CHARACTERISTICS OF ELITE COTTON (*GOSSYPIUM HIRSUTUM* L.) CULTIVARS ASSOCIATED WITH PLANT DENSITY

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ABSTRACT: *Characteristics of two cotton cultivars viz. CIM-448 and CIM-497 planted at 8, 16 and 24 plants m^{-2} densities were investigated under field conditions. Results showed that both cultivars behaved differently regarding different parameters including number of main stem nodes $plant^{-1}$, total number of bolls $plant^{-1}$, lint index, and ginning out turn. Different planting densities influenced significantly the days to flowering, number of main stem nodes $plant^{-1}$, total number of bolls $plant^{-1}$, seeds $boll^{-1}$, number of seeds $plant^{-1}$, seed index, seed cotton yield $plant^{-1}$, cotton seed yield $plant^{-1}$, lint yield $plant^{-1}$ and lint index. Interactive effects of variety and density significantly affected days to flowering, total number of bolls $plant^{-1}$, seed index, cotton seed yield $plant^{-1}$, seed cotton yield $plant^{-1}$, lint yield $plant^{-1}$, lint index and ginning out turn. Maximum seed cotton yield $plant^{-1}$ (57.629 g) and cotton seed yield $plant^{-1}$ (35.658 g) and lint yield $plant^{-1}$ (21.970 g) was observed in CIM-448 planted at 8 plants m^{-2}.*

Key words: cotton, plant density, cultivars, phenology, yield, ginning out turn

INTRODUCTION

Cotton is extensively cultivated important fibre crop grown throughout the globe in more than 50 countries of world, Smith et al., [1]. It is also considered second most important oil seed crop of the world, Ali et al., [2].

Cotton is very crucial crop for country like Pakistan in terms of huge foreign exchange earnings from its products and byproducts. Despite this seed cotton yield per unit area in Pakistan is very low as compared to many other cotton growing countries in the world. Among the various factors responsible for this low yield of cotton crop, low plant population and use of low potential varieties are of prime importance.

Selection of promising cultivar is fundamental aspect in realizing the targeted yield goals linked with attractive return. Various agronomic and fibre quality traits of cotton are influenced by environment and cultivars, Ali et al., [3].

Plant population influence performance of cotton to great extent which is reflected in its overall growth as well as its yield traits. It is well recognized that by maintaining optimum conditions for growth and development of cotton along with optimum plant density result into maximum net return.

It was demonstrated that plant population density exhibit significant effect on different yield and yield component of cotton including seed cotton yield, number of monopodial and sympodial branches, number of boll $plant^{-1}$ and average boll weight, Ahmad et al., [4].

It was found that plant height, number of sympodial branch, total nodes, and total bolls per plant were reduced in cotton grown in ultra-narrow row spacing, Nichols et al., [5].

Due to different effects of plant population density and cotton cultivars on yield associated traits, this study was carried out to determine the suitable plant density and its interactive effect with cotton varieties for improving yield and yield associated traits.

MATERIALS AND METHODS

Study was conducted to investigate the response of elite cotton cultivars to different planting densities at the experimental farm of University College of Agriculture, Bahauddin Zakariya University, Multan. Two cotton cultivars viz. CIM-448 and CIM-497 were planted at three different planting densities i.e. 8, 16 and 24 plant m^{-2}. Experiment was laid out in Randomized Complete Block design with split plot arrangement and 4 replications. Net plot size was 6 x 15 ft^2. Seed was drilled on well prepared seed bed with single row hand drill. Gap filling was done seven days after sowing to avoid patchy crop stand. The plant density was maintained by thinning at plant height of 22 cm. Recommended dose of nitrogen and phosphorus was applied to all treatments. Nitrogen was applied in three different splits i.e. one at time of sowing, second at time of first irrigation and last dose at flowering stage. First irrigation was applied 30 days after sowing and subsequent irrigations were applied as per need of crop. All the agronomic practices was kept normal and uniform for all the treatments. The observations recorded were days to flowering, days to squaring, number of main stem nodes $plant^{-1}$, total number of bolls $plant^{-1}$, seeds boll-1, number of seeds $plant^{-1}$, seed index (g), seed cotton yield $plant^{-1}$, cotton seed yield $plant^{-1}$, lint yield $plant^{-1}$, lint index (g) and ginning out turn (%). Data collected was analyzed statistically by using Fisher's analysis of variance technique and treatment means were compared by the least significant difference (LSD) test at 5 % probability level, Steel et al., [6].

