Madras Agric. J., 105 (1-3): 30-32, March 2018

Effect of Planting Geometry on Growth and Yield of Cotton

R. Sowmiya* and N. Sakthivel
Department of Agronomy
Tamil Nadu Agricultural University, Coimbatore - 641 003

A field investigation was carried out at Tamil Nadu Agricultural University, Coimbatore during winter season of 2017 - 2018 to determine the effect of row spacing on growth and yield of cotton genotype TCH 1819. The experiment was laid out in Randomized Block Design (RBD) with seven spacing treatments *viz.,* 60 x 15 cm, 60 x 20 cm, 75 x 15 cm, 75 x 20 cm, 75 x 30 cm, 90 x 15 cm, 90 x 20 cm and was replicated thrice. Significant variation for plant geometry was observed for all the traits studied. The plant geometry of 60 x 15 cm recorded significantly higher plant height, Leaf Area Index (LAI), Dry Matter Production (DMP). The number of sympodial branches per plant and number of bolls per plant were found significant in wider spacing of 75 x 30 cm. The narrow spacing of 60 x 15 cm registered highest seed cotton yield, net return and B: C ratio followed by the spacing of 75 x 15 cm due to more plant density per unit area.

Key words: High density planting, Plant geometry, Growth, Seed cotton yield

Cotton (*Gossypium hirsutum* L.) is the predominanat fibre and cash crop, not only of India but of the entire world. India is the most important grower of cotton on a global scale. Cotton gives 60% of fibre to Indian textiles, more than one million metric ton of cooking oil and animal feed and 40 million metric ton of biomass in the form of cotton stalks. India has the largest area under cotton and is the second largest producer in the world. Although the crop occupies larger area in the country, the average productivity is low. The cotton productivity of India during 2016 - 17 was 568 kg.ha^{-1} with area coverage of 105 lakh ha and production 351 lakh bales each 170 kg (http://cotcorp.gov.in/statistics.aspx CCI, 2017). The major reason for low productivity of the crop is because of cultivation in small holdings. Yield in small holdings are often depressed because of competition among crops for land and labour, leading to lack of timeliness in field operations and to difficulties in weed control, insect control and picking (Hamdy *et.al.,* 1994). Apart from these constraints, many other countries have attained higher yield levels although their area is negligible. To increase the productivity of cotton in India, agricultural scientists and agronomists have attempted various technologies for several decades in many countries.

The High Density Planting System (HDPS) is now understood as an alternate production system for enhancing the productivity and profitability of cotton. To maximize the yield per unit area, optimum plant population per unit land area has to be maintained and that also varies from variety to variety in cotton (Ali *et al.,* 2009). Spacing is one of the factors which influences yield as well as plant stands. In High Density Planting System (HDPS), researchers aim to maintain 1-2 lakh cotton plants.ha^{-1} of land. The intra row spacing could be as low as 30 cm instead of 90 cm to 1 meter for conventional cotton. The reshaping of crop geometry is an agronomic technique for acquiring higher yield. This alteration enables more number of plants per hectare with 8 - 14 bolls per plant with 4 g per boll. In cotton, the crop geometry has influence on seed cotton yield. Closer plant geometry recorded higher seed cotton yields (Paslawar *et al.,* 2015; Parlawar *et al.,* 2017; Madavi *et al.,* 2017 and Meena *et al.,* 2017). Hence, the present investigation was undertaken to study the influence of plant density on growth and yield attributes of the genotype TCH 1819.

