INFLUENCES OF DIFFERENT PLANT SPACING AND FOLIAR APPLICATION TIMES OF GROWTH REGULATOR (MEPIQUAT CHLORIDE) ON SEED COTTON YIELD OF COTTON

M. S. Ahmed
CDB, Rangpur (Author's email: shaheen01743229987@gmail.com)

ABSTRACT

Plant growth regulators (PGRs) are used in cotton production to optimize yield and quality and even suppressing excess growth whenever necessary. An experiment was carried out during August, 2016 to January, 2017 at Cotton Seed Multiplication, Training and Research Farm, Sreepur, Bangladesh to evaluate the response of seed cotton yield to different plant spacing 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. Narrow plant spacing i.e. plant spacing of 60 cm × 30 cm showed the highest values of maximum seed cotton yield (4.2 t ha^{-1}). In case of MC application, maximum seed cotton (2.62 t ha^{-1}) was noted from 1.0 ml MC L^{-1} water sprayed at 25 DAE. So, foliar application of mepiquat chloride @ 1 ml L^{-1} water at 25 DAE along with plant spacing of 60 cm x 30 cm can be practiced for profitable cotton production at Sreepur, Gazipur areas of Bangladesh.

Key words: MC, foliar application, spacing, seed cotton, yield.

Introduction

Bangladesh produces 156,509 bale or 28,328 ton lint and 28484 ton seed cotton from 43050 hectares of land per year (CDB, 2018). 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 in our country. Lower yield of cotton (*Gossypium hirsutum* L.) in Bangladesh could be met up by increasing per hectare yield following appropriate crop management techniques and using short-durated varieties. However, optimum plant population or spacing is important for crop production through efficient utilization of light, nutrients and water uptake by the plants. Silva *et al.* (2012) opined that flower buds, bolls $plant^{-1}$ and yield were influenced by the spacing in cotton. Now-a-days high population density (closer spacing) has been emerged in USA, Argentina and small areas in Brazil as an alternate crop management for short structured crop canopy cotton plant for economic use of land and yield. Kumar *et al.* (2017) conducted a field experiment at Cotton Research Scheme, VNMKV, Parbhani, India laid out with four levels of plant densities which results indicated that significantly higher seed cotton yield (2063 kg ha^{-1}) was recorded at plant spacing of 45 cm x 15 cm as compared to other wider spacing. CDB (2018) narrated that the highest seed cotton yield (4.48 t ha^{-1}) was obtained from the lowest spacing i.e. 90 cm × 10 cm, where treatments were consisted of 4 levels of plant spacing 90 cm × 45 cm, 90 cm × 25 cm, 90 cm × 15 cm and 90 cm × 10 cm in hybrid cotton DM-3. Again 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 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. 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 seed cotton yield, plant height, average number of open bolls, number of sympodia, boll weight, lint percentage and seed index. Use of plant growth retardant is an eye-catching technology today which improves seed cotton yield through increased number of sympodia by controlling undesirable vegetative development of cotton plant thus giving a short statured plant canopy. Reema *et al.* (2017) obtained maximum bolls plant^{-1} and seed cotton yield while using Pix at 1500 ml/500 litre water as foliar spray at bud initiation stage of cotton. Amit *et al.* (2016) revealed that foliar application of mepiquat chloride (MC) growth retardant @ 300 ppm yielded more seed cotton by improving the setting percentage. Naphthalene Acetic Acid 20 ppm showed better performance in enhancing the grain yields of wheat cultivars (Alam *et al.*, 2002). However, systematic and comprehensive research effort on blending plant spacing, concentration and time of application of MC in order to increase yield of cotton are inadequate or absent at home or abroad. So this present study was designed with a view to assess the response of spacing and foliar application times of MC on seed yield 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 it is early maturing (short duration) and high yielding cultivar. A factorial experiment was conducted with five levels of plant spacing and six times of Mepiquat Chloride (MC) @ 1.0 ml L^{-1} water foliar application. The experimental variables are as Factor A: Level of plant spacings (5): 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}), 75 cm × 40 cm (33,333 plants ha^{-1}); and Factor B: Foliar application times of MC (6): water spray (control), foliar spray at 25 days after emergence (DAE), foliar spray at 50 DAE, foliar spray at 75 DAE, foliar spray at 100 DAE and foliar spray at 125 DAE. The experiment was laid out in a split plot design with three replications. Spacing or plant density was assigned to the main plots and growth regulators in the subplots. 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. Growth regulator, Mepiquat Chloride (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. The total harvest (final) was completed by 24 February, 2017. Data recorded on seed yield of cotton were analyzed 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

