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CORRELATION AND PATH COEFFICIENT ANALYSIS FOR YIELD COMPONENTS TRAITS IN EGYPTIAN COTTON GENOTYPES. (*GOSSYPIUM BARBADENSE* L.)

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Abstract

Five genotypes (*Gossypium barbadense* L.), 10 F_1's half diallel and 30 F_1's three-way crosses were taken into consideration to estimate the phenotypic and genotypic correlation coefficients between yield, fiber, earliness and seed content traits and to estimate the path coefficient analysis for some yield attributes and some fiber traits on seed cotton yield per plant. Phenotypic correlations are generally lower than genotypic correlations because of masking effect of environment at phenotypic level. Correlation estimates indicated significant and highly significant positive correlation of LY/P, NB/P, FL and PRI and highly significant negative correlation of UI and GC % with SCY/P at both genotypic and phenotypic levels. At genotypic level, this trait showed significant positive correlation with FFN trait. NB/P and BW showed high positive direct effect and significant correlation on SCY/P. NB/P followed by BW traits considered as the main and the most consistent sources effecting yield of cotton variation and consequently could be measured as essential characters in selection programs aiming to cotton yield improvement and the breeder may consider those traits as the main selection criteria.

***Keywords*:** Cotton (*Gossypium barbadense* L.), three-way crosses, correlation coefficient, path coefficient of variation.

Introduction

The Egyptian cotton is one of the important strategic crops and is considered one of the main pillars for the Egyptian economy, where it is introduced as an agricultural, industrial and export crop. In addition to the important of cotton as a fiber, the crop seeds also are important sources of protein, oil, and carbohydrates for food, animal feeds, and industrial products. The development of varieties having greater yield potential with better fiber quality is the primary objectives of cotton breeder.

In selecting high yielding genotypes, correlation studied supply reliable information on the nature extent and direction of selection the knowledge of correlation coefficient between different yield attributes helps the breeder to find out the nature and magnitude of the association between these traits which are mast by used attain better yield of the crop. However, correlation alone does not provide information on the contribution of related character, which necessitates the study of cause and effect relationship of different characters among themselves. Therefore, the path analysis depicts the exact relationship of characters there by providing more information than correlation.

The analysis of path coefficient has been mode to identify the important yield attributes by estimating the direct effect of the contributing characters to yield and separating the direct from the indirect effects through other related characters by partitioning the correlation coefficient and finding out the relative importance of different characters as selection the estimates of direct and indirect effects of the yield related characters viz. BW, NB/P, L%, SI, LI, MIC and FS on SCY/P. Path coefficient analysis devised by Wright (1934) is a standardized partial regression coefficient, which helps in partitioning of the correlation coefficient into direct and indirect effects of independent variables on dependent variable. Path analysis helps to elucidate the intrinsic nature of the observed correlations and imparts a degree of confidence in the selection schemes adopted for a given situation (Dewey and Lu, 1959).

Materials and Methods

The characters taken into consideration for phenotypic and genotypic correlation coefficients were estimated from: 5 genotypes, 10 F_1's half diallel and 30 F_1's three-way crosses. The genetic materials which used in the present investigation included five cotton (*Gossypium barbadense* L.) genotypes. The selfed seeds of these genotypes were obtained from the Cotton Breeding Section, Cotton Research Institute, Agricultural Research Center, Giza, Egypt.

These five cotton (*Gossypium barbadense* L.) genotypes were involved in a series of hybridization according to half diallel mating design (Griffing, 1956) in 2015 growing season at experimental field in Sakha research station – Kafr El Shikh governorate, Egypt. In 2016 growing season, the selfed seeds from the five parents' genotypes and their 10 F_1's sown and mated in one set of three-way crosses system [Rawlings and Cockerham (1962), Hinkelmann (1965) and Ponnuswamy (1972) and outlined by Singh and Chaudhary (1979)] to produce all possible 30 crosses. In April 2017 growing season, five parental genotypes, 10 F_1's single crosses and 30 three-way crosses were planted in a randomized complete blocks design (RCBD) with three replications at Sakha Research Station, Kafer El-Shikh Governorate, Egypt. Each plot was one row 4.0 m long and 0.6 m. wide. Hills were 0.4 m apart to insure 10 hills per row. Hills were thinned to keep a constant stand of one plant per hill at seedlings stage. Recommended cultural practices were followed to raise agronomically good managed crop.