*Corresponding author's email: sowmiagro94@gmail.com

Material and Methods

The study was carried out during 2017 – 2018 in Winter irrigated season at Eastern Block Farm, Department of Farm Management, Tamil Nadu Agricultural University, Coimbatore situated in the North Western Agro-Climatic Zone of Tamil Nadu at 11°N 76°57´E longitude and at an altitude of 426.7 meters above MSL. The soil of the research field was sandy clay loam in texture, low in available nitrogen (224 kg.ha^{-1}), medium in available phosphorus (13.5 kg.ha^{-1}) and available potassium (250 kg.ha^{-1}). During the cropping period, rainfall of 65.27 mm was received in 16 rainy days. The mean maximum temperature ranges from 28.5 to 32.4^{o}C and the mean minimum temperature ranges from 16.1 to 24.0^{o}C. The experiment was laid out in randomized block design replicated thrice with seven spacing levels [T_1: 60 x 15 cm (1,11,111 plants.ha^{-1}), T_2: 60 x 20 cm (83,333 plants.ha^{-1}), T_3: 75 x 15 cm (88,888 plants.ha^{-1}), T_4: 75 x 20 cm (66,666 plants.ha^{-1}), T_5: 75 x 30 cm (44,444 plants.ha^{-1}), T_6: 90 x 15 cm (74074 plants.ha^{-1}), T_7: 90 x 20 cm(55,555 plants.ha^{-1})].

Field was ploughed once with disc plough followed by cultivator twice. Rotavator was used to break the clods and then bunds, ridges and furrows were formed. The crop was sown on August 23, 2017 by dibbling seeds at a depth of 4 to 5 cm as per spacing in treatments. Fertilizer dose of 100:50:50 kg NPK. ha^{-1} were applied. Entire dose of phosphorus, 50 per cent of N and K were applied as band placement 5 cm away and 5 cm below the seed row as basal placement. The remaining ½ N and K were top dressed at 40 – 45 DAS. Pre emergence herbicide pendimethalin @ 1.0 $kg.ha^{-1}$ was sprayed to prevent the growth of weeds. Hand weeding was carried out at 40 DAS. First irrigation was given at the time of sowing to ensure uniform germination and life irrigation was given on third day after sowing. The subsequent irrigations were scheduled at 7-10 days interval depending upon the field moisture condition. During the cropping period, sucking pest incidence was noticed. Initially imidaclorpid @ 2 $ml.l^{-1}$ was sprayed. At later stages, Acephate @ 4 $ml.l^{-1}$ was sprayed against white fly incidence as and when required. Harvesting of kapas was commenced on 135 DAS and pickings were taken at weekly intervals. The number of bolls on labeled plants from each plot were noted at each picking and expressed per plant. Harvested bolls from each treatment was weighed and expressed in $kg.ha^{-1}$.

Data on different characters *viz.,* growth and yield attributes were statistically analyzed as described by Gomez and Gomez (1984). Wherever the results were significant, critical differences was worked out at five per cent level.

Results and Discussion

Data on growth and yield attributes of the genotype TCH 1819 as influenced by the various spacing levels are presented in Table 1.

Table 1. Effect of plant geometry on growth and yield attributes of cotton at 90 DAS

Treatment Spacing (cm)	Plant height (cm)	Leaf Area Index (LAI)	Dry Matter Production (DMP) ($kg.ha^{-1}$)	Number of Sympodial $branches.plant^{-1}$	Number of bolls m^{-2}	Seed cotton yield ($kg.ha^{-1}$)
T_1 – 60 x 15	91.60	3.61	6150	10	63.80	2565
T_2 – 60 x 20	82.48	3.36	4827	12	53.59	2298
T_3 – 75 x 15	79.58	3.47	5005	11	58.83	2453
T_4 – 75 x 20	74.01	3.00	3973	14	42.90	2112
T_5 – 75 x 30	73.36	2.67	3162	17	35.02	1468
T_6 – 90x 15	70.80	3.19	4341	13	48.88	2184
T_7 – 90x 20	68.56	2.90	3560	15	40.34	1896
SEd	3.53	0.23	303.23	0.80	1.50	75.23
CD(p=0.05)	7.70	0.51	660.74	1.76	3.28	163.93

