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RESEARCH ARTICLE :

Effect of plant geometry on light interception and weed density in cotton under rainfed vertisols

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SUMMARY : Field experiments were conducted to study the influence of high density planting system in cotton genotypes on the growth and yield and its influence on light interception and weed densityduring *winter* season of 2011-12 and 2012-13. The experiments were laid out in strip plot design and replicated thrice with four cotton genotypes *viz.*, SVPR 3, Anjali, Suraj and LH 900 and four spacings *viz.*, 30 × 30 cm, 45 × 30 cm, 60 × 30 cm and 90 × 30 cm. In the experimental field, broad leaved weeds were the dominant weeds followed by sedges and grasses. In the year 2011-12 and 2012-13, the weed species of *Cynodandactylon*, *Panicumrepens*, *Rotoboliacochinsinensis* among grasses. *Cyperusrotundus* was the only sedge weed found in the experimental site. *Trianthemaportulacastrum*, *Partheniumhysterophorus, Digeraarvensis,Amaranthusviridis, Corchorusolitorius* and *Euphorbia hirta* were predominant broad leaved weeds flora found in experimental field. The weed density and their dry matter production were lower at closer plant spacing of 30 × 30 cm and 45 × 30 cm. From this study, it could be concluded and recommended that Anjali variety adopted with a closer plant spacing of 30 × 30 cm for higher seed cotton yield and profitability in rainfed condition.

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KEY WORDS :
High density planting system, Weed density, Light interception

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BACKGROUND AND OBJECTIVES

Cotton is one of the most ancient and very important commercial fibre crop of global perspective with a significant role in Indian agriculture, industrial development, employment generation and improving the national economy. Cotton has an unique name and fame as "King of Fibres" and "White Gold" because of its high economic value among cultivable annual crops.

Cotton is grown in the country in different holdings with varied planting dates, planting density, soil and water condition. Cotton production is labour intensive in almost all the developing countries. A novel way to avoid labour problem is to go for mechanical harvesting. Cotton being an indeterminate in nature it is difficult to harvest the kapas in one time. But research results suggested that by manipulating the crop geometry especially by providing close spacing one time harvest is possible and the yield reduction may be compensated by increasing the plant population by way of High Density Planting

Systems (HDPS).Cotton producers are presently faces problems with rising production costs and static or declining returns from cotton. To combat these problems, one option is growing cotton in reduced row spacing and increased plant populations. Closer row spacings and higher plant populations under HDPS also lead to more rapid canopy closure than conventionally spaced cotton. Rapid canopy closure, in turn leads to reduced weed competition increased light interception and potentially decreased soil water evaporation (Delaney, 2006). An alternate system of high density planting system with varieties is as an alternative for such situations (Venugopalan *et al.,* 2011). This system offers an opportunity to maximize productivity of cotton in India. The optimum plant density will depend upon genotypic characteristics, properties of soils, climatic parameters and management regime (Silvertooth *et al.,* 1999). In this context, this project has been mooted with a view to evaluate the cotton genotypes with different plant densities for Tamil Nadu conditions, with the objective to Study of light interception and weed density influencing Seed cotton yield on High density planting system.

RESOURCES AND METHODS

Field experiments were conducted during *winter* irrigated (August, 2011 to January, 2012) and *winter* irrigated (August, 2012 to January, 2013) at Tamil Nadu Agricultural University (TNAU), Coimbatore with a specific objective to study the influence of High Density Planting Systemin different cotton genotypes.The total rainfall received during the *winter* season of 2011 – 2012 was 635.1 mm received in 30rainy days. The maximum and minimum temperatures prevailed during the cropping period were 30.3^{0}C and 21.1^{0}C, respectively. The mean day relative humidity and the night relative humidity were 56.7 per cent and 89.2 per cent, respectively (Fig. 1). The weather parameter prevailed during the second experiment of *winter* in the year 2012-2013 was depicted in Fig 2. The total rainfall received during the year, 2012-2013 of *winter* season was 220.7 mm received in 12 rainy days. The maximum and minimum temperatures prevailed during the cropping period were 31.2^{0}C and 21.5^{0}C, respectively. The mean sunshine hours during the cropping period was 6.5 hrs and the solar radiation was 357.6 Cal cm^{-2} d^{-1}. The mean day relative humidity and the night relative humidity were 49.4 per cent and 86.3 per cent. The soil of the experimental field at Field No. C1, Cotton Breeding Station was sandy clay loam with low available nitrogen, medium available phosphorus and high available potassium. The experiments were laid out in strip plot design and replicated thrice with four cotton genotypes *viz.,* SVPR 3, Anjali, Suraj and LH 900 and four spacings *viz.,* 30 × 30 cm, 45 × 30 cm, 60 × 30 cm and 90 × 30 cm. As per the recommendation, 60:30:30 (Varieties) kg NPK ha^{-1},was applied. Nitrogen and potassium were applied in three splits, 50 per cent as basal and remaining 50 per cent at equal splits on 45 and 60 DAS. Full dose of phosphorus was applied as basal at the time of sowing.