Observations were recorded on the following traits:

1. **Yield and yield components viz.** seed cotton yield (g/plant) (SCY/P), lint yield (g/plant) (LY/P), boll weight g/plant (BW), number of bolls per plant (NB/P), lint percentage (L%), seed index (SI) and lint index (LI).

2. Fiber traits viz. fiber fineness (Micronaire reading) (Mic.), fiber strength (F.St), fiber length (mm) (FL) and Uniformity index (UI).
3. Earliness traits viz. First fruiting node (FFN), Mean maturity date (MMD) and Production rate index (PRI).
4. Oilseed contents viz. Oil content (OC, %) and Gossypol content (GC, %).

Statistical analysis

All correlations (phenotypic and genotypic) were computed following the statistical technique prescribed by Sharma (1998). The significance of the phenotypic and genotypic correlation coefficients was determined using table of critical values for (r.) with degrees of freedom n-2. Path coefficient analysis was done following to the method suggested by Dewey and Lu (1959). The direct and indirect effects were classified based on scale given by Lenka and Mishra (1973) Table (1).

Table 1 : The scale of the direct and indirect effects values and their rate of scale according to Lenka and Mishra (1973)

Values of direct and indirect effects	Rate of scale
0.00-0.09	Negligible
0.10-0.19	Low
0.20-0.29	Moderate
0.30-0.99	High
More than	Very high

Results and Discussion

The mean squares as seen in Table (2) due to 45 genotypes (5 parents, 10 single crosses and 30 three way crosses) are highly significant for all studied traits, indicating the presence of sufficient genetic variability in the population. Consequently various comparisons suggested to be done are valid and should be conducted to fulfill the objectives of the present study.

Table 2 : The mean squares for yield and yield components, Fiber quality properties, earliness and oilseed traits of the in cotton (*Gossypium barbadense* L.).

SOV	df	SCY/P	LY/P	BW	NB/P	L%	SI	LI	Mic	FS	FL	UI	FFN	MMD	PRI	OC %	GC %
Rep.	2	1.90	4.55	0.23	15.68	1.81	0.28	0.50	0.01	0.04	1.29	2.74	0.06	0.84	0.01	2.19	0.03
Genotype	44	653.82**	110.79**	0.29**	87.16**	5.71**	1.38**	1.46**	0.31**	0.60**	6.07**	5.19**	1.34**	12.83**	0.04**	3.17**	1.13**
Error	88	15.21	2.92	0.06	9.17	0.58	0.35	0.17	0.01	0.03	0.32	0.31	0.12	2.08	0.01	0.55	0.03

*, ** denote significant & highly significant at 5% and 1% levels of probability, respectively.

These results are agreement with Zheng *et al*. (2017), Queiroz *et al*. (2017) and Nawaz *et al*. (2019).

Phenotypic and genotypic correlations:

Phenotypic and genotypic correlation coefficients were estimated between all possible pairs of traits are recorded in Table (3). Genotypic correlations in general are higher than phenotypic correlations. This may be due to the relative stability of genotypes as majority of them were subjected to certain amount of selection (Johnson *et al.,* 1955).

SCY/P recorded significant and highly significant positive correlation with LY/P, NB/P, FL and PRI and highly significant negative correlation with UI and GC % both at genotypic and phenotypic levels. At genotypic level, this trait showed significant positive correlation with FFN trait.

For LY/P in Table (3) showed significant and/or highly significant positive correlation with NB/P, L%, LI, FL and PRI and significant and highly significant negative correlation with UI and GC%. At genotypic level, this trait showed significant positive correlation with BW and negative correlation with OC%.

BW was found to have significant positive correlation with L %, SI, LI, FL, UI and GC % whereas, significant and highly significant negative correlation was observed with NB/P and OC % at both genotypic and phenotypic levels. Whereas, it showed significant positive correlation only with Mic. trait at genotypic level.

Both genotypic and phenotypic correlations revealed that NB/P possessed significant and highly significant positive correlation with FFN and PRI and significant and highly significant negative correlation with SI, UI and GC%. At genotypic level, this trait recorded significant negative correlation only with LI.

L% was found to have significant and highly significant positive correlation with LI, Mic., FL and GC% and significant negative correlation with SI and OC% at both genotypic and phenotypic levels. At genotypic level, this trait showed significant positive correlation with MMD trait.

SI showed highly significant positive correlation only with LI and highly significant negative correlation only with FFN at both levels.

There was a positive significant correlation of LI with Mic., while it possessed highly significant negative correlation with FFN at both levels. At genotypic level, this trait showed significant positive correlation with OC% trait.

Genotypic and phenotypic correlations revealed that Mic. possessed significant positive correlation only with OC% trait.

