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Response of New Cotton Variety MNH-700 to Mepiquat Chloride under Varying Plant Population

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Abstract: Mepiquat chloride (1, 1-dimethyl-piperidinium chloride) as a plant growth regulator that can used by producer to manage the crop development, uniformity and maturity. Field experiments conducted during 2002 and 2003 to evaluate the fact of row spacing and Mepiquat chloride application on cotton (*Gossypium hirsutum* L.) var. MNH-700. Four rates of Mepiquat chloride (4x123, 2x246, 4x246 and 4x370 mL ha^{-1}) and a check with 0 mL ha^{-1} were evaluated for cotton growing in 25, 50 and 75 cm row spacing in 2002 and 2003. Plant height and number of total main stem nodes were different among row spacing and Mepiquat chloride application. The height was highest in plots where no application of Mepiquat chloride. Cotton grown in narrow row spacing (20 and 50 cm) had higher seed cotton yield than 75 cm row spacing, but reduce Ginning Out Turn (GOT) percentage in narrow row spacing negating any increase in seed cotton yield. In general reduced row spacing and Mepiquat chloride application did not lower fiber quality. In some cases, micronair was reduced in narrow row spacing (0.1), but values were in acceptable range for fiber traits. Mepiquat chloride is considered a desirable management tool to control crop growth. Ultra-narrow row spacing should practices only in the areas where plant growth is not accurate or upto the standard. In fertile soils, Mepiquat application is suggested for control of plant growth in efficient way under narrow row spacing in viewing the habit of cotton genotype.

Key words: Mepiquat chloride, cotton, row spacing, fiber characters

INTRODUCTION

Cotton is the most important cash crop of Pakistan. Its yield is nearly stagnant in Pakistan last 10 years, Cotton formers are faced with a difficult task of selecting management study under rising production cost and static or declining net profit. One alternative factor to meet this problem and to optimize profit is growing of cotton in narrow rows. Ultra narrow sow system require planting cotton in rows of 45 cm or less with plant population of 80,000 to 120000 plant ha^{-1}. Producing cotton in ultra-narrow rows requires careful consideration of several management components, which includes the use of plant growth regulators to control plant size and growth. Anthony and Molin[1] suggested that after ginning fibre quality characteristics were different for cultivars harvested with spindle pickers and stripers. Vories *et al.*[2] reported that micronaire was consistently lower for ultra-narrow row cotton, when comparing ultra-narrow cotton with conventional system. To avoid from the insect pest attack pressure and high humidity in ultra narrow cotton requires that plant be kept less than 76 cm tall for efficient control of insect pest attack, good retention and to save bolls from rattening. This can be achieved by selecting short stature, early maturing varieties and by use of growth regulators such as mepiquat chloride (1,1- dimethyl-piperidinum chloride). Mepiquat chloride was introduced to the market in the late 1970,s as plant growth regulator to suppress excessive plant growth by decreasing plant height, number of nodes, branch length and leaf area[3-7]. As a result of maximizing inputs for cotton production under optimum growing conditions plants often become excessively tall and vegetative[8]. Excessive vegetative growth may result in fruit shed[9,10] fewer nodes[11], shortened inter-nodes[12] and produce fewer reproductive branches. As a result the effect of Mepiquat chloride has been used to decrease plant height[10-12]. Increase earliness[13], decrease boll rot[14] and to facilitate insect management. Seed cotton yield response to Mepiquat chloride remained inconsistent. Some researcher have found increase in seed cotton yield[10,13,15,16] with the application of Mepiquat chloride whereas other have observed yield decrease or no yield effects[17-20]. Response of Mepiquat chloride application for seed cotton yield appear to be related to environmental factors encountered by plant throughout growing season and genetics constitution of a variety. Positive yield response is associated with condition that

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favour excessive vegetative growth, such as high nitrogen rates, excessive rainfall, thick stand and tall growing variety.

