Effect of Cotton Varieties and Plant Spacing on Yield and Yield Components of Compact Type Cotton Under HDPS.

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Abstract
To improve productivity and profitability, it is important to investigate new strategies for cotton production. In April 2020, a field experiment was conducted to study the effect of different plant varieties and spacing on the growth and yield of compact-type cotton. The experiment followed a split-plot design with three replications, with four levels of cotton varieties (Suraj, Supriya, CO 15 and CO 17) in the main plots and seven levels of plant spacing (60 cm x 10 cm, 60 cm x 15 cm, 80 cm x 10 cm, 80 cm x 15 cm, 100 cm x 10 cm, 100 cm x 15 cm, and 75 cm x 30 cm) in the subplots. The results revealed that cotton variety CO 17 had been recorded significantly the highest yield and yield attributes, highest number of sympodial branches per plant and number of squares per plant counted higher when compared to other varieties. However, relative parameters the significantly highest number of bolls per plant counted and higher boll weight was recorded and maximum seed cotton yield harvested with CO 17 variety than others.
Results revealed that the 100 x 10 cm plant spacing recorded the highest yield contributing characteristics, such as number of sympodial branches per plant, number of squares per plant and number of bolls per plant. Closer spacing has recorded a significantly higher number of bolls per plant; the highest single boll weight and maximum seed cotton yield were recorded. Among the interaction varieties, CO 17 with a 100 x 10 cm plant spacing registered higher number of sympodial branches per plant, number of squares per plant and number of bolls per plant for yield parameters, comparing to the yield CO 17 with 100 x 10 cm recorded higher seed cotton yield, higher number of bolls per plant and boll weight.

Keywords: Cotton, high density planting system, variety, plant spacing, yield attributes, yield

INTRODUCTION

Cotton (Gossypium hirsutum L.), the most important fibre crop constitutes livelihood for millions of people through cultivation, trade, transportation, ginning and processing (Kumari *et al*., 2022). According to United States Department of Agriculture (USDA), globally, cotton area and production are projected as 35.5 million hectares and 115.7 million bales during 2022-23 (Anonymous, 2022). The cotton textiles industry is the second largest employer in the country after agriculture, while also sustaining the livelihoods of an estimated 6.5 million cotton farmers (Anonymous, 2022). In 2021-22, India produced 362.18 lakh bales of cotton on 120.69 lakh hectares, yielding 510 kg per hectare (Cotton Corporation of India, 2022). The Southern zone (which comprises of states like Telangana, Andhra Pradesh, Karnataka, and Tamil Nadu) is the second biggest producer of cotton after central zone, producing about 30% of the nation's cotton, with Tamil Nadu according to data available with the Indian cotton federation, almost 1.65 lakh hectares of land was under cotton cultivation in the state production was expected to be 6.5 lakh bales during the 2021-2022 cotton season.

India ranks first in the world cotton production by 2021–22, its productivity levels are very low despite the availability of Bt technology. Khan et al. (2019) observed that an expanding population requires global efforts to increase crop production, especially those fulfilling food and clothing needs. On the other hand, high input costs especially higher prices of Bt cotton seed (Gadade *et al*., 2015) coupled with multiple management have threatened cotton productivity. Many cotton producing countries like Brazil, China, Australia, Spain, Argentina and Greece tested, proved and adopted narrow row planting system of cotton as tool to achieve higher productivity (Rossi *et al*., 2004; Ali *et al*., 2010).

In High Density Planting System (HDPS), researchers aim to maintain 1-2 lakh cotton plants ha^{-1} of land. The intra row spacing could be as low as 30 cm instead of 90 cm to 1 meter for conventional cotton. The reshaping of crop geometry is an agronomic technique for acquiring higher yield. This alteration enables a greater number of plants per hectare with 8 - 14 bolls per plant with 4 g per boll. In cotton, the crop geometry has influence on seed cotton yield. Closer plant geometry recorded higher seed cotton yields (Paslawar *et al*., 2015; Parlawar *et al*., 2017; Madavi *et al*., 2017 and Meena *et al*., 2017. Plant competition for resources in higher population resulted in smaller cotton plant with a higher resource use efficiency (Liu et al., 2020) but results in poor boll load and delayed late-season leaf senescence (Luo *et al*., 2018). Increased plant density would be beneficial to cotton yield in the lower fertility field (Dong *et al*., 2010; Sankaranarayanan *et al*., 2018).

