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Influence of high density planting system in *Gossypium hirsutum* genotypes under rainfed light soils

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Abstract

The on farm demonstration was carried out in farmer's fields in five locations of Khammam District of Central Telangana Zone in three consecutive seasons of kharif 2015, 2016 and 2017 by District Agricultural Advisory and Transfer of Technology Centre, Khammam. To study on high density planting of cotton genotypes under rainfed light soils. Four genotypes and three spacing's were imposed to find out optimum plant stand along with cotton genotypes viz., V₁-SURAJ, V₂-NDLH-1938, V₃-WGCV-48 and V₄- BT (NEERAJA) under three spacing's S₁-45X10 cm, S₂-90X30 cm S₃-100X100 cm in rainfed light soils. The investigation result on pooled basis showed that the maximum plant height (164.8 cm), sympodia branches (16.6), Significantly highest No of bolls/Plant (45.9) and No of bolls/ m² (110.9) and highest Boll weight (g) (3.50) and higher seed cotton yield (1811.6 kg/ha) was recorded in (V₄) BT (NEERAJA) over other varieties. However V₂ (NDLH-1938) and V₃ (WGCV-48) were at par each other. The lowest plant height (132.4 cm), Sympodia branches (9.8), No of bolls/Plant (19.7) and No of bolls/ m² (78.7), Boll weight (g) (3.16), and yield (966.5 kg/ha) was recorded in V₁ (SURAJ) variety because V₁, V₂ and V₃ genotypes were non BT varieties similarly the pest incidence were more than V₄ (BT-NEERAJA). S₃-100X100 cm plant geometry recorded highest plant height (154.9 cm), Sympodia branches per plant (16.1), No of bolls/Plant (49.7) and significantly maximum No of bolls/ m² (177.0) and seed cotton yield (1828.6 kg/ha) recorded with S₂-90 X30 cm. The lowest seed cotton yield (1213.2 kg/ha) was noticed with S₁-45 X10 cm due to closer spacing greater competition between inter plants.

Keywords: Bolls, BT, cotton, genotypes, spacing, sympodia, and yield

Introduction

Cotton is one of the most ancient and very important commercial fibre crops of global perspective with a significant role in Indian Agriculture, industrial development, employment generation and improving the national economy. India has largest area under cotton cultivation (11 m ha) during 2013-2014 which accounts 33per cent of the total area in the world. However, in production it ranks second next to china, but productivity as low as 505 kg lint/ha as compared to global average of 735 kg lint/ha (Nasrabad *et al.* 2013) [5]. Cotton has a unique name and fame as "King of Fibres" and "White Gold" because of high economic value among cultivable annual crops. The major contribution from China, India, United States and Pakistan and mostly cultivated in warmer regions (Riaz *et al.*, 2013) [6]. it is fourth most cultivated crop in Telangana state, covering 17.3 lakh hectares and 42.65 Lakh tones of production during 2017. Telangana state has 50.3% (25.29 Lakh ha) crop area under irrigation while, cotton covers 12.6% only (Ministry of Agriculture and Farmers Welfare, Govt. of India 2014-15). It is tropical crop and growth of the crop is greatly influenced by macro and microenvironment. Being glycophyte, cotton has superior tolerance for abiotic stress than over commercial crops. The average production is very low when compared to world's average. This is mainly because 70 percent of cotton area is under rainfed condition. Majority research findings were revealed heavy soils were suitable for cotton cultivation while, majority of farmers in Telangana state cotton cultivated in light soils as a rainfed crop, hence the yields were very low. There is much scope to increase the cotton production in India by increasing the productivity through adoption of appropriate agronomic practices. Closer row spacing's and higher plant population leads to more rapid canopy closure than conventionally spaced cotton.

Rapid canopy closure, in turns leads to reduced weed competition increased light interception and potentially decreased soil water evaporation (Delaney, 2006) [3]. The present study was formulated to evaluate promising genotypes of *Gossypium Hirsutum* amenable to high density planting under rainfed light soils for yield maximization.

