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Influence of Various Plant Spacing on Plant Population and Yields of Cotton (Gossypium Arboreum L.)

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Abstract – To boost output and lower cotton input costs, a narrow plant spacing production system has been proposed as an alternative to the conventional method. However, more examination through into performance of this production system in various parts of the world's cotton belt may be essential. The field experiment was conducted at Hill Cotton Research Station, Balaghata, Bandarban, Bangladesh during 2020-21 growing season to study the performance of SR 27 Cotton line (*Gossypium arboreum* L.) beneath numerous plants spacing. The treatments consisted of four plant spacings viz. 90cm × 45cm, 90cm × 30cm, 90cm × 15cm, 90cm × 10cm. The experiment was carried out with a randomized complete block design and repeated 3 times. The highest seed cotton yield (2705kg/ha) and plant number (68107) per hectare, were recorded with spacing of 90cm × 10cm which was significantly($p<0.01$) more than 90cm × 45cm, 90cm × 30cm and 90cm ×15cm. But, other parameters like plant height (cm), node number of first fruiting branch (NFB), number of monopodial branches/plant, number of sympodial branch/plant, number of bolls/plant and single boll weight (gm) were statistically non-significant but they play a role in yield. So that, narrow (90cm × 10cm) plant spacing is better than others wider plant spacing for getting maximal seed cotton yield and plant population play a key factor to minimize yield losses.

Keywords – Cotton, Plant Spacing, Plant Population, Seed Cotton Yield.

I. INTRODUCTION

Cotton is the most important natural textile fibre in world and day by day raw cotton imports are increasing in Bangladesh [1]. But, Cotton (Gossypium arboreum L.) is grown in the southeastern Chattogram Hill Tracts (CHT) form centuries in Bangladesh [2]. This native cotton species is believed to own domesticated within the Indus vale of the Indian sub-continent and was mostly grownup in tropical and subtropical regions of South Asia till the nineteenth century [3][4]. The hill cotton (Gossypium arboreum L.) is known to have survived vagaries of nature for millions of years and thus tolerant and resistant to diseases, pests and adverse environmental conditions. Hill cotton is a vital cash crop for the farmers of ethnic communities within the CHT. Low productivity of hill cotton is a major bottle neck in its expansion in the area. However, to reap the maximum productivity of cotton, the adoption of promising varieties along with agronomic techniques such as suitable plant spacing plays a crucial role. Hall and Ziska [5] determined that plant population ought to be increased so as to reduce yield losses. Although, Bangladesh have lowest plant population per hectare in cotton growing country and second importer of cotton fabric in world [6]. Yang *et al.* [7] indicated that a rational plant density provided a better canopy micro-environment to gain a higher yield. An applicable plant density might not solely maximize cotton yield and fiber quality for a given variety however additionally scale back inputs by minimizing seed

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use while not sacrificing yield [8]. Plant spacing directly influences the soil moisture extraction, light interception, humidity and wind movement which in turn influence plant height, branches development, fruit location and size, crop maturity and ultimately on cotton yield [9]. Plant height, number of bolls per plant and average boll weight decreased in 20 cm and 10 cm spacing between plants as compared to 30 cm spacing, however seed cotton yield was greater in 10 cm [10]. In cotton, narrow plant spacings have indeed been found to generate a higher yield (14.4%) than the wider spacing utilized in traditional production systems [11][12]. Darawsheh *et al*. [13] observed that, to reduce input cost and increase yield, narrow plant spacing and more plant population is an alternative strategy in cotton production. Keeping these points in view, the present investigation was undertaken to detect the effect of plant spacing on the plant population, yield and yield attributes characters of hill cotton.

II. Materials and Methods

The experiment was conducted at Hill Cotton Research Station, Balaghata, Bandarban, Bangladesh (22°13′13.7″ N latitude and 92°12′18.3″ E longitude) during *kharif* 2020. Four plant spacing's (90cm × 45cm, 90cm × 30cm, 90cm × 15cm, 90cm × 10cm) treatments were set enter a randomized complete block design with 3 replications. Gross plot size was 4.5 × 3.6 m accommodating four rows of cotton. Cotton line 'Hill Cotton SR-27', was utilized in the experiment. The seed was sown on 01 June 2020 and harvested on 19 0ctober 2020. Gap filling (10 days after seeding) and thinning were used to sustain plant population (24 days after sowing). The recommended agronomic and crop protection practices that is given by Cotton Development Board were applied equally for all experimental units. The data were observed from five randomly selected plants within each plot. The observations were recorded for the characters viz. number of plant/hectare, plant height (cm), node number of first fruiting branch (NFB), number of monopodial branches/plant, number of sympodial branch/plant, number of bolls/plant, single boll weight (gm) and seed cotton yield (kg/ha). Data were analyzed using 'Statistix 10' software package. Tukey HSD multiple comparison tests were done to determinate significance of differences among treatments' means.

