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Research Article

Evaluation of plant density and cotton genotypes (*Gossypium hirsutum* L.) on cotton yield and fibre quality

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ABSTRACT : Field experiments were conducted during winter season of 2011-12 and 2012-13 at Tamil Nadu Agricultural University, Coimbatore to study the feasibility of using cotton genotypes in high density planting system for cotton production and to assess its effect on seed cotton yield, oil content and fibre quality parameters. Coimbatore is situated in the Western Zone of Tamil Nadu at 11° North latitude and 77° East longitude with an altitude of 426.7 m above mean sea level. The experiments were laid out in a strip plot design and replicated thrice. The soil in the experimental site was sandy clay loam with low available nitrogen (182 kg/ha), medium available phosphorus (12.6 kg/ha) and high available potassium (340 kg/ha). The experiment consisted of seven cotton genotypes *viz.*, Jai, Ranjeet, TCH 1608, SVPR 3, Anjali, Suraj and LH 900 with four spacings *viz.*, 30 × 30, 45 × 30, 60 × 30 and 90 × 30 cm. Ranjeet planted at the spacing of 30 × 30 cm recorded significantly higher seed cotton yield. The percentage of oil content was significantly higher in Ranjeet genotype than other cotton genotypes. The fibre quality parameters *viz.*, fibre length, fibre strength, micronaire, elongation percentage were significantly influenced by different cotton genotypes. The oil content and fibre quality was not significantly influenced by plant densities.

KEY WORDS : Plant density, Seed cotton yield, Fibre quality, Oil content

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INTRODUCTION

Cotton (*Gossypium hirsutum* L.) "the king of fibres" is the leading fibre crop in the world. India is the only country where all the four species of cotton is grown among the cotton growing countries of the world. Cotton is an important raw material supplying about 65% requirement of the Indian textile industry. Crop management practices to improve fibre quality while maintaining lint yield have become the focus of intense research. Several studies have reported lint yield in upland cotton is negatively related to fibre quality (Green and Culp, 1990), that is, cotton plants need to sacrifice fibre quality to improve lint yield. Thus, accessing strategies to improve fibre quality while maintaining yield levels is crucial and this process requires better understanding of the effects of crop management practices on cotton fibre quality. Bednarz *et al.* (2006) reported lower fibre quality resulted from increased plant density. Cotton is also a good source of edible oil. The cotton seed oil is rich in essential fatty acids such as myristic, palmitic, palmitoleic, steric, oleic and linoleic acid. The deficiency of above acids, leads to narrowing of arteries causing reduced blood supply to the heart. Cotton seed oil will play an important role in meeting the demand of edible vegetable oil in the country (Singh, 2003). The objective of this investigation was to determine the seed cotton yield, oil content and fibre quality of cotton genotypes (*Gossypium*

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hirsutum) affected by different plant densities.

EXPERIMENTAL METHODS

Field experiments were conducted at Tamil Nadu Agricultural University, Coimbatore during the winter season of 2011-2012 and 2012-2013. The objectives of this study were to determine the feasibility of using cotton genotypes in high density planting system for cotton production and to assess its effect on seed cotton yield, oil content and fibre quality parameters. Coimbatore is situated in the Western Zone of Tamil Nadu at 11° North latitude and 77° East longitude with an altitude of 426.7 m above mean sea level. The experiment was laid out in a strip plot design and replicated thrice. The soil in the experimental site was sandy clay loam with low available nitrogen (182 kg/ha), medium available phosphorus (12.6 kg/ha) and high available potassium (340 kg/ha). The treatments consisted of seven cotton genotypes *viz*., Jai, Ranjeet, TCH 1608, SVPR 3, Anjali, Suraj and LH 900 with four spacings *viz*., 30 × 30, 45 × 30, 60 × 30 and 90 × 30 cm (with plant densities *viz*., 111111, 74074, 55555, and 37037 plants ha^{-1}, respectively). The crop was sown and raised using the recommended package of practices as per TNAU crop production guide. Defoliant (Dropp Ultra @ 200 ml per ha) was sprayed at 80 % maturity for uniform boll bursting so that one time harvest was done. The oil content was estimated by using the Soxhlet extraction apparatus by the procedure given by Sadasivam and Manickam (1995). Fibre quality characters were tested using high volume instrument user model: HVI Classic 900.

