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EFFECT OF DIFFERENT PLANT SPACING AND APPLICATION TIMES OF GROWTH REGULATOR (MEPIQUAT CHLORIDE) ON THE PLANT HEIGHT OF COTTON

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ABSTRACT

An experiment was conducted at Cotton Seed Multiplication, Training and Research Farm, Sreepur, Bangladesh during August, 2016 to January, 2017 to evaluate the response of cotton plant height to different plant spacings and time of application of mepiquat chloride (MC) growth regulator. Five plant spacing like 60 cm × 30 cm, 60 cm × 40 cm, 75 cm × 30 cm, 75 cm × 40 cm and 90 cm × 45 cm; MC spray @ 1.0 ml L^{-1} water at 25, 50, 75, 100 and 125 DAE along with water spray as control, were considered as the treatments of the experiment. Plant spacing of 60 cm × 30 cm showed the lowest values of cotton plant height (91.59 cm) whereas MC application, 1MC L^{-1} water at 25 DAE gave shortest plant height (81.41 cm). Plant spacing of 60 cm × 30 cm along with foliar application of 1ml MC L^{-1} water at 25 DAE gave significantly minimum plant height (86.64 cm) as compared to control treatments having conventional wider spacing of 90 cm × 45 cm. So, 1 ml MC L^{-1} water at 25 DAE with 60 cm × 30 cm spacing treatment combination could be practiced for profitable cotton production at Sreepur, Gazipur areas of Bangladesh.

Key words: MC, spacing, foliar application and plant height.

Introduction

Our textile industries are facing serious problems for non-supply of raw cotton at the peak period of knitting. Cotton is not only used for fiber production but also for edible oil, dairy and fisheries feed and also as fertilizer in the form of oilcake. Baumhardt *et al.* (2018) reported that plant height increased significantly with increased row spacing in cotton, while Jahedi *et al.* (2013) obtained reduced plant height, in cotton having narrow row spacing. Application of plant growth regulator (either auxin or retardant) can also lead to improve the growth, flowering and yield of many crops. Plant growth regulators are organic compounds, other than nutrients, that affect physiological processes of plants when applied in small concentrations. These compounds represent diverse chemistries and modes of action and provide numerous possibilities for altering crop growth and development. Their time of use extends from early season when they are applied in-furrow or as seed treatments at planting to late season in preparing the crop for harvest. Timing the first application of mepiquat chloride (MC) has caused concerns among cotton producers in that too much applied too soon can result in serious damage to plant structure and subsequent lint yields. Application timing and concentration that worked well in one production year may be useless or impractical in a subsequent year, for almost two decades the decision of when and how MC to apply has been accomplished through the experienced eye of those who have worked extensively with the product and have come to understand the factors affecting its usage, a better understanding of the physiology of the cotton plant, its water requirements and the influence of its environment (temperature and rainfall) resulted in new capabilities to prescribe accurate MC doses for use in cotton grown in regions normally requiring plant height control (Livingston *et al.,* 1996). Overall benefits from plant growth regulator use in cotton include yield enhancement, improved fiber quality, and greater ease of harvest; more specific responses include alteration of C partitioning, greater root: shoot ratios, enhanced photosynthesis, altered nutrient uptake, improved water status, and altered crop canopy; these responses are a reflection of the interaction of heritable characteristics, cultural inputs, and environment (Cothren *et al.,* 1983). Copur *et al.* (2010) studied that the applied PGRs had significant positive effects on the plant height. Kumar *et al.* (2005) had found reduced plant height (restructuring canopy size) with MC (50 ppm) sprayed at 90 DAS as compare to Chlormequat Chloride (CCC) application in cotton plant. Kataria and Khanpara (2012) reported that the applied Cycocel @ 40 ppm at 90 DAS had significantly decreased the plant height in cotton. Planofix (NAA) had a significant effect on plant height in cotton (Abro *et al.,* 2004). Spitzer *et al.* (2015) found that

maize plant height could be reduced by as much as 125 cm (49% of control) using a double application of ethephon (576 g a.i. ha^{-1}) at growth stages BBCH 18-19 and BBCH 34-36. Zhao *et al.* (2019) reported that application of MC reduced plant height under different plant densities in cotton. Systematic and comprehensive research effort on blending plant spacing, concentration and time of application of mepiquat chloride in order to increase yield of cotton are inadequate or absent at home or abroad. Keeping these views in mind, the present research programme was undertaken with the objectives to determine optimum plant density of cotton and to optimize time of application and concentration of MC as foliar spray on plant height of cotton grown at Sreepur, Gazipur areas of Bangladesh.

