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Correlation Analysis of Yield with Qualitative and Quantitative Traits in Developing Cultivars of Upland Cotton (*Gossypium hirsutum* L.)

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Abstract: The present research was intended to find out phenotypic and genotypic correlation analysis between plant heights, number of sympodial branches plant^{-1}, number of bolls plant^{-1}, Seed cotton yield (kg ha^{-1}), ginning out turn (GOT), staple length, seed index, boll weight and micronaire value of eight cultivars. The research was conducted at the experimental area of Central Cotton Research Institute Sakrand according to randomized complete block design (RCBD) with three replications and eight varieties (CRIS-642, CRIS-644, CRIS-646, CRIS-647, CRIS-648, CRIS-650, CRIS-652 and CRIS-656) of upland cotton during crop year 2014-15. The consequences of statistically analysis indicated that genotypes differ highly significant ($p \leq 0.01$) for plant height, number of bolls plant^{-1} and Seed cotton yield (kg ha^{-1}), whereas number of sympodial branches plant^{-1}, GOT, staple length, seed index, boll weight and micronaire value were significant at ($p \leq 0.05$). Variety CRIS-648 produced tallest plant. Variety CRIS-650 showed uppermost number of sympodial branches plant^{-1}, Seed cotton yield (kg ha^{-1}) and staple length. However the varieties; CRIS-642 performed superior for Seed cotton yield (kg ha^{-1}), GOT, boll weight and micronaire value, CRIS-644 resulted maximum seed index, and CRIS-646 gave pinnacle number of bolls plant^{-1}.

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1. Introduction

Cotton (*Gossypium hirsutum L.*) occupies a prime position as fiber crop of masses of the world in general (Hernandez, 2004) and of Pakistan in particular (Nawaz et al., 2016). The sufficient production of cotton for meeting the fiber requirements of the world's exploding population is now universally realized. Keeping in view the future needs, cotton research needs to be versatile and accelerated to develop more productive cotton genotypes for various agro-ecological production areas of Pakistan. The extent of relationship between the yield and yield attributes is desirable by the plant breeders which facilitate them in selecting plants of desirable characteristics.

As environment or breeding material change, the expression of the different traits changed. Therefore, the information of character associations between the traits themselves and with the yield is important for selecting the high yielding genotypes. Considerable emphasis has been given upon the inter relationship between yield and yield components in cotton (Balouch et al., 1992). Correlation coefficient analysis measures the magnitude of relationship between various plant characters and determines the component character on which selection can be based for improvement in seed cotton yield (Jost and Cothern, 2000). The understanding of the correlation of factors influencing yield is a pre-requisite for designing an effective plant breeding program. It helps in the identification of the yield components, yet they do not provide precise information regarding the relative importance of direct and indirect influence of each componential character (Reta-Sanchez and Fowler, 2002). Significant positive correlation of Seed cotton yield (kg ha^{-1}) with number of sympodial branches plant^{-1}, plant height and bolls plant^{-1} were also observed by Copur (2006). Number of sympodial branches plant^{-1}, boll weight and bolls plant^{-1} were significantly and positively correlated with Seed cotton yield (kg ha^{-1}) (Iqbal et al., 2006). The present study was carried out to assess the correlation estimates of different quantitative traits using eight upland cotton varieties.

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2. Materials and Methods

A field experiment was performed at research area of Central Cotton Research Institute Sakrand, Sindh during the year 2014-15. Eight upland cotton (*Gossypium hirsutum* L.) cultivars including CRIS-642, CRIS-644, CRIS-646, CRIS-647, CRIS-648, CRIS-650, CRIS-652, and CRIS-656 were used as test material in order to work-out correlation analysis between yield and fiber traits. Randomized complete block design (RCBD) was used to conduct experiment in triplicate. The seeds were hand dibbled at the rate of five seeds dibble^{-1}. In order to ensure uniformity and avoid inter plant competition, thinning was done 20 days after sowing and one healthy seedling per hill was maintained.