III. Results and Discussion

Data presented in the Table depicted that seed cotton yield and number of plant/hectare were found to be significantly ($p<0.01$) influenced by different spacing while plant height, node number of first fruiting branch (NFB), number of monopodial branches/plant, number of sympodial branch/plant, number of bolls/plant, single boll weight was non-significantly affected by different spacing. The maximum seed cotton yield (2705kg/ha), were recorded with spacing of 90cm × 10cm which was significantly more than 90cm × 45cm, 90cm × 30cm and 90cm ×15cm. The highest (68107) plant number per hectare of hill cotton crop at 90cm × 10cm plant spacing. 22016, 28807 and 62346 plants per hectare was observed at 90cm × 45cm, 90cm × 30cm and 90cm ×15cm plant spacing respectively. Brar *et al*. [14] sows that when plant to plant spacing is decreased then plant population is increased. Seed cotton yield is increased when plant population is increased. The results of the study area unit in line with Buttar and Singh [15], Singh *et al*. [16] and Awan *et al. [17]*. Also, other parameters like plant height, node number of first fruiting branch (NFB), number of monopodial branches/plant, number of sympodial branch/plant, number of bolls/plant, single boll weight was statistically non-significant at per four spacing. The highest plant height (131.6 cm) was observed in 90cm × 45cm plant spacing and lowest (126.3 cm) is in 90cm ×15cm plant spacing. Statistically highest boll weight (2.3 g) was obtained in 90cm × 45cm plant spacing and the low value of (1.9 g) in case of 90cm × 10cm plant spacing. These results are in line with those of Hussain *et al,* [10] and Boquet [18] who reported that by increasing plant density average boll weight decreases. So that, Plant height and single boll weight are decreasing when spacing is low. But in others, node of first fruiting branch (NFB), number of monopodial branches/plant, number of sympodial Branch/Plant, number of bolls/plant are increasing in low spacing that is not statistically significant.

Table 1. Mean Performance of Hill Cotton as Affected by Various Plant Spacing

Plant spacing (cm)	No. of plant/ha	NFB	Plant height (cm)	No. of monopodial branch/plant	No. of sympodial branch /plant	No. of bolls/ plant	Single boll weight (gm)	Seed cotton yield (kg/ha)
90×45	22016b	3.9	131.6	3.9	12.3	16.7	2.3	857.2b
90×30	28807b	3.7	130.1	3.9	13.8	17.5	2.2	1082.7b
90×15	62346a	4.0	126.3	3.9	12.5	19.1	2.1	2466.8a
90×10	68107a	4.0	127.4	4.0	13.2	21.0	1.9	2705.4a
Level of Significance($HSD_{0.05}$)	**	NS	NS	NS	NS	NS	NS	**
CV	7.4	11.8	4.2	10.4	15.6	11.7	8.0	6.0

Means within a column followed by different letters are significantly different at the 0.05 probability level, ** significances at 0.01 probability levels, N.S. = Non-significant, NFB = Node number of first fruiting branch.

In figure, Seed cotton yield increased by 26.31 %, 187.77% and 215.61% at 90cm × 30cm, 90cm ×15 cm and 90cm × 10cm plant spacing respectively as compared to control (90cm × 45cm). And also Number of plant/ha increased by 30.85%, 183.18% and 209.35% at 90cm × 30cm, 90cm ×15 cm and 90cm × 10cm plant spacing respectively as compared to control (90cm × 45cm). Plant Population is also influencing on plant spacing. Seed cotton yield is increased with lower plant spacing and highest plant population. Nawaz *et al*., [12] also stated such type of results that narrow plant spacing first of all taken into consideration as a way of enhancing yield capability in which less plant density did not fully devour the planting area.

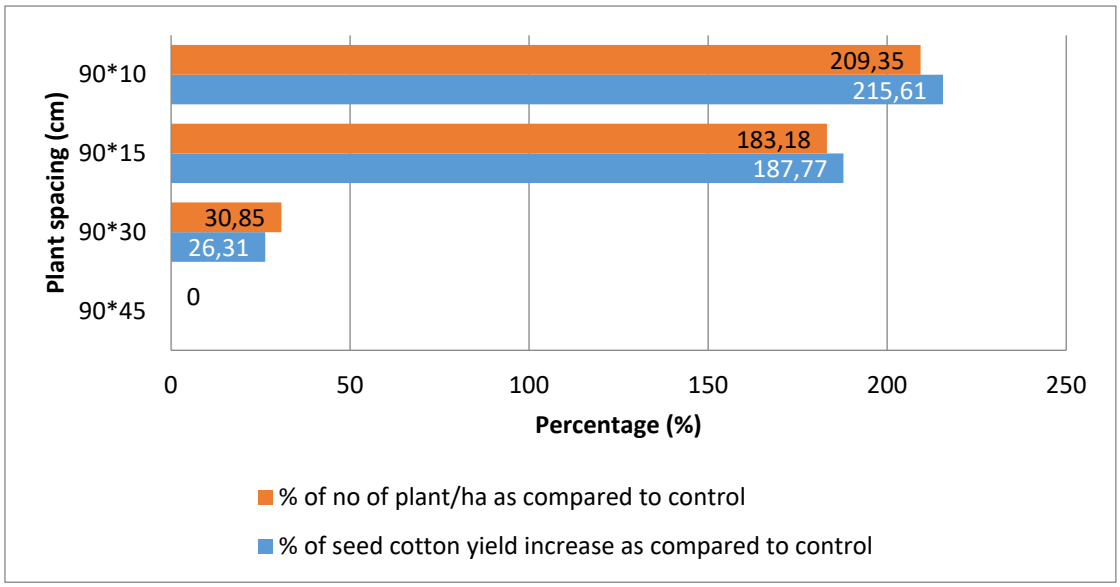

Figure 1. Percentage (%) of seed cotton yield and number of plant/ha increase as compared to control

IV. Conclusion

It can be concluded from this study that for getting highest seed cotton yield, narrow plant spacing is better than wider plant spacing and plant population play a key factor to minimize yield losses. In any case, more assessment through into performance of this production system in different location may be needed.

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