Materials and Methods

The experimental field belongs to the agro-ecological zone of Modhupur Tract (AEZ-28). Cotton inbred cultivar CB 14 was selected as early maturing (short duration) and high yielding cultivar. The experiment was laid out in a split plot design with three replications. The size of each plot was 3.6 m × 4.5 m and the distance between replication to replication was 2.0 m. The distance between intra-plot and main plot were maintained 1.0 m. A factorial experiment was conducted with five levels of plant spacing and six times of MC @ 1.0 ml L^{-1} water foliar application. The experimental variables were: Factor A: Level of plant spacings were 90 cm × 45 cm (24, 691 plants ha^{-1}) (control, CDB recommendation), 60 cm × 30 cm (55,555 plants ha^{-1}), 60 cm × 40 cm (41,666 plants ha^{-1}), 75 cm × 30 cm (44,444 plants ha^{-1}) and 75 cm × 40 cm (33,333 plants ha^{-1}); Factor B: Foliar application times of MC were water spray (control), Foliar spray at 25 DAE (Days After Emergence), 50 DAE, 75 DAE, 100 DAE and 125 DAE. MC was sprayed on the crop canopy @ 1.0 ml L^{-1} water following time of spray in treatment variables on 4 September (25 DAE), 29 September (50 DAE) and 24 October (75 DAE), 18 November (100 DAE) and13 December (125 DAE) 2016, respectively. The total harvest (final) was completed by 24 February, 2017. The mean plant height was recorded and expressed in cm. The analysis was done with the help of computer package MSTAT-C. Least Significant Difference (LSD) was used for mean separation at 5% level of probability (Gomez and Gomez, 1984).

Results and Discussion

The experiment was conducted in Kharif II, 2016 to Rabi 2017 with five levels of plant spacings and six times of foliar application of mepiquat chloride (MC) @ 1.0 ml L^{-1} water at different growth stages. The results obtained in the study have been presented either in table or figure which are followed by discussion.

Effect of plant spacing

No significant variation of plant height was found due to plant spacing treatments. Numerically plant height varied with different plant density ranged from 91.59 to 97.66 cm (Fig. 1). The tallest plant (97.66 cm) was obtained from 90 cm × 45 cm spacing (control) and the shortest plant (91.59 cm) was recorded from 60 cm × 30 cm spacing. Baumhardt *et al.* (2018), Deotalu *et al.* (2013) and Jahedi *et al.* (2013) reported that plant height increased significantly with wider row spacing in cotton as well as Ponnuswami and Rani (2019) obtained similar observation in moringa.

Effect of time of application of MC growth regulator

Plant height varied significantly from 81.41 to 115.87 cm across the treatment variables (Fig. 2). Plants grown without added growth regulator produced significantly tallest plant (115.87 cm) and the shortest (81.41 cm) from foliar sprayed at 25 DAE. Intermediate plant height was recorded when MC sprayed at early (50 DAE) or late (100 and 125 DAE). Kumar *et al.* (2005) reported that 50 ppm MC sprayed at 90 DAS was found to be effective than CCC in reducing cotton plant height. Shahr *et al.* (2015) noted reduced plant height of cotton by 19.5% than control using Pix regulator at 30 days after flowering. Some

other scientists observed reduced plant height of different crops with different growth retardants (Amit *et al.*, 2016 in cotton; Niakan and Habibi, 2013 in cotton; Reddy *et al.*, 1990 in cotton). Eveleigh *et al.* (2010) opined that any growth retardant reduces the production of plant hormone gibberellic acid, which in turn slows cell expansion and elongation thus both leaf growth and internode elongation is ceased down to reduce cotton plant height.