Seed cotton yield was significantly affected by plant spacing and each treatment was varied markedly with others (Fig. 1). Seed cotton yield decreased gradually with wider spacing. The highest seed cotton yield (4.2 t ha^{-1}) was obtained from 60 cm × 30 cm spacing. Spacing 60 cm × 40 cm showed the second highest yield (3.69 t ha^{-1}) and gradually yield decreased with wider spacing. The lowest yield (2.57 t ha^{-1}) was obtained from 75 cm × 30 cm spacing. The closer spacing out yielded control by 92.8% more yield as the increased yield was added with greater plant population per unit area. Yield was highest in 55,555 plants ha^{-1} treatment confirmed by Awais *et al.* (2015). The result was also in conformity with the findings in cotton of CDB (2018); Sowmiya and Sukthivel (2018); Mahi and Lokanadhan (2018); Sher *et al.* (2017); Ali *et al.* (2009) and Wright *et al*. (2008). These results indicated that narrow-wide row planting patterns improved the canopy structure, allowed more IPAR to reach the middle–low strata of the canopy and enhanced the leaf photosynthetic characteristics of maize crops at silking stage compared with control resulting in higher yield.

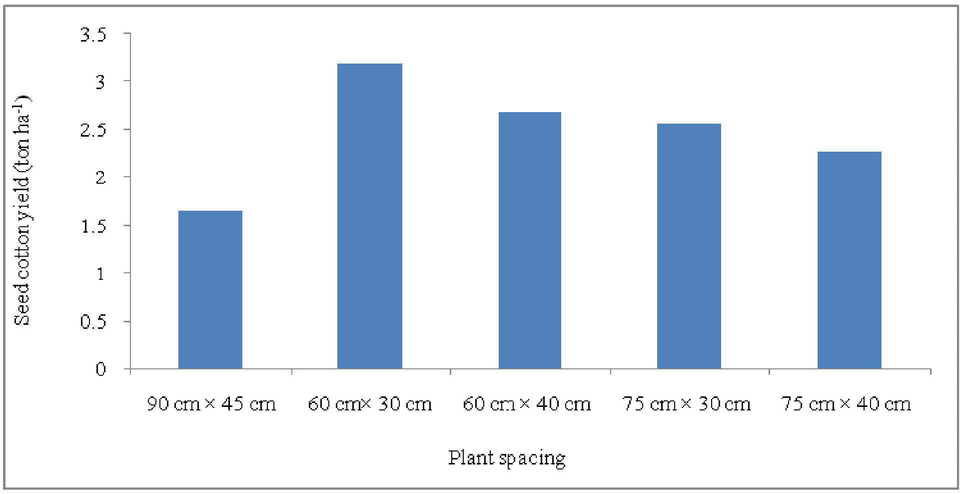

Fig. 1. Influence of different plant spacing on seed cotton yield of cotton ($LSD_{(0.05)}$=0.079)

Effect of time of application of MC growth regulator

MC sprayed from 25 to 125 DAE had significant effect on seed cotton yield over without growth regulator treatment (control). It was apparent that there is an insignificant decrease trend in seed cotton yield with delaying MC spray time (Fig. 2). The seed cotton yield was recorded highest (2.62 t ha^{-1}) from MC sprayed at 25 DAE and the lowest (2.1 t ha^{-1}) at control. Use of growth regulator at 25 DAE had 91.43 % more yield over no growth regulator use. The similar results under different growth regulator application were recorded in different experiments elsewhere (Fang *et al.*, 2019; Reema *et al.*, 2017; Amit *et al.*, 2016; Chaplot, 2015 in cotton and also by Kamran *et al.*, 2017 in maize). Yasmeen *et al.* (2016) reported that the combined application of MLE and MC at 90 days after blooming improved seed cotton yield in Bt cotton. Application of MC alone reduced the plant growth without significantly increasing the yield.

