EFFECT OF FOLIAR APPLICATION OF MEPIQUAT CHLORIDE UNDER VARYING NITROGEN LEVELS ON SEED COTTON YIELD AND YIELD COMPONENTS

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ABSTRACT

Effect of foliar application of mepiquat chloride (1,1- Dimethyl-piperidinium chloride 5% SL (W/V), a plant growth regulator, was assessed on seed cotton yield (cv. CIM-473) at Agronomic Research Station, Bahawalpur, Pakistan during 2005 and 2006 under different nitrogen levels (0, 50, 100, 150, 200 kg/ha). A standard dose of of mepiquat chloride (1 l/ha) was applied at an interval of one week in four equal splits (250 ml/ha) during month of July in both years. The data on seed cotton yield showed significant differences among different nitrogen levels as well as mepiquat chloride treated and untreated plots. On the basis of two years average, mepiquat treated plots gave 3.92 to 18.30 percent increase in seed cotton yield over untreated plots under different N levels. Application of mepiquat chloride increased seed cotton yield during both years and proved as a desirable management tool to control excessive vegetative growth in tall growing cotton cultivars for efficient harvest.

KEY WORDS: ***Gossypium hirsutum*; mepiquat chloride; nitrogen fertilizer; foliar application; agronomic characters; Pakistan.**

INTRODUCTION

Cotton (*Gossypium hirsutum* L.) is a perennial plant with indeterminate growth pattern. Hence vegetative and reproductive growth occurs simultaneously which increases competition for photosynthetic products (3). Excessive vegetative tendencies in cotton lead to loss in reproductive structures (5, 6, 18). The loss of reproductive structures shift energy from reproductive to vegetative portions of the plant, resulting in a rapid proliferation of main stem growth (11). Self-shading may also contribute to the loss of reproductive structures in some cases as the major portion of assimilate supply for these structures is obtained from subtending leaf to the

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reproductive structure (1, 2). When these leaves are shaded by excessive vegetative growth, assimilate supply is depleted due to decreased photosynthetic ability and abortion of fruiting structures can result (11, 18). The most likely cause of this reproductive structure loss is not single one and combinations of several factors and processes work collectively. These physiological processes can initiate a process of reproductive structure abortion and a decline in overall fruit retention (FR) on plant (7).

Mepiquat chloride is a plant growth regulator that has been in use for cotton production for several decades as a management tool in controlling vegetative growth. It is a gibberellic acid suppressant that is absorbed by green portion of the plant and reduces cell elongation. Thus it offers the potential of decreasing leaf area and restrict additional plant height increase (10, 17). Mepiquat chloride has also been associated with enhancing earliness with regards to fruiting development (10, 16, 18).

Brar *et al.* (4) observed that foliar application of mepiquat chloride at 80 DAS produced higher number of sympodial branches (24.90). Haung *et al.* (8) found that cotton sprayed with liquid fertilizer can give a yield increase by 9.3 and 28.8 percent higher than that sprayed with PIX or clear water. Cotton sprayed with PIX produced 17.9 percent higher yield than that sprayed with water. Sawan *et al.* (15) also studied effect of foliar application of plant growth retardants (mepiquat chloride, chlormequat chloride or daminozide) each applied once at 300 ppm at 75 DAS and noted an increase in cotton seed yield per plant and yield per hectare, seed weight, seed viability and seedling vigour due to addition of high N-rate (161 kg N/ha). In another study (14) N fertilizer application (107 or 161 kg N/ha) and foliar application of plant growth regulators [Pix (mepiquat), Cycocel (chlormequat) or Alar (daminozide)] each applied once at 300 ppm, at 75 DAS alongwith higher dose of zinc increased dry matter yield, N and Zn uptake, opened bolls per plant, boll weight, seed index, lint index, seeds per plant, seed cotton yield and lint yield per hectare in *Gossypium barbadense.* Jost and Cothren (9) noted that treatment with a mixture of foliar fertilizers applied throughout season increased cotton yields, boll counts and reproductive nodes, there was a higher boll count at first three positions on first 10 reproductive branches. Influence of mepiquat chloride on growth and yield of cotton revealed that increasing plant density with lowest concentrations of mepiquat chloride (foliar application) increased seed cotton yield and vice versa (12).

The present study was conducted to evaluate effect of mepiquat chloride on plant growth and its reproductive ability to harvest potential seed cotton yield under varying levels of nitrogen.

