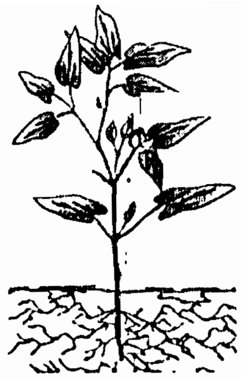

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GENETIC PARAMETERS AND MULTIVARIATE ANALYSIS FOR MORPHOLOGICAL AND SOME BOLL ANATOMICAL TRAITS OF INTRA AND INTERSPECIFIC CROSSES OF COTTON

[26]

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ABSTRACT

The present study was carried out at Giza Research Station during 2002, 2003 and 2004. A partial diallel cross system among eight parents were used to estimate, hybrid vigor, inbreeding depression, potence ratio, general and specific combining ability for morphological traits as well as, anatomical traits of bolls. Multivariate analysis was used to determine the intercorrelation between these traits and infestation percent of bollworms and to clear importance of these traits. The results suggested presence of additive and non additive gene effects in genetic control of these traits. The heritabilities were high for lobbing index, central leaf lobe shape, moderate for plant height and No. of locules per boll in F_2 while it was low for size of nectaries. No appreciable amount of heterosis for any character was observed except plant height. Inbreeding depression and potence ratio indicated that there was mostly Partial dominance for the characters. The parent Okra-leaf and Nectariless were good combiners for all morphological traits. The best combination was (G.70 x Okra leaf) for most of traits in two generations. Factor analysis grouped 11 traits in four axes, which together were responsible of 82.6% of total variability in the dependence structure, first axis accounted for 41.7% of total variance including lobbing index, bract index, size of nectaries, central leaf lobe shape, No. of locules/boll, infestation percent and placenta thickness. The second axis accounted for 18.5% of the total variance including infestation percent, placenta thickness and the radial diameter of locule cavity. Third axis accounted for 11.4% including lobbing index, bract index and the locule wall thickness. The fourth axis was less importance, including plant height and locule wall thickness. The communality index indicated that the traits lobbing index, central leaf lobe shape, bract index and placenta thickness were more important for phenotypic variance. The results suggested that traits of lobbing index, central leaf lobe shape, bract index and placenta thickness have interrelationship with infestation percent due to these traits have higher coefficient on first axis as well as the infestation percent and radial diameter of locule cavity have high coefficient at second axis. It could concluded that traits lobbing index ,bract index , central leaf lobe shape as well as placenta thickness and radial diameter of locule cavity have interrelationship with infestation percentage. The results of genetic relationship indicated the difference between the parental varieties were larger than it's in F_1 and F_2 generations. The parental genotypes were distinct to two cluster and F_2 genotypes distincted to three clusters while F_1 did not distinct to determined clusters.

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INTRODUCTION

Breeding for insect resistance are needed in cotton cultivars for maintaining plant health through out the growing season and for profitable cotton production. The associations of several morphological traits with resistance to insects have been reviewed by many investigators. **Wilson and George (1982)** reported Okra-leaf to be Pink boll-worms resistance trait. **Jones (1982)** found that the Okra-shape leaf cotton is usually associated with accelerated fruiting rates and early maturity when evaluated under an early season insect central program. **Jones (1972)** stated that the frego bract trait is associated with a high level of resistance to the boll weevil.

Jenkins (1976) reported that frego bract caused a 50 % reduction in boll weevil damaged squares compared with normal bract. **Henneberry *et al* (1977)** found that the nectariless trait provides resistance to the pink boll warm.

Hemaida *et al* (2001) evaluate general and specific combining ability (GCA), (SCA) in half diallel crosses among three Egyptian cotton cultivars and two insect- resistant upland cotton lines they found that the best general combiners were two upland cotton lines for earliness, however, the interspecific cross (F.B x G.83) showed high specific combining ability effect for earliness.

Mariz, S. Max (2004) studied characters related to insect resistance in cotton, she found that multivariate technique use principal components revealed that leaf area and leaf shape index were important components among the morphological characters related to resistance in cotton.

The primary objective of this study is to determine gene action and other genetic parameters for morphological traits related to insect resistance as well as determine the superior genotypes. Second objective to use the multivariate analysis to show interrelationship of morphological and boll anatomical traits which related to insect resistance as well as calculate taxonomic distance between different genotypes.

MATERIALS AND METHODS

Five Egyptian cotton cultivars of *G. barbadense* L (G.91, G.90, G70, G. 88 and Suvin) as well as three upland cotton lines insect resistant involving to *G. hirsutum* namely; Okra leaf, Frego bract and Nectariless. The crosses were made in 2002 at Giza Experiment Station using a partial diallel mating design including the eight parents. In 2003, F1 plants were grown to produce selfed seed of F2 progeny and crossing was repeated to produce more F1 seeds in 2004 season, eight parental with the 12 F1 and F2 hybrids were grown in a randomized complete blocks design with three replicates. The parents were treated as random effect. The rows were 4 m long and 60 cm between rows. Hill was spaced 20 cm within rows and at seedling stage, plants were thinned at two plants/hill. Standard cultural methods and processes for Giza Experiment Stations were used. The measurements were taken on ten guarded individual plants in each plot for morphological characters; lobbing index, bract index, central leaf lobe shape (cm), size leaf nectaries (The measurement with mm and transformed to its. Log), number of locules / boll, plant height(cm) at picking time and infestation percent = ((No. of infested locules / plant) / (Total No. of locules/plant).