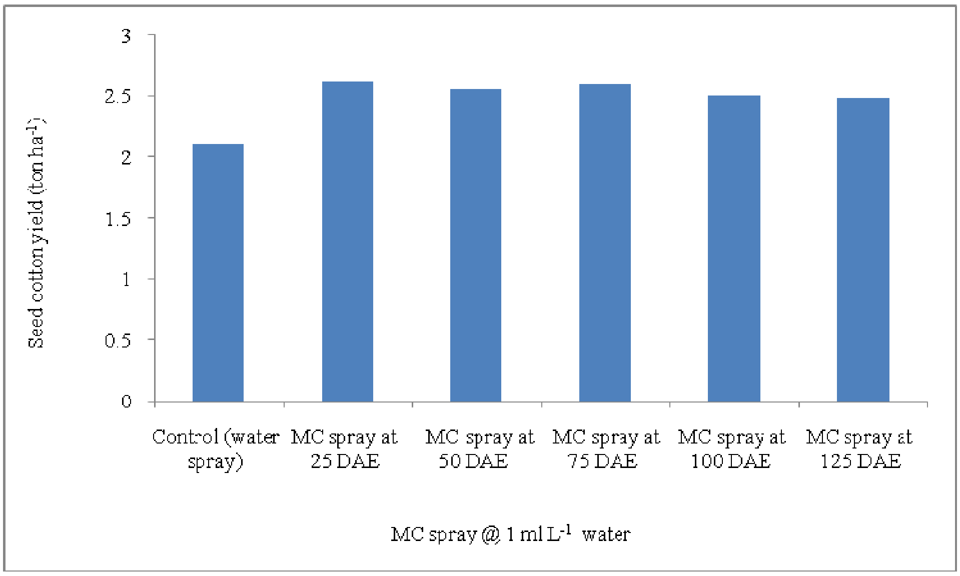

Fig. 2. Influence of time of application of mepiquat chloride on seed cotton yield of cotton ($LSD_{0.05}$=0.145)

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

Combined effect of plant spacing and time of mepiquat chloride (MC) spray on seed cotton yield was statistically significant (Table 1). Combination treatment 60 cm × 30 cm along with growth regulator sprayed at 25, 75 and 100 DAE showed statistically identical highest seed cotton yield (4.06 t ha^{-1}). Plants grown without MC sprayed with spacing of 90 cm × 45 cm treatment combination gave the lowest seed cotton yield (1.20 t ha^{-1}) which was statistically at par with MC foliar sprayed at 25 DAE with the same spacing. Seed cotton yield increased as plant population increased as MC sprayed compared to control in cotton. Zhao *et al.,* 2019; Copur *et al.*, 2010 in cotton and Golada *et al.,* 2018 in baby corn noted the same observation.

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

Treatments	Seed cotton yield (t ha^{-1})
90 cm × 45 cm × Control (water spray)	1.20 n
× MC spray at 25 DAE	1.26 n
× MC spray at 50 DAE	2.72 h-j
× MC spray at 75 DAE	2.74 g-i
× MC spray at 100 DAE	2.77 f-i
× MC spray at 125 DAE	2.29 kl
60 cm × 30 cm × Control (water spray)	2.56 i-k
× MC spray at 25 DAE	4.06 a
× MC spray at 50 DAE	3.36 bc
× MC spray at 75 DAE	4.06 a
× MC spray at 100 DAE	4.06 a
× MC spray at 125 DAE	3.36 bc
60 cm × 40 cm × Control (water spray)	1.75 m
× MC spray at 25 DAE	2.41 j-l
× MC spray at 50 DAE	3.06 c-f
× MC spray at 75 DAE	3.09 c-e
× MC spray at 100 DAE	3.36 bc
× MC spray at 125 DAE	2.77 f-i
75 cm × 30 cm × Control (water spray)	1.68 m
× MC spray at 25 DAE	2.56 i-k
× MC spray at 50 DAE	3.05 c-g
× MC spray at 75 DAE	3.07 c-f
× MC spray at 100 DAE	3.65 b
× MC spray at 125 DAE	3.02 d-h
75 cm × 40 cm × Control (water spray)	2.15 l
× MC spray at 25 DAE	2.16 l
× MC spray at 50 DAE	2.20 l
× MC spray at 75 DAE	3.02 d-h
× MC spray at 100 DAE	3.25 cd
× MC spray at 125 DAE	2.79 e-i
$LSD_{(0.05)}$	0.306
CV (%)	4.13

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

Conclusion

Maximum seed cotton yield (4.03 t ha^{-1}) was observed from 1.0 ml MC L^{-1} water at 25 DAE but minimum seed cotton yield (2.12 t ha^{-1}) was observed in water spray. In respect of combined effect the higher seed cotton yield (4.67 t ha^{-1}) was observed in the crop raised from 60 cm × 30 cm spacing (55,555 plants ha^{-1}) with 1 ml MC L^{-1} water sprayed at 25 DAE. So, foliar application of mepiquat chloride @ 1 ml L^{-1} water at 25 DAE along with plant spacing of 60 cm x 30 cm can be practiced for profitable cotton production in Sreepur, Gazipur areas of Bangladesh. This may also trials in other locations for spreading the profitable cotton production in Bangladesh.

References

Alam, S. M., Shereen, A. and Khan, M. 2002. Growth response of wheat cultivars to naphthalene acetic acid (NAA) and ethrel. *Pak. J. Bot.,* 34(2): 135-137.