The character, F.St showed highly significant negative correlation only with UI at both the levels.

There was positive significant and highly significant correlation of FL with UI and PRI at both levels.

At both the levels, UI noted highly significant negative correlation with FFN and PRI traits. This trait exhibited significant positive correlation with OC% at genotypic level.

The trait, MMD showed highly significant negative correlation only with OC% at both levels. At genotypic level, this trait showed significant negative correlation only with PRI trait.

Both PRI and OC% traits exhibited highly significant negative correlation with GC% at genotypic and phenotypic levels.

These results are in agreement with findings of Nawaz *et al*. (2019), who reported the significant correlation between SCY/P with NB/P and LY and between LY with NB/P, BW, and LI. Joshi and Patil (2018), reported positive correlation between L% with LI and FL and between FL with UI and PRI. However, Reddy *et al*. (2015), stated that negative significant correlation of SCY/P with UI. Kamrul *et al*. (2013) and Joshi and Patil (2018), reported negative correlation of BW with NB/P. Also, Pujer *et al*. (2014) noted negative correlation between PRI with SI and UI.

Table 3. Genotypic and phenotypic correlation coefficient for cotton traits under study.

Traits		LY/P	BW	NB/P	L%	SI	LI	MIC	FS.t	FL	UI	FFN	MMD	PRI	OC %	GC %
SCY/P	rg	0.970**	0.079	0.790**	0.136	-0.031	0.050	0.032	0.014	0.193*	-0.275**	0.166*	-0.057	0.995**	-0.122	-0.262**
	rp	0.967**	0.069	0.763**	0.128	-0.024	0.047	0.033	0.015	0.186*	-0.264**	0.161	-0.041	0.993**	-0.110	-0.255**
LY/P	rg		0.162*	0.724**	0.374**	0.096	0.260**	0.077	-0.022	0.225**	-0.233**	0.125	0.000	0.958**	-0.170*	-0.193*
	rp		0.141	0.695**	0.374**	0.082	0.254**	0.077	-0.021	0.216**	-0.223**	0.119	0.006	0.954**	-0.152	-0.188*
BW	rg			-0.690**	0.312**	0.331**	0.367**	0.187*	-0.065	0.225**	0.302**	-0.145	-0.147	0.096	-0.237**	0.362**
	rp			-0.575**	0.285**	0.281**	0.334**	0.163	-0.056	0.221**	0.258**	-0.117	-0.118	0.083	-0.178*	0.319**
NB/P	rg				-0.070	-0.228**	-0.177*	-0.148	0.021	0.010	-0.456**	0.236**	0.012	0.780**	-0.031	-0.395**
	rp				-0.063	-0.186*	-0.158	-0.132	0.023	0.009	-0.418**	0.213*	0.044	0.748**	-0.027	-0.368**
L%	rg					-0.488**	0.861**	0.215*	-0.142	0.199*	0.101	-0.153	0.167*	0.115	-0.195*	0.209*
	rp					-0.399**	0.813**	0.201*	-0.132	0.183*	0.093	-0.138	0.145	0.108	-0.168*	0.195*
SI	rg						0.876**	0.157	-0.058	0.029	-0.017	-0.352**	-0.075	-0.019	-0.050	-0.062
	rp						0.855**	0.134	-0.049	0.039	-0.011	-0.279**	-0.059	-0.013	-0.039	-0.034
LI	rg							0.211*	-0.096	0.130	0.045	-0.272**	0.066	0.043	-0.146*	0.076
	rp							0.196*	-0.088	0.126	0.041	-0.244**	0.057	0.041	-0.125	0.080
MIC	rg								0.061	-0.008	0.111	0.037	0.092	0.018	0.205*	-0.119
	rp								0.060	-0.008	0.107	0.035	0.092	0.018	0.193*	-0.116
FS.t	rg									0.003	-0.301**	-0.157	0.073	0.001	0.084	0.025
	rp									0.008	-0.288**	-0.141	0.065	0.002	0.075	0.024
FL	rg										0.343**	-0.145	0.048	0.183*	0.063	-0.027
	rp										0.331**	-0.122	0.043	0.177*	0.068	-0.026
UI	rg											-0.280**	0.029	-0.280**	0.181*	0.057
	rp											-0.259**	0.026	-0.268**	0.159	0.054
FFN	rg												0.047	0.155	-0.105	0.117
	rp												0.041	0.151	-0.084	0.114
MMD	rg													-0.175*	-0.990**	-0.169
	rp													-0.158	-0.745**	-0.140
PRI	rg														-0.068	-0.243**
	rp														-0.061	-0.236**
OC %	rg															-0.264**
	rp															-0.225**