RESULTS AND DISCUSSION

Days to flowering were significantly affected by various planting densities and their interaction with varieties. Interaction values showed that maximum days to flowering (51.75) was observed when CIM-448 was planted at 24 plants m^{-2}. It differed statistically from all other treatments. Minimum days to flowering (45.25) were recorded in CIM-497 planted at 16 plants m^{-2}. Saleem et al., [7] also reported that both varieties and row spacing significantly affected the days taken to flowering.

Non-significant differences were observed between different densities and both varieties regarding days to squaring. Interaction between variety and density was also non-significant. These findings differ with the findings reported

by Saleem et al., [7] as they reported significant effect of plant density on days to squaring. Although they also reported non-significant effect of variety on days to squaring.

Main stem nodes per plant were significantly affected by different planting densities. Maximum main stem nodes per plant (39.425) were observed at plant density of 8 plants^{-2}(D_1). Lowest valued (12.375) was recorded at plant density of 24 plants m^{-2} (D_3). Interaction between variety and density was found non-significant. These results are in harmony with results reported by Jost and Cothren et al., [8].

Total number of bolls plant^{-1} were found statistically different due to interaction between varieties and various planting densities. Maximum total number of bolls per plant (18.4) were recorded when CIM-448 was planted at 8 plants m^{-2} (V_1D_1). Minimum number of bolls per plant (12.05) were recorded when CIM-448 was planted at 24 plants m^{-2} (V_1D_3). These results differ from result reported by Ali et al., [9] as they reported non-significant effect of interaction between varieties and planting density on total number of bolls plant^{-1}. Both varieties differed non significantly regarding number of seeds boll^{-1}. Cotton planted at different planting densities significantly affected number of seeds boll^{-1}. Maximum number of seeds boll^{-1} (23.443) were observed at plant density of 8 plant $^{-2}$ (D_1). Minimum number of seeds boll^{-1} (16.784) were recorded where plant density was maintained 24 plants m^{-2} (D_3). Interaction between variety and density remained non-significant. Bednarz et al., [10] also reported that seed number per boll decreased with increase in plant density.

Number of seeds plant^{-1} were significantly affected by different planting densities. Maximum number of seeds plant^{-1} (416.60) were recorded where 8 plants m^{-2} (D_1) were present. While minimum (204.39) were achieved at planting density of 24 plants m^{-2} (D_3). Interactive effect of variety and planting density was found non-significant. Non significant differences were also observed among both varieties regarding number of seeds plant^{-1}.

Interactive effect of variety and planting density significantly affected seed index. Maximum seed index (8.55 g) was observed when CIM-497 was planted at 24 plants m^{-2} (V_2D_3). It was found statistically similar to CIM-448 planted at 8 plants m^{-2}. Minimum seed index (7.8 g) was observed when CIM-448 was planted at density of 16 plants m^{-2} (V_1D_2). Non-significant differences were observed among different varieties regarding seed index. These findings mismatch with finding reported by Shukla *et al.,* [11] as they reported that seed index was not influenced by varieties and planting density.

Cotton seed yield plant^{-1} was found statistically different due to interactive effect of variety and planting density. Maximum cotton seed yield plant^{-1} (35.658 g) was observed when CIM-448 was planted at 8 plants m^{-2} (V_1D_1). Minimum cotton seed yield plant^{-1} (16.420 g) was observed when CIM-448 was planted at 24 plants m^{-2} (V_1D_3). It was found statistically similar when CIM-497 was planted at 24 plants m^{-2}. Non-significant differences were observed among both the varieties regarding cotton seed yield plant^{-1}. All the planting densities performed differentially regarding cotton seed yield plant^{-1}.