Plant population was maintained with 30cm and 75cm inter-plant and inter-row spacing. Recommended dose of fertilizers (120:60 kg N: P) were applied in using urea and DAP. At the time of land preparation complete phosphorus and 33% of total nitrogen was incorporated into soil. Remaining nitrogen was topdressed in three equal split doses. At the time of maturity, the observations were recorded for sympodial branches plant^{-1}, plant height (cm), number of bolls plant^{-1}, boll weight, seed index, seed cotton yield, micronaire value, ginning out turn (GOT) and fiber length (mm) as described earlier (Ahsan et al., 2014). All the agronomic practices were done uniformly and inputs were given according to local recommendations. Data was recorded from randomly selected five plants from each replication. The data regarding different traits in each genotype were averaged across the replications and subjected to statistical analysis for determining significant differences between means (Gomez and Gomez, 1984). Correlation analysis was determined following procedure described by Snedecor and Cochran (1980).

3. Results and Discussion

3.1 Performance of genotypes

Mean performance of studied genotypes for various qualitative and quantitative traits are presented in Table1. The data showed that variety CRIS-648 produced tallest plant (145.0cm) at the same time as CRIS-650 had shortest plant (116.7cm) as compared to other genotypes. For sympodial branches plant^{-1} CRIS-652 showed maximum number of sympodial branch plant^{-1} (22.7) whereas, lowest number of sympodial branches plant^{-1} i.e., 163 was produced by genotype CRIS-650. Variety CRIS-646 produced higher number of bolls plant^{-1} (176.7) while CRIS-642 obtained lower number of bolls plant^{-1} (126.7) as among the studied genotypes. Variety CRIS-642 gave higher seed cotton yield (kg ha^{-1}) (225.6g) but variety CRIS-650 had buck value (181.8 g).

In case of GOT CRIS-642 gave uppermost (44.9%) despite the fact that lowest GOT was observed (37.9%) in CRIS-646 variety. Highest staple length was obtained from variety CRIS-650 (28.4mm) although CRIS-644 showed lowest staple length (26.5mm). In case of seed index variety CRIS-644 obtained good results (7.9g) whereas, variety CRIS-646 obtained satisfactory results (6.4g). The variety CRIS-642 gave highest boll weight (3.98g) while variety CRIS-647 gave lowest boll weight (2.64). In case of micronaire value CRIS-642 produced desirable micronaire value (4.9µg/inch) fallowed CRIS-650 (4.8µg/inch). In general CRIS-642 displayed over all better performance in four out of nine qualitative and quantitative characters.

The analyses of variances for studied parameters are presented in Table 2. Studied genotypes exhbitied highly significant ($p \leq 0.01$) differences for seed cotton yield, plant height and number of bolls plant^{-1}, whereas sympodial branches plant^{-1}, GOT, staple length, seed index, boll weight and micronaire value were significant at ($p \leq 0.05$).

Table 1: Mean performance of eight cotton genotypes for various qualitative traits