Materials and Methods

The District Agricultural Advisory and Transfer of Technology Centre (DAATT Centre), Khammam has conducted the on farm demonstration entitled “demonstration of high density planting of cotton genotypes under rainfed light soils “ during kharif season of 2014-15, 2015-16 and 2016-17, soils were medium to light sandy clay loam texture. The experiment was laid out in five randomized locations with four genotypes and three spacing’s. One acre was allotted as a representative area for testing the performance of high density cotton planting in genotypes in farmer’s fields Viz., V₁-SURAJ, V₂- NDLH-1938, V₃- WGCV-48 and V₄-BT (NEERAJA) and three spacing’s Viz., S₁- 45 X10 cm, S₂-90 X30 cm and S₃-100X100 cm. The mean annual rainfall is 945 mm distributed in 49 rainy days in three years. The average mean maximum and minimum temperature are 37.6°C and 23.4°C during crop period in three years respectively. Generally the commencement of cotton sowing was taken up in first fortnight of June to end of the June, sometimes up to July first week due to late onset of monsoons. The cotton seed was treated with Thiram @ 3 g per kg seed before sowing. Cotton seeds were sown with local bullock drawn implements according to adjusted row space in between row to rows and plants. Cotton seed used @ 2 kg/ha seed rate. The crop was fertilized with 90:50:50 kg NPK/ha. Full dose of P, half dose of K and one fourth N applied at the time of sowing remaining half dose of K at the time of boll formation to development stage and one fourth dose of N applied at 25 DAS, remaining one fourth dose of N were applied at square formation stage and last one fourth dose of N applied at boll development stage. Post emergence herbicides were applied during heavy rains with the help of knapsack sprayer fitted with flat fan nozzle at spray volume 300 l/ha. Awareness on high density cotton planting was created by campaigns and field visits. This had evoked interest among the farmers in adopting high density cotton planting in the District. Trainings, frontline demonstrations, on farm testing, field days, Exposure visits and Rythusadassus have been used systematically during 2014-2016 to convince and disseminate the high density cotton planting in the District to the farming community. The observations on growth attributes were taken at different intervals and yield attributing characters like Plant height, no of sympodia

branches per plant, no of bolls per plant, no of bolls m⁻², and boll weight were recorded at harvest. The cost of cultivation was worked out based on the labour and input cost incurred towards cotton cultivation in different treatments.

Data Analysis

The data was analyzed using ANOVA and the least significant difference (LSD) values at 5% level of significance were calculated and used the split plot design test significant difference between treatment means.

Results and Discussion

The various growth aspects and yield attributes of cotton as influenced by genotypes and various plant geometries under rainfed conditions in light soils have been studied and the results of these findings have been presented in this paper.

Growth Attributes

Plant height (cm)

Genotypes

The data on progressive of growth and development of cotton as significantly influenced by the genotypes under rainfed light soils, during kharif season were recorded at periodical intervals in cropping season. The plant height was increased continuously up to maturity. The increase in plant height was rapid during 30 to 120 days after sowing and there after it was slow down. Significantly maximum plant height (164.8 cm) was recorded in (V₄) BT (NEERAJA) than other varieties. However V₂ (NDLH-1938) and V₃ (WGCV-48) were at par each other, the lowest plant height (132.4 cm) was recorded in V₁ (SURAJ) variety because V₁, V₂ and V₃ genotypes were non BT varieties similarly the pest incidence were more than V₄ (BT- NEERAJA) hence the plant height was reduced. Similar reports revealed by Bharathi *et al.*, (2012) [1].

Plant geometry

The plant height was significantly influenced by plant geometry. S₃-100X100 cm plant geometry recorded highest plant height (154.9 cm) than S₁-45 X10 cm due to less competition between plants by less no of plants per unit area, high light interception and more utilized natural resources than other spacing’s, however it was on par with S₂-90 X30 cm (145.0 cm). Similar results revealed by Delany (2006). The lowest plant height (124.8cm) was recorded with S₁-45 X10 cm due to heavy competition between more plants per unit area.

Interaction: Interaction was not found significant between genotypes and spacing.