Interaction between variety and planting density significantly affected seed cotton yield plant^{-1}. Maximum seed cotton yield plant^{-1} (57.629 g) was observed when CIM-448 was planted at 8 plants m^{-2} (V_1D_1). Minimum seed cotton yield plant^{-1} (26.367 g) was achieved when CIM-448 was planted at density of 24 plants^{-2} (V_1D_3). It was found statistically similar to V_2D_3, where seed cotton yield plant^{-1} was 28.407 grams. Non-significant differences were observed among the varieties while all planting densities significantly affected seed cotton yield plant^{-1} individually. Ahmad et al., [12] also reported the same results.

Lint yield plant^{-1} was affected significantly due to interactive effect of variety and planting density. Maximum lint yield plant^{-1} (21.970 g) was achieved in case of CIM-448 seeded at density of 8 plants^{-2} (V_1D_1), while minimum values (11.189 g) were achieved when CIM-497 was planted at 24 plants m^{-2} (V_2D_3). Non-significant differences were observed among V_1D_1 and V_2D_1 regarding lint yield plant^{-1}.Both the varieties non-significantly affected lint yield plant^{-1} individually.

Significant differences were observed due to interaction between variety and planting density regarding lint index. Maximum lint index (5.5525 g) was achieved when CIM-497 was seeded at 24 plants^{-2} (V_2D_3). Minimum value (4.8008 g) was observed when CIM-448 was planted at 24 plants^{-2} (V_1D_3). It was found statistically similar to V_1D_2 where lint index was 4.637 grams. Both the varieties and planting densities significantly affected lint index individually. These findings are in line with findings reported by Shukla et al., [11] as they reported that lint index was significantly affected by both plant density and varieties.

Interactive effect of variety and planting density significantly affected ginning out turn. Maximum value of ginning out turn (39.371 %) was achieved in case of CIM-497 planted at 24 plants m^{-2} (V_2D_3). Minimum values (37.278 %) were achieved when CIM-448 was planted at 16 plants^{-2}. All the planting densities could not effect ginning out turn individually. However both the varieties individually affected ginning out turn significantly. These result do not match with findings reported by Ali *at al.*, [9].

CONCLUSION

Both varieties performed differentially at different planting densities regarding different parameters. CIM-448 out-performed CIM-497 at density of 8 plants m^{-2} in terms of seed cotton yield, cotton seed yield and lint yield per plant. However ginning out turn was found maximum in case of CIM-497 planted at 24plants m^{-2}. It can be concluded from the study that densely planted cotton cultivars could not perform to their best potential due to less space available for each plant for their optimum growth.