Inappropriate planting density, either low or high may exhibit enormous risk for yield formation (Khan *et al*., 2020). Optimizing plant population is an inexpensive practice that can significantly increase crops production, including castor and cotton (Severino *et al*., 2012; Li *et al*., 2020). At present, high density planting system has been suggested as an alternative strategy instead of conventional one to increase yield and it is a time-tested agronomic technique to improve yield profitability and also to improve input use efficiency (Venugopalan *et al*., 2011; Nalayini and Manickam, 2018). Therefore, establishing an appropriate plant stand is paramount to obtain higher yields as lower plant density will be wastage of resources while, high plant density limits individual plant growth (Brodrick *et al*., 2013). Cotton is extremely sensitive to adverse environmental conditions and field management. The current day cotton varieties are of long duration, tall-growing, and with long sympodial growth. This leads to an increase in the cost of cultivation because of more manual pickings (Gunasekaran *et al*., 2020).

To improve productivity, optimize profit, and select management strategies under rising production costs, the alternative way is a high -density planting system. It is the manipulation of row spacing, plant density, and the spatial arrangement of cotton plants for obtaining higher yields. In simple terms, it is growing cotton densely than what is being practiced. This planting system produces fewer bolls than conventionally planted cotton but retains a higher percentage of total bolls in the first sympodial position and a lower percentage in the second position (Vories and Glover 2006). The High Density Planting System (HDPS) besides providing better light interception, efficient leaf area development, and early canopy closure which will shade out the weeds and reduce their competitiveness (Wright et al., 2011) also provides synchronized flowering, uniform boll bursting and early cut-off (Gunasekaran *et al*., 2020). Hence, HDPS is the solution to improve productivity and profitability, increase input use efficiency, and minimize the risks associated with current cotton production in India.

Differences in canopy architectural attributes among varieties impact cotton growth, lint yield and management. The response of varieties with contrasting plant architecture to planting densities has important implications to cotton crop management decisions such as seeding rates. Reductions in seeding rates are gaining traction due to high seed costs and technology fees associated with transgenic cotton varieties coupled with increased adoption of seed treatments for disease, insect, and nematode control. The consequent reduction in plant density may have implications for variety selection and crop management due to modifications in plant architectural traits. Cotton plant architecture is a hereditary character that can be modified by selection

The availability of compact genotypes, altering of crop geometry, application of growth regulators and application of fertilizers on need based will bring the high density cotton under mechanized cultivation in India. To mechanize the cotton cultivation since it is a labour intensive and to increase the profitability, compact cotton genotypes provide a great scope. Compact genotypes are ideally suited for machine pickings and high density planting because of their short stature, lesser vegetative growth, fewer and shorter fruiting branches, short inter branch and inter boll distance and synchronous maturity. Due to their earliness it can be harvested in two or three pickings (Patil *et al*., 2017).
Cotton varieties like CSH 3075, CO 15, CO 17, etc. are specifically developed for the cultivation of cotton under HDPS in India. CO 15 and CO 17 varieties are released by the Department of Cotton, Tamil Nadu Agricultural University, Coimbatore, and these varieties have shown considerable improvement in the yield over the check variety Suraj (National check entry identified for HDPS) (Kumar *et al*., 2020). Development of ideal varieties having better adaptation to high density planting with better growth characters and optimum plant population is paramount importance for this new method of HDPS. With this back ground, present investigation was carried out evaluate suitable varieties and to standardize optimum plant population requirement of cotton under HDPS.

MATERIALS AND METHODS

The experiment on "Influence of cotton varieties and plant spacing on growth, yield and yield parameters" was conducted during April 2020 to find out the influence of different plant varieties and various plant spacing of compact type cotton on growth and yield at a farmer's field at Subrayapuram village, Thirunallar taluk, Karaikal district of Puducherry, India The experimental site is situated at 10°93'N latitude and 79°78'E longitude at an altitude of +4 m above mean sea level in the southern part of India. Karaikal region comes under the Eleventh Agro Climatic Zone of India under All India Agro Climatic Zonal Classification (PCI, 1989). It is classified as PC_2 - Coastal deltaic alluvial plain zone under All India agroecological classification. The soil analysis resulted that the texture of the soil is clay loam with having organic carbon upto 0.46 during 2020. The initial soil analysis resulted that available nitrogen is low (208 kg ha^{-1}), available phosphorous is medium (15.8 kg ha^{-1}) and available potassium is medium (271 kg ha^{-1}) during the year 2020. Karaikal region has a tropical climate with a mean maximum and minimum temperature of 33.2 ^{o}C and 24.4 ^{o}C, respectively. The annual total rainfall is 1314.55 mm. The total annual evaporation is 1956.4 mm and the annual total bright sunshine hour is 2610.2. The mean annual morning and evening relative humidities are 87.4 and

