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BIOMETRICAL ASSOCIATION OF PLANT HEIGHT AND YIELD COMPONENTS IN *GOSSYPIUM HIRSUTUM* L.

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ABSTRACT

Seven cotton (*Gossypium hirsutum* L.) cultivars (one standard variety namely CRIS-134 and six advanced strains namely CRIS–19, CRIS-82, CRIS-83, CRIS-467 CRIS-468 and CRIS-5-A) were analyzed for quantitative characters. Mean performance of genotypes showed that the Cultivar CRIS-468 produced numerically highest seed cotton yield and bolls per plant, the cultivars CRIS-82 and CRIS-83 took significantly lowest number of days to open their first boll.

Correlation studies revealed significant negative correlation (r = - 0.44) and (r = - 0.28) between character combinations such as, plant height with number of sympodial branches and plant height with Gining Out Turn (G.O.T.%), respectively. Further plant height showed significant positive correlation with characters such as number of days to open first boll (r = + 0.3), number bolls per plant (r = + 0.26) and average boll weight (r = + 0.29) indicating that the plant height is important in increasing seed cotton yield yet it may cause delay in maturity. While correlation study showed highly significant positive association of plant height with number of days to open first boll, number of bolls per plant and average boll weight.

Key-words: Cotton cultivars, plant height, seed cotton yield

INTRODUCTION

Cotton (*Gossypium hirsutum* L.) is an important crop of Pakistan. It is a dual purpose crop which provides fiber as well as vegetable oil (Akram *et al*., 2013). Cotton is one of the major crops and popularly referred as "*White Gold*", is an important fiber crop of global importance, cultivated in tropical and sub-tropical regions of more than seventy countries of the world (Ali *et al*. 2012; Dinakaran *et al*, 2012).

The development of early maturing and high yielding cotton varieties can overcome the problem of low yield of cotton in our country. There are many traits on which earliness and yield of cotton crop depends, some of them are height of plant, number of sympodial branches, number of bolls per plant, boll weight, ginning outturn percentage, main stem node number on which first sympodial branch develops, number of nodes above white flower in first position and number of days to open first boll etc. It is therefore, necessary for plant breeders to know about the relationship between yield and yield components and characters controlling earliness in maturity to evolve high yielding early maturing varieties.

Study of correlation of various morphological characters is helpful in the identification of relatively important yield components and characters controlling early maturity. There are two directions of correlation positive correlation, when one character increases with the corresponding increase of other character. The negative correlation indicates decrease in one character at the expense of the other.

Jones (1925) classified correlation in two types i.e. somatic and genetic correlation. He explained that somatic correlation is actually the result of the environmental effects and the other is due to germplasm make up which can be attributed to different expressions of factors and linkage between different factors. Although correlation is an important asset for plant breeders and it provides the direct and indirect influence on seed cotton yield. Whereas path coefficient analysis provides an effective means of partitioning correlation coefficient into unidirectional and alternate pathways. The analysis thus permits a critical examination of specific factors that those produce a given correlation and can be successfully employed in formulating an effective selection strategy. Correlation can be successfully employed in formulating an effective selection programme in cotton breeding. The technique of correlation coefficient analysis has been used by Zerihum *et.al.* (2009); Azeem and Azhar (2006) in cotton crop.

Therefore the present study was envisaged to study seven important cultivars of Sindh namely (i) CRIS-19, (ii) CRIS-134, (iii) CRIS-82, (iv) CRIS-83, (v) CRIS-467, (vi) CRIS-468 and (vii) CRIS-5A, to examine critically their yield potential through study of their yield components and to find out the co-relationship between them. In order to provide first hand information to the cotton breeders for utilization towards development of new improved cotton cultivars with increased yield and earliness.

MATERIALS AND METHODS

A cotton research varietal trial comprised of seven cotton (*Gossypium hirsutum* L.) cultivars (one standard variety namely CRIS-134 and six advanced strains namely CRIS–19, CRIS-82, CRIS-83, CRIS-467 CRIS-468 and CRIS-5-A) which were raised in a randomized complete block design with five replications. The experiment was performed at the experimental area of the Department of Plant Breeding and Genetics, Sindh Agriculture University Tando Jam. The seeds of the cotton strains were obtained from the Central Cotton Research Institute, Sakrand. Each treatment plot in each replication was comprised of four rows and length of each row was 45 feet. The distance between rows was kept as 2.5 feet and a distance of 8″-9″ (20-22.5 cm) between plants was maintained by the thinning out extra plants. Observations were recorded on ten randomly selected plants from each cultivar from the two central rows of each replication. The selected uniform plants from the two central rows were tagged for observations. After completion of recording the data, analysis of variance was conducted for all the characters under study after Snedecor and Cochran (1967). Simple Correlation Coefficients were calculated between the following seven important character combinations.

1. Plant Height v/s Main stems' Node Number of First Sympodial Branch.
2. Plant Height v/s Sympodial Branches per Plant.
3. Plant Height v/s Number of Days to Open First Boll.
4. Plant Height v/s Number of Bolls per Plant.
5. Plant Height v/s Average Boll Weight
6. Plant Height v/s Seed cotton Yield per Plant.
7. Plant Height v/s Ginning out Turn Percentage.