Light interception :

Light interception measurements were taken on 40, 80 and 120 DAS using a Lux meter. Readings were recorded in open as well as at the top, middle and ground level of the base crop. Keeping the light intensity in the open as 100, light interception was calculated (%) was calculated by using the following formula (Chelliah, 1996).

$$\text{Light interception (\%)} = \frac{\text{Light intensity in open (Lux)} - \text{Average intensity in crop (Lux)}}{\text{Light intensity in open (Lux)}}$$

Observation on weeds:

Weed density:

A quadrat (0.25m^2) was placed at four randomly selected places in sampling area of each plot and the weed species were accounted on 40 DAS expressed as number m^{-2}. Weeds were grouped in to three categories like Grasses, Sedges and Broadleaved weeds.

Weed dry weight:

Two quadrats of 0.25 m^2 each were placed at random outside the net plot and the weeds falling within the quadrat were removed, shade dried and oven dried at 70°C for 72 hours and the dry weight of weeds were expressed as kg ha^{-1}.

Seed cotton yield was harvested from net plot area and expressed in kg ha^{-1}. The data on various observations recorded during the course of the investigation were analyzed statistically by adopting the procedure described by Gomez and Gomez (1984).

OBSERVATIONS AND ANALYSIS

The results obtained from the present study as well

as discussions have been summarized under following heads and Table 1 to 4.

Light interception :

The light interception was higher with the closer plant spacing of 30 × 30 cm spacing due to earlier canopy closer than wider row spacing (Table 1). This is in consonance with the findings of Roche *et al.* (2003) that the Ultra narrow Row (UNR) crop reached maximum light interception earlier than the conventionally spaced crop and similar result was given by Wilson (2006) revealed that greater light interception was observed in 38 cm rows relative to 97 cm rows. Closer row spacing (19 to 25 cm) lead to more rapid canopy closure than in

Table 1 : Effect of cotton genotypes and plant density on light interception (%)

Treatments	2011-12			2012-13		
	40 DAS	80 DAS	120 DAS	40 DAS	80 DAS	120 DAS
Genotypes						
SVPR 3	71.2	79.7	79.3	59.4	75.2	72.4
Anjali	70.4	84.2	75.7	57.3	69.3	64.4
Suraj	73.5	84.5	77.4	62.4	71.8	67.8
LH 900	69.1	83.6	75.4	57.0	64.7	61.8
S.E.±	2.9	1.7	1.7	1.5	1.7	1.6
C.D. (P = 0.05)	NS	NS	NS	NS	NS	NS
Spacing (cm)						
30 × 30	77.4	86.7	84.4	69.6	80.5	74.7
45 × 30	75.4	85.2	82.2	66.6	77.5	72.3
60 × 30	72.3	82.4	78.4	62.0	74.3	69.6
90 × 30	70.3	82.5	75.7	59.8	71.0	66.7
S.E.±	1.9	1.1	1.0	0.9	1.0	0.9
C.D. (P = 0.05)	4.7	2.8	2.4	2.1	2.5	2.3
Interaction	NS	NS	NS	NS	NS	NS

NS= Non-significant

Table 2: Effect of cotton genotypes and plant densityon weed density (No. m^{-2})at 40 DAS