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Anatomical traits

Transverse section was made in boll after fertilization at first week for eight parents and twelve hybrids (F_1),to measure some anatomical traits; boll wall thickness, radial diameter locule cavity ; locule wall thickness and. placenta thickness

Statistical and genetical analyses

1- The analysis of variance was calculated according to F-tests by **Cochran and Cox (1957)**.
2- Estimation of general and specific combining ability effects for partial diallel by **Chaudhary *et al* (1977)**.
3- Heterosis percentages were calculated relative to mid-parent (M.P) and better parent (B.P).

$$H (M.P) = F1 - M.P / M.P \times 100$$
$$H (B.P) = F1 - B.P / B.P \times 100$$

4- Inbreeding depression (I.D) =

$$\bar{F}_1 - \bar{F}_2 / \bar{F}_1 \times 100$$

5- Potence ratio =

$$\bar{P}_1 + \bar{P}_2 - 2\bar{F}_1 / \bar{P}_2 - \bar{P}_1$$

The significance of heterosis and inbreeding depression were T-tested by the appropriate least significant difference L.S.D as follows. - L.S D, for

Mid – Parent heterosis $= ta \times \sqrt{3\ MSE\ /\ 2r}$

Better Parent and inbreeding depression $= ta \times \sqrt{2\ MSE\ /\ r}$

6- Heritability estimated, in broad sense ($h^2 b_s$ %) and narrow senses ($h^2 n_s$ %) were calculated by **Verhalen and Murray (1969).**

F_1: $H^2 b_s \% = ((½ A + D) / (½ A + D + E)) x 100$
$H^2 n_s \% = (½ A / (½ A + D + E)) x 100$
F_2: $H^2 b_s \% = ((¼ A + ½ D) / (¼ A + ½ D + E)) x 100$
$H^2 n_s \% = (¼ A / (¼ A + ½ D + E)) x 100$

Where: A=Additive gene effect
D= Dominance gene effect.
E= Enviromental effect

7-Multivariate analysis

A- The factor analysis methods, discussed by **Cattle (1965)** consist of the reduction of large number of correlated variables to much smaller numbers of clusters of variables called (Factor). After loading of the first factor was calculated the process was repeated on the residual matrix to find further factors. The means were normalized prior to multivariate analysis by dividing standard deviation and subtracting the mean for each trait.

B- Cluster analysis was performed on genotypes (r) matrix using measure of square euclidean distance and genotypes are clustered. The genotypes group sequent clustered based on similarity of genotypes, the distance between clusters was measured using the original quantitative characters after calculate the standard units.

RESULTS AND DISCUSSION

The analysis of variance of eight parents and their F_1 and F_2 partial diallel *hybrids for morphological characters are presented in* **Table (1).** The data in **Table (1)** showed that mean squares of genotypes (parents, F1 and F_2) were highly significant indicating that genotypic variability and genetic material were valid to proceed for further analysis. Also the results in **Table (1)** showed significant interaction for mean squares of parents' vs. crosses (between F_1 and F_2) indicating that the average of heterosis and inbreeding depression over all crosses, were significant for these characters, same results were obtained by **Wilson and George (1980).**

Table 1. Mean squares of morphological characters for eight parents, F_1 and F_2 partial diallel hybrids in cotton

S.O.V	d. f	Lobbing index	Bract index	Plant height (cm)	Size of leaf nectaries (mm)	Central leaf lobe shape (cm)	No. of locules /boll
Replicate	2	9.14	10.08	2.0	0.15	0.08	0.03
GENOTYPES	31	110.30**	184.49**	1360.52**	0.25**	1.19**	0.83**
P	7	253.43**	545.62**	2327.78**	0.53**	3.76**	2.04**
F_1	11	85.63**	107.55**	1466.04**	0.200**	0.29*	0.56**
F_2	11	57.99**	44.01**	620.48**	0.15**	0.48**	0.47**
P. vs. F1 hybrids	1	1520.601**	455.524**	1565.418**	2.066**	1.284**	0.152**
F2 hybrids	1	66.066**	30.380**	1364.344**	2.050**	0.887**	0.102**
Error	62	4.49	4.43	47.02	0.02	0.05	0.03

Combining ability and gene action

The variance of F_1 and F_2 hybrids were partioned into main effects, general combining ability (GCA) which equal half additive genetic variance and specific combining ability (SCA) which equal the dominance gene effects.

The data in **Table(2)** revealed that both GCA and SCA variances were significant for all studied characters in both generations except SCA for, central leaf lobe shape in both generations and No. of locules / boll and lobbing index in F_1 generation. These results suggested the presence of additive and non additive in genetic control of these characters, thus the method of recurrent selection can be used to discard the unfavorable alleles and improve these characters. These results are in harmony's with those obtained by **Wilson and George (1980) and (1982)**. The estimates of the narrow sense heritability in **Table (2)** showed that these estimates were high (>50%) for lobbing index and central leaf lobe shape in both generations and No of locules/boll exhibited high estimates of narrow sense heritability in F1 and were moderate (30-.50%) for plant height and No of locules/boll in F_2, while low heritability values (< 30%) were found for plant height in F_1 and bract index in F2. While size of leaf nectaries in both generations exhibited lower narrow sense heritability (< 30%). Different results were obtained by **Bowman and Jones, (1982)** who indicated that the bract size was controlled by additive gene action although dominance gene effect contributed significantly, **Bowman and Jones, (1984)** found that narrow sense heritability estimates were ranged from 20% to 92% for bract surface area, **Rashad (2005)** stated that moderate heritability values were detected for frego bract, bract width and bract area traits.

Performance of parents and general combining ability effects

Table (3) showed mean performance and GCA effects for eight parents. The mean values of parents showed differences with range of 67.91 – 94.02, 39.31 -76.92, 111.67 -176.67, 1- 2.72, 1.73-4.36 and 3.00 – 4.70 for lobbing index, bract index, plant height, size of nectaries, central leaf lobe shape and number of locules per boll respectively. The results in **Table (3)** showed GCA effect for each parents, the results suggested that Okra leaf was good combiner for lobbing index due to it had positive and higher GCA effects in F_1 and F2 generation .While Nectariless exhibited positive and significant general effect in F1 which indicated that this parent was good combiner in F1. Concerning bract index, the parental line "Nectariless" braved to be good combiner for this trait in both generations, while Okra leaf and Frego bract were good combiners in F_2 due to that these parents exhibited negative and significant general effects.