62.2%, respectively. The statistical design adopted for the experimentation was Split Plot design, with three replications and twenty-eight treatment combinations. The main plots were four cotton varieties viz., M1: Suraj; M2 Supriya, M3: CO 15 (TCH 1705) and M4: CO 17 (TCH 1819) Each of these main plots were divided into seven sub-plots. The sub-plots consisted of seven plant spacing viz., S1: 60 cm × 10 cm; S2: 60 cm × 15 cm; S3: 80 cm × 10 cm; S4: 80 cm × 15 cm; S5: 100 cm × 10 cm; S6: 100 cm × 15 cm and S7: 75 cm × 30 cm as the experiment was laid on April 2020.

Field was ploughed once with disc plough followed by cultivator twice. Rotavator was used to break the clods and then bunds, ridges and furrows were formed. The crop was sown on April 24, 2020 by dibbling seeds at a depth of 4 to 5 cm as per spacing in treatments. Fertilizer dose of 100:50:50 kg NPK. ha^{-1} was applied. Entire dose of phosphorus, 50 per cent of N and K were applied as band placement 5 cm away and 5 cm below the seed row as basal placement. The remaining ½ N and K were top dressed at 40 – 45 DAS. Pre emergence herbicide pendimethalin @ 1.0 kg ha^{-1} was sprayed to prevent the growth of weeds. Hand weeding was carried out at 40 DAS. First irrigation was given at the time of sowing to ensure uniform germination and life irrigation was given on third day after sowing. The subsequent irrigations were scheduled at 7-10 days interval depending upon the field moisture condition. During the cropping period, sucking pest incidence was noticed. Initially imidaclorpid @ 2 $ml.l^{-1}$ was sprayed. At later stages, Acephate @ 4 $ml.l^{-1}$ was sprayed against white fly incidence as and when required. Harvesting of kapas was commenced on 125 DAS and pickings were taken at 2-3 days intervals. The number of bolls on labeled plants from each plot were noted at each picking and expressed per plant. Harvested bolls from each treatment was weighed and expressed in kg ha^{-1}. Data on different characters viz., yield and yield attributes were statistically analyzed as described by Gomez and Gomez (1984). Wherever the results were significant, critical differences was worked out at five per cent level.

RESULTS AND DISCUSSION

Number of sympodial branches plant^{-1}

Cotton varieties and plant spacings had a marked influence on the number of sympodial branches per plant. With regards to cotton varieties, the number of sympodial branches per plant was significantly higher with M_4 (CO 17) of 13.14, and it was comparable with M_3 (CO 15) and M_1 (Suraj). The least number of sympodial branches per plant of 12.74 were registered with the varieties M_2 (Supriya). In respect of plant spacings, significantly higher number of sympodial branches per plant was registered under S_5 (100 x 10 cm) with values of 14.14, and it was followed by S_2 (60 x 15 cm). The significantly lower number of sympodial branches per plant of 12.78 was registered with 75 × 30 cm (S_7) spacing. Regarding interaction effect between cotton varieties and plant spacings was found to be non-significant. This might be due to the reason that the higher ability of compact type cotton varieties in harnessing the solar energy and converting it in to biomass and subsequently in to reproductive parts such as sympodia, flowers and bolls. This is in line with the findings where sympodial branches and boll production were more in Bunny Bt under dry land condition (Manjunatha *et al.,* 2010).

Number of squares plant^{-1}

Data regarding the number of squares per plant was significantly altered by cotton varieties and plant spacing. With respect to cotton varieties, M_4 (CO 17) cotton variety significantly recorded higher number of squares per plant of (42.08), and it was comparable with M_3 (CO 15) and M_1 (Suraj). Significantly lower number of squares per plant of 38.79 was registered with the variety M_2 (Supriya).

In respect of plant spacings, significantly higher number of squares per plant of 41.82 was registered under the spacing of S_5 (100 x 10 cm). This was followed by the treatment 60 x 15 cm (S_2). The lowest squares per plant of 37.35 was registered with 75 x 30 cm (S_7). Regarding interaction effect between cotton varieties and plant spacings did not show any significant variations and this might be due to reduced competition for resources like nutrients, light, spacing etc. This is in confirmation with the earlier findings of Stephenson *et al.* (2011) and Kumar *et al*., (2017) they reported that higher plant density decreased the monopodia and increase sympodia and number of fruit branches.