Table 1: Growth &Yield attributes of cotton were influenced by genotypes under of different spacing’s in rain fed light soils

Treatments Genotypes	Plant Height (cm)				Sympodia branches/Plant				No of bolls/Plant			
	2015	2016	2017	Pooled	2015	2016	2017	Pooled	2015	2016	2017	Pooled
V ₁ - SURAJ	132.4	134.2	130.0	132.2	9.3	9.8	10.3	9.8	18.5	19.2	21.5	19.7
V ₂ -NDLH-1938	145.6	143.8	138.6	142.6	11.5	12.2	13.4	12.3	22.7	24.5	25.2	24.1
V ₃ - WGCV-48	147.4	146.3	142.5	145.4	11.8	12.4	13.6	12.6	24.3	25.6	26.3	25.7
V ₄ -BT (NEERAJA)	168.5	162.4	163.7	164.8	15.6	16.7	17.5	16.6	38.4	40.7	58.8	45.9
SEm±	8.2	6.3	8.4	7.60	1.4	1.7	1.6	1.56	5.4	5.6	12.4	7.80
C.D. at 5%	19.4	16.0	20.5	18.6	3.7	4.2	3.8	3.9	13.4	14.0	30.5	19.3
Spacing												
S ₁ -45 X10 cm	127.5	124.5	122.6	124.8	9.4	10.2	10.5	10.0	17.4	19.3	21.5	19.4
S ₂ -90 X30 cm	147.3	144.4	143.3	145.0	14.8	15.5	16.6	15.6	42.6	46.7	54.6	47.9
S ₃ -100X100 cm	157.8	154.3	152.7	154.9	15.2	16.0	17.2	16.1	44.7	48.8	55.9	49.7
SEm±	6.4	7.3	7.5	7.0	2.3	2.5	2.7	2.5	7.8	8.4	12.7	9.6
C.D. at 5%	14.0	18.4	17.6	16.6	5.4	5.7	6.4	5.8	17.6	18.8	22.8	19.7
Interaction	NS	NS	NS	NS	NS	NS	NS	NS	NS	NS	NS	NS

Sympodia branches/Plant

Genotypes

Sympodia branches per plant were significantly influenced by genotypes. More sympodia branches (16.6) were recorded in (V₄) Bt Variety (NEERAJA) than other varieties. However V₂ (NDLH-1938) and V₃ (WGCV-48) were at par each other, the lowest Sympodia branches (9.8) per plant was recorded in V₁ (SURAJ) variety because V₁, V₂ and V₃ genotypes were non BT varieties hence the branching capacity was vary variety to variety. Similar results founded by Venugopalan *et al.*, (2014) [9].

Plant geometry

Sympodia branches per plant were significantly influenced by plant geometry. S₃-100X100 cm plant geometry recorded significantly more Sympodia branches per plant (16.1) over other spacing's, due to less competition between plants by less no of plants per unit area than other spacing's, however it was on par with S₂-90 X30 cm (15.6). the lowest number of Sympodia branches per plant was noticed with S₁-45 X10 cm due to closer spacing heavy competition between inter plant per unit area this is conformation with Singh *et al.*, (2012) [7].

Interaction: interaction was not found significant between genotypes and spacing.

Yield Attributes

Genotypes

The No of bolls/Plant and No of bolls/ m² were significantly influenced by genotypes. Significantly highest No of bolls/Plant (45.9) and No of bolls/ m² (110.9) and highest Boll weight (g) (3.50) were recorded in (V₄) Bt Variety (NEERAJA) than other varieties because low pest incidence of boll worms due to BT gene, followed by V₂ (NDLH-1938) and V₃ (WGCV-48) were at par each other, the lowest No of bolls/Plant (19.7) and No of bolls/ m² (78.7) and Boll weight (g) (3.16) was recorded in V₁ (SURAJ) variety. Similar results were revealed by Singh *et al.*, (2012) [7].

