500ml at 75th day of emergence for more yields under arid environmental conditions.

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