RESULTS AND DISCUSSION

Table-1 showed that the cultivars under study expressed significant differences amongst themselves only for a few quantitative characters such as main stem node number on which first sympodial branch was borne, number of days taken to open first boll and ginning out turn %. Whereas, there were no significant differences among the cultivars single plant data collected on all cultivars was pooled together to calculate values of simple correlation coefficient to determine characters associations in the cotton crop as a whole and not for individual cultivars as these cultivars did not show much of variation in their single plant performance responses for yield and yield components.

Mean Performance of Cultivars

The mean values presented in Table-2, for this character revealed that cultivar CRIS–83 produced first sympodial branch at 6^{th} node on main stem (6.1) while the cultivar CRIS-468 developed its first sympodial branch at significantly higher position i.e. at approximately 8^{th} node on the main stem having mean value of 7.4. The cultivar CRIS-467 on average, developed the lowest number of sympodial branches (18.0) per plant, whereas, the cultivar CRIS-82 developed numerically highest number of sympodial branches (19.7) per plant. Cultivars CRIS-5A and CRIS-83 produced numerically lowest number of nodes (24.3) per plant, whereas the cultivar CRIS-468 produced numerically highest number of nodes (25.3) per plant. On an average cultivar CRIS-82 was the shortest having mean plant height of 82.7 cm whereas, the cultivar CRIS-467 was numerically tallest having mean plant height of 102.1 cm. Table-2, revealed that the cultivars CRIS-82 and CRIS-83 took significantly lowest number of days i.e. about 92 days (91.9 days) to open their first boll, while cultivar CRIS-467 took significantly highest number of days (97.4) to open its first boll. However, cultivar CRIS-5A produced numerically lowest number of bolls (19.9) per plant, whereas cultivar CRIS-468 produced numerically highest bolls (25.1) per plant. However, cultivar CRIS-5A produced numerically lowest number of bolls (19.9) per plant, whereas cultivar CRIS-468 produced numerically highest bolls (25.1) per plant. However, it was seen from the Table-2, that numerically highest average boll weight (2.38g) was produced by cultivar CRIS-134, whereas, the cultivar CRIS-82 produced the lowest average boll weight (2.14g). Cultivar CRIS-468 produced numerically highest seed cotton yield (57.4gm) per plant. Whereas, cultivar CRIS-5A produced numerically lowest seed cotton yield (46.5gm) per plant. However, it was observed from the Table 2 that cultivars CRIS-19 possessed significantly highest ginning outturn percentage (34.9%) while cultivar CRIS468 possessed significantly lowest ginning outturn percentage (33.9%), Study of relationship between yield and yield components is an important technique available with cotton borders for exploitation towards development of new improved cotton cultivars, therefore, present study also included estimation of phenotypic correlation coefficient (r) and coefficient of determination (r^2) for the following character combinations presented in table-3.

Plant Height v/s Main stem Node Number of First Sympodial Branch

The correlation coefficient value for the character combination plant height v/s main stem node number of first sympodial branch (r = + 0.175) was non significant (Table-3) which suggested that there was no relationship between two characters and were independent of each other. The result is accordance to the work carried out by Soomro (1999), who reported non-significant and positive association between these two characters. The coefficient of determination (r^2 = 0.031) revealed that 3.1% of total variation in plant height was induced by main stem node number of first sympodial branch

Plant Height v/s Sympodial Branches per Plant

The phenotypic correlation between plant height and sympodial branches per plant was negative and highly significant (r = -0.44). This showed that increase in plant height had a decreasing effect on the number of sympodial branches per plant. The coefficient of determination (r^2 = 0.194) suggested that 19.4 % variation in sympodial branches was observed due to their association with plant height. It was interesting to note that there was a significantly negative association (r= -0.44) between plant height and number of sympodial branches per plant which suggested that increase in plant height caused a simultaneous decrease in number of sympodial branches. This type of behavior of the newly developed cotton cultivars is probably the result of selection pressure to force cultivars to enter into the reproductive phase earlier rather than the plants to continue to grow vegetatively. The results reported by Qayyum *et al.* (1992) and Larik *et al.* (1999) were in accordance with the findings reported in the present studies.

Plant Height v/s Number of Days to Open First Boll

Significantly positive association between plant height and number of days to open first boll was recorded (r = + 0.30) which indicated that the number days to open first boll increased with increase in plant height. This is similar to the results found by Bhatnagar (1995). The value of coefficient of determination (r^2 = + 0.09) showed that 9% variation in number of days to open first boll was due to its association with plant height. The values of correlation coefficient was low and consequent by the values of coefficient of determination was also very low suggesting that though plant height is an important character in increasing seed cotton yield, yet it may cause delay in maturity. Therefore, the modern breeding selection pressures in developing new cultivars have pushed earliness forward and increase in yield is to be achieved by accommodating more number of plants in a hectare due to smaller stature of plants of new cultivars.

