CORRELATION, PATH COEFFICIENT AND THE IMPLICATION OF DISCRIMINANT FUNCTION FOR SELECTION IN COTTON

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ABSTRACT

The present investigation was carried out at Sakha Agric. Res.,station during 2004, 2005, and 2006 growing seasons to determine the nature and extent of association between lint cotton yield/plant and its component traits .In addition, to study the direct and indirect effects of their components on lint yield/plant and to construct a suitable selection index in the parents, F_1 and F_2 generations of two intra-specific cotton crosses viz Giza 89 x Pima S_6 (cross I) and Giza 88 x Karshensky $_2$ (cross II) .The results showed highly significant and positive phenotypic correlation coefficient was achieved between both number of open bolls/plant and boll weight with lint cotton yield/plant in all generations in two crosses except boll weight in P_2 in cross I. Highly significant and positive phenotypic correlation was detected between lint index with both lint percentage and seed index over all generation in two crosses. Inverse relationship was observed between both boll weight and number of open bolls/plant in the two crosses except parents in cross II.

The direct effects of both number of open bolls/plant and boll weight were positive and high in its magnitude and exceeded the other rest traits for lint cotton yield/plant, as well as these two traits were high indirect effect on most studied traits. The results showed that number of open bolls/plant, boll weight and their interactions contributed approximately 70% to 85% from the total lint cotton yield variation over all generations in the two crosses except F_2 in cross II. The relative contribution of seed index, lint index and number of seeds/boll and their interactions ranged fron

4.93% to 38.96% approximately from the total lint cotton yield variation over all generations in the two crosses. The residual effect of unstudied yield components in this investigation amounted to about 0.07% to 1.49% from the total lint yield variation.

The expected gain as percentage ranged from 0.538 to 48.68 %. The highest expected gain as percentage (48.68%) for lint yield/plant occurred when selection basis involved lint percentage, number of open bolls/plant ,seed index, number of seeds/boll and lint index($Yx_2x_3x_4x_5x_6$) in cross I . Whereas, the expected gain as percentage in cross II ranged from 0.196 to 35.67 %. The highest expected gain of 35.67% was expected when the index included the seven studied characters in the discriminant function. .All of the yield component characters showed positive gain when combination of two or more characters were involved in a function. The expected gains were high when the index involved the major components affected in lint cotton yield/plant such as number of open bolls, boll weight and lint percentage led to high improvement of lint yield capacity in cotton breeding progroms.

Key word: correlation, path coefficient , lint cotton yield and selection indices .

INTRODUCTION

Lint cotton yield depends on the joint contribution of several component traits. The existence of correlation between a complex trait and its component is an indication of gene association or pleitropism **(Kebede et al 2001 ; Dilday et al., 1990).** Correlation and path analysis are two common methods used to evaluate the relationships between a complex trait and its component traits **(Bora el al., 1998;Ball el al.,2001 ;Cramer&Wehner,2000; Samonte et al.;1998)**.A simple phenotypic relationship between a complex trait and each of its component traits can be detected by correlation analysis. Sample correlation coefficients can be partitioned into direct and indirect effects to the target trait by the path analysis **(Wright. 1920).**

Association between characters is very important and gives very useful information to the crop breeders.

The magnitude of association between yield characters in terms of their direct and indirect effects on lint cotton yield is a great value for cotton breeding programs. Consequently, the breeding studies attempt to introduce the information about nature of association between traits to effective selection programs to increase either seed cotton or lint cotton yield in the early segregating generation **(F_2)** where selection is intensely practical. Most studies of correlation coefficients have involved population generated with the objective of selection for pure line cotton breeding. These research data, however, provided a general perspective of genetic association among cotton traits and the genetic relationships between parents and their off-spring . If the correlation between lint cotton yield and a character is due to it the direct effect, it reflected a true relationship between them and selection can be practiced for such a character in order to improve the yield. But if the correlation is mainly due to indirect effect of the character through another component trait the breeder has to select for the trait through which the indirect effect is expected **(Fonseca and Patterson 1968).** Ghoneim et al **(1993)** stated that seed index ,number of bolls/plant and seeds/boll were positively and significantly correlated with lint yield /plant ,while lint percentage was insignificant. Also, he show that direct effects in **(r)** formation were negative with all traits except No.of bolls /plant which surpassed all traits in respect to their direct effect value followed by No. of seeds/boll . Okasha **(1998)** found that all studied traits were positive and highly significant in both crosses with lint cotton yield/plant except with seed index in cross I. Also, he showed that No.of bolls/plant was the major contributor to lint yield and it followed by lint index, boll weight and seed index. Heba *et al* **(2006)** found that lint percentage and bolls number /plant and their interaction excreted the greatest effect on lint cotton yield in the first G. barbadense group .While, boll weight followed by bolls number/plant and their joint effect were the most contributions to lint yield in the second G.hirsutum group.

The present investigation is target to determine the nature and extent of association between lint yield /plant and some other traits. Moreover, to study direct and indirect effects of yield component characters on lint yield/plant through path analysis and to construct a suitable selection index in the parents, F_1 and F_2 generations of the two intra-specific cotton crosses viz, Giza 89 x Pima S_6 **(cross I)** and Giza 88 x Karshensky $_2$ **(cross III)** .

Material and Methods

The experimental work of this study was carried out at Sakha Agricultural Research Station, Cotton Breeding Department, Cotton Research Institute, A.R.C. Egypt. Four parents belonging to *Gossypium barbadense* L. two of them as new germplasm viz ,Pima S_6 and Karshensky $_2$ beside Giza 88 and Giza 89 as a new Egyptian cotton varieties . Two intra-specific crosses were derived from Giza 89 x Pima S_6 **(cross I)** and Giza 88 x Karshensky$_2$ **(cross II)** in 2004 growing season. Parents and F_1 plants were grown in 2005 season and many flowers were selfed to keep purity of parents and to obtain F_2 seed respectively,. In the same time, parents were crossed again to increase F_1 seeds.

