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FLUENCE OF GENOTYPES AND PLANT DENSITY ON YIELD AND ECONOMICS OF OTTON

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ABSTRACT

Field experiments were conducted during *winter* irrigated season of 2013-14 and 2014-15 at South Indian Textile Mill Association Farm, (SIMA) Udumalpet with the objective to find out the influence of different genotypes and spacings (high density) on the yield and economics of cotton (*Gossypium hirsutum L.*). The experiment was laid out in a split plot design replicated thrice. Three genotypes *viz*, culture SHS 102, culture SHS 374, culture SHS-2-4 and one variety Anjali were fitted in the main plot and four spacings *viz*., 45 x 15 cm (Very high density), 45 x 20 cm, 60 x 15 cm (High density) and 60 x 20 cm (Medium high density) respectively were tried in the sub plot. The results of the experiment revealed that among the cotton genotypes, culture SHS 102 followed by culture SHS 374 recorded higher yield. Among the plant spacings, 60 x 15 cm spacing favourably increased seed cotton yield of all the cotton genotypes. With regard to the treatment combinations, the culture SHS 102 and SHS 374 registered s higher seed cotton yield at a plant spacing 60 × 15 cm and both were comparable with each other. The economic returns were higher with culture SHS 102 and culture 374 at plant spacing of 60 × 15 cm. The benefit cost ratio was also higher with culture SHS 102 at a spacing of 60 x 15 cm followed by culture SHS 374 at 60 x 15 cm.

ey words : *Genotypes, plant density, yield, economics, cotton.*

otton is one of the most ancient and very important ommercial fibre crops of global perspective. Cotton has a gnificant role in Indian agriculture in terms of industrial evelopment, employment generation and national conomy. Cotton has a unique name and fame as "King of ibres" and "White Gold" because of its high economic alue among cultivable annual crops. It provides mployment opportunities to about 70 million people and ontributes nearly 75 per cent of total raw material to the extile industry in India. It is the backbone of the flourishing extile industry in India.

The manipulation of row spacing, plant density and he spatial arrangements of cotton plants for obtaining igher yield have been attempted by agronomists for everal decades in many countries. The most commonly ested plant densities range from 5 to 15 plants m^{-2} (Kerby *et al.*, 1990) resulting in a population of 50000 to 150000 lants ha^{-1}. The concept on high density cotton planting, ore popularly called Ultra Narrow Row (UNR) cotton as initiated by Briggs *et al.* (1967). Ultra narrow row otton has row spacings as low as 20 cm and plant opulation on the range of 2 to 2.5 lakh plants ha^{-1}, while onventional cotton is planted in rows of 90 to 100 cm part and has a plant population of about 1,00,000 plants a^{-1}. However in India, the recommended plant density for otton seldom exceeded 55,000 plants ha^{-1}.

The advantages of high density planting system nclude better light interception, efficient leaf area evelopment and early canopy closure which will shade ut the weeds and reduce their competitiveness (Wright *et al.*, 2011). Therefore, the high density planting system (HDPS) is now being conceived as an alternate production system having a potential for improving the productivity and profitability, increasing input use efficiency, reducing input costs and minimizing the risks associated with the current cotton production system in India.

Genotype selection, a key management component in any cropping system, is even more critical in high density planting system. High yielding potential is a predominant consideration with early maturity of the crop. But, plant size and fibre properties are also important factors to be considered.

So far, limited research has been done on this aspect elsewhere. In this context, this experiment was initiated with a view to evaluate the cotton genotypes with different plant densities for yield and economics under Tamil Nadu conditions.

MATERIALS AND METHODS

Field experiments were conducted at SIMA Research Farm during the year 2013-14 and 2014-15 during winter to evaluate different plant density on the growth, yield and economics of cotton genotypes.