Sr. No.	Genotypes	Plant height (cm)	Sympodial branches (plant^{-1})	Number of bolls (plant^{-1})	Seed cotton yield (kg ha^{-1})	Ginning out turn (%age)	Staple length (mm)	Seed index (g)	Boll weight (g)	Micronaire value (µg inch^{-1})
1	CRIS.642	134.0 ab	19.3 ab	126.7 e	225.6 a	44.9 a	27.5 bc	7.0 bc	3.98a	4.9 a
2	CRIS.644	129.0 ab	21.3 a	151.0 bcd	216.5 ab	39.1 b	26.4 d	7.8 a	3.22 cd	5.0 ab
3	CRIS.646	136.7 a	20.6 ab	176.7 a	189.8 bcd	37.9 b	27.3 bcd	6.4 d	2.88 de	4.1 d
4	CRIS.647	135.7 ab	19.7 ab	153.7 abc	209.0 abd	38.7 b	27.6 abc	7.1 bc	2.64 e	4.8 c
5	CRIS.648	145.0 a	19.6 ab	128.3 de	185.3 bcd	38.2 b	28.0 ab	7.8 a	3.60 abc	4.8 abc
6	CRIS.650	116.7 b	16.3 b	143.0 bcde	181.7 cd	39.7 b	28.4 a	7.1 bc	3.88 ab	4.8 c
7	CRIS.652	133.3 ab	22.6 a	133.3 cde	203.2 abcd	39.9 b	26.9 cd	7.4 ab	3.50 bc	4.5 cd
8	CRIS.656	128.3 ab	19.0 ab	163.3 ab	172.6 d	39.8 b	27.2 bcd	6.8 cd	2.90 de	5.0 bc
LSD @ 0.05%		19.47	4.89	23.75	32.21	3.50	0.86	0.55	2.26	0.53

Table 2: Analysis of variance (mean square) of eight cotton genotypes for quantitative and qualitative traits

SOV	DF	PH	SB	BP	SCY	GOT	SL	SI	BW	MIC
Repl.	2	83.16 ns	8.66 ns	57.12 ns	703.97 ns	17.88 ns	0.01 ns	0.15 ns	0.81 ns	0.06 ns
Variety	7	200.00**	10.38*	930.85**	1329.0**	14.31*	1.14*	0.71*	18.37*	0.70*
Error	14	123.64 ns	7.80 ns	183.98 ns	533.11 ns	3.98 ns	0.24 ns	0.10 ns	1.66 ns	0.09 ns

* = Significant at 0.05 level of probability, ** = Significant at 0.01 level of probability, ns = Non significant.PH = Plant height, SB = Sympodial branch plant^{-1}, BP = number of bolls plant^{-1}, BW = boll weight (g), SCY = Seed cotton yield (kg ha^{-1}) (g), SL = Staple length (mm), SI = Seed index (g) and MV = Micronaire value (µg/inch).

3.2Coorelation analysis

Correlation study is very much important to select desirable selection criteria for yield improvement. Phenotypic correlation between cotton yield and yield components in eight cultivars are presented in Table 3. Plant height showed negative but non-significant correlation with number of bolls plant^{-1}, GOT, micronaire value, staple length and boll weight, whereas non significant and positive correlation with number of sympodial branch plant^{-1}, seed index and seed cotton yield (kg ha^{-1}). This indicates that, increase of plant height may not have any remarkable effect on GOT and number of bolls plant^{-1}, staple length, boll weight, micronaire value and not endurable results on any other traits like sympodial branches plant^{-1}, seed index seed cotton yield^{-1}. Surriya (1996) and Soomro (2000) also foumed similar correlation of yield with various characters.

The interaction between sympodial branches plant^{-1} with staple length and number of bolls plant^{-1} was observed unhelpful but considerable, helpful and highly significant with seed cotton yield (kg ha^{-1}) and negative but non-significant by means of GOT, seed index, boll weight and micronaire value. This suggests that amplify in number of sympodial branches plant^{-1} would ultimately bring decrease in seed index, boll weight, GOT and micronaire value but fruitful results for number of bolls^{-1}, staple length and positive results for seed cotton yield (kg ha^{-1}). The results were according to the observations by Qayyum et al. (1992) and Satange et al. (2000).

Positive but significant affiliation was examined between number of seed cotton yield and bolls plant^{-1}, pessimistic but non-significant through micronaire value and staple length, highly considerable but negative with seed index and boll weight, and furthermore, a non significant interaction was checked by way of GOT. The results further illustrate that, greater than ever number of bolls plant^{-1} will support to boost up seed cotton yield (kg ha^{-1}) but rest of other characters may not get positive change. The similar type of results was reported by Afiah and Ghoneim (2000) and Hussain et al. (2000).