Cotton production in ultra-narrow row requires a uniform plant density without skips and control of excessive growth for efficient picking, So the use of mepiquat chloride may be a good in ultra-narrow row management systems, particularly on fields with a history of excessive vegetative growth. Several researchers have evaluated the use of Mepiquat chloride in ultra narrow row systems in recent years. Kerby[21] reported that early low application of Mepiquat chloride is more important than high application rates in latter[22], reported 7% increase lint yield in 25 and 51 cm treated with mepiquat chloride in a 4 year study. Reduction in fibre quality were observed in 38 and 76 cm rows cotton system. A two year study in south Carolina consisting of mepiquat chloride rate (4x0.29, 2x0.58, 4x0.58 and 4x0.88 L ha^{-1}) and 3 row spacing (19, 38 and 76 cm) found no differences in seed cotton yield[23]. In ultra-narrow row cotton system use of mepiquat chloride may be dependent in rainfall, fruit load, soil fertility and other related factors. Wright *et al.*[24] suggested inter-nodal length of crop should be maintained and managed for 5 cm or less and Mepiquat chloride used as required and according to crop situation.

The objective of this study was to evaluate the effectiveness of row spacing and mepiquat chloride management strategy on cotton growth in and seed cotton yield with fibre quality for a new variety MNH-700 under Multan condition.

MATERIALS AND METHODS

Field experiment was conducted during 2002-03 at Cotton Research Station, Multan, to evaluate the growth of cotton Cv. MNH-700 (developed at Cotton Research Station, Multan) in three row spacing and five mepiquat chloride application strategies. Row spacing was kept 25, 50 and 75 cm with the five treatment of mepiquat chloride.

Four application of 123 mL ha^{-1}, two application of 246 mL ha^{-1}, four application of 246 mL ha^{-1}, four application of 370 and 0 mL ha^{-1} as a check.

Mepiquat chloride application began at pin head square (PHS) and was applied by Knap sac hand spray (246 L ha^{-1} water). Final application was applied at 15 August. In both year, cotton was sowing in flat row profile into adequate soil moisture by drill. Planting date was second week of May. Plant to plant distance was kept 30 cm in each case. Plant population was approximately 129000, 64500 and 43000 plants ha^{-1} in 25, 50 and 75 cm in row to row distances respectively. Nitrogen was applied @150 kg ha^{-1} in the form of urea (46% N) for all row spacing each year. All culture practices perform to optimize yield in each row spacing and were consistent with recommended agronomic practices. Data was collected for the following traits.

1. Plant height (Fortnightly after 40 days from sowing date)
2. Number of nodes per plant (as per height record)
3. Seed cotton yield
4. Ginning out turn (%)
5. Fiber length (mm)
6. Fiber fineness

Treatments were arranged in split plot in a randomized with main plots consistent of row spacing and five subplot consisting of Mepiquat chloride treatments with three replication. All data were subjected to analysis of variance. Means were separated using Fisher's protected Least Significant Difference (LSD Test) test. In all statistical test significance was determined at $p \leq 0.05$. Interaction between row spacing and mepiquat chloride level for each variable was measured.

RESULTS AND DISCUSSION

Analysis of variance of plant height for both years (Table 1 and 2) indicated that significant differences exist among the Mepiquate Chloride treatment and row spacing under study while interaction between spacing and mepiquate application is also significant. It also indicated that Mepiquate application reduced height of the plant under high and low application. Plant measurement taken in 2002 and 2003 indicated that high Mepiquat chloride treatment reduced plant height at 2, 4 and 5 weeks After Pin Head Square (WAPHS) compared with untreated check (Table 3 and 4). Height reduction ranged from approximately (16 to 27%) for all the lowest to highest application rate of Mepiquat chloride, respectively, while mepiquat chloride treatment reduce plant height at 4 weeks after PHS compared with untreated check approximately 23 to 38% for lowest to highest application rate, respectively for both years. At 5 weeks after PHS height reduction were approximately 28 to 41% for lowest to highest application rate (Table 3 and 4). In row spacing, plant height was not effected at 4 or 5 week after PHS in 2002 and 2003, but plant height was reduced significantly in 25 cm row spacing for the both years. The number of total main stem nodes at 5 weeks after PHS was greatest in 75 cm rows averaging approximately one additional node compared with narrow spacing (Table 5 and 6).