n=135

Path Coefficient Analysis

The observed correlation between yield and a particular yield component characters were the net result of the direct effect of that components and indirect effects through other yield attributes. The total correlation coefficient between yield and its component characters may sometimes be misleading, as it may be an over or under estimate of its correlation with other characters. If the correlation coefficients between causal factor and yield are equal to its direct effect, then the correlation explains the true relationship and direct selection of this trait will be effective. If the correlation coefficient is positive and its direct effect is negative or negligible, then the indirect effects seem to be the cause of correlations. Under such situations, the other factors have to be considered simultaneously.

Correlations coefficient may be negative, but the direct effect is positive and high. Under these conditions, limited simultaneous selection model has to be followed i.e., restrictions are to be imposed to invalidate the undesirable indirect effects, in order to make use of the direct effect (Singh and Chaudhary, 1977). If correlation coefficient is negative and direct effect is also negative, then we have to drop the selection based on the character.

The results obtained by path analysis in the present study for some yield components and some fiber characters with the seed cotton yield and estimates of direct and indirect contributions to yield were discussed character wise hereunder in Table (4).

BW (1.255) and NB/P (1.654) showed high positive direct effect and significant correlation on SCY/P. On the other hand L % (-0.030) and LI (-0.202) recorded negative direct effect at genotypic level with non-significant positive correlation on SCY/P, the traits that contributed positively and indirectly may be given weightage in selection programme for yield improvement.

SI trait exhibited moderate positive direct effects at genotypic level with non-significant negative correlation on SCY/P. Meanwhile, the Mic. revealed low positive direct effect with positive correlation on SCY/P at genotypic level.

FS.t exhibited negligible positive direct effect joined with positive correlation at genotypic level on SCY/P.

Table 4 : Phenotypic and Genotypic path coefficients of quality, yield and yield components in cotton

characters	BW	NB/P	L%	SI	LI	Mic.	FS.t	SCY/P
BW	**1.255**	-1.142	-0.009	0.038	-0.074	0.013	-0.003	0.079
NB/P	-0.866	**1.654**	0.002	-0.026	0.036	-0.010	0.001	0.790**
L%	0.391	-0.116	**-0.030**	0.056	-0.174	0.015	-0.006	0.136
SI	0.415	-0.378	-0.015	**0.114**	-0.177	0.011	-0.002	-0.031
LI	0.460	-0.293	-0.026	0.100	**-0.202**	0.015	-0.004	0.050
Mic.	0.235	-0.245	-0.006	0.018	-0.043	**0.070**	0.002	0.032
FS.t	-0.081	0.035	0.004	-0.007	0.019	0.004	**0.039**	0.014

BW= Boll weight, NB/P=Number of boll per plant, L %= Lint percentage, SI= Seed index, LI= Lint index, Mic.= Microneair reading, FS.t= Fiber strength and SCY/P= Seed cotton yield per plant.

Bold values are direct effects; Genotypic residual effect = 0.00

The component of residual effect in path coefficient analysis in seed cotton yield and fiber quality traits was 0.00. The low residual effect revealed that the traits selected for path coefficient analysis were adequate and appropriate (Nawaz *et al*., 2019).

In general the results obtained in this investigation indicated that the NB/P followed by BW traits were the major and the most consistent sources effecting yield of cotton variation and consequently may be considered as important characters in selection programs aiming to cotton yield improvement and the breeder may consider those traits as the main selection criteria. The obtained results were in harmony with those previously obtained by Farooq *et al*. (2014), Pujer *et al*. (2014), Reddy *et al*. (2015), Joshi and Patil (2018), Nawaz *et al*. (2019) and Queiroz *et al*. (2019).

Conclusion

Study of genotypic and phenotypic correlations could be Enriches the knowledge about the nature of the relationship between characters affecting the cotton yield. Phenotypic correlations are generally lower than genotypic correlations because of masking effect of environment at phenotypic level. Correlation studies indicated significant and highly significant positive correlation of LY/P, NB/P, FL and PRI and highly significant negative correlation of UI and GC % with SCY/P at both genotypic and phenotypic levels. At genotypic level, this trait showed significant positive correlation with FFN trait. The path analysis revealed very high direct positive effect of NB/P followed by BW which had the main contributions to SCY/P. Selection for these traits can be lead to increase seed cotton yield of Egyptian cotton.

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