Table 2. Combining ability and heritability for partial diallel hybrids in cotton

S.O.V	d. f	Lobbing index	Bract index	Plant height (cm)	Size of leaf nectaries(mm)	Central leaf lobe shape (cm)	No. of locules /boll
F_1 G.C.A.	7	132.51**	155.99**	1807.72**	0.23**	0.43**	0.86**
F_1 S.C.A.	4	3.57	22.77**	868.10**	0.15**	0.04	0.02
F_2 G.C.A.	7	84.47**	54.87**	844.02**	0.16**	0.69**	0.64**
F_2 S.C.A.	4	11.63*	25.00**	226.11**	0.14**	0.12	0.17**
h^2b, F_1		91.64	94.06	96.19	88.95	73.98	91.43
h^2b, F_2		81.07	78.41	81.58	76.40	74.26	84.44
h^2n, F_1		93.35	69.46	29.62	15.85	80.15	93.49
h^2n, F_2		59.71	28.30	47.08	2.92	57.03	47..15

*, ** significant at 0.05 and 0.01% , respectively.

Table 3. Mean performance and general combining ability effects of eight parents (p) in F1 and F2 partial diallel hybrids in cotton.

Parents	Lobbing index			Bract index			Plant height (cm)			Size of leaf nectaries (mm)			Central leaf lobe shape(cm)			No. of locules /boll		
	Mean P.	GCA (F1)	GCA (F2)	Mean P.	GCA (F)	GCA (F2)	Mean P.	GCA (F1)	GCA (F2)	Mean P.	GCA (F1)	GCA (F2)	Mean P.	GCA (F1)	GCA (F2)	Mean P.	GCA (F1)	GCA (F2)
G. 91	75.61	-2.77	-1.14	68.77	0.81	4.79*	175.67	-23.68*	21.92*	1.81	0.07	-0.02	1.73	-0.13	-0.09	3.00	-0.39*	-0.37*
G. 90	75.50	-3.48*	-1.22	76.92	-2.49	2.46	160.33	-14.42*	4.26	2.41	0.32*	0.29*	1.83	0.08	-0.01	3.00	-0.49*	-0.60*
G. 70	76.86	0.40	1.47	70.14	4.17*	2.91*	171.67	1.86	16.34*	2.72	0.04	-0.02	1.85	0.09	0.08	3.03	-0.25*	-0.35*
G. 88	76.49	-0.90	-0.28	71.49	5.01*	2.14	176.67	12.88*	-5.65	1.65	0.06	0.06	1.74	-0.06	-0.13	3.0	-0.31*	-0.23
Suvin	78.83	-1.19	0.16	63.47	8.74*	0.35	148.33	14.71*	-6.85	1.62	0.15	-0.03	1.79	-0.06	-0.06	3.4	-0.24*	-0.07
Frego bract	67.91	-3.68*	-3.33*	39.31	-0.13	-3.69*	111.67	20.11*	-8.11	1.61	-0.12	0.08	1.35	-0.34*	-0.37*	4.57	0.56*	0.70*
Okra leaf	94.02	5.48*	6.67*	56.79	8.65*	-3.85*	121.50	9.39	-6.36	1.48	-0.24*	-0.22*	4.36	0.29	0.61*	4.70	0.53*	0.51*
Nectariless	93.63	6.15*	-2.33	44.40	-7.47*	-5.12*	114.67	8.58	-15.55*	1.00	-0.27*	-0.14	3.82	0.28	-0.04	4.70	0.60*	0.40*
L.S.D $_{0.05}$	3.46	2.92	2.92	3.44	2.90	2.90	11.20	9.46	9.46	0.25	0.20	0.20	0.36	0.30	0.30	0.26	0.24	0.24

Significant at 5%*

For plant height, the parental G.91 and G.90 were good combiners in F_1 generation, while parental Nectariless was good combiner in F_2 generation, due to that these parents exhibited negative and significant general effects. Regarding size of nectaries the results suggested that Okra-leaf parental was good combiner in both generations and Nectariless was good combiner in F_1. The parental line Okra-leaf was good combiner for central leaves shape in both generations. Concerning No. of locules / boll the parents Frego bract, Okra leaf and Nectariless were good combiners for this trait as these parents exhibited positive and significant general effects. The previous results suggested that the parental Nectariless and Okra leaf were the best parents considered important for insect resistance.

The performance F_1 generation, heterosis and potence ratio

Table (4) presents percentage heterosis over mid-parent, heterosis over better parents and potence ratio. Significant positive heterosis over mid parent was recorded for lobbing index only in crosses (P_2 x P_7) and (P_3 x P_6). Heterosis over better parent was negative significant in all crosses except for crosses of (P_1 x P_4), (P_1 x P_6), (P_2 x P_5) and (P_2 x P_6) these results were confirmed from the values of potence ratio due to that potence ratios were positive and less than unity for all crosses except for two crosses (P_1 x P_4) and (P_1 x P_5). These results suggested that in these crosses there were partial dominance of high lobbing index, however the potence ratios were 1.38 and -1.67 for crosses of (P_1 x P_5) and (P_1 x P_4), respectively, indicating that these crosses exhibited over dominance of high lobbing index in the first cross and of low lobbing index for second cross. Concerning bract index, the results in **Table (4)** showed that three crosses (P_1 x P_4), (P_2 x P_7) and (P_3 x P_7) out of 12 crosses exhibited negative heterosis over mid parent and better parent and their potence ratio suggesting over dominance or complete dominance for low bract index. In opposite of these results the data showed that four crosses exhibited positive heterosis and partial dominance except for the crosses (P_1 x P_5) exhibited over dominance for high bract index. Same results were obtained by **Rashad (2005).** Concerning the plant height there are three crosses exhibited negative heterosis over mid-parent and better parent as well as their potence ratio suggesting over dominance for short plant. The other crosses exhibited positive heterosis with partial dominance or over dominance for increasing plant height.