Plant Height v/s Number of Bolls per Plant

Significantly positive association between plant height and number of bolls per plant was recorded (r = + 0.26) which indicated that the number of bolls per plant increased with increase in plant height. The value of coefficient of determination showed that 6.8% variation in number of bolls per plant was due to its association with plant height**.** This exhibited that selection for high bolls per plant based on plant height would be beneficial. Satange *et al*,. (2000), Afiah and Ghoneim (2000); Hussain *et al.*, (2000) conducted research studies with cotton (*Gossypium hirsutum* L.) and obtained positive and highly significant association between plant height and bolls per plant

Plant Height v/s Average Boll Weight

Significantly positive correlation between plant height and average boll weight has been recorded (r = + 0.29) which showed that boll weight was increased by increase in plant height. The results reported here are in complete agreement with Ansari *et al,* (1991), Satange *et al,* (2000) and Soomro (2000) who also worked with cotton and found that plant height was highly significantly correlated with boll weight. The value of coefficient of determinations (r^2 = 0.084) revealed that 8.4% variation in average boll weight was due to its association with plant height. The values of correlation coefficient was low and consequent by the values of coefficient of determination was also very low suggesting that though plant height is an important character in increasing seed cotton yield, yet it may cause delay in maturity.

Table 1. Mean squares obtained from analysis of variance of some important quantitative traits in seven upland cotton cultivars.

Source of variance	D.F	MSN bearing first sympodial branch	Number of sympodial branch	Plant height (cm)	Number of bolls per plant	Average boll weight	Seed cotton weight per plant	GOT percen-tage
		Mean Squares	Mean squares	Mean squares	Mean squares	Mean squares	Mean squares	Mean squares
Replications	4	7.135	0.786	58.62	9.27	0.065	62.17	0.329
Genotypes	6	1.375**	1.507 NS	293.70NS	17.328NS	0.046NS	91.38NS	0.928**
Errors	24	0.343	1.714	172.13	7.36	0.029	42.6	0.163

*, ** = Significant at 0.05 and 0.01 levels of probability respectively NS = Non- significant

Table 2. Mean values of various agronomic characters studied in seven upland cotton cultivars.

Cultivars	MSN bearing first sympodial branch	Number of sympodial branch	Number of nodes per plant	Plant height (cm)	Number of bolls per plant	Average boll weight (gm)	Seed cotton weight per plant (gm)	GOT percen-tage
Cris-134	7.0 b	18.4	24.4	94.7	20.0	2.38	47.46	33.86 d
Cris-5A	6.7 cd	18.4	24.3	97.5	19.9	2.34	46.54	33.99 c
Cris-19	6.6 cd	19.0	24.7	85.9	22.9	2.18	54.44	34.40 b
Cris-82	6.5 d	19.7	24.8	82.7	21.6	2.14	49.22	34.66 a
Cris-83	6.1 c	19.1	24.3	83.4	21.2	2.19	47.64	34.85 a
Cris-467	7.1 b	18.0	24.6	102.1	23.1	2.35	54.12	34.86 a
Cris-468	7..6 a	18.9	25.3	96.1	25.1	2.23	57.42	34.89 a
		NS	NS	NS	NS	NS	NS	

Means followed by same letter, within the same column are not significantly different at p≤ 0.05

Table 3. Estimates of correlation coefficient and coefficient of determination for all the characters combinations of eight quantitative traits in seven upland cotton cultivars.

S. No.	Character Combinations	Correlation Coefficient (r)	Coefficient of Determination (r^2)
1.	Plant height v/s Main stem node number of first sympodial branch.	+0.175 NS	0.031
2.	Plant height v/s Sympodial branches per plant.	-0.44**	0.194
3.	Plant height v/s Number of days to open first boll.	+0.30*	0.09
4.	Plant height v/s Number of bolls per plant.	+0.26*	0.068
5.	Plant height v/s Average boll weight	+0.29*	0.084
6.	Plant height v/s Seed cotton weight per plant.	+0.18NS	0.032
7.	Plant height v/s G.O.T. Percentage	-0.28 NS	0.078

Plant Height v/s Seed Cotton Yield per Plant

The correlation coefficient value for the character combination plant height v/s seed cotton yield per plant (r = + 0.18) was non significant which suggested that there was no relationship between plant height and seed cotton yield per plant and these characters are independent of each other. The values of correlation coefficient was low and consequent by the values of coefficient of determination was also very low suggesting that though plant height is an important character in increasing seed cotton yield, yet it may cause delay in maturity. Surriya (1996) conducted experiments in cotton and also found that non-significant association between plant height and yield per plant.

Plant Height v/s Ginning Out Turn Percentage

The phenotypic correlation between plant height and ginning out turn percentage was negative and significant (r = -0.28). This showed that increase in plant height had a decreasing effect on ginning out turn percentage. The coefficient of determination ($r^2 = 0.078$) suggested that 7.8% variation in ginning out turn percentage was due to its association with plant height. Table-3 showed that plant height had also significant but negative correlation ship with G.O.T. though the impact of such an association is small yet it may have some what decreasing effect on the yield of lint per plant. These results are in full accordance with the findings reported by Azeem and Azhar (2006) during their studies in cotton (*Gossypium hirsutum* L.)

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