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Leena B Parihar
Ph.D Scholar, Department of Agricultural Botany PGI, Dr. PDKV., Akola, India

TH Rathod
Senior Research Scientist, Cotton Research Unit, Dr. PDKV., Akola, India

SM Raut
Ph.D Scholar, Department of Agricultural Botany PGI, Dr. PDKV., Akola, India

NS Kahate
Ph.D Scholar, Department of Agricultural Botany PGI, Dr. PDKV., Akola, India

Correspondence
Leena B Parihar
Ph.D Scholar, Department of Agricultural Botany PGI, Dr. PDKV., Akola, India

Impact of genotypes and high density planting on yield and yield attributes and quality parameter in hirsutum cotton

Leena B Parihar, TH Rathod, SM Raut and NS Kahate

Abstract
The experiment was laid out in a Randomised block design with three replications. There were twelve treatment combinations. Four levels of plant geometry viz. 45×10 cm, 60×10 cm, 75×10 cm and 60×15 cm and three hirsutum genotypes of cotton namely AKH081, NH615 and Suraj were applied. The gross plot size was 2.7 ×3 m^2. The quality parameters like 2.5% staple length fiber strenght, microniar value, fiber fineness and uniformity ratio were not influenced significantly by plant geometry and genotypes. Plant geometry 45×10 cm recorded significantly higher seed cotton yield (kg/ha). Cotton genotype AKH 081 can be sown at plant spacing 45×10 cm recorded more seed cotton yield (2428.89 kg ha^{-1}).

Keywords: High density, quality parameters, yield, hirsutum cotton

Introduction
Vigilant production and economic strategies are important for cotton growing farmers due to expanding cost of cultivation and stagnating productivity. Adoption of High density Planting System (HDPS) and newly released desi cotton varieties offer an alternate to sustainable production and decrease production cost. Cotton (*Gossypium* spp.), the queen of fibre or white gold, is one of the most important commercial crop of India. It is one of the most important cash crops next to food grains that play a vital role in Indian national economy (Patel *et al.*, 2016) [13]. In India cotton is grown over an area 105 lakh hectares with production 351 lakh bales and productivity 568 kg lint ha-1 (Anonymous, 2017) [2]. The majority (90%) of cotton in Maharashtra is rainfed system of high density (HDP) leading to more rapid canopy closer and decreased soil water evaporation is becoming popular to address. In many countries narrow row planting have been adopted after showing improvement in cotton productivity (Ali *et al.*, 2010) [3]. The adoption of HDP along with better genotype with boll worm control is one of option under rainfed situation of Vidharbha and control sucking pests in initial stage is needed (Kalyan *et al.*, 2009) [10]. The maximum exploitation of these genotypes can be achieved only after determining their optimum planting densities in comparison to recommended cotton varieties. In view of the above, present research work carried out with the objective to find out the effect of High Density Planting System (HDPS) on yield, and quality parametes of *hirsutum* cotton.

Material and method
The experiment was conducted at experimental field of Cotton Research Unit, Dr. P.D.K.V., Akola, during 2014-15. The topography of experimental field was fairly uniform, levelled and with a good drainage. The experiment was laid out in FRBD design with four factors of plant densities i.e. 45 x 10, 60 x10, 75 x 10 and 60 x 15 cm^2 in main plots and three factors of cotton varieties *i.e.*, AKH-081, NH-615 and Suraj in sub plots. The recommended package of practices was followed during the course of the investigation. The observation yield parameters were recorded at harvest stages. i.e number of bolls $plant^{-1}$, single boll weight, seed cotton yield $plant^{-1}$, seed cotton yield (kg/ha), seed index, harvest index, earliness index and ginning out turn.The seed cotton yield from each net plot was picked and the same weighed separately at each picking. The single boll weight was also recorded. The total seed cotton yield (kg ha^{-1}) worked out by summation of a quantity of seed cotton picked in all pickings. The collected data was statistically analysed by Gomez and Gomez (1984) [7] method.