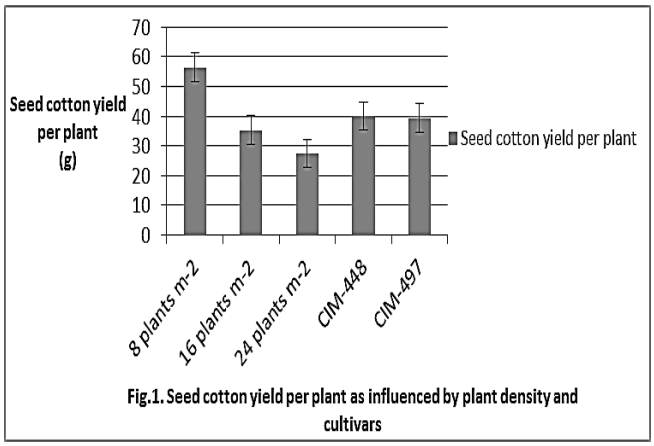

Fig.1. Seed cotton yield per plant as influenced by plant density and cultivars

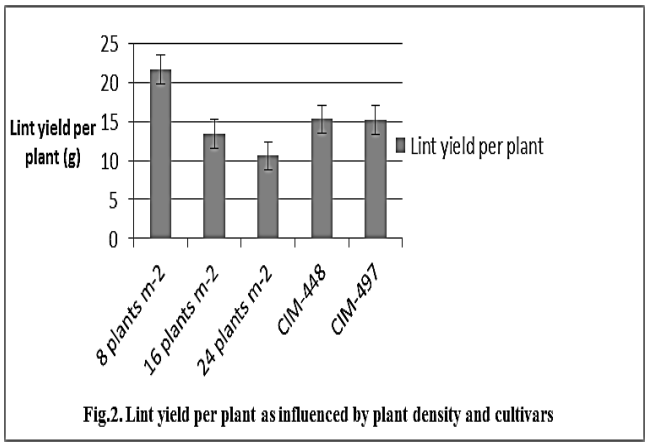

Fig.2. Lint yield per plant as influenced by plant density and cultivars

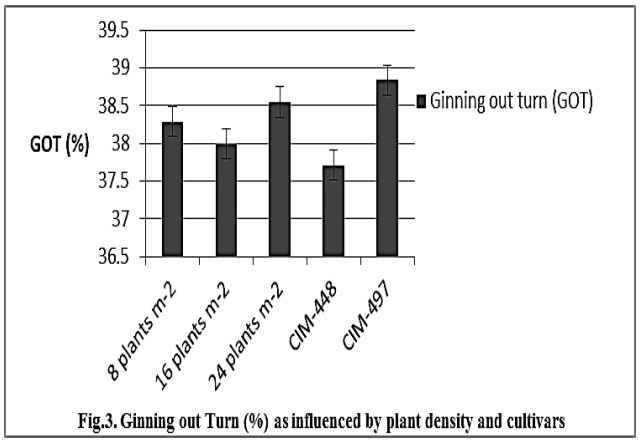

Fig.3. Ginning out Turn (%) as influenced by plant density and cultivars

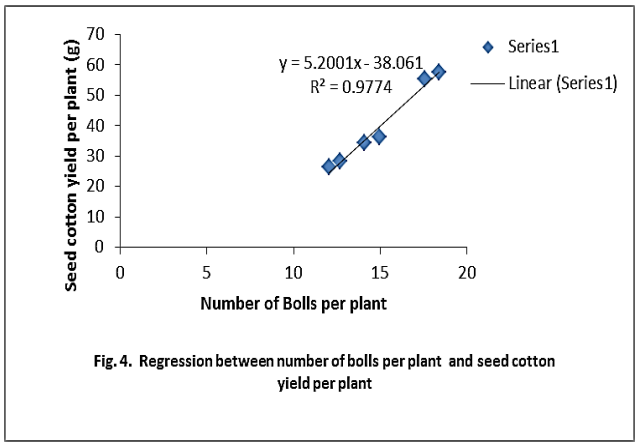

Fig. 4. Regression between number of bolls per plant and seed cotton yield per plant

Table1:-Phenological and yield characteristics of cotton cultivars associated with plant density

	Days to flowering	Days to squaring	Main stem nodes per plant	Total number of bolls per plant	Number of Seeds per boll	Number of seeds per plant
Cultivars						
V_1 (CIM-448)	47.667	32.667	36.233 B	15.133 A	20.166	307.47
V_2 (CIM-497)	47.250	33.083	37.067 A	14.783 B	19.416	288.49
Planting density						
D_1 (8 Pants m^{-2})	46.625 B	33.375	39.425 A	17.975 A	23.443 A	416.60 A
D_2 (16 plants m^{-2})	45.375 C	32.500	37.000 B	14.525 B	19.145 B	272.96 B
D_3 (24 plants m^{-2})	50.375 A	32.750	33.525 C	12.375 C	16.784 C	204.39 C
Interaction						
V_1D_1	45.750 D	32.750	39.350	18.400 A	23.085	424.13
V_1D_2	45.500 D	32.250	36.900	14.950 C	19.963	290.93
V_1D_3	51.750 A	33.000	32.450	12.050 F	17.448	207.35
V_2D_1	47.500 C	34.000	39.500	17.550 B	23.801	409.07
V_2D_2	45.250 D	32.750	37.100	14.100 D	18.328	254.99
V_2D_3	49.000 B	32.500	34.600	12.700 E	16.119	201.42

Note: Means sharing same letters do not differ significantly from each other at 5% probability level

Table 2: yield characteristics of cotton cultivars associated with plant density

	Seed index (g)	Cotton seed yield per plant (g)	Seed cotton yield per plant (g)	Lint yield per plant (g)	Lint index (g)	Ginning out turn (%)
Cultivars						
V_1 (CIM-448)	8.0417	24.923	40.059	15.266	4.8721 B	37.709 B
V_2 (CIM-497)	8.3917	24.125	39.391	15.136	5.3314 A	38.840 A