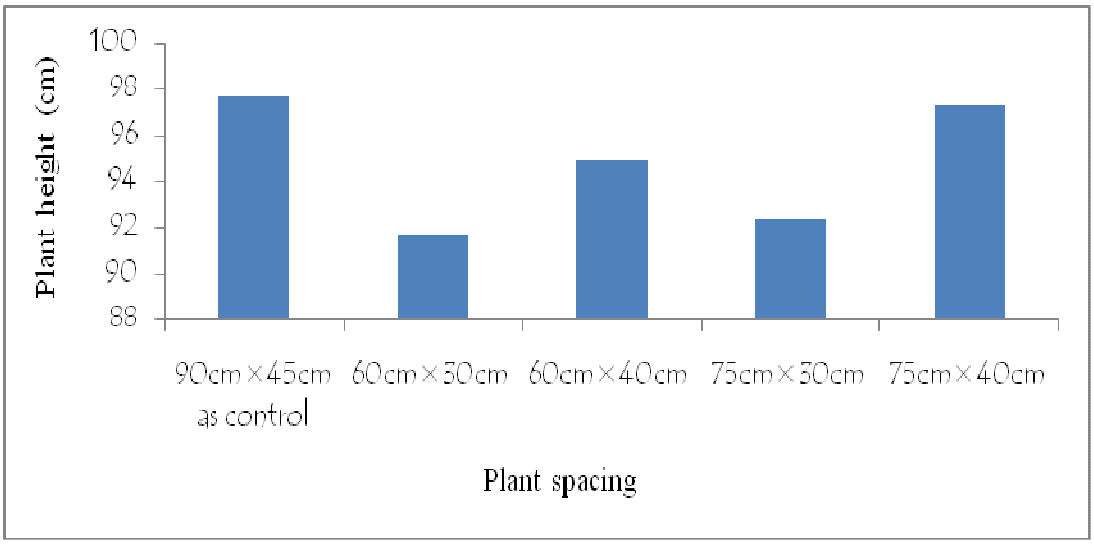

Fig. 1. Influence of different plant spacing on plant height of cotton (LSD $_{(0.05)}$=0.079)

