

GROWTH, YIELD AND QUALITY PERFORMANCE OF COTTON CULTIVAR BH-160 (*Gossypium hirsutum* L.) AS INFLUENCED BY DIFFERENT PLANT SPACING

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ABSTRACT

A field experiment was carried out in District Toba Tek Singh to evaluate the effect of plant spacing on growth, yield and quality of cotton variety BH-160 (*Gossypium hirsutum* L.). The treatments comprised of four plant spacing's viz. 15 cm, 22.5 cm, 30 cm and 37.5 cm. The experiment was laid out in randomized complete block design (RCBD) by using four replications. The data exhibited that plant spacing significantly influenced number of sympodial branches per plant, plant height (cm), number of bolls per plant, average boll weight (g), seed cotton yield per plant (g) and seed cotton yield (kg ha^{-1}) while number of monopodial branches per plant, ginning out turn (%), fibre length (mm) and fibre fineness (μinch^{-1}) were affected non significantly by plant spacing. It is suggested that for the purpose of getting higher seed cotton yield per hectare the farmers should adopt the practice of growing cotton crop in general and particularly the variety BH-160 at plant spacing of 22.5 cm x 75 cm.

Key word: Growth, Quality, Cotton

INTRODUCTION

Cotton (*Gossypium hirsutum*) is the most beneficial fibre and cash crop of Pakistan and earns a good fortune for the country in the form of foreign exchange. Cotton was grown on an area of 2.8 million hectares with a production of 11.8 million bales with average seed cotton yield 713 kg ha^{-1} . It accounts for 7.3 % of the value added products in agriculture and about 1.6 % to GDP. (GOP, 2009). Low yield of cotton in Pakistan is due to many crop husbandry problems such as weed infestation, insect pest and diseases, water shortage, low seed rate, low or more plant population, improper plant spacing, soil management practices, shedding of flowers and bolls etc. Too close spacing interferes with normal root and plant development and increases the interplant competition results ultimately in yield reduction (Prasad and Prasad, 1993) while wider interplant spacing may result in more vigorous growth of weeds. Brar *et al* (2002) conducted an experiment to evaluate the effects of plant spacing (67.5 x 15 cm, 67.5 x 30 cm, and 67.5 x 45 cm) and reported that 67.5 x 45 cm significantly improved the number of flowers, number of bolls and number of open bolls per plant but gave the lowest seed cotton yield. Hussain *et al.* (2000) reported that 30cm spacing between plants increased plant height, number of bolls per plant and boll weight as compared to 10 cm and 20 cm. However seed cotton yield was greater at 10 cm while plant spacing did not affect ginning out turn or fibre quality, where as Muhammad *et al.* (2002) studied that the boll weight decreased by increasing plant population.

It is imperative that cotton crop should be planted by using a versatile method that ensure efficient uptake of nutrients, minimizing mutual shading and inter plant competition. To overcome this problem, the modern technology emphasis on the proper plant spacing to ensure the high productivity of cotton. Keeping in view the importance of cotton crop and its significant response to spatial arrangements, the present study was executed with the objective to establish the best spacing for enhancing yield in cotton without significantly affecting the yield and quality attributes and to find the optimum number of plants per unit area for exploiting the maximum genetic potential of the cv. BH-160.

MATERIALS AND METHODS

A field experiment was conducted at farmer's field in Toba Tek Singh to study the effect of four plant spacings i.e. 15, 22.5, 30 and 37.5 cm in cotton. The farmers of this area have adopted cotton – wheat rotation. Prior to cotton, wheat was sown in this field. For the thorough mixing of the residue of the previous crop, one ploughing with mould board plough and four ploughings with ordinary cultivator followed by planking was given for seedbed preparation. The experiment was sown on 15th of May, 2006 using cotton variety (cv. BH-160) in 75 cm spaced rows with a single row hand drill. The net plot size maintained was 6m x 10m. Nitrogen and phosphorus at the rate of 120 and 60 kg ha^{-1} were applied in the form of Urea and DAP, respectively. Whole of the P and half of the N were applied at the time of seedbed preparation while remaining half nitrogen was splitted in further two splits i.e. one with first irrigation and other at

flowering. Thinning was done on 15th June to maintain the respective plant spacing in each plot according to the treatments. All other agronomic practices like hoeing, earthing-up, weeding, fertilizer application and irrigation were kept uniform for all the treatments. Fifteen plants were randomly selected from each plot for recording data. The number of branches and plant height were taken at final picking and number of bolls per plant was the sum of number of bolls at each picking from the selected plants. Quality parameters were evaluated by using standard procedure. Data recorded on growth, yield and quality characteristics were statistically analyzed by using Fisher's analysis of variance technique and least significant difference (LSD) test at 0.05 probability was applied to compare differences among the individual treatment means (Steel *et al.*, 1997).