Table 1: Mean square for height, number of nodes, yield and fiber quality traits of cotton during 2002-03

		Height (cm)							
SOV	df	2 weeks	4 weeks	5 weeks	Yield (kg ha^{-1})	No. of nodes	GOT (%)	Staple length (mm)	Mike
Replication	2	0.20	0.42	2.42	64.06	1.75	0.001	0.006	0.015
Spacing (Sp)	2	3.26*	8.08*	20.55*	16870.46*	2.02	0.014	0.011	0.001
Error I	4	0.06	0.32	1.22	366.73	1.42	0.009	0.008	0.008
Treatment (Tr)	4	718.40*	1791.80*	1156.60*	208477.90*	0.94	0.016	0.015	0.002
Sp x Tr	8	5.15*	5.61*	80.10	7121.85*	1.57	0.009	0.006	0.002
Error II	24	1.61	1.71	256.12	469.34	0.70	0.005	0.013	0.004

* Significant

Table 2: Mean square for height, number of nodes, yield and fiber quality traits of cotton during 2003-04

		Height (cm)							
SOV	df	2 Weeks	4 Weeks	5 Weeks	Yield (kg ha^{-1})	No. of nodes	GOT (%)	Staple length (mm)	Mike
Replication	2	0.600	0.267	0.46	951.08	0.200	0.086	0.041	0.001
Spacing (Sp)	2	6.460*	5.260	6.06	95765.60*	10.460*	0.011	0.009	0.002
Error I	4	0.460	0.930	1.93	554.08	0.167	0.019	0.007	0.002
Treatment (Tr)	4	605.270*	1579.140*	2904.30*	2359.08*	1.020	0.028	0.013	0.001
Sp x Tr	8	11.744*	11.460*	12.34*	14953.60*	0.772	0.029	0.050	0.001
Error II	24	1.620	1.820	2.08	586.20	0.539	0.027	0.013	0.004*
Significant									

Table 3: Effect of mepiquat chloride application and row spacing on plant height at 2, 4, 5 weeks after pin head square (WAPHS) and number of main stem nodes, yield and fiber characters at 6 weeks after pin head square on cotton in 2002-03

Treatment	Height (cm)							
Mepiquat chloride (m L ha^{-1})	2 weeks	4 weeks	5 weeks	Yield (kg ha^{-1})	No. of nodes	GOT (%)	Staple length (mm)	Mike
123	59.00	64.30	69.1	2883.0	21.0	39.5	27.3	4.6
246	58.30	53.40	64.6	2780.0	20.8	39.5	27.4	4.6
246	51.40	53.40	60.4	2677.0	21.6	39.5	27.3	4.6
370	52.60	88.00	83.4	2757.0	20.8	39.5	27.4	4.6
0	73.80	65.00	85.7	1725.0	21.1	40.5	27.3	4.6
Cd=0.05	2.88	1.72	20.9	39.2	NS	NS	NS	NS

Table 4: Effect of mepiquat chloride application and row spacing on plant height at 2, 4, 5 weeks after pin head square (WAPHS) and number of main stem nodes, yield and fiber characters at 6 weeks after pin head square on cotton in 2003-04

Treatment	Height (cm)							
Mepiqaut chloride (mL ha^{-1})	2 weeks	4 weeks	5 weeks	Yield (kg ha^{-1})	No. of nodes	GOT (%)	Staple length (mm)	Mike
123	61.80	68.0	75.70	2960.00	21.6	39.3	27.5	4.6
246	59.70	65.7	73.30	2924.00	21.6	39.2	27.5	4.6
246	54.00	56.1	61.50	2882.00	22.4	39.0	27.5	4.6
370	53.70	56.2	61.70	2896.00	21.6	39.0	27.4	4.6
0	73.80	88.5	105.50	1772.00	21.8	39.8	27.5	4.6
Cd=0.05	1.67	1.77	1.89	31.73	NS	NS	NS	NS

Table 5: Effect of row spacing on height, seed cotton yield, number of nodes and fiber quality characters, 2002-03.

Treatment	Height (cm)							
spacing (cm)	2 weeks	4 weeks	5 weeks	Yield (kg ha^{-1})	No. of nodes	GOT (%)	Staple length (mm)	Mike
25	59.60	64.80	71.40	2565.0	20.8	38.8	27.4	4.6
50	58.70	64.10	73.80	2598.0	20.9	39.0	27.4	4.6
75	58.90	65.60	72.80	2531.0	21.5	40.8	27.3	4.7
Cd=0.05	0.62	0.28	2.65	46.0	NS	NS	NS	NS

Jost[25] reported 2.5 main stem node less for cotton in 19 cm row spacing compared with 38, 76 and 101 cm row spacing. But the variety MNH700 reduced only one node under 25 cm row spacing as compared to 75 cm distance, which is a desired character when cotton cultivated at high population then normal. So the variety MNH700 can be used for cultivation under narrow row spacing [21].