EXPERIMENTAL RESULTS AND ANALYSIS

The results obtained from the present study have been discussed in detail under following heads :

Seed cotton yield:

The seed cotton yield was significantly influenced by cotton genotypes and plant spacing. Among the cotton genotypes, Ranjeet and Jai recorded significantly higher seed cotton yield of 3311 and 3115 kg ha^{-1}, respectively during 2011-12 and were at par with each other (Table 1). The cotton genotype SVPR 3 recorded minimum yield (1510 kg ha^{-1}) which was also comparable with Suraj during 2011-12. Jagannathan and Venkitaswamy (1996) revealed that dwarf compact genotypes responded favourably to a population of 1, 11,000 plants ha^{-1} on Vertisols.

Comparing the plant spacings, the plant spacing of 30 × 30 cm recorded significantly higher seed cotton yield (3168 kg ha^{-1}) followed by 45 × 30 cm spacing. Lower seed cotton yield was observed with the plant spacing of 90 × 30 cm (1498 kg ha^{-1}) in 2011-12. Ali *et al*. (2010) revealed that significantly maximum seed cotton yield was obtained with narrow spacing 15 cm followed by 30 cm than 45 cm row spacing in silt loam soil in Pakistan. Similar results were reported by Delaney *et al.* (2002); Brodrick *et al.* (2012) and Singh *et al.* (2012).

The interaction was significant with cotton genotypes and different plant spacing. In the year 2011-12, adopting a plant spacing of 30 × 30 cm in Ranjeet significantly recorded higher seed cotton yield of 4511 kg ha^{-1} followed by Jai (4378 kg ha^{-1}) were comparable with each other. The genotype SVPR 3 at the spacing of 90 × 30 cm registered lower seed cotton yield and comparable with Suraj and LH 900. Venugopalan *et al.* (2011) found that *Gossypium hirsutum* genotypes Anjali, PKV 081 and CCH 724 were more amenable to closer spacings *i.e.* higher planting densities (166000 plants ha^{-1}) on rainfed vertisols under Maharastra. The similar trend was observed in both the years.

Table 1 : Effect of plant densities on seed cotton yield (kg ha^{-1}) in *G.hirsutum* genotypes

Genotypes	2011-12 Spacing (cm)					2012-13 Spacing (cm)				
	30 × 30	45 × 30	60 × 30	90 × 30	Mean	30 × 30	45 × 30	60 × 30	90 × 30	Mean
Jai	4378	3304	2783	1996	3115	4003	3085	2605	1830	2881
Ranjeet	4511	3378	3072	2281	3311	4232	3095	2783	2005	3029
TCH 1608	3556	2963	2333	1644	2624	3112	2545	2141	1535	2333
SVPR 3	2178	1615	1300	948	1510	1963	1462	1181	861	1367
Anjali	2556	2133	1867	1326	1970	2376	1901	1659	1208	1786
Suraj	2478	1748	1400	1052	1669	2193	1598	1268	858	1479
LH 900	2522	1793	1650	1237	1800	2197	1678	1503	1138	1629
Mean	3168	2419	2058	1498		2868	2195	1877	1348	
		S.E.±	C.D. (P=0.05)				S.E.±	CD (P=0.05)		
Genotypes (G)		126	275				120	262		
Spacing (S)		92	226				90	220		
G at S		185	386				171	356		
S at G		186	393				170	363		

Table 2 : Effect of plant densities on oil content (%) in *G.hirsutum* genotypes

Treatments	2011-12	2012-13
Genotypes		
Jai	16.60	16.68
Ranjeet	24.70	24.50
TCH 1608	14.25	14.18
SVPR 3	12.40	12.53
Anjali	13.35	13.18
Suraj	17.13	17.20
LH 900	17.38	17.35
S.E. ±	1.08	1.06
C.D. (P = 0.05)	2.35	2.31
Spacing (cm)		
30 × 30	16.61	16.31
45 × 30	16.36	16.51
60 × 30	16.60	16.53
90 × 30	16.60	16.70
S.E. ±	0.73	0.77
C.D. (P = 0.05)	NS	NS
Interaction	NS	NS