Ali, A., Tahir, M., Ayub, M., Ali, I., Wasaya, A. and Khalid, F. 2009. Studies on the effect of plant spacing on the yield of recently approved varieties of cotton. *Pakistan J. Life Soc. Sci.,* 7(1): 25-30.

Amit, K., Deol, J. S. and Brar, A. S. 2016. Response of different *Bt* cotton (*Gossypium hirsutum* L.) hybrids to canopy modification practices. *J. Appl. Nat. Sci.*, 8 (3): 1188-1197.

Awais, M., Wajid, A., Ahmad, A., Saleem, M. F., Bashir, M. U., Saeed, U., Hussain, J. and Habib-ur-Rahman, M. 2015. Nitrogen fertilization and narrow plant spacing stimulates sunflower productivity. *Turkish J. Field Crops.*, 20(1): 99-108.

Chaplot, P. C. 2015. Response of cotton, *Gossipium hirsutum* L. to plant growth regulators, Directorate of Extension Education. *Int. J. Farm Sci.,* 4(4): 59-63.

Copur, O., Demirel, U. and Karakus, M. 2010. Effects of several plant growth regulators on the yield and fiber quality of cotton (*Gossypium hirsutum* L.). *Not. Bot. Hort. Agrobot. Cluj.*, 38(3): 104-110.

Cothren, J. T., Albers, D. W., Urwiler, M. J. and Guthrie, D. S. 1983. Comparative growth analysis of mepiquat chloride-treated cotton cultured under controlled environment. Proc. Tenth Ann. Meet. *Plant Growth Regulator Soc. Am., Lake Alfred.* FL., 253-261.

CDB. 2018. Cotton Extension and Research Report. Cotton Development Board, Khamarbari, Farmgate, Dhaka, Bangladesh. pp. 10-125.

Fang, S., Binglin, C., Kai, G., Shanshan, W., Wei, H. and Zhiguo, Z. 2019. Foliar and seed application of plant growth regulators affects cotton yield by altering leaf physiology and floral bud carbohydrate accumulation. *Field Crops Res*., 231:105-114.

Golada S. L., Sharma, G. L., Nepalia, V. and Puniya, R. 2018. Response to different levels of spacing, nitrogen and plant growth regulators on baby corn. *Agric. Sci. Digest.*, 38(3): 159-165.

Kamran, M., Cui, W., Ahmad, I., Meng, X., Zhang, X., Su, W., Chen, J., Ahmad, S., Fahad, S., Han, Q. and Liu, T. 2017. Effect of paclobutrazol, a potential growth regulator on stalk mechanical strength, lignin accumulation and its relation with lodging resistance of maize. *Plant Growth Regulation*., 8: 342.

Mahi, E. I. T. and Lokanadhan, S. 2018. Yield and Yield Components of Winter Cotton (*Gossypium hirsutum* L.) Genotypes Influenced by Plant Spacings. *Int. J. Plant Soil Sci*., 20(6): 1-6.

Rao, S., Shashidhar, S., Vinayak H., Shantappa, D. and Nataraj, M. 2015. Response of transplanted Bt cotton (*Gossypium hirsutum* L.) to different plant geometry. *Environ. Ecology*., 33 (1A): 396-398.

Reema, V., Chachar, Q. I., Chachar, S. D., Chachar, N. A., Laghari, A., Vistro, S. A. and Kumbhar, I. 2017. Impact of plant growth regulators on the growth and yield of cotton. *Int. J. Agri. Tech.*, 13(3): 353-362.

Silva, P. T., Macedo, F. G., Camacho, M. A., Santos, C., Santi, A., Krause, W. and Rambo, J. R. 2012. Spacing and plant density effect on reproductive development of herbaceous cotton. *Sci. plena*., 8(5):1-8.

Sowmiya, R. and Sakthivel, N. 2018. Effect of planting geometry on growth and yield of cotton. *Madras Agric. J.*, 105(1-3): 30-32.

Wright, D. L., Marois, J. J., Sprenkel, R. K. and Rich, J. R. 2008. Production of ultra narrow row cotton. Publ. SS-AGR-83, Inst, Food And Agric. Sci., Agron. Deptt. Florida Cooperative Extension Service, Univ. Florida. USA.

Yasmeen, A., Arif, M., Labar, N. H., Waqas, M. and Qadir, A. 2016. Growth, yield and quality response of cotton as influenced by growth regulators, planting geometry and fertilizer application under agro-climatic conditions of multan. *Int. J. Agric. Biol*., 18(6): 1109-1121.

Zhao, W., Yan, Q., Hongkun, Y., Xiaoni, Y., Leran, W., Binglin, C., Yali, M. and Zhou, Z. 2019. Effects of mepiquat chloride on yield and main properties of cotton seed under different plant densities. *J. Cotton Res.*, 2: 1-10.