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RESEARCH PAPER

Influence of cultivation methods and crop geometries on earliness traits and yield of cotton (*Gossypium hirsutum* L.)

M. Anbarasi* **and** K. Chelladurai[1]
Department of Agronomy, Jaya Agricultural College, Vyasapuram, Thiruvallur (T.N.) India
(Email: anbarasiagri@gmail.com)

Abstract : Field experiments were conducted to study the earliness traits and yield of the cotton under mechanized and conventional cultivation methods with varying crop geometry during the summer season of 2015 and 2016 on sandy clay loamy soil at the irrigated upland farm of Eastern Block, Tamil Nadu Agricultural University, Coimbatore. The experiments were laid out in split plot design and replicated thrice. The treatment comprised of two cultivation methods *viz.*, mechanized cultivation (M_1) and conventional cultivation (M_2) were assigned in main plot and four spacings *viz.*, 45 cm x 15 cm (1,48,148 plants/ha) (S_1), 60 cm x 15 cm (1,11,111 plants/ha) (S_2), 75 cm x 15 cm (88,888 plants/ha) (S_3) and 75 cm x 30 cm (44,444 plants/ha) (S_4) in subplot. The results of this study revealed that the earliness traits of cotton *viz.,* the appearance of the first square, the appearance of the first flower, days to attain 50 per cent flowering, days to first boll open and boll maturation period were significantly influenced by crop geometries, whereas cultivation methods did not show any variation regarding earliness traits and the cotton cultivated under mechanized cultivation method with the spacing of 45 x 15 cm registered higher seed cotton yield.

Key Words : Cultivation method, Mechanized cultivation, Conventional cultivation, Crop geometry, Earliness traits, Seed cotton yield

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INTRODUCTION

Cotton (*Gossypium hirsitum* L.) is one of the most important fibres and cash crops throughout the history of India and it also plays an important social and economic role in the Indian society in the present age. It provides employment opportunities to about 70 million people and contributes nearly 75 per cent total raw material to the textile industry in India. Commercial cotton is grown in 80 countries and 123 countries are involved in the cotton-related activities (AICCIP, 2016). The world cotton production is 96.5 million bales of 480 lb, in which India has emerged as the world's first producer of cotton accounting 26.4 million 480 lb. bales, followed by china, United States, Pakistan etc. India also second largest consumer and exporter representing 5.3 and 5.8 million 480 lb. bales in 2015-16 (USDA, 2017). Cotton cultivation is highly labour intensive particularly for picking. In most of the developing countries, especially in India cost of labour hiring is swiftly escalating. Their mechanization in cotton production will definitely play a key role in keeping the expenditure under control.

*** Author for correspondence :**
[1]Department of Agronomy, Sethu Bhaskara Agricultural College and Research Foundation, Visalayankottai, Karaikudi (T.N.) India

The High Density Planting System (HDPS) is currently recognized as a viable alternative for increasing cotton output and profitability. This technology aims to establish 7-8 plants per meter of row length. The goal is to limit the number of bolls per plant to 6-8 and maximize the number of bolls per unit area in order to achieve a high yield in a short period of time. When there are few bolls per plant, the fruiting period is short (4-5 weeks), the plant matures early, and it produces high-quality fibers (Venugopalan, 2019).

High density planting system in cotton unites with mechanization by boosting the production due to synchronized maturity which enabled mechanized picking. Thus, an attempt has been made through this study to check the influence of cultivation methods and crop geometries on Earliness traits and the yield of cotton.