For size of leaf nectaries, the data in **Table (4)** showed that six crosses out of 12 crosses exhibited negative heterosis over mid-parent and the potence ratio indicated over dominance for crosses (P_1 x P_6) and (P_3 x P_6) and it was partial dominance for crosses (P_2 x P_7), (P_3 x P_7) and (P_3 x P_8) for decreasing size of leaf nectaries, while two crosses of (P_4 x P_8) and (P_5 x P_8) exhibited partial dominance for enlargement size of leaf nectaries. The most of hybrids exhibited positive heterosis over better parent for size of leaf nectaries. Regarding the central leaf lobe shape, three crosses (P_2 x P_8), (P_4 x P_8) and (P_5 x P_8) exhibited heterosis over mid parent was positive and their potence ratio were also positive and less than unity. These observations suggest that the genes for longest central lobe were partially dominant to genes for shortest central lobe. The results also indicated that the three hybrids exhibited negative heterosis over mid parent with partial dominance for gene of longest central lobe. Regarding to number of locules per boll, four crosses exhibited positive significant heterosis relative to mid parent with negative potence ratio less than unity suggesting that partial dominance for decreasing number of locules per boll. All crosses exhibited negative significant heterosis relative to better parent.

F_2 performance and inbreeding depression

Table (5) presents, means of F_2 performance and inbreeding depression. The data showed positive values of inbreeding depressions were 8.84, 13.18 and 10.30 percent in cross (P_3 x P_8), (P_4 x P_8) and (P_5 x P_8) respectively,for lobbing index indicating that dominance and gene interaction controlled this character. While the other crosses exhibited insignificant inbreeding depression suggesting that these crosses had additive effect and it was major component of variance of these crosses. Estimates of bract index in F_2 were lightly higher than those in F_1 therefore, the dominance and epitasis were not important in bract index and that this character was controlled by additive effects. Insignificant differences were noted in other crosses.

For plant height five crosses exhibited significant decrease in F_2 performance in crosses (P_2 x P_6), (P_3 x P_7), (P_4 x P_7), (P_4 x P_8) and (P_5 x P_8) indicating that dominant genes and gene interaction controlled this character in these crosses. While negative values of inbreeding depression for the

Table 4. Mean performance of F_1 hybrids, heterosis % relative to mid - parent (M.P), better parent (B.P) and potence ratio (P.R) for morphological characters in partial diallel hybrids

CROSSES	Lobbing index				Bract index				Plant height (cm)			
	Mean	M.P	B.P	P.R	Mean	M.P	B.P	P.R	Mean	M.P	B.P	P.R
$P_1 x P_4$	76.81	0.99	0.39	-1.67	65.26	-6.94	-5.10*	-3.58	163.33	-7.32*	-7.06*	25.8
$P_1 x P_5$	74.97	-2.85	-4.82*	1.38	74.61	12.84*	17.55*	3.20	108.60	-32.96*	-26.77*	-3.90
$P_1 x P_6$	73.81	2.86	-2.38	0.53	63.13	16.82*	60.00*	0.62	149.33	3.90	33.66*	0.18
$P_2 x P_5$	75.59	-2.01	-4.06	0.94	68.70	-2.13	8.24*	-0.22	123.77	-19.77*	-16.52*	-5.08
$P_2 x P_6$	73.07	1.95	-3.18	0.37	59.68	2.69	51.82*	0.08	174.67	28.46*	56.40*	1.59
$P_2 x P_7$	81.17	4.19*	-13.62	0.38	51.07	-23.61*	-10.07*	-1.57	147.00	4.33	20.99*	0.31
$P_3 x P_6$	75.88	4.83*	-1.30	0.78	66.26	21.08*	68.56*	0.75	174.00	22.79	55.77*	1.08
$P_3 x P_7$	86.92	1.70	-7.55*	-0.17	56.92	-10.31*	0.23	-1.0	178.50	21.76*	46.91*	1.27
$P_3 x P_8$	86.00	0.88	-8.12*	-0.09	60.03	4.74	34.93*	0.21	165.17	15.36*	44.03*	0.77
$P_4 x P_7$	84.04	-1.47	-10.6*	0.14	59.69	-6.94*	-5.11	-0.61	177.00	18.71*	45.68*	1.01
$P_4 x P_8$	84.98	-0.06	-9.19*	0.01	61.73	6.45*	38.75*	0.28	166.50	14.28*	45.16*	0.67
$P_5 x P_8$	85.44	-0.93	-8.76*	0.11	60.72	12.49*	36.48*	0.71	168.00	27.76*	46.47*	2.17
$L.S.D_{0.05}$	3.46	3.0	3.46	-	3.44	2.98	3.44	-	11.20	9.70	11.20	-

Table 4. Cont.

CROSSES	Size of leaf nectaries (mm)				Central leaf lobe shape (cm)				No. of locules /boll			
	Mean	M.P	B.P	P.R	Mean	M.P	B.P	P.R	Mean	M.P	B.P	P.R
$P_1 x P_4$	1.75	1.16	6.06	0.25	1.82	4.90	4.60	-17	3.1	3.33	3.33	0
$P_1 x P_5$	2.11	23.03*	30.25*	4.16	1.82	3.41	1.68	-2	3.1	-3.13	-8.82*	0.5
$P_1 x P_6$	1.51	-11.7	-6.21	-2.0	1.56	1.30	-9.83	0.11	3.97	4.89	-13.13*	-0.24
$P_2 x P_5$	2.04	1.24	25.93*	0.06	1.89	4.42	3.28	4.0	3.07	-4.06	-9.71*	0.65
$P_2 x P_6$	2.15	6.97	33.54*	0.35	1.68	5.66	-8.20	0.38	3.90	3.04	-14.66*	-0.15
$P_2 x P_7$	1.64	-15.68**	10.81	-0.66	2.13	-31.18*	-51.15*	0.76	3.73	-3.12	-20.64*	0.14
$P_3 x P_6$	1.47	-21.18*	-8.7	-1.55	1.66	3.75	-10.27	0.24	4.00	5.26	-12.47*	-0.26
$P_3 x P_7$	1.53	-15.00*	3.38	-084	2.53	-18.52*	-41.97*	0.46	4.10	6.08	-12.77*	-0.28
$P_3 x P_8$	1.54	-27.87*	54.0*	-0.04	2.34	32.58*	-38.74*	0.50	4.17	20.35*	-11.28*	-0.37
$P_4 x P_7$	1.60	2.24	8.11	0.41	2.21	-27.54*	-49.31	0.64	4.03	4.68	-14.26*	-0.21
$P_4 x P_8$	1.47	-22.63*	47.0*	0.45	2.28	33.33*	-40.31*	0.48	4.00	15.94*	-14.89*	-0.18
$P_5 x P_8$	1.50	-20.42*	50.0*	0.61	2.22	27.95*	-41.88*	0.60	4.17	14.25*	-11.28*	-0.18
$L.S.D_{0.05}$	0.24	0.22	0.24	-	0.36	0.32	0.36	-	0.28	0.24	0.28	-