Number of bolls plant^{-1}

Number of bolls per plant was significantly influenced by variety and plant spacing and also among their interactions (Table 2). The variety CO 17 produced significantly more number of bolls per plant (12.24) which was on par with CO 15 (12.03). The variety Supriya produced lower number of bolls (10.93). This difference might be due to genetic potential of the plant. Similar result was reported by Ajayakumar *et al.* (2017).

Comparing plant spacings, the higher number of bolls per plant of 13.18 was significantly registered with 100 x 10 cm. and this might be due to reduced competition for resources like nutrients, light, spacing etc. This is in confirmation with the earlier findings of Stephenson *et al.* (2011) and Kumar *et al*., (2017) they reported that higher plant density decreased the monopodia and increase sympodia and number of fruit branches. Significantly least number of bolls per plant of 11.10 was registered under the spacing of 75 x 30 cm.

Among the interaction, the treatment combinations of CO 17 cotton variety adopted with the spacing of 100 x 10 cm recorded a significantly higher number of bolls per plant of 13.86. It was followed by CO 17 with a spacing of 60 x 15 cm. Significantly lower number of bolls per plant of 12.82 was registered with the combination of Supriya raised with a spacing of 75 × 30 cm. This in consonance with the earlier findings of Udikeri and shashidhara (2017) who had reported that increased sympodia and boll number were higher due to better assimilation and translocation of photosynthates to the reproductive sink.

Boll weight (g boll^{-1})

Boll weight was significantly influenced by variety (Table 2) and the genotype CO 17 recorded significantly higher boll weight (3.67 g) which was on par with CO 15 (3.58 g). Lower boll weight (3.41 g) was recorded with supriya. The difference in genotypes in their yield potential might be depending on many physiological processes, which are controlled by both genetic makeup of the plant and the environment (Udikeri and Shashidhara, 2017).

Among the different plant spacings followed, cotton crop grown with spacing of 100 x 10cm (S_5) significantly registered higher value of 3.80 g and it was followed by 60 x 15 cm (S_2). The lower boll weight of 3.31 g was registered with 75 x 30 cm (S_7) spacing. Boll weight was significantly differed with plant spacing. This in confirmation with the report of Sadhik *et al.* (2022) that there is significant difference was observed in boll weight between different spacing treatments

The interaction effect was found to be significant. The variety CO 17 adopted with the spacing of 100 x 10 cm (M_4S_5) recorded significantly higher boll weight of 4.02 g, followed by CO 17 with 60 x 15 cm (M_4S_2) spacing. Venugopalan *et al.* (2011) and Sawan, (2016) reported that irrespective of cotton genotypes the boll number per plant decreased with closer spacing due to greater inter-plant competition. However, the increase in the number of plants per unit area at closer spacing compensated for this decline and hence the boll number m^{-2} was significantly higher at all the closer spacings compared to the recommended (75 × 30 cm) spacing.

Seed cotton yield (kg ha^{-1})

Seed cotton yield was significantly influenced due to variety and plant spacing listed in (Table 3). Among the different cotton varieties chosen, the cotton variety CO 17 (M_4) significantly registered higher the seed cotton yield of 2129 kg ha^{-1}, which was superior to the rest of the treatments. This was followed by CO 15 (M_3) with seed cotton yield of 2030 kg

ha^{-1}. The lowest seed cotton yield of 1813 kg ha^{-1} was obtained from the cotton variety Supriya. The differences in seed cotton yield by the genotypes might be the yielding ability of a genotype is the reflection of its yield attributing characters like more number of matured open bolls and boll weight (Sisodia and Khamparia (2007) Tuppad (2015). Since the genotype CO 17 is resistance to bollworm attack and produced healthy matured bolls with more boll weight.