In 2006 season, field experiment was designed to evaluate the parents, F_1, and F_2 generations in a randomized complete block design with three replicates of each cross. Each replicate consists of 20 rows. 3 rows for each non-segregating generation (P_1, P_2 and F_1) and 11 rows for F_2 segregating generation .The row was 4.5 m in length and 65cm in width. Hills were spaced at 40 cm apart and comprised one plant/ hill. All agricultural practices were applied as cotton growing recommendations. At the end of season, seed cotton yield of each plant was separately harvested and ginned for each entry of the two crosses to determine the following characters:

1- Lint cotton yield /plant (L.C.Y. /P.) (g) .
2- Boll Weight (B.W)(g) .
3- Lint percentage (L. %).
4- Seed index (S.I.)
5-Number of open bolls /plant (B./P.)
6- Number of seeds/boll.(S/B) 7- Lint index. (L.I.).

The phenotypic correlation coefficient was calculated as described by **Sndecor** and **Cochrran** (1981) for all possible pairs of the studied characters including lint cotton yield/plant. To obtain more information about the relative contribution of specific character to lint cotton yield/plant and remaining characters, the path coefficient analysis was performed for each cross. The partitioning correlation coefficient into direct and indirect effects at phenotypic level was made by determining path coefficient using the method proposed by **Dewey** and **Lu** (1959).

The phenotypic and genotypic variance and covariance obtained from the F_2 generation were used for constructing discriminant functions using different character combinations according to the procedure given by **Simth** (1936). The lint cotton yield /plant Was also included as one of the independent character as suggested by **Robinson *et al*** (1951). The expected genetic advance from straight selection (G.A.(S)) and from discriminant function (G.A.(D))Were calculated as follow :

$$G.A.(S)=\frac{Z}{P}X\frac{gyy}{\sqrt{tyy}} \text{ and } G.A.(D)$$

$$=\frac{Z}{p}\sqrt{b_1g_1y+b_2g_2y+\ldots+b_ng_ny}$$

where: $\frac{Z}{P}$ is the selection different in standard unit for the present study it was 2.06 for 5% selection (**Lush1949**) G_{yy} and i_{yy} are the genotypic and phenotypic varance of a character y

$b_1, b_2, \ldots b_n$ are the relative weight for each character and g_{1y}, g_{2y} are the genotypic co-variances of ndependent character with y.

The expected gain from the discrininant function over straight selection Wascalculated for all the functions studied as follow :

$$\text{Expected gain in percent}=\left(\frac{G.A.(D)}{G,A(s)}-1\right)X100$$

ESULTS AND DISCUSSION

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Phenotypic correlation:

Knowledge concerning the association between characters is of prime importance to the breeder as it broadens the perspective with which could manipulate indirect selection for two or more traits simultaneously .This association may be either harmful or beneficial, depending upon the direction of genetic correlation and the objectives of the breeders. The phenotypic correlation coefficient from the parents (P_1 and P_2), F_1 and F_2 generation for each cross between all possible pair of characters including lint cotton yield/plant ,the obtained results are recorded in Table 1. The results showed that lint cotton yield /plant was highly significant and positively correlated with number of open bolls/plant over the four generations in the two crosses and with boll weight over P_1, F_1 and F_2 in cross I, but insignificant and positive value in cross II, indicating that there is a strong relationship betweenlint yield/plant Withboth number of bolls/plant and boll weight. Consequently, phenotypic selection for high number of open bolls /plant and heavyer bolls led to an increase in yield capacity. These results are in agreement with those obtained by **Awaad** (1984**), Abo-Sen** (2001) and **El-Lawendy** (2003). Inverse relationship was detected between boll weight and number of bolls /plant in the two crosses except parents in cross I, which revealed that an increase in boll number there would be a considering decline in boll weight **Jain (1980)** and **Dhanda et al (1984)** who found similar findings in biparental intermated progenies. Such undesirable associations need to be broken by intermating hybridization system as they create difficulties in simultaneous improvement of these important yield components.

Significant and positive phenotypic correlation was detected between lint percentage and lint index in both crosses over all generations but insignificant and negative with seed index over all generations in the two crosses except F_1 and F_2 in cross II. Highly significant and positive phenotypic correlation was detected between lint index with seed index in both crosses over all generations. **Abdel Zaher and Nagib** (2002) reported that lint percentage was highly significant and positive correlated with lint index and negatively correlated with seed index. In this study positive significant relationships were detected between lint percentage and lint

cotton yield /plant over all generations in cross II. Weak correlation, or negative were noticed in cross I.

Significant positive phenotypic correlation coefficient was obtained between boll weight and number of seeds/bolls over all generations in the two crosses, suggesting that either the genes governing these traits were common linked or pleiotropy gene effects. This result is in agreement with that obtained by **Dhanda et al** (1984) and **Okasha** (1998). Significant negative correlation of seed index with number of seeds/boll was observed in crosses over all generations except P_2 and F_2 in cross I ,which, were detected a negative correlation, suggesting that selection for heavy seeds led to a reduce in the number of seeds\boll and vice versa.

Generally, when the relationship between lint yield/plant and the yield component traits showed positive and significant associations, consequently, these observations suggested that selection practiced for the improvement of any one of a set of correlation characters above would automatically improve the other. The independent relationship indicated that selection could be practiced for both characters at the same time with out any reduction for the other.