The experiments were laid out in split plot design replicated thrice with four cotton genotypes viz., GP 102, GP 374, culture SH-2-4 and Anjali and four spacings viz., 45×15 cm, 45× 20 cm, 60 × 15 cm and 60 × 20 cm. The soil of the experimental site was sandy clay loam in texture, belonging to *Typic Ustropept*. The nutrient status

e-1 : Effect of cotton genotypes and plant density on yield of cotton (q ha^{-1}).

Treatment	2013-14					2014-15				
	S_1	S_1	S_1	S_1	S_1	S_1	S_2	S_3	S_4	Mean
V_1	22.72	22.72	22.72	22.72	22.72	23.17	23.90	25.48	23.68	24.06
V_2	18.90	18.90	18.90	18.90	18.90	19.27	21.92	24.99	21.65	21.96
V_3	15.15	15.15	15.15	15.15	15.15	14.96	17.08	21.99	19.51	18.38
V_4	14.18	14.18	14.18	14.18	14.18	15.02	16.22	21.39	19.24	17.97
Mean	17.74	17.74	17.74	17.74	17.74	18.11	19.78	23.46	21.02	
	SEd		SEd		SEd	SEd		SEd		
V	0.58		0.58		0.58	0.58		0.58		
S	0.41		0.41		0.41	0.41		0.41		
V at S	0.92		0.92		0.92	0.92		0.92		
S at V	0.82		0.82		0.82	0.82		0.82		

	:	Culture SHS 102	S_1	:	45 x 15 cm
	:	Culture SHS 374	S_2	:	45 x 20 cm
	:	Culture SHS-2-4	S_3	:	60 x 15 cm
	:	Anjali	S_4	:	60 x 20 cm

oil at the beginning of experiment was low in available ogen (190 kg ha^{-1}), medium in available phosphorus 2 kg ha^{-1}) and medium in available potassium (346 kg). The cotton crop was raised as per the treatments by owing all the standard package of practices.

Observations on seed cotton yield were recorded economics were also worked out

SULTS AND DISCUSSION

ed cotton yield (Table 1) : The seed cotton yield was nificantly influenced by cotton genotypes and plant cing.

Among the cotton genotypes, culture SHS 102 orded significantly higher seed cotton yield of 24.20 24.06 q ha^{-1} during 2013-14 and 2014-15, pectively. The variety Anjali recorded lower seed on yield (17.51 and 17.97 q ha^{-1}during 2013-14 and 14-15, respectively). However, the yield obtained under variety Anjali was comparable with the culture S-2-4 during both the years of study.

Stable cotton varieties/hybrids with high yielding ential are of paramount importance among the large mber of varieties recommended for cultivation. Among genotypes, culture SHS 102 recorded higher seed on yield followed by culture SHS 374 during both the rs of study. The yield reduction due to culture SHS 374 s 11.85 per cent during 2013-14 and 8.72 per cent ing 2014-15 comparing the yield under culture SHS 2. The culture SHS 102 and 374 recorded comparably her yields over the other cotton genotypes, which could attributed due to the increased sympodial branches, ting points, higher boll setting and boll numbers as denced in the present study.

Better vegetative growth and profuse boll bearing has taken a major share in increasing the seed cotton yield of culture SHS 102 and 374 over other cotton genotypes. Ongoing growth and development events pertaining to biomass and square production, leaf area maintenance with canopy development were favourably influenced thus realizing higher productivity reflected through higher partitioning of assimilates in to the developing bolls. Further the higher seed cotton yield might be attributed due to higher retention of bolls from the first flush of flowers like Bt hybrids with no boll damage. This might have resulted due to utilization of more nutrient energy in the nourishment of maximum number of bolls that were saved from the boll damage. This is in confirmation with the earlier findings of Mayee *et al.* (2004) and Nehra *et al.* (2004) who found that Bt cotton hybrids recorded significantly higher seed yield than non-Bt hybrids because of higher boll retention and significantly higher seed cotton yield reduced bollworm damage.