P_1 = Giza 91　P_2 = Giza 90　P_3 = G.70　P_4 = Giza 88
P_5 = Suvin　P_6 = Frego bract　P_7 = Okra leaf　P_8 = Nectariless

Table 5. Mean performance of F2 hybrids and inbreeding depression (I.D) for morphological characters in partial diallel hybrids in cotton

CROSSES	Lobbing index		Bract index		Plant height (cm)		Size of leaf nectaries (mm)		Central leaf lobe shape (cm)		No. of locules /boll	
	Mean	I.D	Mean	I.D	Mean	I.D	Mean	I.D	Mean	I.D	Mean	I.D
$P_1 x P_4$	77.35	-0.65	69.60	-6.65*	174.33	-6.74	1.78	-1.71	1.76	3.30	3.10	0
$P_1 x P_5$	76.71	-2.27	73.30	1.76	175.20	-61.33*	1.68	20.38*	1.73	4.95	3.03	2.26
$P_1 x P_6$	73.55	0.41	65.55	-3.83	180.50	-20.90*	1.63	-7.95	1.48	5.13	4.17	-5.04
$P_2 x P_5$	76.97	-1.85	67.26	2.10	164.10	-32.55*	1.84	9.80	1.87	1.06	3.17	-3.26
$P_2 x P_6$	75.45	-3.15	64.95	8.83*	156.67	10.30*	2.32	9.30	1.71	1.19	3.50	-2.56*
$P_2 x P_7$	81.94	-0.86	63.27	-23.89*	155.67	-5.92	1.59	3.05	2.37	-11.27	3.70	0.80
$P_3 x P_6$	74.62	1.71	63.89	3.58	166.00	4.60	1.57	-6.80	1.48	10.84	4.13	-3.25
$P_3 x P_7$	86.85	0	65.07	-14.32	166.87	6.50*	1.62	-5.88	2.86	-13.04	3.67	10.49*
$P_3 x P_8$	78.42	8.84*	62.39	-3.93	171.0	-3.51	1.50	2.60	1.90	18.80*	3.77	9.59*
$P_4 x P_7$	85.67	-2.02	62.89	-5.36	158.2	10.62	1.50	6.25	2.33	-5.43	4.00	0.74
$P_4 x P_8$	73.85	13.18*	65.03	-5.35	135.50	18.62	1.55	-5.44	1.80	21.05*	3.77	5.75*
$P_5 x P_8$	76.60	10.30**	57.90	4.64	135.67	19.23*	1.57	-4.67	1.89	14.09	4.03	3.36*
$L.S.D_{0.05}$	3.46	3.46	3.44	3.44	11.20	11.20	0.24	0.24	0.36	0.36	0.28	0.28

P_1 = Giza 91 P_2= Giza 90 P_3 = G.70 P_4 = Giza 88
P_5 = Suvin P_6 = Frego bract P_7 Okra leaf P_8= Nectariless

crosses of (P_1 x P_5), (P_1 x P_6) and (P_2xP_5) were noted indicating that the dominance was unimportant. Regarding size of leaf nectaries the cross of (P_1x P_5) showed positive inbreeding depression indicating that dominant genes controlled this character in this hybrid, while the rest of values were insignificant. The two crosses of (P_3 x P_8) and (P_4 x P_8) exhibited positive inbreeding depression indicating that dominant genes controlled this character in these crosses, while the rest of crosses exhibited insignificant inbreeding depression. The dominant gene and gene interaction controlling the number of locules/boll in crosses (P3xP7), (P3xP8), (P4xP8) due to positive inbreeding depression for these hybrids. While (P_2 x P_6) exhibited negative inbreeding depression indicated that this hybrid was controlled by additive genes.

Boll anatomy

The microscopic parameters of transverse section of boll representing both F_1s and their parental varieties are shown in **Table (6).** It is evident that the F_1s showed reduced boll wall thickness when compared with parents. The parental Suvin and F_1 of (G.90 x Okra leaf), (G.70 x Okra leaf) and (G.88 X Nectariless) exhibited lowest boll wall thickness (560 μ) for suvin and (525 μ) for the obivious hybrids. While the parental G.90 exhibited highest boll wall thickness (787.5 μ). Also the F1 hybrid (G. 91 x G. 88) exhibited highest boll wall thickness (735 μ). The radial diameter of locule cavity is shown in **Table (6).** The data indicated that F1 hybrids were smaller than parents regarding radial diameter of locule cavity .The parental suvin and F1 (G.90 x Frego bract) exhibited highest radial diameter of locule cavity (2275, 1977.5 μ) respectively, while the parental Frego bract and F1 (G.70 x Okra leaf) exhibited lowest radial diameter of locule cavity (1512, 1312.5 μ) respectively. The locule wall thickness in **Table (6)** showed differences among parents, the cultivars G.70 and Okra leaf exhibited highest locule wall thickness (262.5 μ) , while the parental G.90 and G.88 exhibited lowest locule wall thickness (157.5μ) However the F1 hybrids exhibited highest locule wall thickness of parents. Concerning the placenta thickness the range of differences between parents was (1050 μ) for Okra leaf and Nectariless and Suvin (875 μ) .Also the results showed difference in placenta thickness of F1 hybrids were reduced compared with parents (525 μ) for (G.91 xG.88) ,(875 μ) for (G.90 x Okra leaf) .It could be concluded that the differences between F_1's were lower than the differences between the parents for all boll measurements .