Among the plant spacing adopted the treatment of 100 x 10 cm (S_5) significantly registered the highest seed cotton yield of 2268 kg ha^{-1}. This was followed by 60 x 15 cm (S_2), with a seed cotton yield of 2168 kg ha^{-1}. The lowest seed cotton yield of 1714 kg ha^{-1} was recorded in the spacing of 75 x 30 cm (S_7). Single plant has greater opportunities to achieve maximum productivity when given ample space to grow, it ultimately resulted in better nourishment and higher seed cotton yield plant-1 but these higher values of yield components in wider spacing were compensated through higher plant population per unit area under closer spacing and resulted in higher yields. These results are in agreement with Singh *et al*. (2012), Nalayini and Manickam (2018)

Among the interaction between cotton varieties and plant spacing, cotton varieties CO 17 raised with a plant spacing of 100 x 10 cm (M_4S_5), registered the maximum seed cotton yield of 2456 kg ha^{-1}. This was followed by the treatment combination of cotton variety CO 17 with a spacing of 60 x 15 cm, which recorded the seed cotton yield of 2328 kg ha^{-1}. The treatment combination of variety Supriya with spacing of 75 x 15 cm had registered the lowest seed cotton yield of 1624 kg ha^{-1}. From this it is clearly understood that CO 17 could withstand plant population pressure and the competition between the plants are also found to be lesser. All the yield attributing characters were lesser with closer spacing of 100 × 10 cm thus the increase in seed cotton yield might be due to more plant population over wider spacing in the experiment. Further the angle and orientation of leaves were found adjusted at higher population, thereby minimizing overlapping and mutual shading, responsible for greater leaf development at high population resulting in increased growth and yield attributes. Increase in yield in HDPS was also reported by Arunvenkatesh and Rajendran (2013); Paslawar *et al*., 2015; Pradeep Kumar *et al*., 2017; Nalayini and Manickam (2018) and chen *et al*., 2019.

Harvest index (Table 19)

The harvest index (HI) was evident from the data that cotton varieties and plant spacing significantly influenced by the treatments listed in (Table 3). Regarding the cotton varieties, M_4 (CO 17) significantly registered highest value of harvest index of 0.35 was observed due to cotton varieties. The cotton variety Supriya (M_2) registered the lowest harvest index of 0.32. Among the plant spacing, the spacing of 100 x 10 cm (S_2) significantly registered highest harvest index of 0.35, and it was on par with the plant spacing of 60 x 15 cm (S_2), which recorded the harvest index of 0.34. The lowest harvest index of 0.32 was registered under 75 x 30 cm (S_7).

Conclusions

The present field experiment inferred that the compact cotton variety CO 17 performed differently and better to obtain higher seed cotton yield among the different varieties. Among the plant spacing, adopting 100 x 10 cm plant spacing (1,00,000 plants ha^{-1}) is found to be optimum for the high density planting system. If mechanized combine harvesting is possible with the treatment combination of CO 17 with 100 x 10 cm spacing. Thus from the conclusion drawn, cultivation of CO 17 at closer spacing of 100 x 10 cm was to be optimum for obtaining higher productivity with enhanced economic returns under irrigated condition.

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Table 1. Effect of cotton varieties and plant spacing on on number of sympodial branch plant^{-1} and number of squares plant^{-1}

Treatment	Number of sympodial branch plant^{-1}					Treatment	Number of squares plant^{-1}				
	M_1	M_2	M_3	M_4	Mean		M_1	M_2	M_3	M_4	Mean
S_1	13.10	12.78	12.96	13.44	**13.09**	S_1	38.92	36.94	37.86	39.84	**38.47**
S_2	13.86	13.68	13.96	14.62	**14.03**	S_2	42.86	40.66	43.09	44.78	**42.85**
S_3	13.12	12.84	13.67	13.72	**13.34**	S_3	40.58	37.18	40.76	41.56	**40.02**
S_4	13.79	13.06	13.84	13.92	**13.65**	S_4	42.58	38.96	42.78	42.96	**41.82**
S_5	14.02	13.74	14.06	14.74	**14.14**	S_5	43.12	42.38	43.18	44.86	**43.39**
S_6	13.70	12.94	13.76	13.83	**13.56**	S_6	40.86	38.76	42.46	42.64	**41.18**
S_7	12.62	12.54	12.86	13.18	**12.68**	S_7	36.86	36.64	37.16	38.72	**37.35**
Mean	**13.47**	**13.09**	**13.59**	**13.84**		**Mean**	**40.84**	**38.79**	**41.18**	**42.08**	
	M	**S**	**MxS**	**SxM**			**M**	**S**	**MxS**	**SxM**	
SEd	0.24	0.23	0.49	0.47		**SEd**	0.58	0.57	1.20	1.13	
CD(p=0.05)	0.59	0.47	NS	NS		**CD(p=0.05)**	1.43	1.14	NS	NS	