Results and Discussion

Effect on yield contributing parameters

Number of Bolls plant^{-1}

Plant geometry significantly influenced the number of bolls plant^{-1}. Plant geometry of 60 x 15 cm recorded significantly more number of bolls plant^{-1} (10.45).Number of bolls plant^{-1} was significantly influenced due to different hirsutum genotypes. Genotype AKH081 (9.99) produced significantly more number of bolls plant^{-1}.Significantly more number of sympodial branches plant-1 and higher photosynthetic area for longer duration under wider geometry induced more number of bolls plant-1 than closer geometry. These finding are in agreement with those of Nehra et al. (2004) [12] and Anonymous (2006) [1]. The significant decrease in number of bolls plant-1 with increase in plant density were also experienced by Sharma et al. (2001) [19], Kalaichelvi (2009) [9] and Reddy and Kumar (2010) [18]. Thatikunta et al. (2016) [15] observed that Deltapine 9121 under wider spacing of 75 x 10 cm recorded minimum time for square formation (41.1 days), 50% flowering (66.7 days) and boll formation (92.3 days), maximum values for yield attributes such as number of bolls per plant (7.9) and single boll weight (2.9).

Seed cotton yield plant^{-1} (g)

On an average of 15.23 (g) seed cotton yield plant^{-1} was collect in three picking. Treatment differences in respect of seed cotton yield plant^{-1} due to different plant geometry were observed to be significant. Wider plant geometry of 60 x 15 cm (17.36 g) recorded significantly higher weight of seed cotton yield plant^{-1}. Under wider geometry availability of photosynthates to individual plant was more to produce maximum seed cotton yield as compared to closer plant geometry. This might be due to overall improvement in growth attributes and its positive effect on number of bolls plant^{-1} under wider plant geometry. The above result are in conformity with the findings of Solanke et al. (2001), Raut et al. (2005), Giri et al. (2008) and Reddy and Gopinath (2008) [23, 16, 6]. Differences in respect of seed cotton yield plant-^{1} were significant among the three hirsutum genotypes. Genotype AKH081 recorded significantly more seed cotton yield (16.52 g).

Seed Cotton Yield (kg ha^{-1})

Data pertaining to seed cotton yield ha^{-1} as influenced by different treatments are given in the Table 1. The mean seed cotton yield was 2102 kg ha^{-1}. The differences due to plant geometry in seed cotton yield ha^{-1} were significant. Closer plant geometry of 45 x 10 cm recorded significantly higher seed cotton yield (2428.89 kg ha^{-1}).It was observed that numbers of bolls plant^{-1} were highest under the wider geometry but the seed cotton yield was highest in closer geometry due to the higher plant population than the wider geometry. Similar results were also reported by Raut et al. (2005a) [16], Srinivasan (2006) [24], Sisodia and Khamparia (2007) [22], Giri et al. (2008) [6], Reddy and Gopinath (2008) [17], Bhalerao and Gaikwad (2010) [4] and Reddy and Kumar (2010) [18]. Pradeep Kumar et al. (2017) recorded that significantly higher seed cotton yield (2063 kg/ha) was recorded at plant spacing of 45 x 15 cm^2 as compared to other spacing. The seed cotton yield was significantly influenced by different hirsutum genotypes. Among the different hirsutum genotypes, genotype AKH081 (V1) recorded higher seed cotton yield (2225 kg ha-1).The increase in seed cotton yield in genotypes might be because of better vegetative growth and more number of monopodial, sympodial branches, number of bolls plant^{-1} and seed cotton yield plant^{-1} as compared to the other genotypes. The highest seed cotton yield produced by genotypes AKH081 might be due to the genetic ability and better photosynthetic efficiency through better source sink relations as reflected in harvest index.

Single boll weight (g)

The data reported in table indicate that the difference due to various plant geometry in respect of boll weight was significantly influenced. A wider plant geometry of 60 x 15 cm produced more boll weight (2.51) g. The variation in boll weight in plant geometry was due to fact that the better aeration and adequate interception of light and lesser competition of nutrients at wider spacing, which resulted in synthesis of higher photosynthates and thereby helped to produce higher boll weight. Differences in respect of seed cotton yield plant^{-1} were significant among the three hirsutum genotypes. Genotype AKH081 recorded significantly more seed cotton yield 16.52 g. This increase in seed cotton yield might be due to more number of bolls per plant, boll weight per plant as compaired to local check (Nehra *et al*. 2004) [12]. The boll weight is major yield components in *G. hirsutum* cotton under rainfed condition (Singh *et al*. 1983) [20] Khadi *et al.* (2008) [11] reported that increase in lint yield because of increasing boll weight and boll number. Jadhav *et al.* (2015) [8] reported boll weight was significantly influenced by plant geometries. Maximum boll weight (3.48 g) was recorded in wider spacing of 150 x 36 cm, followed by (3.28 g) in 120 x 45 cm and the minimum boll weight (3.10 g) recorded in 180 x 30 cm.