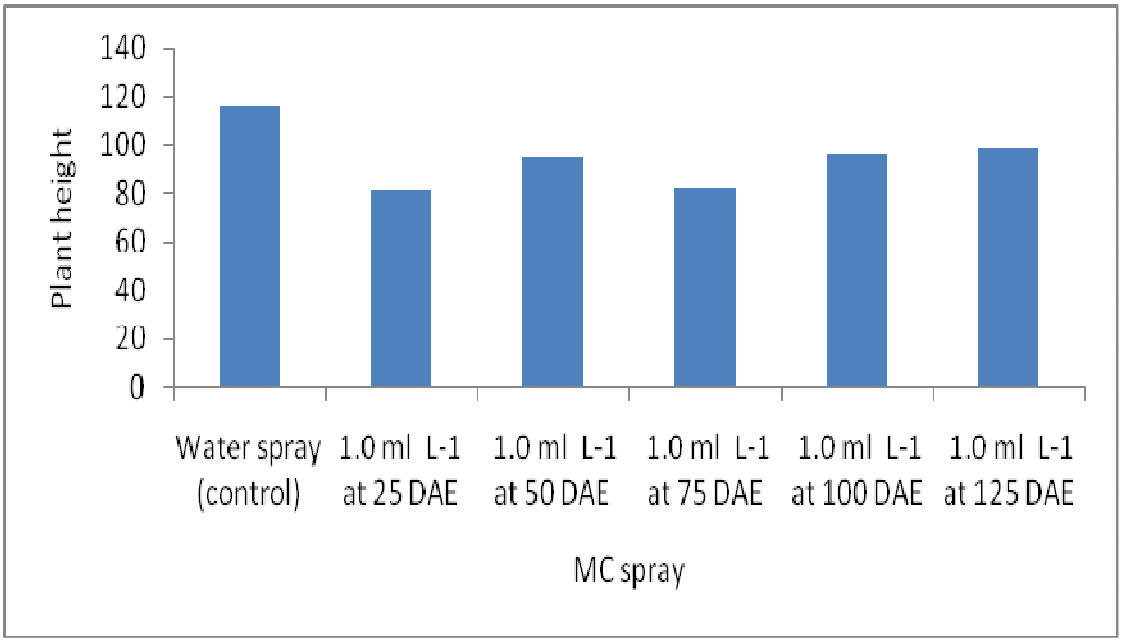

Fig. 2. Influence of time of application of mepiquat chloride on plant height of cotton (LSD $_{0.05}$=0.145)

Combined effect of plant spacing and time of application of MC growth regulator

The combined effect of plant spacing and time of application of growth regulator on plant height was significant (Table 1). Plant height increased with the increase of plant spacing irrespective of growth regulator application time. Irrespective of plant population, gradual shorter plants were observed when plants sprayed with MC compared to control which indicated that MC reduces plant height. Significantly the highest plant height (127.48 cm) was recorded at 90 cm × 45 cm spacing coupled without MC, control and the lowest (86.64 cm) at 25 DAE foliar spray and 60 cm × 30 cm spacing. The findings are corroborated to Zhao *et al.* (2019) who stated that application of MC reduced plant height under different plant densities in cotton. Similar result was reported by Lucieli *et al.* (2017) in maize.

Table 1. Combined effect of plant spacing and time of application of MC growth regulator on plant height of cotton

Treatments	Plant height (cm)
90 cm × 45 cm × Control (water spray)	127.48 a
× MC spray at 25 DAE	98.13 b-d
× MC spray at 50 DAE	98.00 b-d
× MC spray at 75 DAE	98.00 b-d
× MC spray at 100 DAE	99.10 b-d
× MC spray at 125 DAE	99.00 b-d
60 cm × 30 cm × Control (water spray)	105.43 bc
× MC spray at 25 DAE	86.64 d
× MC spray at 50 DAE	86.74 d
× MC spray at 75 DAE	86.74 d
× MC spray at 100 DAE	97.45 b-d
× MC spray at 125 DAE	90.78 cd
60 cm × 40 cm × Control (water spray)	107.46 b
× MC spray at 25 DAE	87.89 d
× MC spray at 50 DAE	87.78 d
× MC spray at 75 DAE	87.75 d
× MC spray at 100 DAE	99.33 b-d
× MC spray at 125 DAE	104.78 bc
75 cm × 30 cm × Control (water spray)	109.44 b
× MC spray at 25 DAE	89.56 cd
× MC spray at 50 DAE	89.53 cd
× MC spray at 75 DAE	89.45 cd
× MC spray at 100 DAE	98.22 b-d
× MC spray at 125 DAE	90.89 cd
75 cm × 40 cm × Control (water spray)	105.56 bc
× MC spray at 25 DAE	94.93 b-d
× MC spray at 50 DAE	94.64 b-d
× MC spray at 75 DAE	94.46 b-d
× MC spray at 100 DAE	97. 78 b-d
× MC spray at 125 DAE	97.89 b-d
$LSD_{(0.05)}$	16.423
CV (%)	8.89

Means having same letters in the same column indicates no significant difference at $P \leq 0.05$.

Conclusion

Combined influence of plant density and time of application and concentration of growth regulator developed the higher plant height (127.48 cm) which was obtained by water sprayed with 90 cm × 45 cm spacing but the minimum plant height (86.64 cm) from 1 ml MC L^{-1} water at 25 DAE with 60 cm × 30 cm spacing treatment combination that could be can be practiced for profitable cotton production in Sreepur, Gazipur areas of Bangladesh. This may be disseminated in other locations for spreading the profitable cotton production in Bangladesh.

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