RESULTS AND DISCUSSION

Number of monopodial branches per plant: Data regarding number of monopodial branches per plant given in Table-1 revealed non-significant effect of plant spacing on number of monopodial branches per plant. The number of monopodial branches per plant is a genetically controlled factor and plant spacing had little effect on it, therefore the results obtained were non-significant. These results are similar to the results obtained by Anjum (2003) who reported non-significant effect of plant spacing on number of monopodial branches per plant.

Number of sympodial branches per plant: Data representing number of sympodial branches per plant are presented in Table-1. Plant spacing had highly significant effect on the number of sympodial branches per plant. Statistically the maximum number of sympodial branches per plant (15.102) was recorded in plant spacing of 22.5 cm followed by plants sown at 30 cm apart giving 13.49 number of sympodial branches per plant. However, the minimum number of sympodial branches per plant (10.952) was found in the plots sown at 37.5 cm plant spacing which was statistically lower than the 15 cm spacing with (11.842) sympodial branches per plant. More number of sympodial branches per plant in 22.5 cm was probably due to the reason that the plants in these plots had optimum space to utilize the soil and environmental resources to the maximum extent. However, these results are in contradiction with the findings of Hussain *et al.* (2000) who reported more number of sympodial branches per plant in wider plant spacing.

Plant height (cm): Plant height is a genetically controlled factor but environmental and nutritional stress may also influence the height of a plant. The data regarding plant height in Table-1 revealed significant differences for plant height among the plant spacing

treatments. The maximum plant height (103.897 cm) was recorded at 22.5 cm plant spacing. The minimum plant height (99.853 cm) was found in the plots sown at 37.5 cm plant spacing but was statistically at par with 15 cm plant spacing. The increase in plant height sown at 22.5 cm plant spacing was perhaps due to the optimum space available to the plants to flourish and to absorb the nutrients and water in order to meet their nutritional demands in a benefiting way. The minimum plant height in the plots sown at 37.5 cm space was due to their more spread of plant branches which inhibited apical dominance. These results are in line with the findings of Wankhade *et al.* (2002) who reported that plant height is affected by environmental conditions and genetic make up of crop plants. However, these are in contrary with the findings of Anjum (2003) who found no effects of plant spacing on plant height.

Number of mature bolls per plant: The more number of bolls per plant, the more will be the expected seed cotton yield. The data on number of bolls per plant presented in Table-1 exhibited that plant spacing significantly affected the number of bolls per plant. The maximum number of bolls per plant (31.40) was found at 22.5 cm plant spacing which was statistically at par with 30 cm plant spacing. The minimum number of bolls per plant 25.721 found in 37.5 cm plant spacing. The more number of bolls per plant in 22.5 cm plant spacing was due maximum number of braches and bolls per plant while the minimum number of bolls per plant in 37.5 cm plant spacing was due to minimum number of sympodial branches per plant in this spacing. These results are in contrast with those of Palomo *et al.* (2000) and Siddiqui *et al.* (2007) who reported that the number of bolls per plant decreased with increase in plant density.

Average boll weight (g): Data pertaining to the average boll weight given in Table-1 indicated highly significant results. The maximum average boll weight was 2.275 g found at 37.5 cm plant spacing, while the minimum average boll weight 1.793 g was found in 15 cm plant spacing and it has statistically lower average boll weight than the treatment P3 which was significantly higher with 2.257 average boll weight sown at 30 cm plant spacing. The more average boll weight in 37.5 cm plant spacing was due to more plant spacing and less number of bolls per plant but more utilization of assimilatory material for their growth and development in this treatment. These results are in consonance with the findings of Hussain *et al.* (2000) who reported that wider spacing increased average boll weight.

Seed cotton yield per plant (g): Seed cotton yield per plant is an important factor contributing to final yield. It is the result of number of sympodial branches per plant, number of bolls per plant and average boll weight. The more seed cotton yield per plant means that there will be

more final yield per hectare. The data on seed cotton yield per plant reflected in Table-1 revealed that plant spacing significantly influenced the seed cotton yield per plant in different plant spacing treatments. The maximum 52.375 g was found in 22.5 cm plant spacing followed by 46.395 g seed cotton yield per plant was found in spacing 30 cm. The minimum seed cotton yield per plant 40.963 g was obtained from 37.5 cm plant spacing. More seed cotton yield per plant in 22.5 cm plant spacing was due to more number of sympodial branches per plant, more number of bolls per plant and more average boll weight in this plant spacing. These results are in agreement with those reported by Palomo *et al.* (2000) and Alfaqei *et al.* (2002) who stated that yield per plant increases with decreasing plant density.