Plant geometry

The No of bolls/Plant and No of bolls/ m² were significantly influenced by plant geometry. S₃-100X100 cm plant geometry recorded significantly more No of bolls/Plant (49.7) over

other spacing's, due to less competition between plants by less no of plants per unit area than other spacing's, however it was on par with S₂-90 X30 cm (47.9). Same reports conformed by Bharathi *et al.* (2012) [1]. Significantly maximum No of bolls/ m² (177.0) recorded with S₂-90 X30 cm due to optimum plant density per unit area increased the no of bolls per unit area followed by S₃-100X100 cm it was on par with S₂-90 X30 cm. The lowest number of No of bolls/Plant (19.4), No of bolls/ m² (102.6) and Boll weight (g) (3.30) was noticed with S₁-45 X10 cm due to closer spacing greater competition between inter plant per unit area.

Interaction: interaction was not found significant between genotypes and spacing.

Seed Cotton Yield

Genotypes

The seed cotton yield was significantly influenced by genotypes. Significantly higher seed cotton yield (1811.6 kg/ha) was recorded in (V₄) Bt Variety NEERAJA than other genotypes due to low damage of boll worms incidence in BT variety, followed by NDLH-1938 (1132.4 kg/ha) and WGCV-48 (1189.0 kg/ha) were at par each other, the lowest yield (966.5 kg/ha) was recorded in V₁ (SURAJ) variety because of high incidence of boll worm cotton yield was reduced. Similar results were revealed by Ushanandini *et al.*, (2017) [8].

Plant geometry

Seed cotton yield (kg/ha) was significantly influenced by plant geometry. Significantly maximum seed cotton yield (1828.6) recorded with S₂-90 X30 cm due to optimum plant density per unit area increased the no of bolls per unit area followed by S₃-100X100 cm it was significantly gave better performance than S₁-45 X10 cm. The lowest seed cotton yield (1213.2 kg/ha) was noticed with S₁-45 X10 cm due to closer spacing greater competition between inter plants hence less no of bolls per plant and less no of bolls per unit area as well as more incidence of boll worms leads to lower cotton yield. Similar results were revealed by Heitholt *et al.*, (1992) [4].

Interaction: Interaction was not found significant between genotypes and spacing

Table 2: Yield & yield attributes of cotton were influenced by genotypes under of different spacing's in rain fed light soils

Treatments	No of bolls/ m ²				Boll weight (g)				Seed cotton Yield (kg/ha)			
	2015	2016	2017	Pooled	2015	2016	2017	Pooled	2015	2016	2017	Pooled
Genotypes												
V ₁ - SURAJ	76.4	78.5	81.4	78.7	3.10	3.14	3.24	3.16	938.7	976.4	984.6	966.5
V ₂ -NDLH-1938	78.6	82.4	85.3	82.1	3.23	3.28	3.32	3.27	1117.5	1134.4	1145.4	1132.4
V ₃ - WGCV-48	80.5	84.6	87.6	84.2	3.26	3.30	3.34	3.30	1164.3	1188.6	1214.0	1189.0
V ₄ -BT (NEERAJA)	104.7	109.4	118.7	110.9	3.51	3.54	3.65	3.50	1558.4	1742.5	2134.0	1811.6
SEm±	11.5	12.4	14.3	12.7	0.27	0.18	0.21	0.22	145.7	170.6	181.6	170.0
C.D. at 5%	21.4	22.6	24.7	22.9	0.63	0.48	0.54	0.55	364.4	426.6	454.0	415.0
Spacing												
S ₁ -45 X10 cm	96.6	98.5	112.8	102.6	3.31	3.33	3.36	3.30	1148.6	1234.4	1256.8	1213.2
S ₂ -90 X30 cm	173.2	177.4	180.6	177.0	3.42	3.44	3.58	3.48	1664.7	1746.5	2074.6	1828.6
S ₃ -100X100 cm	155.7	160.3	162.7	159.5	3.43	3.45	3.60	3.50	1462.4	1485.3	1669.7	1539.0
SEm±	30.4	31.5	34.3	32.0	0.16	0.20	0.22	0.29	150.7	173.0	231.4	194.5
C.D. at 5%	58.6	65.3	64.7	62.8	0.44	0.58	0.61	0.54	376.8	432.6	578.7	486.4
Interaction	NS	NS	NS	NS	NS	NS	NS	NS	NS	NS	NS	NS

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