The attachment between Seed cotton yield as well as GOT was seen constructive but non-significant, unhelpful and non momentous between micronaire value along with staple length encouraging but non-significant with seed index and boll weight. It enlighten that ever-increasing of seed cotton yield (kg ha^{-1}) give approving result for GOT and micronaire value but eventually diminish other behavior. These results of variation were supported by findings of previous studies (Rauf et al., 2004; Preetha et al., 2007; Sekloka et al., 2008).

Table 3: Matrix of correlation of eight genotypes for quantitative traits

	PH	SB	BP	SCY	GOT	SL	SI	BW	MIC
PH	1.00								
SB	0.348 ns	1.00							
BP	-0.126 ns	-0.031 *	1.00						
SCY	0.296 ns	0.243 **	0.371 *	1.00					
GOT	-0.332 ns	-0.126 ns	0.045 ns	0.088 ns	1.00				
SL	-0.019 ns	-0.526 *	-0.127 ns	-0.272 ns	0.018 ns	1.00			
SI	0.081 ns	-0.029 ns	-0.600 **	0.301 ns	0.104 *	0.024 ns	1.00		
BW	-0.034 ns	-0.255 ns	-0.590 **	0.176 ns	0.245 ns	0.379 *	0.463 *	100	
MIC	-0.197 ns	-0.013 ns	-0.139 ns	-0.100 *	0.410 *	-0.062 ns	0.359 ns	0.003 ns	1.00

* = Significant at 0.05 level of probability, ** = Significant at 0.01 level of probability, ns = Non significant.PH = Plant height, SB = Sympodial branch plant^{-1}, BP = number of bolls plant^{-1}, BW = boll weight (g), SCY = Seed cotton yield (kg ha^{-1})(g), SL = Staple length (mm), SI = Seed index (g) and MV = Micronaire value (µg/inch).

The inter relationship of GOT by means of seed index and micronaire value was encouraging significant and non significant by staple length and boll weight. Similar results have also been described earlier by Baloch (2002) and Iqbal et al. (2003). They also illustrated that, escalating of GOT will be beneficial in favor of seed index, micronaire value but not for staple length and boll weight. Comparable results have also been evaluated by Taohua and Haipeng (2006).

Staple length showed activist but non considerable connection with seed index and affirmative but significant with boll weight, and pessimistic although non-significant by mean of micronaire value. These results demonstrate that, rising of staple length may not have any notable achievement of seed index and micronaire values but boll weight will be enhancing certainly. These types of outcome are quite encouraging in cotton breeding. Khan and Azhar (2000) conducted correlation studies in cotton and related results were accomplished by them.

Seed index displayed optimistic however important relation with boll weight, whereas micronaire value remained non-significant. This association suggests that amplifying of seed index will be in favor of boll weight but not supportable for micronaire value. Same consequences also obtained by Makhdoom et al. (2010) and Megadum et al. (2012). In addition, the correlation of boll weight with micronaire value was observed positive but non-significant. This result advises that, increasing of boll weight is not outstanding outcome in good turn of micronaire value. Our results are in conformity with those of Soomro (2000) and Carvalho (2001).

4. Conclusion

The analysis of variance exposed significant genotypic variations for plant height, sympodial branches plant^{-1}, seed index, seed cotton yield (kg ha^{-1}), boll weight, bolls plant^{-1}, micronaire value, staple length and GOT. Variety CRIS-642 showed higher seed cotton yield (kg ha^{-1}), micronaire value, GOT and boll weight. In general CRIS- 642 displayed over all better performance in four out of nine qualitative and quantitative traits, hence this variety may be used for hybridization and selection to develop new promising cotton varieties. Correlation suggested that boll weight is the most important yield component and could be exploited as selection criteria in future breeding programs for further improvement of cotton yield.

Competing Interests: The authors declare that there is no potential conflict of interest.

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