Treatments	2011-12				2012-13			
	Grasses	Sedges	BLW	Total	Grasses	Sedges	BLW	Total
Genotypes								
SVPR 3	2.75 (14)	2.58 (11)	2.77 (15)	3.71 (40)	2.60 (12)	2.67 (13)	2.59 (12)	3.62 (36)
Anjali	2.56 (11)	2.83 (15)	2.93 (18)	3.80 (44)	2.73 (14)	2.51 (11)	2.56 (11)	3.60 (35)
Suraj	2.68 (13)	2.64 (12)	3.08 (20)	3.84 (45)	2.53 (11)	2.53 (11)	2.54 (11)	3.52 (33)
LH 900	2.61 (12)	2.73 (14)	3.30 (26)	3.95 (52)	2.63 (12)	2.59 (12)	2.57 (11)	3.59 (35)
S.E.±	0.13	0.14	0.24	0.16	0.13	0.09	0.13	0.14
C.D. (P = 0.05)	NS	NS	NS	NS	NS	NS	NS	NS
Spacing (cm)								
30 × 30	2.38 (9)	2.39 (9)	2.42 (10)	3.38 (28)	2.35 (9)	2.33 (8)	2.23 (7)	3.26 (24)
45 × 30	2.55 (11)	2.53 (11)	2.77 (15)	3.63 (36)	2.49 (10)	2.47 (10)	2.46 (10)	3.46 (30)
60 × 30	2.65 (12)	2.65 (12)	3.02 (19)	3.80 (44)	2.65 (12)	2.65 (12)	2.63 (12)	3.64 (36)
90 × 30	2.78 (14)	2.74 (14)	3.23 (24)	3.97 (52)	2.80 (15)	2.72 (13)	2.74 (14)	3.77 (41)
S.E.±	0.12	0.07	0.16	0.11	0.12	0.09	0.12	0.09
C.D. (P = 0.05)	NS	0.18	0.39	0.27	0.29	0.21	0.29	0.22
Interaction	NS	NS	NS	NS	NS	NS	NS	NS

Figures in the parenthesis denotes original values Transformation: log (X+2) NS= Non-significant

wide rows (Robinson, 1993), which leads to increased light interception (Kreig, 1996).

Weed density and weed dry matter production :

Weed density and weed dry matter production was less at closer spacing of 30 × 30 and 45 × 30 cm(Table 3 and 4) might be due to the higher population pressure of the cotton crop suppressed the weed growth at significant level over wider spacing which have provided more space for weed growth and thus, the crop suffered from severe weed competition as earlier reported by Jost and Cothren (2000) that closer spacing recorded lesser weed competition in cotton. Crop suppression of weeds is generally maximized in row spacings and patterns that result in early canopy closure and maximum light interception by the cotton crop (Molin *et al.*, 2004 and Gwathmey *et al.*, 2008).

Seed cotton yield:

The seed cotton yield was significantly influenced by cotton genotypes and plant spacing. By adopting a plant spacing of 30 × 30 cm in Anjali variety recorded

Table 3: Effect of cotton genotypes and plant densityon weed dry matter production (g m^{-2}) at 40 DAS

	2011-12				2012-13			
Treatments	Grasses	Sedges	BLW	Total	Grasses	Sedges	BLW	Total
Genotypes								
SVPR 3	3.04 (19)	3.19 (23)	4.34 (81)	4.90 (136)	2.83 (15)	3.19 (23)	4.08 (59)	4.71 (111)
Anjali	2.85 (16)	3.46 (30)	4.53 (95)	4.99 (149)	2.96 (18)	3.02 (19)	4.05 (56)	4.69 (109)
Suraj	2.98 (18)	3.26 (25)	4.68 (109)	5.03 (154)	2.76 (14)	3.05 (20)	4.03 (55)	4.61 (101)
LH 900	2.90 (17)	3.35 (27)	4.92 (140)	5.14 (175)	2.85 (16)	3.11 (21)	4.07 (57)	4.69 (108)
S.E.±	0.15	0.15	0.25	0.20	0.14	0.11	0.14	0.19
C.D. (P = 0.05)	NS	NS	NS	NS	NS	NS	NS	NS
Spacing (cm)								
30 × 30	2.66 (12)	2.98 (18)	3.94 (53)	4.55 (94)	2.57 (11)	2.82 (15)	3.67 (38)	4.34 (75)
45 × 30	2.84 (15)	3.14 (22)	4.34 (79)	4.81 (123)	2.72 (13)	2.98 (18)	3.94 (50)	4.55 (93)
60 × 30	2.94 (17)	3.27 (25)	4.62 (102)	5.00 (148)	2.88 (16)	3.17 (22)	4.13 (60)	4.74 (112)
90 × 30	3.08 (20)	3.36 (27)	4.85 (129)	5.17 (176)	3.04 (19)	3.25 (24)	4.26 (69)	4.87 (128)
S.E.±	0.13	0.09	0.19	0.16	0.13	0.10	0.13	0.12
C.D. (P = 0.05)	NS	0.22	0.45	0.38	0.32	0.25	0.33	0.30
Interaction	NS	NS	NS	NS	NS	NS	NS	NS