Table 1: Phenotypic correlation coefficients between all possible pairs of seven studied traits over parents (P_1 and P_2), F_1 and F_2 of cross Giza 89 x Pima S_6 (Upper right) and Giza 88 x $Karshensky_2$ (lower left)

Traits	Gen	B.W.	L.%	B./p.	S.I	S./B.	L.I.	L.C.Y./
B.W	P_1	-	-0.475**	0.592**	0.218	0.809**	-0.152	0.771**
	P_2	-	0.178	-0.366*	0.297	0.819**	0.329	-0.038
	F_1	-	-0.163	0.324	0.099	0.805**	-0.054	0.619**
	F_2	-	-0.035	0.074	0.394	0.722**	0.284	0.389*
L.%	P_1	0.364*	-	-0.429*	-0.298	-0.403*	0.463**	-0.391*
	P_2	0.217	-	-0.279	0.128	-0.100	0.745**	-0.137
	F_1	-0.089	-	-0.231	-0.087	-0.272	0.671**	-0.119
	F_2	0.108	-	0.146	0.034	-0.252	0.639**	0.235
B./p.	P_1	-0.142	0.186	-	0.117	0.505**	-0.203	0.961**
	P_2	0.193	0.179	-	0.261	-0.441*	-0.008	0.931**
	F_1	-0.004	0.288	-	-0.073	0.363*	-0.225	0.928**
	F_2	-0.061	0.125	-	0.061	-0.007	0.139	0.931**
S.I	P_1	0.191	-0.181	-0.174	-	-0.374*	0.707**	0.131
	P_2	-0.224	-0.001	-0.067	-	-0.263	0.756**	0.368*
	F_1	-0.023	0.131	0.226	-	-0.383*	0.678**	-0.009
	F_2	0.059	0.101	0.375*	-	-0.321	0.788**	0.190*
S./B	P_1	0.707**	0.221	-0.048	0.520**	-	0.648**	0.645**
	P_2	0.770**	0.025	-0.117	-0.77**	-	-0.229	-0.193
	F_1	0.402*	0.444*	-0.298	0.869**	-	0.492**	0.574
	F_2	0.721**	-0.242	-0.119	0.587**	-	-0.396*	0.197
L.I	P_1	0.433*	0.612**	-0.002	0.666**	0.247	-	-0.165
	P_2	-0.051	0.600**	0.056	0.797**	-0.632**	-	0.161
	F_1	-0.084	0.733**	0.359*	0.797**	-0.884**	-	-0.099
	F_2	0.115	0.803**	0.113	0.661**	-0.525**	-	0.296
L.C.Y./ pl	P_1	0.218	0.394*	0.929**	-0.156	0.22	0.17	-
	P_2	0.301	0.439*	0.861**	-0.157	0.22	0.14	-
	F_1	0.156	0.499*	0.954**	0.229	0.31	0.49*	-
	F_2	0.351	0.406*	0.867**	0.067	0.11	0.34	-

*,** Significant at 0.05 and 0.01 level, respectively

B.w = Boll Y eight L. % = Lint percentage

B./ p = Number of open bolls /plant S.I = Seed index

S. /B = Number of seeds/boll L.I = Lint index.

L.C.Y./p. = Lint cotton yield /plant

Path coefficient analysis:

The analysis of phenotypic path coefficient has been made to identify the important yield attributes by estimating the direct of the contributing characters to lint cotton yield. As well as, 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 criteria.

The direct and indirect effects of yield component characters studied on lint cotton yield /plant in the two intra-specific cotton crosses over parents (P1 and P_2),F_1 and F_2 generations are illustrated in Table 2. The data display that number of open bolls/plant and boll weight had a positive phenotypic correlation with lint cotton yield/plant over all generations in cross I except for boll weight in P_2. These results mean that positive phenotypic correlation (r) was mainly formed the direct effect. The direct effect of both lint index and lint percentage had positive or negative (r) via lint cotton yield /plant in the two crosses over all generations and small in its magnitude except F_4 of lint index, P1 and F_1 of lint percentage in cross I as well as P_2 and F_1 in cross II. **Ismail et al** (1988). On the other hand, the indirect effect of B./p via boll weight was positive over all generations except x_2 in cross I, while revealed the opposite trend in cross II in all generations. **Heba et al** (2006) cleared that lint percentage and bolls number /plant and their interaction excreted the greatest effect on lint cotton yield in the first barbadense group while ,boll weight followed by bolls number/plant and their joint effect were the most contributions to lint yield in the second hirsutum group. **El-Biely et al** (1996), reported that the main source of lint cotton yield variation according to their importance were boll number and their interaction with of boll weight under the three distance.

Indirect effect of seed index via boll weight was positive over most generations in two crosses but higher relation in cross I than other one. Number of seeds/boll was negative direct effect via lint cotton yield/plant in the two crosses over all generations except x_1 in cross I but small magnitude. On other hand, the main positive effect of number of seeds /plant passed through boll weight in two

Table (2): Partitioning of the phenotypic correlation coefficients between lint cotton yield /plant via other components for the parents, F_1 and F_2 generations of the two crosses studied