M1: Suraj; M2 Supriya, M3: CO 15 (TCH 1705) and M4: CO 17 (TCH 1819)

S1: 60 cm × 10 cm; S2: 60 cm × 15 cm; S3: 80 cm × 10 cm; S4: 80 cm × 15 cm; S5: 100 cm × 10 cm; S6: 100 cm × 15 cm and S7: 75 cm × 30 cm

Table 2. Effect of cotton varieties and plant spacing on Number of bolls plant^{-1} and Boll weight (g)

Treatment	Number of bolls plant^{-1}					Treatment	Boll weight (g)				
	M_1	M_2	M_3	M_4	Mean		M_1	M_2	M_3	M_4	Mean
S_1	11.26	10.22	11.58	12.18	**11.51**	S_1	3.26	3.31	3.52	3.67	**3.46**
S_2	12.58	11.78	13.16	13.76	**12.82**	S_2	3.64	3.52	3.76	3.91	**3.71**
S_3	11.76	10.42	11.82	11.86	**11.47**	S_3	3.49	3.39	3.56	3.57	**3.50**
S_4	12.48	11.12	12.56	13.12	**12.32**	S_4	3.60	3.44	3.62	3.74	**3.60**
S_5	13.18	12.45	13.22	13.86	**13.18**	S_5	3.78	3.58	3.80	4.02	**3.80**
S_6	11.84	11.06	12.46	12.52	**11.97**	S_6	3.54	3.40	3.59	3.61	**3.54**
S_7	10.14	9.45	10.36	11.46	**11.10**	S_7	3.37	3.14	3.44	3.68	**3.31**
Mean	**11.88**	**10.93**	**12.03**	**12.24**		**Mean**	**3.54**	**3.41**	**3.58**	**3.67**	
	M	**S**	**MxS**	**SxM**			**M**	**S**	**MxS**	**SxM**	
SEd	0.20	0.19	0.41	0.38		**SEd**	0.02	0.02	0.04	0.04	
CD(p=0.05)	0.48	0.39	0.86	0.77		**CD(p=0.05)**	0.05	0.04	0.09	0.08	

M1: Suraj; M2 Supriya, M3: CO 15 (TCH 1705) and M4: CO 17 (TCH 1819)

S1: 60 cm × 10 cm; S2: 60 cm × 15 cm; S3: 80 cm × 10 cm; S4: 80 cm × 15 cm; S5: 100 cm × 10 cm; S6: 100 cm × 15 cm and S7: 75 cm × 30 cm

Table 3. Effect of cotton varieties and plant spacing on Seed cotton yield (kg ha^{-1}) and Harvest index

Treatment	Seed cotton yield (kg ha^{-1})					Treatment	Harvest index				
	M_1	M_2	M_3	M_4	Mean		M_1	M_2	M_3	M_4	Mean
S_1	1735	1638	1826	1915	**1779**	S_1	0.32	0.31	0.33	0.33	**0.32**
S_2	2138	1970	2236	2328	**2168**	S_2	0.36	0.34	0.37	0.37	**0.36**
S_3	1876	1712	1938	2010	**1884**	S_3	0.34	0.32	0.35	0.34	**0.34**
S_4	2063	1893	2124	2217	**2074**	S_4	0.35	0.34	0.36	0.36	**0.35**
S_5	2214	2050	2320	2486	**2268**	S_5	0.36	0.34	0.37	0.38	**0.36**
S_6	1969	1801	2032	2126	**1982**	S_6	0.34	0.33	0.35	0.35	**0.34**
S_7	1676	1624	1732	1823	**1714**	S_7	0.32	0.32	0.32	0.33	**0.32**
Mean	**1953**	**1813**	**2030**	**2129**		**Mean**	**0.34**	**0.33**	**0.35**	**0.35**	
	M	**S**	**MxS**	**SxM**			**M**	**S**	**MxS**	**SxM**	
SEd	36	35	74	70		**SEd**	0.01	0.01	0.01	0.01	
CD(p=0.05)	89	71	157	141		**CD(p=0.05)**	0.02	0.01	0.03	0.02	

M1: Suraj; M2 Supriya, M3: CO 15 (TCH 1705) and M4: CO 17 (TCH 1819)

S1:60 cm × 10 cm; S2: 60 cm × 15 cm; S3: 80 cm × 10 cm; S4: 80 cm × 15 cm; S5: 100 cm × 10 cm; S6: 100 cm × 15 cm and S7: 75 cm × 30 cm