NS=Non-significant

Quality parameters:

Oil content:

The cotton genotypes significantly influenced oil content. The percentage of oil content was significantly higher in Ranjeet (24.7 and 24.5 % in 2011-12 and 2012-13, respectively) than other cotton genotypes followed by LH 900, Suraj and Jai were comparable with each other. The lower oil content was recorded by SVPR 3, Anjali and TCH 1608 and was at par with each other (Table 2.). The genotype CSH 3075 recorded higher oil content (19.6 %) in central zone of India under irrigated condition (AICCIP, 2013). The different plant densities did not influenced on oil content.

Fibre quality:

Lint index, seed index and ginning percentage:

The quality parameters differed significantly due to genotypes. The lint index was significantly higher in Ranjeet (6.19 and 6.14 in 2011-12 and 2012-13, respectively) followed by Jai and TCH 1608 which were comparable with each other in both years. Comparably lower lint index was registered by LH 900, Anjali and Suraj in both years of study (Table 3).

Comparably the genotypes Ranjeet, TCH 1608 and Jai recorded higher seed index. Significantly lower seed index was registered by Anjali, LH 900 and Suraj which were at par with each other in both the years of study (Table 3). The higher lint index and seed index was registered by TCH 1705 in Coimbatore under irrigated condition (AICCIP, 2013).

No significant difference was observed with different plant spacings on lint index and seed index (Table 3). The ginning percentage was not significantly influenced by both cotton genotypes and plant densities (Table 3).

Table 3 : Effect of plant densities on ginning percentage, lint index and seed index in *G.hirsutum* genotypes

Treatments	2011-12			2012-13		
	Lint index	Seed Index	Ginning percentage	Lint index	Seed index	Ginning percentage
Genotypes						
Jai	5.69	9.82	36.7	5.53	9.66	36.4
Ranjeet	6.19	10.30	37.5	6.14	10.21	37.5
TCH 1608	5.48	9.85	35.7	5.44	9.91	35.4
SVPR 3	4.42	7.69	36.5	3.97	7.31	35.2
Anjali	3.69	6.32	36.8	3.52	6.36	35.6
Suraj	3.74	6.72	35.8	3.60	6.50	35.7
LH 900	3.49	6.70	34.2	3.46	6.56	34.5
S.E.±	0.21	0.36	1.5	0.20	0.35	1.5
C.D. (P = 0.05)	0.45	0.77	NS	0.44	0.77	NS
Spacing (cm)						
30 × 30	4.64	8.23	36.0	4.50	8.09	35.6
45 × 30	4.68	8.14	36.5	4.50	8.06	35.7
60 × 30	4.65	8.23	36.0	4.55	8.06	36.0
90 × 30	4.70	8.20	36.3	4.53	8.07	35.8
S.E.±	0.12	0.21	0.9	0.12	0.20	0.9
C.D. (P = 0.05)	NS	NS	NS	NS	NS	NS
Interaction	NS	NS	NS	NS	NS	NS

NS=Non-significant

2.5 % span length:

Higher 2.5 % span length was recorded with Jai (30.18 and 29.58 in 2011-12 and 2012-13, respectively) and which was comparable with TCH 1608, Suraj and Ranjeet in both years of study (Table 4). The higher fibre length was registered by cotton genotype CCH 12 and closely followed by F 2383 and F 2381 (AICCIP, 2013). Plant density did not affect fibre length. Similar results were given by Feng *et al.* (2011).

Tenacity:

The cotton genotype, Suraj recorded significantly higher values of fibre strength (23.93 and 23.55 g tex^{-1} in the year 2011-12 and 2012-13, respectively) and comparable with Jai in 2012-13 (Table 4). In 25-cm rows, cultivar DP NuCotn35B had higher strength values than PM 1220RR, ST 474, ST BXN47 (Nichols *et al.*, 2004). The fibre strength was not significantly influenced by different plant densities.