Sources of variation	Crosses							
	GIZA 89 × PIMAS$_6$				GIZA 89 × Karshensky$_2$			
	P_1	P_2	F_1	F_2	P_1	P_2	F_1	F_2
Lint yield/plant vs boll weight								
Direct effect	0.326	0.628	0.868	0.432	0.736	0.499	0.191	0.408
Indirect effect via lint %	-0.110	0.001	-0.064	0.009	-0.040	0.063	-0.028	0.011
Indirect effect via No.bolls/plant	0.478	-0.406	0.274	0.066	-0.135	-0.176	-0.003	-0.053
Indirect effect via seed index	0.032	-0.071	0.010	-0.216	-0.088	-0.025	-0.001	-0.009
Indirect effect via seeds/boll	0.024	-0.216	-0.495	-0.079	-0.308	-0.071	-0.010	-0.028
Indirect effect via lint index	0.022	0.026	0.026	0.177	0.053	0.011	0.008	0.023
Total	0.77**	-0.038	0.62**	0.389	0.218	0.301	0.156	0.351
Lint % vs lint yield/plant								
Direct effect	0.232	0.005	0.397	0.887	-0.111	0.228	0.314	0.102
Indirect effect via boll weight	-0.155	0.112	-0.141	0.032	0.268	0.109	-0.017	0.044
Indirect effect via No.bolls/plant	-0.347	-0.310	-0.196	-0.042	0.177	0.164	0.254	0.108
Indirect effect via seed index	-0.044	-0.031	-0.009	-0.033	0.083	0.000	0.006	-0.015
Indirect effect via seeds/boll	-0.012	0.026	0.115	0.001	-0.096	0.002	0.011	0.010
Indirect effect via lint index	-0.065	0.060	-0.320	0.087	0.075	-0.124	-0.069	0.157
Total	-0.392*	-0.138	-0.120	0.931**	0.395*	0.439*	0.500*	0.406*
N0.bolls/plant vs lint yield/plant								
Direct effect	0.807	1.110	0.845	0.845	0.953	0.914	0.881	0.859
Indirect effect via boll weight	0.193	-0.230	0.281	0.281	-0.104	-0.096	-0.001	-0.025
Indirect effect via lint %	-0.990	-0.001	-0.090	-0.090	-0.021	0.052	0.091	0.013
Indirect effect via seed index	0.017	-0.063	-0.008	-0.088	0.080	-0.008	0.010	-0.006
Indirect effect via seeds/boil	0.015	0.116	-0.208	-0.208	0.021	0.011	0.008	0.005
Indirect effect via lint index	0.029	-0.001	0.107	0.107	0.000	-0.012	-0.034	0.022
Total	0.769**	0.932**	0.647**	0.647**	0.929**	0.861**	0.955**	0.868**
Seed index vs lint yield/plant								
Direct effect	0.146	-.0.239	0.104	-0.549	-0.458	0.111	0.044	-0.152
Indirect effect via boll weight	0.071	0.187	0.086	0.171	0.141	-0.112	-0.005	0.024
Indirect effect via L.%	-0.069	0.006	-0.034	-0.009	0.020	-0.001	0.041	0.010
Indirect effect via No.bolls/plant	0.0943	0.290	-0.061	0.054	-0.166	-0.062	0.199	0.032
Indirect effect via seeds/boll	-0.011	0.069	0.219	0.035	0.226	0.071	0.022	0.023
Indirect effect via lint %lint	-0.102	0.060	-0.323	0.490	0.081	-0.164	-0.073	0.129
index	0.131	0.368*	-0.009	0.190	-0.157	-0.157	0.229	0.068
Total								
Seeds/boll vs Lint yield/plant								
Direct effect	0.093	-0.264	-0.574	-0.109	-0.435	-0.092	-0.026	-0.0395
Indirect effect via boll Weight	0.264	0.515	0.751	0.312	0.520	0.385	0.077	0.294
Indirect effect via L.%	-0.093	-0.005	-0.106	0.072	-0.025	-0.007	-0.139	-0.025
Indirect effect via No.bolls/plant	0.407	-0.489	0.307	0.006	-0.046	-0.107	-0.263	-0.103
Indirect effect via seed index	-0.055	0.063	-0.039	0.176	0.238	-0.085	-0.039	0.089
Indirect effect via lint index	0.093	-0.018	0.234	-0.297	-0.030	0.130	0.084	-0.103
Total	0.645**	-0.194	0.574**	0.197	0.223	0.223	-0.306	0.113
Lint index vs lint yield/plant								
Direct effect	-0.144	0.079	-0.476	0.621	0.122	-0.206	-0.094	0.195
Indirect effect via boll Weight	-0.049	0.207	-0.047	0.123	0.318	-0.026	-0.016	0.047
Indirect effect via L.%	0.107	0.004	0.261	-0.182	-0.068	0.173	0.230	0.082
Indirect effect via No.bolls/plant	-0.164	-0.009	-0.191	0.124	-0.002	0.052	0.317	0.097
Indirect effect via seed index	0.104	-0.181	0.071	-0.433	-0.305	0.088	0.034	-0.100
Indirect effect via seeds/boll	-0.019	0.061	0.281	0.044	0.108	0.058	0.023	0.021
Total	-0.165	0.161	-0.099	0.297	0.172	0.140	0.493*	0.342
Residual	0.002	0.015	0.007	0.015	0.002	0.003	0.001	0.019

crosses over most generations, this result was assured by positive (r) value. If the correlation coefficient is positive and almost equal to its direct effect, then correlation explains the true relationship and direct selection through this trait Y ill be effective. whereas, the correlation coefficient is positive, but the direct effect is negative or negligible, the indirect effect seems to be a cause of correlation.

Generally, the results of path analysis showed that the direct effect of number of open bolls/plant followed by boll weight were high in magnitude and exceeded the other traits for lint cotton yield/plant also, both two traits were high indirect effect for most studied traits added that the other traits had a slight director indirect effect on lint cotton yield /plant .**Okasha**,(1998) reported that direct effect of bolls/plant, lint index, and boll weight were the major contributor for highly significant correlation in cross I. While, a direct effect of lint percentage, seed index and No. of seeds/boll were negative and low magnitude in the cross II for lint yield/plant.

The relative importance in percent of the tested lint yield/plant over all generations in the two crosses is illustrated in Tables 3 and 4. The results showed that No. of bolls/plant, boll weight and their interactions contributed approximately 70% to 85% from the total lint cotton yield variation over all generations in the two crosses except F_2 in cross II. The relative contribution of seed index, lint index and number of seeds/boll and their interactions ranged from 4.93% to 38.96% approximately from the total lint cotton yield variation over all generation in the two crosses. The residual effect of the other yield components concluded in this investigation amounted to about 0.07% to 1.49% from the total lint yield variation. Indicated that no.of bolls/pant and boll weight play the main effect on lint cotton yield /plant, and this means that lint cotton yield /plant must be needed mainly to these two traits. This agrees with that obtained by **Ismail et al (1988), Ghoneim *et al* (1993), El Beily et al (1996), Okasha (1998) and Heba *et al* (2006).**

Table 3. Relative importance (direct and joint effects) in percent of lint cotton yield /plant variation in each generation of cross Giza 89 x Pima S6 (cross I).