Growth attributes

The growth character *viz.,* plant height, Leaf Area Index (LAI), Dry Matter Production (DMP) was favorably influenced by narrow spacing of 60 x 15 cm at all growth stages. Plant density showed no significant difference with plant height at 30 DAS and thereafter, difference in plant height was observed with respect to various spacing levels. The highest plant height was recorded with the narrow spacing of 60 x 15 cm. The increase in height could be due to competition for light among the plants. This was in conformity with the findings of Munir *et al.* (2015) that the availability of horizontal space for individual plant in narrow rows reduced due to which intense inter plant competition for nutrient and light supp:ressed node app:earance and plants grew taller in respect of vertical space. The leaf area was higher in narrow spacing of 60 x 15 cm was due to increased plants per unit land area. This was in consonance with the findings of Udikeri and Shashidhara (2017) that the total dry matter production and supply of required photosynthates for the developing bolls largely depends on leaf area and leaf area index. The increased LAI was due to more number of plants per unit area there by more number of leaves leads to more LAI. Higher dry matter production was observed with the narrow spacing of 60 x 15 cm. Increased dry matter production in narrow spacing may be due to more accumulation of dry matter in leaves, stem and reproductive parts. Similar results were found by Darawsheh *et al.* (2007) that higher dry matter production at narrow spacing may be related with the better distribution of plant population in the case of NR (Narrow Row) system, which may be more effective to intercept the light.

Yield attributes

The yield attributing character *viz.,* number of sympodial branches per plant, number of bolls per plant was positively influenced by wider spacing of 75 x 30 cm while the seed cotton yield was highest (2565 $kg.ha^{-1}$) in narrow spacing of 60 x 15 cm followed by 75 x 15 cm (2453 $kg.ha^{-1}$). The number of sympodial branches was found higher in wider spacing of 75 x 30 cm. In narrow spacing due to increased plant population per unit area, there may be competition for light, moisture, nutrient, space and congestion in the growing induced more vertical growth through nodal elongation. Thus most of the photosynthates consumed in vertical growth restricted lateral branching. Similar results were found by Sisodia and Khamparia (2007), Parlawar *et al.* (2017) that decrease in sympodia with increasing plant densities in cotton. The number of bolls per plant was found higher at wider spacing of 75 x 30 cm. Nagender *et al.*

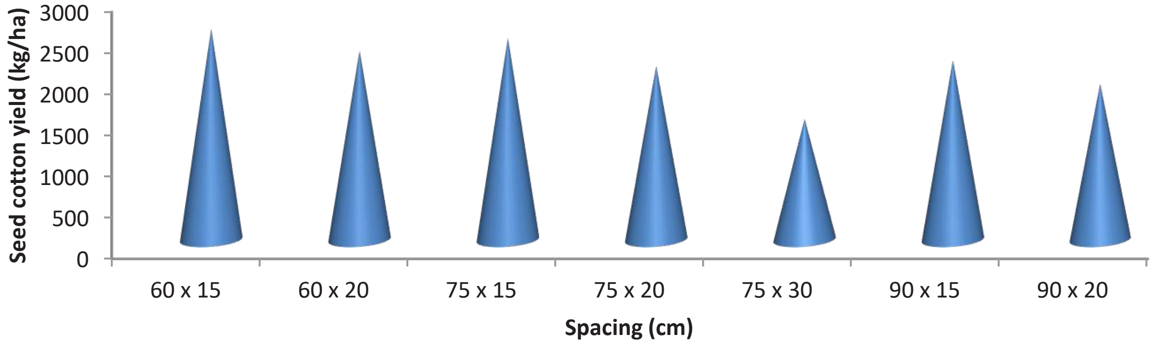

Fig 1. Effect of plant geometry on seed cotton yield (kg.ha^{-1})

(2017) noted that low density stands set more of their bolls on second and third positions and on vegetative branches. Larger bolls in low density stands was due to that plants retain and mature higher per cent of their squares in low density stand. The seed cotton yield was higher in narrow spacing of 60 x 15 cm. This is in consonance with the findings of Wells and Meredith (1986), Arunvenkatesh *et al.* (2017) found that cotton cultivar could alter canopy structure and light interception characteristics and the higher lint yield was observed with closer spacing in cotton genotypes (Heitholt *et al.,* 1992). Wider spacing registered more number of bolls and yield per plant but higher plant population compensated the yield per plant in narrow spacing though there were less number of bolls and yield per plant.