Micronaire :

Among the cotton genotypes, significantly finer fibres were observed with Anjali, Suraj, SVPR 3 and TCH 1608 and were at par with each other (Table 4). LH 900 recorded significantly higher micronaire value followed by Jai. The genotype CSH 3075 registered lower micronaire value closely followed by CCH 12, RS 2718, GTHV 09, and GTHV 04 under irrigated conditions of Coimbatore (AICCIP, 2013). The plant densities did not significantly influenced on micronaire values. Micronaire was significantly higher in 38-cm than in 19-cm spacing, but neither differed from the 76-cm rows in Texas (Clawson *et al.*, 2006).

Uniformity (%):

No significant difference was observed with cotton genotypes and plant spacings on uniformity ratio (Table 4). Jost and Cothern (2000) opined that the decrease in fibre uniformity in the 19 cm row spacing compared with the fibre produced by plants in the wider row spacings also may have been influenced by a lack of photosynthate production or less available moisture; while, fibre length and strength measurements were not consistent between years.

Elongation percentage:

The elongation percentage was significantly influenced by cotton genotypes. Among the cotton genotypes, significantly higher elongation percentage was recorded by Anjali (7.15) and was comparable with SVPR 3, Jai and TCH 1608 in the year 2011-12 (Table 4).

In 2012-13, Anjali registered significantly higher elongation percentage and was at par with SVPR 3. The elongation percentage was significantly lower with the cotton genotypes Suraj, Jai and LH 900 and were comparable with each other in both the years of study.

The quality parameters were not influenced by the population levels. Micronaire, fibre length, strength, and

Table 4 : Effect of plant densities on fibre quality in *G.hirsutum* genotypes

Treatments	2.5 % span length (mm)	Fibre srength (g tex^{-1})	Micronaire (10^{-6} g in^{-1})	Uniformity (%)	Elongation (%)	2.5 % span length (mm)	Fibre strength (g tex^{-1})	Micronaire (10^{-6} g in^{-1})	Uniformity (%)	Elongation (%)
Genotypes										
Jai	30.18	20.13	3.63	48.35	5.90	29.58	22.05	4.13	49.55	5.53
Ranjeet	27.58	18.00	3.56	47.73	7.08	25.60	19.45	3.70	48.33	6.28
TCH 1608	29.73	18.15	3.50	48.80	6.78	28.60	21.13	3.33	46.70	5.88
SVPR 3	21.75	18.45	3.40	49.73	7.13	26.08	20.38	3.10	50.13	7.05
Anjali	23.73	20.03	3.18	50.70	7.15	23.58	19.63	2.98	50.35	7.20
Suraj	29.28	23.93	3.30	48.68	5.88	28.13	23.55	3.05	48.45	5.28
LH 900	22.60	18.58	4.63	49.75	5.93	22.38	18.53	4.58	49.70	5.75
S.E.$\pm$	1.42	1.08	0.17	2.43	0.33	1.38	1.09	0.19	2.46	0.30
C.D. (P = 0.05)	3.10	2.35	0.37	NS	0.72	3.00	2.37	0.41	NS	0.66
Spacing (cm)										
30 × 30	26.10	19.46	3.49	49.26	6.39	26.39	20.03	3.76	49.09	6.19
45 × 30	26.39	19.10	3.61	48.93	6.57	26.64	21.01	3.37	48.46	6.07
60 × 30	26.74	20.20	3.56	49.43	6.51	26.63	21.20	3.54	49.69	6.39
90 × 30	26.39	19.67	3.70	48.80	6.71	25.44	20.44	3.53	48.89	5.90
S.E.$\pm$	1.21	0.91	0.16	2.24	0.29	1.17	0.95	0.16	2.27	0.29
C.D. (P = 0.05)	NS	NS	NS	NS	NS	NS	NS	NS	NS	NS
Interaction	NS	NS	NS	NS	NS	NS	NS	NS	NS	NS

NS=Non-significant

uniformity were not affected by increasing population density in silty loam soils of Stoneville (Molin and Hugie, 2010).