Source of Variation	P_1		P_2		F_1		F_2	
	CD	RI%	CD	RI%	CD	RI%	CD	RI%
Boll weight (1)	0.106	15.97	0.394	13.29	0.754	2.89	0.19	13.29
Lint percentage (2)	0.053	0.36	0.000	4.43	0.153	7.83	0.08	0.84
No. bolls/plant (3)	0.651	26.78	1.231	44.47	0.715	61.52	0.79	58.99
Seed index (4)	0.021	6.19	0.057	0.65	0.011	0.16	0.30	1.84
N0.seeds/boll (5)	0.001	5.57	0.069	0.45	0.327	0.05	0.01	0.13
Lint index (6)	0.021	0 44	0.006	2.26	0.226	0.71	0.39	3.06
(1) x (2)	-0.072	1.76	0.001	3.34	-0.110	0.85	0.01	0.72
(1) x (3)	0.312	5.85	-0.510	9.39	0.475	0.10	0.06	3.46
(1) x (4)	0.021	3.79	-0.089	1.32	0.018	0.03	-0.19	0.59
(1) x (5)	0.015	13.34	-0.272	3.79	-0.859	0.31	-0.07	1.86
(1) x (6)	0.014	2.29	0.033	0.56	0.045	0.24	0.15	1.47
(2) x (3)	-0.161	1.16	-0.003	5.03	-0.153	12.68	-0.07	1.77
(2) x (4)	-0.020	0.54	-0.000	0.01	-0.007	0.29	0.01	0.25
(2) x (5)	-0.005	0.63	0.000	0.07	0.121	0.57	-0.02	0.16
(2) x (6)	-0.031	0.49	0.001	3.80	-0.249	3.45	-0.23	2.57
(3) x (4)	0.028	4.94	-0.139	0.73	-0.013	1.39	-0.06	0.78
(3) x (5)	0.024	1.19	0.258	1.06	-0.351	1.06	0.00	-0.65
(3) x (6)	0.047	0.02	-0.002	1.13	0.181	4.75	0.15	3.04
(4) x (5)	-0.003	6.11	-0.033	0.84	0.046	0.16	-0.04	0.56
(4) x (6)	-0.030	2.19	-0.029	1.84	-0.067	0.51	-0.54	3.13
(5) x (6)	0.005	0.77	0.009	1.28	-0.268	0.34	0.05	0.65
R. F	0.002	0.07	0.015	0.17	0.007	0.11	0.02	1.49
Total	1.00	100.0	1.00	100.0	1.00	100.0	1.00	100.0

CD denote coefficient of determination

RI % denote relative importance

Table 4. Relative importance (direct and joint effects) in percent of lint cotton yield/plant variation in each generation of cross Giza 88 x Karshenky$_2$ (cross II).

Source of Variation	P_1		P_2		F_1		F_2	
	CD	RI%	CD	RI%	CD	RI%	CD	RI%
Boll weight (1)	0.542	6.47	0.249	12.50	0.036	14.62	0.17	5.47
Lint percentage (2)	0.012	3.27	0.083	0.00	0.099	2.96	0.01	2.38
bolls/plant (3)	0.908	39.63	0.835	39.04	0.776	13.86	0.74	33.01
Seed index (4)	0.209	1.30	0.012	1.82	0.002	0.21	0.02	8.83
N0.seeds/boll (5)	0.189	0.05	0.009	2.21	0.001	6.34	0.00	0.35
Lint index (6)	0.015	1.25	0.042	0.20	0.009	4.39	0.04	11.30
(1) x (2)	-0.059	4.37	0.063	0.03	-0.011	2.14	0.01	0.25
(1) x (3)	-0.199	18.96	-0.176	16.18	-0.001	9.21	-0.04	1.66
(1) x (4)	-0.129	1.27	-0.025	2.83	-0.000	0.35	-0.01	5.48
(1) x (5)	-0.452	0.93	-0.071	8.61	-0.004	16.66	-0.02	2.01
(1) x (6)	0.078	0.87	0.011	1.05	0.003	0.87	0.02	4.47
(2) x (3)	-0.039	9.77	0.094	0.09	0.159	2.97	0.02	2.16
(2) x (4)	-0.018	1.23	-0.00	0.01	0.004	0.14	0.00	0.32
(2) x (5)	0.021	0.35	0.001	0.01	0.007	2.35	0.00	0.46
(2) x (6)	-0.017	1.87	-0.071	0.02	-0.044	4.84	0.03	6.36
(3) x (4)	0.152	1.68	-0.014	4.41	0.018	0.25	-0.01	1.73
(3) x (5)	0.040	1.44	0.019	8.18	0.013	6.81	0.01	0.04
(3) x (6)	-0.001	2.87	-0.021	0.05	-0.059	3.52	0.04	4.51
(4) x (5)	-0.207	0.19	0.016	1.06	0.002	0.89	-0.01	1.13
(4) x (6)	-0.074	1.81	-0.036	0.92	-0.006	1.31	-0.04	15.76
(5) x (6)	0.026	0.33	-0.024	0.31	-0.004	5.19	0.01	1.59
R. F	0.002	0.100	0.003	0.48	0.001	0.13	0.02	0.44
Total	1.00	100.0	1.00	100.0	1.00	100.0	1.00	100.0

Selection index.