Among the plant spacings, the plant spacing of 60 x 15 cm recorded significantly higher seed cotton yield (23.01q ha^{-1} in 2013-14 and 23.46 q ha^{-1} in 2014-15) followed by 60 x 20 cm spacing. Lower seed cotton yield was observed with the plant spacing of 45 x 15 cm (17.74 and 18.11 q ha^{-1} in 2013-14 and 2014-15, respectively).

Comparing the plant spacings, high density planting with optimum inter and intra row spacing (60 x 15 cm) recorded higher seed cotton yield compared to closer and wider row sapcing (45 x 15 and 60 x 20 cm, respectively). The yield reduction under very high density planting due to closer spacing of 45 x 15 cm was 15.13 per cent in 2013-14 and 15.69 per cent in 2014-15 comparing the yield under medium high density planting of 60 x 15 cm.

e-2 : Effect of cotton genotypes and plant density on economics of cotton.

eatment	2013-14				2014-15			
	Cost of cultivation (₹/ha)	Gross return (₹/ha)	Net return (₹/ha)	B:C ratio	Cost of cultivation (₹/ha)	Gross return (₹/ha)	Net return (₹/ha)	B:C ratio
V_1S_1	46965	113600	66635	2.42	47581	120484	72903	2.53
V_1S_2	48815	119650	70835	2.45	49431	124280	74849	2.51
V_1S_3	48815	125950	77135	2.58	49431	132496	83065	2.68
V_1S_4	50175	124800	74625	2.49	50791	123136	72345	2.42
V_2S_1	46965	94500	47535	2.01	47581	100204	52623	2.11
V_2S_2	48815	104350	55535	2.14	49431	113984	64553	2.31
V_2S_3	48815	121550	72735	2.49	49431	129948	80517	2.63
V_2S_4	50175	106150	55975	2.12	50791	112580	61789	2.22
V_3S_1	46965	75750	28785	1.61	47581	77792	30211	1.63
V_3S_2	48815	83700	34885	1.71	49431	88816	39385	1.80
V_3S_3	48815	107800	58985	2.21	49431	114348	64917	2.31
V_3S_4	50175	95600	45425	1.91	50791	101452	50661	2.00
V_4S_1	46965	70900	23935	1.51	47581	78104	30523	1.64
V_4S_2	48815	81450	32635	1.67	49431	84344	34913	1.71
V_4S_3	48815	104850	56035	2.15	49431	111228	61797	2.25
V_4S_4	50175	93050	42875	1.85	50791	100048	49257	1.97

a statistically not analysed.

e yield reduction under medium high density due to der spacing (60 x 20 cm) was 8.82 per cent in 2013-14 d 10.40 per cent in 2014-15 comparing the yield under acing of 60 x 15 cm (medium high density).

In the year 2013-14, adopting a plant spacing of 60 × cm in culture SHS 102 significantly recorded higher ed cotton yield of 25.19 q ha^{-1} followed by culture SHS 2 with 60 x 20 cm of plant spacing (24.96 q ha^{-1}) and th were comparable with each other. The least seed tton yield was recorded under the mbination of variety Anjali at 45 x 15 cm spacing.

During 2014-15, the treatment combination of ture SHS 102 sown at a spacing of 60 x 15 cm corded higher seed cotton yield followed by culture SHS 4 with the plant spacing of 60 x 15 cm and culture SHS 2 at 60 x 20 cm and were comparable with each other. e least seed cotton yield was recorded under the riety Anjali at 45 x 15 cm spacing.

The interaction between cotton genotypes and plant acing had also significant influence on seed cotton eld. This showed that optimum plant spacing varied epends on the growth habits and canopy alteration from brid to hybrid. This is in consonance with the findings of apna *et al.* (1976) who reported that optimum plant nsity is dependant on the inherent vegetative habit of riety and conditions of soil fertility, moisture and cultural actices.