Table 6. Measurements of anatomical and infestation percent in cotton bolls for eight parents and F_1 hybrids of partial diallel hybrids.

Genotypes	Boll wall thicknes (μ).	Radial diameter of locule (μ)cavity	Locule wall thickness	Placenta thickness (μ	Infestation%
G. 91 (P_1)	752.5	2042.3	175	525	22.50
G. 90 (P_2)	787.5	2100	157.5	700	17.04
G. 70 (P_3)	577.5	1954.8	262.5	700	23.26
G 88 (P_4)	700.0	2217.3	157.5	612.5	12.34
Suvin (P_5)	560.0	2275	192.5	875.0	18.01
Frego bract(P_6)	612.0	1512	210.0	700	12.84
Okra leaf(P_7)	595.0	2030	262.5	1050	9.13
Nectariless (P_8)	700	1540	192.5	1050	7.71
P_1 x P_4	735	1750	280	525	23.46
P_1 x P_5	560	1855	262.5	787.5	19.94
P_1 x P_6	647.5	1838.5	210	787.5	29.25
P_2 x P_5	647.5	1802.5	175	787.5	20.20
P_2 x P_6	612.5	1977.5	175	787.5	18.34
P_2 x P_7	525	1470	175	875	13.03
P_3 x P_6	577.5	1610	175	612.5	25.71
P_3 x P_7	525	1312.5	510	647.5	22.85
P_3 x P_8	612.5	1715	175	700	14.33
P_4 x P_7	612.5	1750	210	612.5	26.89
P_4 x P_8	525	1435	297.5	700	21.44
P_5 x P_8	612.5	1557.5	245	647.5	22.89

Infestation percentage of boll worms

The data in **Table (6)** revealed that the parental cultivars G.88 exhibited lowest infestation percent comparing with other Egyptian cultivars, the data showed that best hybrids For infestation percent were P_2 x P_7 and P_3 x P_8.

Multivariate analysis

A- Factor analysis

The relative magnitude of the coefficient of each trait relating it to the first four principle component from the principal component analysis can often provide an interpretation for each component axes **Table (7).** The sign of the coefficient is irrelevant, and is in fact arbitrary, though negatively correlated traits will generally have opposite signs on given axes **Brown (1991)**. Each character proved to be an important source of variation in at least one P_c axes. However because each of P_c axes was given equal weight in the multivariate analysis some characters might posses greater important in determining plant phenotypes than others (**Hair *et al* 1987**) .The results suggest that the first four principal component axes were accounted for 82.6% of total variance of all characters.

Table 7. Principle factor and communalities of each morphological and boll anatomical traits in partial diallel hybrids.

Factor	Variable	Communality	PC Axes			
			Pc1	Pc2	Pc3	Pc4
	Lobbing Index **	0.952	-0.752	0.028	-0.522	-0.335
	Bract index**	0.898	0.783	-0.156	-0.510	0.018
	Size of leaf nectaries	0.772	0.748	-0.298	-0.070	0.344
1	Central leaf lobe shape	0.961	-0.809	-0.248	-0.460	-0.187
	No. of Locules/ boll	0.847	-0.860	0.231	0.206	-0.108
	Infestation%*	0.781	0.554	0.664	-0.170	0.060
	Placenta thickness*	0.853	-0.698	-0.532	-0.062	0.282
2	Radial diameter of locule cavity	0.770	0.498	-0.672	-0.256	-0.067
3	Locule wall ***thickness	0.796	-0.213	0.401	-0.573	0.511
4	Plant height	0.841	0.476	0.482	-0.195	-0.587
	Variance	9.08	4.59	2.03	1.26	1.21
	Var %	0.826	0.417	0.185	0.114	0.110

*Important at both first and second axes.
**Important at both first and third axes.
***Important at both third and forth axes.

The first (Pc_1) axis account for about 41.7%, Pc_1 has its higher coefficients for lobbing index, bract index, size of leaf nectaries, central leaf lobe shape, No. of locules / boll, infestation percentage and placenta thickness. These results suggested that in intercorrelation is implied among these traits with high coefficients on the same axis **(Brown, 1991)** these results suggested that the leaves traits and placenta thickness have essentially a component of resistance for bollworms. The second principle component account for 18.5% of total variance of all traits, the larger coefficients are on infestation percentage, placenta thickness and radial diameter of locule cavity.

These results indicated that placenta thickness and radial diameter of locule cavity have important component of resistance for bollworm.. The third principle was less important as this component account for 11.4% of total variance of all traits. The higher coefficients are lobbing index, bract index and locule wall thickness with these axis. The forth principal component account for 11%, the traits plant height and locule wall thickness were higher coefficient with the forth axis.

Lobbing index, central leaf lobe shape, bract index and placenta thickness exhibited the higher communality values (h^2 0.952, 0.961, 0.898 and 0.853) suggesting that these traits were important for phenotype variance. The PC1 showed that the lobbing index, bract index, size of leaf nectaries, central leaf lobe shape, No. of locules / boll as well as placenta thickness and infestation percentage were primary source of variation having the largest coefficient in the first axis. However infestation percentage, placenta thickness and radial diameter of locule cavity appeared to have the second largest coefficients. The results showed that infestation percentage and placenta thickness have equal importance at both first and second axes.

These results indicated that lobbing index, bract index, size of leaf nectaries, central leaf lobe shape and No. of locules/boll, placenta thickness and radial diameter of locule cavity were more important in principal component analysis among studied characters related to bollworm resistance in cotton due to that first axis account for 41.7% and second account for 18.5% for all variance. It could conceluded that these traits have essentially of resistance for bollworm. These results were in agreement with those obtained by **Mariz (2004)**.