Seed cotton yield (kg ha⁻¹): Seed cotton yield is the ultimate gain of the inputs applied and the contribution from the other growth factors of plant. The ultimate focus of the study is to increase the final yield under given circumstances. The increase in seed cotton yield is mainly a result of the number of plants per unit area, number of sympodial branches per plant, number of bolls per plant and average boll weight. Data regarding seed cotton yield presented in Table-1 indicated that plant spacing significantly influenced seed cotton yield kg/ha amongst the treatments under study. The maximum seed cotton yield (3217.237 kg ha⁻¹) was found in 22.5 cm plant spacing followed by plant spacing of 30 cm with a seed cotton yield of 3104.208 kg ha⁻¹, while the minimum seed cotton yield (2620.765 kg ha⁻¹) was obtained from 37.5 cm plant spacing. More seed cotton yield in 22.5 cm plant spacing was due to more number of plants per unit area, number of sympodial branches per plant and more number of bolls per plant in this plant spacing. The minimum seed cotton yield 2620.765 kg ha⁻¹ was produced in the treatment sown at 37.5 cm plant spacing.

These results are in line with those reported by Alfaqei *et al.* (2002) and Khan *et al.* (2005) who reported that seed cotton yield decreases with the increase in plant spacing.

QUALITY PARAMETERS

Ginning out turn (%), Fibre length (mm) and Fibre fineness (µg inch⁻¹): Data regarding ginning out turn are presented in Table-1. A perusal of the data indicated that plant spacing did not influence ginning out turn. However, ginning out turn ranged between 36.46% to 37.17% among the different treatments of plant spacing with the maximum 37.17% ginning out turn was obtained from the treatment P2 sown at 22.5 cm plant spacing while the minimum 36.46% GOT was observed in the treatment sown at 37.5 cm plant spacing. These results are similar with those reported by Hussain *et al.* (2000) who reported that plant spacing and nitrogen application did not affect the ginning out turn and fibre quality. While, Jost and Cothren (2001) reported that GOT increased significantly by decreasing plant spacing and this result might be attributed due to difference in genetic makeup, environmental condition and growth habits of crop plants.

Fibre length is a genetically controlled factor but it can be influenced by environmental factors also. Data regarding fibre length are given in Table-1. A perusal of the data indicated non significant effect of plant spacing on fibre length. More fibre length (29.63 mm) was recorded in the treatment sown at 30 cm plant spacing. However, plant spacings of 22.5 cm and 37.5 cm gave a fibre length each of 29.25 mm. The minimum fibre length of 28.75 mm was observed in plant spacing of 15 cm. These results are in contrary with the results of Donald (2005).

Table-1: Means not sharing a letter differ significantly using LSD at 5 % probability level

Treatments	No. of monopodial braches plant ⁻¹	No. of sympodial braches plant ⁻¹	Plant height at harvest (cm)	No. of bolls plant ⁻¹	Avg. boll weight (g)	Seed cotton yield plant ⁻¹	Seed cotton yield (kg ha ⁻¹)	Ginning out turn (%)	Fibre length (mm)	Fibre fineness (µg/inch)
P1 (15 cm)	1.775	11.842 ^c	99.993 ^c	26.383 ^b	1.793 ^d	44.515 ^b	2856.370 ^{bc}	36.49	28.75	4.075
P2 (22.5 cm)	1.825	15.102 ^a	103.897 ^a	31.395 ^a	2.190 ^c	52.375 ^a	3217.237 ^a	37.17	29.25	4.275
P3 (30 cm)	1.775	13.490 ^b	101.668 ^b	29.895 ^a	2.257 ^b	46.395 ^b	3104.208 ^{ab}	36.89	29.63	3.850
P4 (37.5 cm)	1.825	10.952 ^d	99.853 ^c	25.710 ^b	2.275 ^a	40.963 ^c	2620.765 ^c	36.46	29.25	3.850
LSD (0.05)	NS	0.6006	1.347	2.307	0.01600	2.148	259.8	NS	NS	NS

The fibre fineness among various plant spacing showed in Table-1 has non-significant difference. The fibre fineness of various plant spacings ranged between 3.850 to 4.275 µg inch⁻¹. The maximum and minimum fibre fineness was recorded in the treatments P2 and P4 sown at a plant spacing of 22.5 cm and 37.5 cm respectively. The fiber fineness is a genetically controlled factor and plant spacing had a little or no effect on it. Therefore the results obtained were non-significant. These results are

similar to the results obtained by Hussain *et al.* (2000) who reported non-significant effect of plant spacing on fiber fineness.

Conclusion: It may be concluded from this study that the spatial arrangement of 75 cm x 22.5 cm produced optimum number of plants per hectare and this plant spacing/planting density compensated the lower values of yield components and produced more yield. Therefore, it

is recommended that spatial arrangement of 75 cm x 22.5 cm is most suitable for achieving higher yield of cotton under agro-ecological conditions of Toba Tek Singh, especially medium statured varieties like BH-160.

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