Conclusion:

Among cotton genotypes, Ranjeet planted at the spacing of 30 × 30 cm recorded significantly higher yield. Irrespective of plant densities, Ranjeet recorded significantly higher oil content, lint index and seed index. Finer fibre with higher elongation percentage was recorded by Anjali. The cotton genotypes, Jai and Suraj recorded significantly higher values of both fibre length and fibre strength. Ginning percentage and uniformity ratio was not significantly influenced by cotton genotypes and plant spacing.

REFERENCES

AICCIP (2013). AICCIP Annual Report 2012-13. pp. 68-77.

Ali, A., Ali, L., Sattar, M. and Ali, M.A. (2010). Response of seed cotton yield to various plant Populations and planting methods. *J. Agric. Res*., **48** (2) :163-169.

Bednarz, C.W., Nichols, R.L. and Brown, S.M. (2006). Seeding rate modifica-tions of cotton within-boll yield components. *Crop Sci.*, **46** (5) : 2076–2080.

Brodrick, R., Bange, M.P., Milroy, S.P. and Hammer, G.L. (2012). Physiological determinants of high yielding ultra-narrow row cotton: Biomass accumulation and partitioning. *Field Crops Res.*, **134** : 122–129.

Clawson, E.L., Cothren, J.T. and Blouin, D.C. (2006). Nitrogen fertilization and yield of cotton in ultra-narrow and conventional row spacings. *Agron. J.,* **98** (1):72-79.

Delaney, D.P., Reeves, D.W., Monks, C.D., Patterson, M.G., Mullins, G.L. and Gamble, B.E. (2002). Cover crops and tillage combinations for wide and ultra narrow row cotton. In: Proc. of 25th Annual Southern Conservation Tillage Conference for Sustainable Agriculture. Auburn, 24-26 June 2002.

Feng, L, Bufon, V.B., Mills, C.I., Hequet, E., Bordovsky, J.P., Keeling, W., Boman, R. and Bednarz, C.W. (2011). Effect of irrigation, cultivar and plant density on cotton within- boll fiber quality. *Agron. J.,* **103**(2): 297-303.

Green, C.C. and Culp, T.W. (1990). Simultaneous improvement of yield, fibre quality and yarn strength in upland cotton. *Crop Sci.,* **30** (1) : 66–69.

Jagannathan, N.T. and Venkitaswamy, R. (1996). Effect of plant density and nutrient levels of new cotton varieties. *Madras Agric. J*., **83**(3): 159–161.

Jost, P.H. and Cothren, J.T. (2000). Growth and yield comparisons of cotton planted in conventional and ultra-narrow row spacings. *Crop Sci.,* **40** (2) : 430-435.

Molin, W.T. and Hugie, J.A. (2010). Effects of population density and nitrogen rate in ultra narrow row cotton. *SRX Agriculture*, 2010:1-6.

Nichols, S.P., Snipes, C.E. and Jones, M.A. (2004). Cotton growth, lint yield, and fiber quality as affected by row spacing and cultivar. *J. Cotton Sci.*, **8** : 1-12.

Sadasivam, S. and Manickam, A. (1995). *Biochemical methods for agricultural sciences*, Wiley Eastern Ltd., New Delhi. p.235-236.

Singh, J., Babar, S., Abraham, S., Venugopalan, M.V., Majumdar, G. (2012). Fertilization of high density, rainfed cotton grown on vertisols of India. *Better Crops*, **96**(2): 26-28.

Singh, P. (2003). *Cotton breeding*. 275p.

Venugopalan, M.V., Prakash, A.H., Kranthi, K.R., Deshmukh, R., Yadav, M.S. and Tandulkar, N.R. (2011). Evaluation of cotton genotypes for high density planting systems on rainfed vertisols of central India. In: Proc. World Cotton Research Conference-5, Mumbai, India. pp. 341-346