MATERIALS AND METHODS

This study was conducted at Agronomic Research Station, Bahawalpur, Pakistan during kharif 2005 and 2006. Different nitrogen doses (0, 50, 100, 150 and 200 kg/ha) were applied to cotton (cv. CIM-473) in three splits i.e. 1/3 at sowing 1/3 at first irrigation and 1/3 at flowering/boll formation stage. Mepiquat chloride was sprayed @ 250 ml per hectare four times in treated plots during month of July at an interval of one week. A control (no spray) was also maintained. Layout system was RCBD under factorial arrangement with three replications. Net plot size was 4.5 x 8 meter. Phosphorus (50 kg/ha) was applied as basal dose to all treatments. Sowing was done in second week of May during both seasons. First irrigation was applied at 45 DAS and subsequent irrigations were given at an interval of two weeks. Plant protection measures were adopted as and when required according to pest attack. For recording data on number of bolls per plant, plant height, sympodial branches and number of nodes per plant, ten plants were randomly selected from each plot and for boll weight 100 bolls were picked randomly and weighed. Seed cotton yield was recorded on net plot basis during the last week of November of both years and then averaged on hectare basis. The data were analyzed statistically using least significant difference test (P = 0.05) to compare differences among treatment s' means according to Steel and Torrie (13).

RESULTS AND DISCUSSION

Bolls per plant and 100-boll weight

Two years average data (Table 1) revealed that treatment of mepiquat chloride enhanced fruit retention as compared to untreated plots. The same trend was noted during both the years. These results agree to those of earlier workers (10, 16, 18). The difference in average bolls per plant under varying nitrogen levels was significant. Maximum bolls per plant (32) were recorded at nitrogen level of 200 kg treated plots which was significantly at par with 150 kg N (31).

In case of 100 boll weight, significant differences were noted due to application of mepiquat chloride, having a remarkable impact on final seed cotton yield. Number of bolls per plant had an increasing trend with increasing N level upto 150 kg under both treated and untreated plots. However, no statistical difference was observed in boll weight of 150 and 200

kg N (Table 1). Maximum 100-bolls weight (345.5g) was noted in 200 kg N level in treated plot as compared to untreated plot (328.5 g).

Table. 1 Effect of mepiquat chloride under varying nitrogen levels on yield components of cotton (two years average).

Mepiquat chloride treatment	Nitrogen levels (kg/ha)	Average Bolls/ plant	100-boll weight (g)	Plant hieght (cm)	Sympodial branches/ plant	Nodes/ plant
Control	0	19 e	272.5 d	123 c	22.67 c	30.33 c
(Untreated plots)	50	22 d	301 c	128 ab	24 bc	33.33 c
	100	25 c	320.5 b	136 ab	27 b	36 b
	150	28 b	329.5 ab	140 ab	29 a	37 b
	200	28 b	328.5 ab	142 a	29 a	37 b
	Mean	24.4	310.4	133.8	26.33	34.73
Mepiquat	0	19 e	279.5 d	113 c	22 c	30.67 c
chloride	50	22 d	314 bc	121 c	27.67 b	35 bc
treated plots	100	27 bc	330 ab	123 c	29.39 a	38 ab
	150	31 a	338.5 a	126 bc	30.33 a	39.33 a
	200	32 a	345.5 a	134 ab	32 a	41.33 a
	Mean	26.2	321.5	123.4	28.27	36.87
	L.S.D.	2.90	17.2	14.8	4.32	3.48

Plant height

The data (Table 1) revealed significant differences in plant height with different nitrogen levels as well as mepiquat chloride treatments. Higher plant height (142 cm) was recorded under untreated plots as compared to treated plots (134 cm) in case of 200 kg N level. York (17) and Kerby (10) also reported similar findings. Plant height showed an increasing trend with increasing nitrogen levels in both treated and untreated plots. However, mean plant height at each N level was significantly higher in untreated (control) plots than mepiquat chloride treated plots.

Sympodial branches per plant

The data (Table 1) revealed significant differences in sympodial branches for different nitrogen levels as well as mepiquat treated and untreated plots. Higher sympodial branches were recorded in case of treated plots. Brar *et al.* (4) also reported higher number of sympodial branches when mepiquat chloride was applied. In case of different nitrogen levels maximum number of sympodial branches was produced by 150 and 200 kg N levels (28 each) both being statistically at par under untreated plots with an increasing trend from zero to 150 kg N. In treated plots, higher number of sympodial branches (32) was recorded under 200 kg N treatment being statistically at par with 100 kg (30.33) and 150 kg N (29.39). However, increasing trend was also observed from zero to 200 kg N. Jost and Cothren (9) also reported that

treatments with mixture of foliar fertilizer applied throughout season increased yield, boll counts and reproductive nodes and there was higher boll count at first three positions on first ten reproductive branches.