Selection indeces for lint yield/plant were constructed for the F$_2$ generation and different combinations were examined in an attempt to identify those characters which may be of help during breeding program. The selection indeces and expected gain in percent over straight selection for lint yield/plant in the two crosses are given in Tables 5 and 6. Table 5 showed that the expected gain for lint cotton yield/plant in percent ranged from 0.538 to 48.68 %. The highest expected gain in percent (48.68%) occurred Y hen selection basis involved lint percentage, number of open boll/plant, seed index, number of seeds/boll and lint index ($Yx_2x_3x_4x_5x_6$). It is worthing to mention that the number of open bolls/plant showed highly significant and positive phenotypic correlation with lint cotton yield and was the main component of it. Consequently, any selection basis depending on number of open bolls /plant led to high improvement of lint yield capacity. **Al-Rawi and Ahmed** (1984) indicated increases in efficiency of selection for yield ranged from 1.4 to 34.0%for various indices. In practice, when a selection index based on combination of characters, including yield an advantage of practical significance was obtained over selection based on yield only. The index incorporated yield, bolls/plant and seeds/boll ($I_{w\ 12}$) was superior to all other selection indices in predicted advance and is recommended therefore

Table 6 cleared that the expected gain in percent ranged from 0.196 to 35.67 %. The highest gain of 35.67% was expected when all the seven studied characters ($Yx_1x_2x_3x_4x_5x_6$)) were included in the discriminant function. .All of the component characters showed positive gain when a combination of two or more characters were studied in a function. The expected gains were high only when number of open bolls was also included in a discriminant function. it worth to note that, number of open bolls/plant showed highly significant and positive correlated with lint cotton yield/plant .Also , number of open bolls/plant passed indirect effect through both lint index and number of seeds/boll. **Hazel** (1943) showed that selection for several traits at the same time by using the selection index was more efficient than selection for one trait at a time. El-lawendy (2003) reported that highest realized genetic advance for lint yield was achieved when applying the indices includes bolls/plant, seeds/boll and lint/seeds in population II and lint index seed/boll and lint/seed in population III.

Generally, from the results of discriminant function we can recommend that the breeder should be selected the parents carefully and take the main characters which showed significant and positive association with yield to improve lint capacity in cotton breeding programs. As well as, selection should depend on many numbers of characters effects on yield to maximize efficient the selecion method in breeding programs.

Table 5: Expected gain in percent in lint cotton yield/plant over straight selection from the use of various selection indexes cf Giza 89 x Pima S6 (cross I)

Selection index	b value							Expected gain in percent
Y x_1	0.66	-0.045						1.146
Y x_2	0.613	0.684						5.079
Y x_3	0.808	0.427						12.684
Y x_4	0.645	0.642						1.214
Y x_5	0.644	0.307						0.538
Y x_6	0.622	1.714						11.429
Y x_1x_2	0.678	0.088	1.059					13.640
Y x_1x_3	1.579	-4.514	-0.408					34.504
Y x_1x_4	0.657	-0.024	0.773					2.653
Y x_1x_5	0.642	0.737	0.273					2.091
Y x_1x_6	0.641	-0.408	1.887					6.488
Y x_2x_3	0.604	1.691	0.666					44.999
Y x_2x_4	0.663	1.093	0.686					14.178
Y x_2x_5	0.661	1.026	0.383					13.134
Y x_2x_6	0.677	0.974	0.845					15.607
Y x_3x_4	0.891	0.331	0.273					33.787
Y x_3x_5	1.109	0.071	0.048					34.557
Y x_3x_6	0.580	0.659	2.557					37.40
Y x_4x_5	0.652	0.416	0.294					2.536
Y x_4x_6	0.611	-0.944	3.411					8.72
Y x_5x_6	0.614	0.425	1.625					5.496
Y $x_1x_2x_3$	0.658	0.230	1.677	0.608				45.704
Y $x_1x_2x_4$	0.675	0.088	1.061	0.799				15.001
Y $x_1x_2x_5$	0.668	0.162	1.036	0.407				14.080
Y $x_1x_2x_6$	0.691	-0.114	0.902	1.098				16.576
Y $x_2x_3x_4$	0.651	1.707	0.609	0.517				46.114
Y $x_2x_3x_5$	0.585	1.700	0.671	0.469				45.328
Y $x_2x_3x_6$	0.636	1.655	0.646	0.599				47.257
Y $x_3x_4x_5$	1.657	-0.529	-1.322	-0.378				36.458
Y $x_3x_4x_6$	0.633	0.566	-2.531	5.848				41.808
Y $x_4x_5x_6$	0.599	-1.008	0.449	3.441				9.210
Y $x_1x_2x_3x_4$	0.699	0.219	1.695	0.558	0.574			46.824
Y $x_1x_2x_3x_5$	0.790	-0.808	1.631	0.453	0.495			45.940
Y $x_1x_2x_3x_6$	0.723	-0.029	1.598	0.552	0.712			47.942
Y $x_2x_3x_4x_5$	0.757	1.626	0.481	0.272	0.357			46.363
Y $x_2x_3x_4x_6$	0.676	0.735	0.600	-1.714	4.521			48.424
Y $x_3x_4x_5x_6$	0.640	0.542	-2.598	0.446	5.847			42.166
Y $x_2x_3x_4x_5x_6$	0.791	0.414	0.456	-0.528	0.341	5.472		48.677
Y $x_1x_2x_3x_4x_5$	0.526	-2.396	1.720	0.408	1.139	0.722		47.080
Y $x_1x_2x_3x_4x_6$	0848	-1.899	0.409	0.395	-2.940	0.641	5.820	47.978

Table 6: Expected gain in percent in lint cotton yield/plant over straight selection from the use of various selection indexes of Giza 88 x Karshensky $_2$ (croII)