The seed cotton yield varied significantly among Mepiquat chloride treatments and row spacing (Table 1 and 2). Seed cotton yields were higher in narrow-row spacing compared with 75 cm row spacing for both years (Table 5 and 6). Mepiquat chloride application of 123 mL ha^{-1} for four time had highest yield (2883 and 2960 kg ha^{-1} for the year 2003 and 2004, respectively) as

Table 6: Effect of row spacing on height, seed cotton yield, number of nodes and fiber quality characters, 2003-04

Treatment spacing (cm)	Height (cm) 2 weeks	4 weeks	5 weeks	Yield (kg ha^{-1})	No. of nodes	GOT (%)	Staple length (mm)	Mike
25	60.1	66.4	75.2	2684	21.0	39.5	27.5	4.6
50	60.4	66.7	75.2	2768	21.9	39.4	27.4	4.6
75	61.4	67.6	76.3	2608	22.7	41.6	27.5	4.4
Cd=0.05	1.26	NS	NS	56.64	0.99	NS	NS	NS

compared to other treatments. Mepiquat chloride treatments resulted in higher seed cotton yield compared with untreated check in 2003 and 2004 (Table 3 and 4). These results indicated that the variety MNH700 is suitable for sowing under low spacing for achieving higher seed cotton production with use of growth regulators under Multan conditions the results may can be varied with changing the genotype and environment.

Ginning out turn %age (GOT %) was higher for the plot not treated with Mepiquat chloride than plots receiving Mepiquat application in both years (Table 3 and 4). GOT % in 75 cm rows was approximately 2% higher than cotton grown in narrow-row in both years 2002 and 2003 (Table 5 and 6). These findings are in similar to Atwell *et al.*[26] who reported an average of 28 to 32% GOT for ultra-narrow row cotton and conventional cotton, respectively. The differences in GOT with previous findings may be due to different genotype used in experimental material. From the analysis of variance (Table 1 and 2), it was observed that the differences in GOT among mepiquat chloride application and row spacing was non-significant. So the effect of Mepiquat chloride application on GOT was inconsistent as there was non-significant differences in GOT due to row spacing and Mepiquat chloride application in the year 2002 and 2003. Mepiquat chloride application increased the seed cotton yield for all treatments compared with untreated check by an average of 1096 kg ha^{-1} in 2002, 1143 kg ha^{-1} seed cotton yield was higher on average basis while during 2003, seed cotton yield was increased approximately 1143 kg ha^{-1} over non-treated of Mepiquat chloride application[13, 15-16].

Analysis of variance for staple length and micronaire for both year (Table 1 and 2) indicated that non-significant differences exist among the Mepiquat chloride application treatment and row spacing under study for variety MNH700. The effect of row spacing and Mepiquat application chloride application on staple length were inconsistent over two year (Table 3-6). It indicated that row spacing and Mepiquat chloride application has no effect on staple length of cotton. Other studies[2, 27-29] have reported similar results; however Jost[25] found altra-narrow spacing reduced staple length over conventional spacing. The difference may be due to different genotypes and environment.

Cotton produce in 75 cm row have higher micronaire value compared with cotton produce in narrow row spacing when averaged over Mepiquat chloride treatments in 2002 (Table 5), but difference was non-significant. The previous finding[2,29] reported a decrease in micronaire for cotton grown in ultra-narrow rows compared with conventionally grown cotton, while Jost[25] found no significant difference in micronaire due to row spacing. Application of Mepiquate chloride is not affected micronaire in any year of study. The range of micronaire value was similar for both years for the variety MNH-700 under Multan conditions.

Plant height and inter-nodal length were reduced by application of mepiquat chloride which indicated that highest reduce due to reduction in inter-nodal length, which ultimately decrease height node ratio by mepiquat chloride application. Cotton grown in a narrow row spacing at higher seed cotton yield, than cotton produces in 75 cm. Row spacing, however, GOT was lower in narrow row spacing. Overall reduced row spacing and mepiquat chloride application is not lower fiber quality in any respect. Although mepiquat chloride application not increased yield, but its use is desirable in altra-narrow row cotton production to control, the crop growth especially on fields with history of excessive growth. Data from this study suggest that total quantity of mepiquat chloride application played role in managing the plant growth as compared to number of application.

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