Planting density						
D_1 (8 Pants m^{-2})	8.3625 A	34.839 A	56.455 A	21.615 A	5.1892 A	38.287
D_2 (16 plants m^{-2})	8.05 B	21.914 B	35.333 B	13.419 B	4.9394 B	37.989
D_3 (24 plants m^{-2})	8.23 A	16.819 C	27.387 C	10.568 C	5.1767 A	38.548
Interaction						
V_1D_1	8.4 AB	35.658 A	57.629 A	21.970 A	5.1784 B	38.125 BC
V_1D_2	7.8 D	22.692 C	36.181 C	13.489 B	4.6370 C	37.278 D
V_1D_3	7.925 CD	16.420 E	26.367 D	9.947 D	4.8008 C	37.725 CD
V_2D_1	8.325 ABC	34.021 B	55.281 B	21.260 A	5.1999 B	38.450 B
V_2D_2	8.3 BC	31.137 D	34.485 C	13.348 B	5.2418 B	38.7 AB
V_2D_3	8.55 A	17.218 E	28.407 D	11.189 C	5.5525 A	39.371 A

Note: Means sharing same letters do not differ significantly from each other at 5% probability level

REFERENCES

[1] Smith, C. W. and J. T. Cothren. Cotton: origin, history, technology, and production. John Wiley & Sons, 1999.

[2] Ali, A., M. Tahir, M. Ayub, I. Ali, A. Wasaya, and F. Khalid. Studies on the effect of plant spacing on the yield of recently approved varieties of cotton. *Pakistan Journal of Life and Social Sciences (Pakistan)*, **7** (1):25-30. 2009.

[3] Ali, H., M. N. Afzal, S. Ahmad, and D. Muhammad. Effect of cultivars and sowing dates on yield and quality of Gossypium hirsutum L. crop. *Journal of Food, Agriculture and Environment*, **7** (3&4):244-247. 2009.

[4] Ahmad, A., R. Ali, S. Zamir, and N. Mahmood. Growth, yield and quality performance of cotton cultivar BH-160 (*Gossypium hirsutum* l.) As influenced by different plant spacing. *Journal of Animal and Plant Sciences*, **19** (4):189-192. 2009.

[5] Nichols, S., C. Snipes, and M. Jones. Cotton growth, lint yield, and fiber quality as affected by row spacing and cultivar. *Journal of cotton science*, **8**:1-12. 2004.

[6] Steel, R., J. Torrie, and D. Dickey. Principles and procedures of statistics: A biometrical approach. WCB: McGraw-Hill, New York, 172-177. 1997.

[7] Saleem, M. F., S. A. Anjum, A. Shakeel, M. Y. Ashraf, and H. Z. Khan. Effect of row spacing on earliness and yield in cotton. *Pakistan Journal of Botany*, **41** (5):2179-2188. 2009.

[8] Jost, P. H., and J. T. Cothren. Phenotypic alterations and crop maturity differences in ultra-narrow row and conventionally spaced cotton. *Crop science* **41** (4):1150-1159. 2001.

[9] Ali, A., M. Tahir, M. Ayub, I. Ali, A. Wasaya, and F. Khalid. Studies on the effect of plant spacing on the yield of recently approved varieties of cotton. *Pakistan Journal of Life and Social Sciences (Pakistan)*, **7** (1):25-30. 2009.

[10] Bednarz, C. W., R. L. Nichols, and S. M. Brown. Plant density modifications of cotton within-boll yield components. *Crop science*, **46** (5):2076-2080. 2006.

[11] Shukla, U., M. Khakare, V. Srivastava, R. Kumar, S. Singh, V. Kumar, and K. Kumar. Effect of spacings and fertility levels on growth, yield and quality of cotton (*Gossypium hirsutum* L.) hybrids under rainfed condition of vidarbha. *The Bioscan-A Quarterly Journal of Life Sciences*, **8** (2):561-567. 2013.

[12] Ahmad, A., R. Ali, S. Zamir, and N. Mahmood. Growth, yield and quality performance of cotton cultivar BH-160 (*Gossypium hirsutum* L.) As influenced by different plant spacing. *J. Anim. Pl. Sci* **19** (4):189-192. 2009.