Material and Methods

Field experiments were conducted at Tamil Nadu Agriculture University, Coimbatore during the summer 2015 and 2016. The soil of the experimental site was sandy clay loam in texture, belonging to *Typic Ustropept* series. The nutrient status of soil at the beginning of the experiment was low in available nitrogen (210 kg ha^{-1}), medium in available phosphorus (12.6 kg ha^{-1}) and high in available potassium (572 kg ha^{-1}). Cotton Surabhi variety was taken as a test crop. The experiment was laid out in split plot design, replicated thrice and the same layout was maintained during both the years of study. Cultivation methods were assigned to main plots and crop geometries were assigned to sub plots. Main plot treatments were two cultivation methods *viz.,* Mechanized cultivation (M_1) and Conventional cultivation (M_2). Sub plot treatments were four spacings *viz.,* 45 x 15 cm (S_1), 60 x 15 cm (S_2), 75 x 15 cm (S_3) and 75 x 30 cm (S_4). For the mechanized cultivation method, crops were raised on flatbed and the major cultivation practices from sowing to harvest were done with machines, whereas in the conventional cultivation method, crops were raised by ridges and furrow system and the cultivation practices from sowing to harvest were done as per the crop production guide of TNAU (CPG, 2012). The machine used for mechanized cultivation systems were, sowing with an inclined plate planter, weeding with a power weeder, irrigation and fertigation with a micro-irrigation system and harvesting with a portable battery-operated cotton picker. The test crop of cotton Surabhi variety was used. The observation of the appearance of the first square, the appearance of the first flower, days to attain 50 percent flowering, days to first boll open and boll maturation period and seed cotton yield were recorded.

Results and Discussion

The effect of plant density on earliness may be greater and of more economic importance than yield. The earliness traits of cotton *viz.,* the appearance of the first square, the appearance of the first flower, days to

Table 1 : Effect of cultivation methods and crop geometries on earliness traits and yield of cotton during summer, 2015

Treatments	Days to first square (DFS)	Days to first flower (DFF)	Days to 50 % flowering	Days to fist open boll (DFOB)	Boll maturation period (BMP)	Seed cotton yield (kg/ha)
Cultivation method						
M_1 - Mechanized cultivation	33.9	45.0	76.8	88.3	43.3	2323
M_2 - Conventional cultivation	34.6	46.7	79.4	90.6	44.2	2027
S.E.±	0.6	0.8	1.3	1.5	0.7	60
C.D. (P=0.05)	NS	NS	NS	NS	NS	258
Crop geometry						
S_1 - 45 cm x 15 cm (148,148 plants/ha)	33.3	44.3	76.9	86.9	42.5	2512
S_2 - 60 cm x 15 cm (111,111 plants/ha)	33.7	44.7	77.3	87.7	43.0	2349
S_3 - 75 cm x 15 cm (88,888 plants/ha)	34.8	46.4	78.5	90.8	44.4	1989
S_4 - 75 cm x 30 cm (44,444 plants/ha)	35.1	47.3	79.8	92.4	45.1	1850
S.E.±	0.6	0.8	1.3	1.5	0.7	85
C.D. (P=0.05)	1.3	1.7	2.9	3.3	1.6	185
Interaction	NS	NS	NS	NS	NS	S

NS= Non-significant

Table 2 : Effect of cultivation methods and crop geometries on earliness traits and yield of cotton during summer, 2016

Treatments	Days to first square (DFS)	Days to first flower (DFF)	Days to 50 % flowering	Days to fist open boll (DFOB)	Boll maturation period (BMP)	Seed cotton yield (kg/ha)
Cultivation method						
M_1 - Mechanized cultivation	34.3	46.3	77.5	90.5	44.2	2262
M_2 - Conventional cultivation	35.0	47.6	79.7	92.6	45.0	2011
S.E.±	0.6	0.8	1.4	1.6	0.8	59
C.D. (P=0.05)	NS	NS	NS	NS	NS	253
Crop geometry						
S_1 - 45 cm x 15 cm (148,148 plants/ha)	33.7	45.6	76.4	88.7	43.1	2462
S_2 - 60 cm x 15 cm (111,111 plants/ha)	34.1	45.9	78.1	89.8	43.9	2299
S_3 - 75 cm x 15 cm (88,888 plants/ha)	35.2	47.7	79.2	93.3	45.6	1973
S_4 - 75 cm x 30 cm (44,444 plants/ha)	35.5	48.6	79.7	94.4	45.9	1813
S.E.±	0.6	0.8	1.3	1.5	0.8	83
C.D. (P=0.05)	1.3	1.7	2.9	3.4	1.6	182
Interaction	NS	NS	NS	NS	NS	S