Selection index	b value							Expected gain in percent
Y x_1	0.551	4.447						2.217
Y x_2	0.586	0.695						0.721
Y x_3	0.733	0.327						12.251
Y x_4	0.586	0.602						0.735
Y x_5	0.589	0.901						1.348
Y x_6	0.576	1.023						0.196
Y x_1x_2	0.533	4.652	0.830					6.617
Y x_1x_3	0.601	3.849	0.480					27.781
Y x_1x_4	0.550	4.583	0.559					2.575
Y x_1x_5	0.543	7.105	0.328					5.624
Y x_1x_6	0.541	4.571	1.034					3.774
Y x_2x_3	1.087	-4.434	-0.063					7.747
Y x_2x_4	0.571	0.817	0.605					4.748
Y x_2x_5	0.568	0.880	0.951					7.868
Y x_2x_6	0.568	0.698	1.138					5.894
Y x_3x_4	0.739	0.320	0.461					26.941
Y x_3x_5	0.807	0.256	0.698					30.451
Y x_3x_6	0.778	0.274	0.111					27.881
Y x_4x_5	0.577	1.842	1.188					4.336
Y x_4x_6	0.571	0.096	1.345					1.917
Y x_5x_6	0.544	1.220	2.204					5.727
Y $x_1x_2x_3$	0.764	1.965	0.415	0.293				31.127
Y $x_1x_2x_4$	0.533	4.758	0.826	0.558				6.958
Y $x_1x_2x_5$	0.536	7.463	0.672	0.290				9.824
Y $x_1x_2x_6$	0.530	4.723	0.740	1.064				8.071
Y $x_2x_3x_4$	0.823	0.348	0.226	0.535				30.583
Y $x_2x_3x_5$	0.935	0.090	0.111	0.425				32.700
Y $x_2x_3x_6$	0.822	0.272	0.224	0.969				31.501
Y $x_3x_4x_5$	0.681	0.399	1.454	1.034				29.685
Y $x_3x_4x_6$	0.802	0.254	0.931	-0.234				28.177
Y $x_4x_5x_6$	0.541	1.215	1.315	1.887				6.161
Y $x_1x_2x_3x_4$	0.755	1.928	0.438	0.303	0.529			31.415
Y $x_1x_2x_3x_5$	0.710	5.352	0.529	0.358	0.281			33.789
Y $x_1x_2x_3x_6$	0.775	1.582	0.331	0.277	0.967			32.297
Y $x_2x_3x_4x_5$	0.934	0.106	0.112	0.512	0.440			32.968
Y $x_2x_3x_4x_6$	0.818	-1.288	0.229	-3.078	6.816			31.998
Y $x_3x_4x_5x_6$	0.788	0.279	1.465	0.793	-0.182			30.746
Y $x_2x_3x_4x_5x_6$	0.875	-0.265	0.174	-2.525	0.593	6.254		34.392
Y $x_1x_2x_3x_4x_5$	0.701	23.727	-0.502	0.355	-5.148	-2.781		34.554
Y $x_1x_2x_3x_4x_6$	0.657	22.824	-1.721	0.402	-8.335	-2.514	5.734	35.670

REFERANCES

Abdel Zaher,G.H. and M.A. Nagib (2002). Evaluation of nine strains of Giza 83 cotton variety. J.Sci.,Mansoura Univ., 27(9):5693-5700.

Abo-Sen, Z.F. (2001). The relative contributions of yield components to cotton yield.J.Agric.Sci.,Mansoura Univ.,26(2):681-685.

Al-Rawi, K.M. and A. A. Ahmed (1984). Evaluation of the relative efficiencies of several selection indices for predicting yield performance in Upland cotton (*Gossypium hirsutum* L.)Iraqi J. Agric. Sci., 2(1):15-27.

Awaad, M.M.M. (1984). Study on yield components and lint properties in some cotton cultivars. MSc .Thesis Fac., Agri. ,Moshtoher. Zagazig Univ. Egypt.

Ball , R.A.; R. W .Mc NeW ;E.D.Vories; T.C. Kessling and L.C. Puroel (2001). Path analysis of population density effects on short-season soybean yield. Agron. J.93:187-195.

Bora, G.C.;S. N. Gupta, Y .S. Tomer and S. Singh.(1998). Genetic variability, correlation and path analysis in faba bean(Vicia faba).Indian J. Agric Sci.68:212-214.

Cramer, C.S.and T.C.Wehner,(2000). Path analysis of the correlation between fruit number and plant traits of cucumber population. Hort Sci.35; 708-711.

Dewey,D.R. and K.H. Lu (1959). Correlation and path coefficient analysis of components of crested wheatgrass seed production. Agron .J.(51):515-518.

Dhanda, S.S.; A. P.Tyagi and D.S. Jatasra (1984). Character associations among quantitative and quality attributes of Upland cotton. Ind. J. Agric.Sci. 54(1)24-29.

Dilday, R.H;Mgonjo; S.A.Amonsilpa ;F.C.Collins and B.R.Wells (1990). Plant height vs. mesocotyl and coleoptile elongation in rice; Linkage or pleiotropism. Crop Sci. 30;815-818

El-Beily,M.A.;H.B. Abou-Tour and A.A. Okasha(1996). The relative contribution of yield components to lint yield in three cultivars of Egyptian cotton. J. Agric., Res. Tanta Univ., 22(1):61-67.

El-Lawendy, M. A. M. (2003). Effect of some selection procedures on lint yield and seed characters improvement in cotton. Ph.D.Thesis.Fac., Agri.,Moshtohor Zagazig Unvi.,Egypt.

Fonseca, S. and F.L. Patterson (1968). Yield components heritabilities and inter-relationships in winter wheat (*Tritcuim aestivum* L.). Crop Sci.,8:614-617.

Ghoneim, E. M.; M.O. Ismail and A.A. El-Ganyni(1993). Yield analysis in F_2 of an Egyptian cotton cross. Zagazig J. Agri., Res., Vol 20 No (1 A): 89-99.

Hazel, L. N. (1943). The genetic basis for constructing selection indexes.Genetics.,28:476-490.

Heba, H.E. Hamed ;A. M. El-Marakby and Afaf,M. Tolba(2006). Correlation and path coefficient analysis for yield and its components in intra and inter spicific crosses of cotton.Res.Bult., Ain Shams Univ.,1-12.

Ismail, M. O.; S. A. El-Shaarawy and H. Y. Awad, (1988). Correlation and path coefficient analysis for yield and its component in F_2 and F_3 generations of an interspecific cotton cross. Annals of Agri., Sci., Moshtohor, Zagazig Univ. 26(4):2343-2355.