Figures in the parenthesis denotes original values Transformation: log (X+2) NS= Non-significant

Table 4 : Interaction effect of cotton genotypes and plant density on seed cotton yield (kg ha^{-1})

Treatments	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
Genotypes										
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.±	C.D. (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		

higher seed cotton yield followed by LH 900 (Table 4). This is in confirmity with the findings of Wells and Meredith (1986) 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).

Conclusion:

The seed cotton yield was invariably increased with closer planting of 30 × 30 cm due to higher canopy closure and light interception it reduces the weed population and which was reflected in the yield. Among the varieties Anjali performed well under closer planting of 30 × 30 cm and it may highly suitable for high density planting system under rainfedvertisols.

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REFERENCES

Chellaiah, N. (1996). Effect of sowing method, intercropping and foliar nutrition on the productivity of summer irrigated cotton (*Gossypium hirsutum*, L.) Ph.D.Thesis, Tamil Nadu Agricultural University, Coimbatore, T.N (INDIA).

Gomez, K.A. and Gomez,A.A. (1984). *Statistical procedures for agricultural research* (2nd Ed). Intl. Rice. Res. Int., P.O.Box. Manila Philippines and John Wiley and Sons, New York, U.S.A., 680pp.

Gwathmey, C.O., Steckel, L.E. and Larson, J.A. (2008). Solid and skiprowspacings for irrigated and nonirrigated upland cotton. *Agron. J.*, **100** : 672–680.

Heitholt, J.J., Pettigrew,W.T. and Meredith, W.R. (1992). Light interception and lint yield of narrow-row cotton. *Crop Sci.*, **32**: 728-733.

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 : 430-435.

Krieg, D.R. (1996). Physiological aspects of ultra-narrow row cotton production. In:*Proc. Beltwide Cotton Conf.*, Nashville,TN. 9–12 Jan. 1996. Natl. Cotton Counc.Am., Memphis, TN, 66.

Molin, W.T., Hugie, J.A. and Hirase, K. (2004). Prickly sida (*Sidaspinosa* L.) and spurge (*Euphorbia hyssopifolia* L.) response to wide row andultra narrow row cotton (*Gossypium hirsutum* L.) management systems.*Weed Biol. & Mgmt.*, **4** : 222–229.

Robinson, J.R.C. (1993). Narrow row cotton: economics and history. In: *Proc. Beltwide Cotton Conf., New Orleans*, LA. 10–14 Jan. 1993. Natl. Cotton Counc. Am., Memphis, TN, 133–137pp.

Roche, R., Michael Bange, Stephen Milroy and Graeme Hammer (2003). In:Proc. of the 11th Australian Agronomy Conference, 2-6 February 2003, Geelong, Victoria.

Silvertooth, J.C., Edmisten, K.L. and McCarty,W.H. (1999). Production practices. In: Smith, C.W. (Ed.) *Cotton: Origin, history, technology and production*. John Wiley and Sons, NEW YORK, U.S.A.463–465pp.

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 rainfedvertisols of central India. In: *Proc. of World Cotton Research Conference*- **5**, Mumbai, India, 7-11 Nov. 2011.

Wells, R. and Meredith, W.R. (1986). Heterosis in upland cotton I. Growth and leaf area partitioning. *Crop Sci.*, **26**: 1119–1123.

Wilson, D. G. J. (2006). Evaluation of weed management and the agronomic utility of cotton grown on a 15-inch row configuration. Ph.D. Thesis, North Carolina State University, Raleigh, NC.