Economics

The gross monetary returns (₹ 115425.ha^{-1}) and net monetary returns (₹ 65706.ha^{-1}) were highest with closer spacing of 60 x 15 cm. The B: C ratio was maximum with narrow spacing of 60 x 15 cm (2.32) followed by 75 x 15 cm (2.25). These results are in accordance with the report of Meena *et al.* (2017) that maximum net return (₹ 57553.ha^{-1}) and B:C ratio (2.50) was observed at 90 x 45 cm closer spacing over 90 x 60 cm spacing (₹ 45690.ha^{-1}) and 90 x 90 cm (₹ 40565 ha^{-1}) wider spacing.

Conclusion

The genotype TCH 1819 tested with various spacing levels can be concluded that in high density planting system, the narrow spacing of 60 x 15 cm favorably increased crop growth, yield attributes and seed cotton yield.

References

Arunvenkatesh, S. Rajendran, K. and R. Baskaran. 2017. Effect of plant geometry on light interception and weed density in cotton under rainfed vertisols. *Agric. Update,* **12** (TECHSEAR-2): 421-425.

Darawsheh, M. K. Aivalakis, G. and D. L. Bouranis. 2007. Effect of Cultivation System on Cotton Development, Seed Cotton Production and Lint Quality, *The European Journal of Plant Science and Biotechnology* **(1)2**: 206-213.

Gomez, K. A. and A. A. Gomez. 1984. Statistical procedures for agricultural Research (2nd edn.) A John Wiley and Sons Intersciences Publications Book of An International Res. Institute, Philippines. p. 680.

Madavi, B. Rani, P. L. Sreenivas, G. and K. Surekha. 2017. Effect of High Density Planting and Weed Management Practices on Weed Drymatter, Weed Indices and Yield of Bt Cotton. *Int. J. Pure App. Biosci,* **5 (4)**: 1945-1950.

Meena, H. Meena, P. K. P. and B. L. Kumhar. 2017. Evaluation of Hirsutum Cotton Varieties under Various Fertility Levels and Plant Geometries. *Int.J.Curr. Microbiol.App.Sci,* **6(7)**: 541-544.

Munir, M. K. Tahir, M. and M. F. Saleem. 2015. Growth, Yield and Earliness response of cotton to row spacing and nitrogen management. *The Journal of Animal & Plant Sciences*, ***25*(3)**: 729-738.

Nagender, T. Reddy, D. R. Rani, P. L. Sreenivas, G. Surekha, K. Gupta, A. and P. D. Sreekanth. 2017. Response of Nitrogen Fertilization and Plant Densities on Bt and Non-Bt Cotton (*Gossypium hirsutum* L.) Hybrids. *Int.J.Curr.Microbiol.App.Sci,* **6(9)**: 3199-3207.

Parlawar, N. D. Jiotode, D. J. Khawle, V. S. Kubde, K. J. and P. D. Puri. 2017. Effect of Planting Geometry and Varieties on Morpho – Physiological Parameters and Yield of Cotton. *IJRBAT,* **5(2)**: 429-436.

Paslawar, A. N. Deotalu, A. S. and P. W. Nemade. 2015. High density planting of cotton variety AKH – 081 under rainfed condition of Vidharbha. *Plant Archives,* ***15*(2)**: 1075-1077.

Udikeri, M. and G. B. Shashidhara. 2017. Performance of compact cotton genotypes under high density planting system at different fertilizer levels. *J. Farm Sci,* **30(4)**: 460-466.

Received : January 23, 2018; Revised : February 07, 2018; Accepted : February 28, 2018