Jain, D. K. (1980). Genetics of yield components and fiber characters in desi cotton .Ph. D. Thesis, Haryana Agricultural Unviversity, Hissar (Unpublished).

Kebede, H.; P. KSubudhi ; D.T. Rosenow and H.T.Nguyen (2001). Quantitative trait loci influencing drought tolerance in grain sorghum (*Sorghum Biccolor* L. Moench) Theor. Appl. Genet 103;266-276.

Luch, J.L.(1949). Animal breeding plans.Iowa State Univ. Press, Ames

Okasha, A,A.(1998).Study of correlation and path coefficient of an Egyptian cotton crosses. J. Agri., Sci., Mansoura Univ., 23(5):1843-1853.

Robinson, H,F,; F.E Comstock and P.H.Harvey, (1951). Genotypic and phenotypic correlalion in corn and their implications in selection. Agron.J., 43:282-287.

Samonte, S.O.P.; L.T.Wilson and A.M.McClung (1998). Path analysis of yield and yield-related traits fifteen diverse rice genotypes. Crop Sci. 38:1130-1136.

Smith,H.F.(1936). Adiscriminant function for plant selection. Ann. Eugen.,(7):240-250.

Snedecor, G. W . and W. G. Cochran (1981). Statistical method 6th (Ed),pp.175-191.IoY a Stat. Univ., press. Ames Iowa. U.S.A.

Tyagi, A. P. (1978). Genetic architecture of yield component, quality characters and their plausible biochemical bases in Upland cotton. Ph.D.Thesis, Haryana Agric. Univ., Hissar (Unpublished).

Wright. S.,(1920). The relative importance of heredity and environment in determining the piebald patten of guinea-pigs. Proc. Nat Acad Sci USA 6:320-332.

الملخص العربى

استخدام الارتباط ومعامل المرور و تطبيق تحليل التمايز كأداة للانتخاب في القطن

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معهد بحوث القطن.- مركز البحوث الزراعية.

أجريت هذه الدراسة فى محطة البحوث الزراعيـة بـسخا .قـسم بحوث تربيه القطن – معهد بحوث القطن خـلال مواسـم النمـو ٢٠٠٤ و٢٠٠٥ و٢٠٠٦ بهدف دراسه مدى وطبيعة الارتبـاط بـين محـصول القطن الشعر/نبات ومكوناتة وكذلك التاثير المباشر والغير مباشـر لتلـك المكونات لتكوين افضل ادلة انتخاب لتحسين محصول القطن الشعر/نبات باستخدام الاباء والجيل الاول و الثانى لهجنـين صـنفيين مـن القطـن

x٨٩ هما جـــ(*Gossupium barbadense* L.) بيما س٦ (الهجــين الاول) جـــx٨٨ كارشنسكى ٢ (الهجين الثانى) .أظهرت النتائج وجود ارتباط موجب ومعنوى بين محصول القطن /نبات و كل من عدد اللــوز المتفتح/نبات و متوسط وزن اللوزة فى كلا الهجنين فــى كــل الاجيــال الدروسه باستثناء صفة متوسط وزن اللوزة للاب الثــانى فــى الهجــين الاول. كان هناك ارتباط موجب وعالى المعنويه بين معامل الشعر و كل من تصافى الحليج و معامل البذرة فى كلا الهجنين على مستوى جميــع الاجيال كذلك وجدت علاقه ارتباط عكسيه بين متوســط وزن اللــوزة و عدد اللوز المتفتح/نبات فى كلا الهجنين باستثناء الاباء فى الهجين الثانى.

كان التأثير المباشر لكل من عدد اللوزالمتفتح /نبات و متوسط وزن اللوزة موجبا وعالى فى تقديرة عن باقى المكونات بالنسبة محصول القطن الشعر لكل نبات بالاضافة لذلك كان لهما تاثير غير مباشــرموجب فى معظم الصفات الاخرى المدروسه فى كلا الهجنين. شكلت كــل مــن متوسط وزن اللوزه و عدد اللوز المتفتح/نبات و تفاعلتهما نسبه تراوحت ما بين ٧٠-٨٠% تقريبا من محصول القطن الشعر الكلــى فــى كــلا الهجنين باستثناء الجيل الثاني فى الهجين الثانى. وهذا يدل عل ان كلا من متوسط وزن اللوزه و عدد اللوز المتفتح/نبات يلعبان الدور الرئيسى فــى محصول القطن الشعر لكل نبات . كانت مساهمه معامل البذرة و معامل الشعر و عدد البذور/لوزة و تفاعلتهما مــا بــين٤,٩٣-٣٨,٩٦% مــن محصول السعر الكلى/نبات. كانت مساهمه الــصفات الاخــرى الغيــر مدروسه فى محصول القطن الشعر الكلى ما بين ٠,٠٧-١,٤٩ %

تراوحت قيم التحسين المتوقع نتجه الانتخاب ل٥% من نباتات الجيل الثانى من ٠,٥٣٨ الى ٤٨,٦٨%. وكانت اعلــى قيمــه تحــسين متوقعه لمحصول القطــن الــشعر(٤٨,٦٨ %) عنــدما اشــتمل الــدليل الانتخابى على تصافى الحليج وعدد اللوز المتفتح/نبات و معامل البذرة و عددالبذور/لوزة ومعامل الشعر ($Y\ x_2x_3x_4x_5x_6$) فى الهجين الاول.فى حين تراوح مابين ٠,١٩٦ الى ٣٥,٦٧ % في الهجين الثــانى و كانــت اعلى تحسين متوقعه لمحصول القطن الشعر (٣٥,٦٧ %) عندما اشــتمل الدليل الانتخابى على كل الصفات الدروسه وهى متوسط وزن اللــوزة و تصافى الحلــيج وعــدد اللــوز المتفــتح/نبــات و معامــل البــذرة و عددالبذور/لوزة ومعامل الشعر($Y\ x_1x_2x_3x_4x_5x_6$)