Number of nodes per plant

Significant differences were also recorded for number of nodes per plant among different nitrogen levels as well as mepiquat treated and untreated plots. Higher number of nodes was recorded in treated plots than untreated plots. Jost and Cothren (9) also reported higher number of reproductive nodes in mepiquat chloride treatments. In case of N levels, maximum number of nodes per plant (41.33) was recorded in 200 kg N under treated plots with increasing trend from zero to 200 kg N. In untreated plots increasing trend was observed but with less number of nodes per plant. It revealed that in treated plots, plants consumed extra nitrogen in producing more nodes. Brar *et al.* (4) also reported similar findings.

Seed cotton yield

The data (Table 2) revealed significant differences among nitrogen levels as well as mepiquat chloride treated and untreated plots. On the basis of two

Table 2. Effect of foliar application of mepiquat chloride under varying nitrogen levels on seed cotton yield during kharif 2005 and 2006.

Nitro-gen levels (kg/ha)	2005			2006			Mean of both season		
	Un-Treat-ed plots	Treated plots	% age increase at each N level over untrea-ted plots	Un-Treat-ed plots	Trea-ted plots	% age increase at each N level over untreated plots	Un-Treate d plots	Trea-ted plots	% age increase at each N level over untreated plots
0	826f	854f	3.39	1167g	1219g	4.45	997e	1037e	3.92
50	1644e	1775e	7.97	1979f	2093ef	5.76	1812d	1934d	6.87
100	2047d	2279bc	11.33	2315de	2481cd	7.17	2181bc	2380b	9.25
150	2128cd	2479ab	16.49	2667bc	2833ab	10.37	2398b	2656a	13.43
200	2142cd	2561a	19.56	2567c	2948a	17.03	2355b	2755a	18.30
Mean	1757	1990	-	2139	2315	-	1949	2152	
LSD	200.8			243.1			220		

years average, different nitrogen levels of treated plots showed 3.92 to 18.30 percent increase in seed cotton yield over untreated plots. Overall an increase of 10.4 percent was noted in treated plots. Huang *et al*. (8) also observed that crop sprayed with PIX produced 17.9 percent higher than that sprayed with water. As far as the season effects are concerned the yield level

during kharif-2006 remained higher (2139-2315 kg/ha) than that during kharif-2005 (1757-1990 kg/ha) due to favorable climatic conditions.

The yield trends showed that in mepiquat chloride treated plots, better yields were recorded with higher N level (200 kg/ha) while under untreated plots better seed cotton yields were recorded with 150 kg nitrogen level; higher nitrogen dose beyond this induced more vegetative growth and less seed cotton yield. The same trend was observed during both crop seasons.

Value cost ratio (VCR)

Value cost ratio is an important criterion related to economics of commodity produced and determines net profit of farmer. In this study different values of VCR were determined on the basis of economic analysis (Table 3). Higher VCR (7.71) with maximum net return (Rs. 10800/ha) was observed for 200 kg nitrogen level (Table 4) which can be considered as the most economical nitrogen level for the application of mepiquat chloride.

Table 3. Economic analysis of various nitrogen levels and mepiquat chloride treatments on cotton variety cim-473 at agronomic research station, Bahawalpur.

Items	(Untreated plots)					(Treated plots)				
Nitrogen levels (kg/ha)	0	50	100	150	200	0	50	100	150	200
Seed cotton yield (kg/ha)	997	1812	2181	2398	2355	1037	1934	2380	2656	2755
Value of yield (Rs.)	30409	55266	66521	73139	71828	31629	58987	72590	81008	84028
Cost of N fertilizer (Rs.)	0	1087	2174	3261	4348	0	1087	2174	3261	4348
N-application charges (Rs.)	0	200	200	200	200	0	200	200	200	200
Cost of mepiquat chloride (Rs.)	0	0	0	0	0	1100	1100	1100	1100	1100
Pesticide application charges (Rs.)	0	0	0	0	0	300	300	300	300	300
Total expen-diture (Rs/ha)	0	1287	2374	3461	4548	1400	2687	3774	4861	5948
Cost that vary	-	-	-	-	-	1400	1400	1400	1400	1400
Net benefits (Rs/ha)	30409	53979	64147	69678	67280	30229	56300	68816	76147	78080

Price of mepiquat chloride Rs.1100 per litre

Price of seed cotton during 2005 = Rs.1150/ 40 kg
Price of seed cotton rate during 2006 = Rs.1290/40 kg
Average price = Rs.1220/40kg
Price / kg = Rs. 30.50

Table 4. Value cost ratio of mepiquat chloride application.

Fertilizer Levels (kg N/ha)	Net profit (Rs/ha)		Difference	Cost that vary (Rs./ha)	VCR
	Untreated plots	Treated plots			
0	30409	30229	-180	1400	-
50	53979	56300	2321	1400	1.66
100	64147	68816	4669	1400	3.34
150	69678	76147	6469	1400	4.62
200	67280	78080	10800	1400	7.71

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