NS= Non-significant

attain 50 per cent flowering, days to first boll open and boll maturation period were significantly influenced by crop geometries, whereas cultivation methods did not show any variation regarding earliness traits (Table 1 and 2) and there was no significant interaction effect between cultivation methods and crop geometries on earliness traits during both the years of study.

Days to first square (DFS) :

The appearance of the first square is considered an important trait to assess earliness in cotton (Poehlman, 1987). From these experimental results, the closer spacing (45 cm x 15 cm) took minimum days to attain the first square (33.3 and 33.7), than the wider spacings (75 cm x 15 cm and 75 cm x 30 cm) during both the years of study. This might be due to increased inter-plant competition, which might have made the plants enter the flowering phase earlier (Bednarz *et al.*, 2000 and Mygdakos *et al.*, 2004).

Days to first flower (DFF) :

The appearance of the first flower is easily recognizable and more reliable to assess earliness in cotton compared to square initiation (Saleem *et al.,* 2009). Cotton grown on narrow rows (45 x 15 cm and 60 x 15 cm) attained earlier flower (44.3 and 44.7 days in 2015; 45.6 and 45.9 days in 2016) than grown on conventional rows (75 x 30 cm) due to increased inter-plant competition for nutrients, water and light etc. (Jost and Cothren, 2001).

Days to attain 50 % flowering :

The day to 50 per cent flowering was earlier with the closer spacing of 45 cm x 15 cm (76.9 and 76.4 during both 2015 and 2016, respectively). This was comparable with crop geometry of 60 cm x 15 cm.

Days to first open boll (DFOB)

Lesser number of days (86.9 and 88.7) to first open boll was recorded with crop geometry of 45 x 15 cm and was comparable with crop geometry of 60 cm x 15 cm. The higher number of days (90.8 and 92.4 in 2015; 93.3 and 94.4 in 2016) for the first open boll was recorded with crop geometries of 75 cm x 15 cm and 75 cm x 30 cm and both were comparable with each other. Delay in appearance first boll opening was observed with wider spacing was due to less competition and this facilitated the cotton plants to utilize light, nutrients, etc., more efficiently which led to more vegetative growth and delayed flower and boll opening. Similar findings reported by Saleem *et al.* (2009) lend support to the above findings.

Boll maturation period (BMP) :

Among the crop geometries, both 45 cm x 15 cm and 60 cm x 15 cm were at par with each other and took significantly fewer days (42.5 and 43.0 during 2015; 43.1 and 43.9 during 2016) for boll maturation than 75 cm x 15 cm and 75 cm x 30 cm which recorded a higher number of days.

Seed cotton yield :

Cotton under mechanized cultivation produced a higher seed cotton yield of 2323 and 2262 kg ha^{-1} during 2015 and 2016 than the conventional cultivation method. It might be due to the mechanization allowing a faster, less laborious and timely operations of farm tasks which claimed to lead both to increase yields and greater intensity of land use (Yadav *et al.,* 2014). Crop geometry 45 x 15 cm (S_1) recorded higher seed cotton yield (2512 and 2462 kg ha^{-1} on 2015 and 2016) than the others due to a greater number of picked bolls per unit area (Srinivasan, 2006). It was comparable with crop geometry 60 x 15 cm (S_2).

Conclusion:

Results of the experiments concluded that cotton under mechanized cultivation with closer crop geometry 45 x 15 cm took less number of days to attain earliness traits and recorded higher seed cotton yield during both the year of the experimentation. Cotton under mechanized cultivation with crop geometry 60 x 15 cm was the next best treatment compared to the rest of the combinations.

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