B- Taxonomic distance between genotypes

Measure of dissimilarity is taxonomic distance based on large number of stble morphological and boll anatomy characters. **Fig. (1)** and **Table (8)** showed that the parental genotypes; Okra leaf and Nectariless consist a cluster at within taxonomic distance 12.64 with level similarity of 71.57% and at taxonomic between other parents 30.00 with level similarity of 32.29% .The other parents were divided at taxonomic distance 27.73 with level similarity of 37.62 for parents Frego bract and rest of parents which represents *G. barbadense* while the obivious parents represents *G. hirsutim*. The parents [(G.70, G.91), (G.88,G 90, Suvin)] exhibited a range of similarity between 74.1% for parent Suvin at taxonomic distance of 11.26 for G.70,G.91 which consist cluster by within distance 5.24 and similarity of 88.21%.

Concerning F_1 Table (8) and Fig. (2) showed that the diversity between F_1 genotypes were ranged between distance taxonomic of 3.10 with similarity level 89.21 for cluster (G.88 x Nectariless),(Suvin x Nectariless)and taxonomic of 11.78 with similarity level 59.01 for F_1(G.90 x Frego bract). These results indicated that diversity between F_1s were less than that between parents indicating that the heterosis effect due to additive gene effects and dominance varince were less important for determing F1 varinces .The dendrogram in **Fig. (2)** showed that the intraspecific hybrids (G91 x Suvin), (G90 x Suvin) were exhibited highly distance and more similarity level however the hybrids (G91x Suvin),(G90 x Suvin) consist a cluster with level similarity 76.67 with distant taxonomic 6.71. The interspecific hybrids (G.90 x Frego bract),(G.90 x Okra leaf) exhibited taxonomic distance and dissimilarity .The Dendrogram in **Fig. (2)** showed the smallest distance between two genotypes (G.88 x Nectariless),(Suvin x Nectariless) is 3.1 with similarity level of 89.21, at the range of distances between 4.96 to 9.30 there are four groups (G.88 x Okra leaf),(G70 x Okra leaf) ,(G.70 x Nectariless) and (G.91x Frego bract),(G.70 x Frego bract) with level similarity ranged between 82.75% to 72.47%. These results suggested that the diversity between the hybrids did not depend upon the distance between parents, this finding is in harmony with that obtained by **El-Hoseiny (2004)**.

Regarding F_2, the dendrogram showed in **Fig. (3)** F_2 genotypes first clusters were divided into three subgroups [(G.91 xG88), (G.90x Suvin)], (G.91 x Suvin) and (G.90 x Frego bract) within

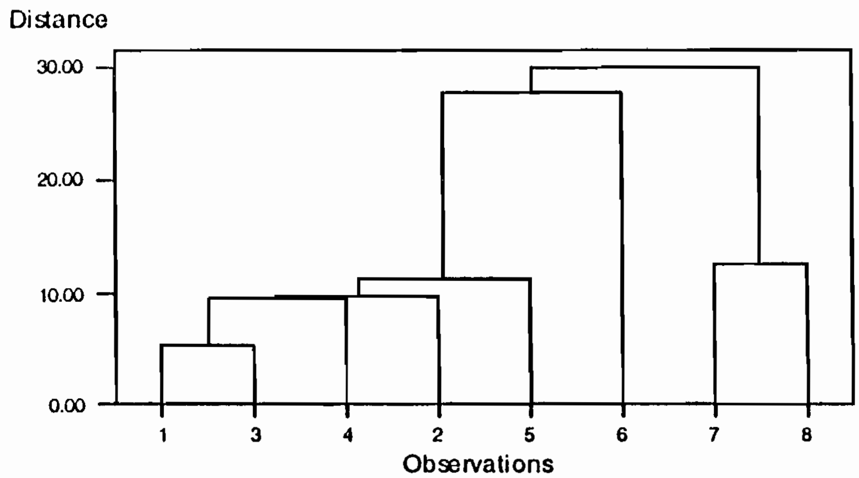

Fig 1. Dendrogram of taxonomic distance of parents for morphological and boll anatomical traits.

1-Giza 91	5-Suvin
2-Giza 90	6-Frego bract
3-Giza 70	7-Okra leaf
4-Giza 88	8-Nectariless

Table 8. Euclidean distance and similarity level for parented, F_1 and F_2 of partial diallel crosses

PARENTAL VARIABLES					F_1					F_2				
No of Clusters	Cluster joined Group 1	Group 2	Distance	Similarity	No of Clusters	Cluster joined Group 1	Group 2	Distance	Similarity	No of Clusters	Cluster joined Group 1	Group 2	Distance	Similarity
7	1	3	5.24	88.21	11	11	12	3.10	89.21	11	1	4	3.51	82.2
6	1	4	9.54	78.55	10	10	11	4.96	82.75	10	3	7	4.20	78.7
5	1	2	9.74	78.10	9	8	10	5.23	81.79	9	1	2	5.31	73.0
4	1	5	11.26	74.69	8	2	4	6.71	76.67	8	6	10	5.69	91.0
3	7	8	12.64	71.57	7	8	9	7.56	73.72	7	6	9	6.22	68.4
2	1	6	27.74	37.62	6	3	7	7.91	72.47	6	3	6	6.33	67.9
1	1	7	30.00	32.54	5	3	8	9.83	65.80	5	3	8	6.50	61.9
					4	3	6	11.10	61.37	4	1	5	7.24	63.2
					3	1	3	11.60	59.66	3	11	12	8.16	58.5
					2	1	2	11.76	59.10	2	3	11	9.57	51.5
					1	1	5	11.78	59.01	1	1	3	9.85	50.0