Seed index

Data regarding seed index as influenced by different treatments are presented in Table 1. The mean value of seed index was 7.63 g (100 cotton seed weight). The data reported in table indicate that the difference due to various plant geometry in respect of seed index was significantly influenced. A wider plant geometry of 60 x 15 cm produced more seed index (8.02) g. Pradeep Kumar et al. (2017) [14] observed that, seed index was founded significantly higher (5.36 g) at wider spacing of 45x30 cm. Similar trend was observed by Dhillon *et al.*, (2006) [5].

Harvest index

Differences in respect of harvest index were significant. Wider geometry of 60 x 15 cm (37.2 %) recorded higher harvest index. Genotype AKH081 (37.62 %) registered significantly highest harvest index.

Earliness index

The data in respect earliness index at various plant geometry and genotypes are also presented in Table 1. The mean earliness index was 57.94 per cent. Earliness index was influence significantly by different of plant geometry. 45x 10 cm plant geometry recorded maximum earliness index (64.10). Genotype AKH081 (60.10 %) registered significantly highest earliness index.

Ginning out turn

The average ginning out turn recorded was 32.61 per cent. Ginning out turn was not significantly influenced due to different plant spacing. Similar results were obtained by Reddy and Gopinath (2008) and Reddy and Kumar (2010) who reported that ginning percentage was free of population pressure. Ginning out turn was significantly influenced due to different genotypes. Genotype AKH081 (V1) (33.42) was found significantly maximum ginning out turn.

Quality parameters
The quality characters *viz.*, 2.5% staple length, fiber strength, microniar value, fiber fineness and uniformity ratio were not significantly influenced by various spacing and genotypes under study. These quality parameters are controlled by genes and nutrition.

Conclusion
The seed cotton yield was invariably increased with closer planting of 45×10 cm. Among the genotype AKH081 performed well under closer planting 45×10cm and it may highly suitable for high density planting system.

Table 1: Influence of High Density Planting System (HDPS) on yield and yield attribute of hirsutum cotton

Treatment	Yield and yield attribute							
	Seed cotton yield(g)/ plant	Seed cotton yield (kg/ha)	Number of boll/ plant	Single boll weight (g)	Seed index (g)	Harvest index (%)	Earliness index (%)	Ginning out turn (%)
A) Plant geometry (spacing)								
S_1 - 45×10	13.71	2428.89	8.66	2.40	7.26	35.33	64.10	31.45
S_2 - 60×10	14.93	2261.00	8.99	2.48	7.45	36.12	61.27	32.22
S_3 - 75×10	15.26	1818.17	9.52	2.49	7.82	36.45	54.17	32.87
S_4 -60×15	17.36	1901.17	10.45	2.51	8.02	37.2	52.23	33.90
SE(m)±	0.38	30.71	0.11	0.01	0.05	0.19	0.96	0.47
CD at 5%	1.13	90.06	0.31	0.02	0.13	0.57	2.81	NS
B) Genotypes								
V_1 –AKH081	16.52	2225.00	9.99	2.48	7.69	37.62	60.10	33.42
V_2 – NH615	14.27	1991.75	9.00	2.43	7.82	35.07	55.90	32.16
V_3 -Suraj	15.15	2090.17	9.24	2.50	7.40	36.14	57.83	32.26
SE(m)±	0.33	26.59	0.09	0.00	0.14	0.17	0.83	0.55
CD at 5%	0.98	78.00	0.27	0.01	NS	0.49	2.44	1.60
Interaction S×V								
SE(m)±	0.67	53.19	0.18	0.01	0.18	0.34	1.66	0.95
CD at 5%	NS	155.99	NS	0.03	NS	0.98	NS	NS

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