In both the experiments conducted, culture SHS 102 nd 374 had recorded significantly higher yield with a ant spacing of 60 × 15 cm. This is in conformity with the findings of Anjum *et al.* (2010) who found that maximum seed cotton yield was recorded with 75 cm row spacing followed by 60 cm row spacing, whereas minimum seed cotton yield was observed with 90 cm row spacing. From this it is clearly understood that culture SHS 102 could accommodate in optimum plant density and the competition between the plants are also found to be lesser. All the yield attributing characters were lesser with closer spacing of 45 × 15 cm thus the decrease in seed cotton yield might be due to more plant population over wider spacing in the experiment.

Another factor is that wider spacing (medium high density planting) paved a way for enhanced availability of nutrients to the crop and increased the nutrient uptake which helped in improved crop growth, which in turn was expressed in terms of yield. This is in line with the earlier findings of Bhalerao *et al.* (2008) and Saleem *et al.* (2009) who reported similar findings.

Economic analysis (Table 2 and 3) : Different cotton genotypes with various plant spacings showed variations in gross return, net return and benefit cost ratio during both the cropping period.

Among the different treatment combinations, the cotton culture SHS 102 at 60 × 15 cm spacing (V_1S_3) registered higher gross return (Rs. 1, 25 950 and Rs. 1, 32, 496 ha^{-1} in 2013-14 and 2014-15, respectively) followed by culture SHS 374 at 60 × 15 cm spacing (V_2S_3). The lowest gross income was recorded with the variety Anjali at 45 × 15 cm (V_4S_1) in both the years.

Higher net return was recorded by the cotton culture

S 102 at 60 × 15 cm spacing (V_1S_3) (Rs.77, 135 and 83,065 ha^{-1} in 2013-14 and 2014-15, respectively). e lowest net return was registered with the variety ali at 45 × 15 cm (V_4S_1) in both the years.

The highest B:C ratio was also registered by culture S 102 at 60 × 15 cm (V_1S_3) (2.58 and 2.68 in 2013-14 2014-15, respectively) followed by culture SHS 374 at plant spacing of 60 × 15 cm. The lowest B:C ratio was orded in Anjali at 45 × 15 cm in both the years.

Economic viability of crop management is the most criteria in transforming new investigations to mers' field.

Considering the plant spacing, adopting closer acing of 45 x 15 cm had recorded higher cost of tivation due to the increased seed requirement in both years of study. The gross returns and net returns were her with culture SHS 102 with plant spacing of 60 x 15 (V_1S_3) followed by the culture SHS 374 at 60 x 15 cm acing during both the years of study. Remunerative nomic returns realized under this treatment nbination were due to reduced cost of cultivation and eased yield obtained under these treatments. The ult of Anjum *et al.* (2015) who reported higher net rns at 70 × 15 cm than other closer spacing is in port of the present result.

In any investment economics, it is the B:C ratio ch is more important to compare the profitability of the itments to identify the technologies to improve the d. From the study conducted, it is found that treatment nbination of culture SHS 102 sown at the spacing of 60 5 cm (V_1S_3) has recorded higher B:C ratio followed by wed by culture SHS 374 at 60 x 15 cm (V_2S_3). This mainly due to the better performance of genotype , which gave higher net returns in the former nbination treatment which increased the B:C ratio, e in the later treatment combination it was due to ier yield coupled with reduction in the cost of duction. The results of Anjum *et al.* (2015) who rted that 70 × 20 cm has given higher B:C ratio pared to the spacing of 70 × 10 cm and 70 × 15 cm support the present findings.

NCLUSION

ng the cotton genotypes, culture SHS 102 followed by culture SHS 374 recorded higher yield. Among the plant spacings, the plant spacing of 60 x 15 cm favourably increased seed cotton yield of all the cotton genotypes. With regard to the treatment combinations, the culture SHS 102 and SHS 374 registered higher seed cotton yield at a plant spacing 60 × 15 cm and both were comparable with each other. The economic returns were higher with culture SHS 102 and culture 374 at plant spacing of 60 × 15 cm. The benefit cost ratio was also higher with culture SHS 102 at a spacing of 60 x 15 cm followed by culture SHS 374 at 60 x 15 cm.

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