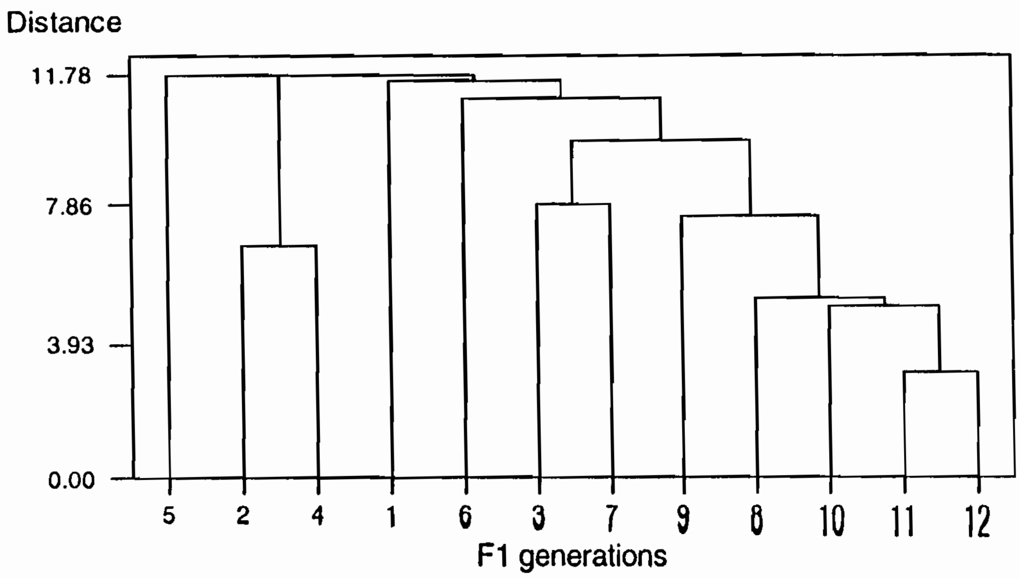

Fig 2. Dendrogram of taxonomic distance of F1 crosses for morphological and boll anatomical traits.

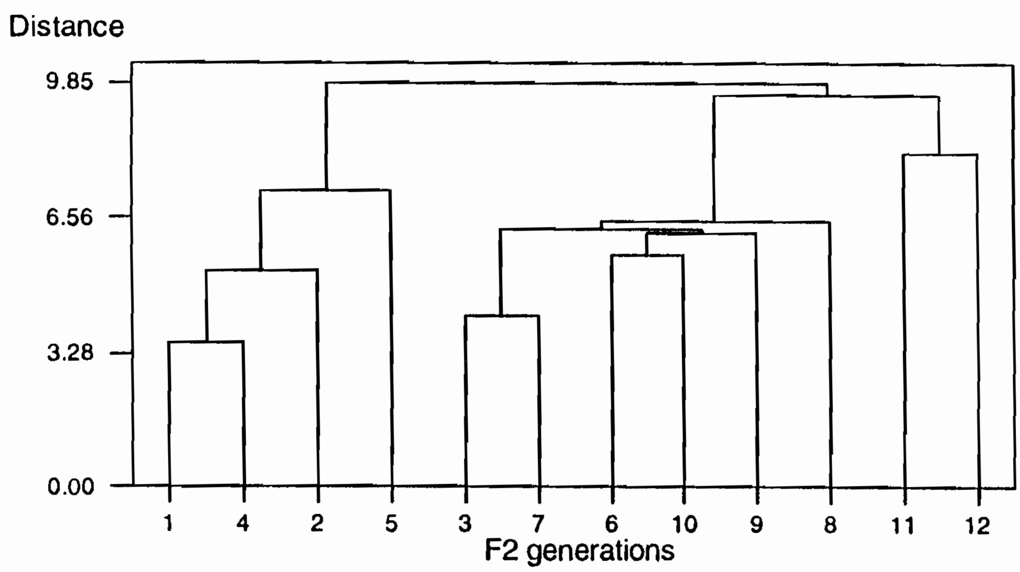

Fig 3. Dendogram of taxonomic distance for F2 crosses from morphological traits

1- Giza 91 xGiza88	5- Giza 90xFrego bract	9- Giza 70x Nectariless
2- Giza 91xSuvin	6- Giza 90xOkra leaf	10- Giza 88xOkra leaf
3- Giza 91xFrego bract	7- Giza 70xFrego bract-	11-Giza 88xNectariless
4- Giza 90xSuvin	8- Giza 70xOkra Leaf	12-Suvin x Nectariless

distance 3.51, 5.31 and 7.24 respectively; with similarly level of 82.16, 73.02 and 66.96 respectively. Three of these hybrids (G.91 x G88), (G.91 x Suvin) and (G.90 x Suvin) were intraspecific while the hybrid (G.90 x Frego bract) was interspecific. The second cluster was divided to two sub cluster at 9.57 with similarity level 51.38. The first sub cluster consist of [(G.88 x Nectariless),(Suvin x Nectariless)] hybrids with within distance 8.16 with similarity level 58.84, the second sub cluster consist of sub groups [(G.91 x Frego bract), (G.70 x Frego bract)] ,[(G.90 x Okra leaf), (G 88 x Okra leaf)] ,(G.70 x Nectariless) and (G.70 x Okra leaf) with within distance of 4.20, 5.69, 6.21 and 6.50 respectively, with similarity level 78.67%, 71.09, 68.41 and 66.96 respectively. It could be concluded that the F_2s genotypes were distnicted to three groups' .The first cluster represents the *barbadense* intraspecific hybrids and the other two cluster represent the interspecific crosses.

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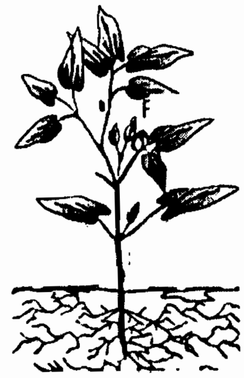
حوليات العلوم الزراعية
جامعة عين شمس، القاهرة
مجلد(٥١)، عدد (٢)، ٣٨٥-٣٩٩، ٢٠٠٦



التقديرات الو راثية وتحليل العامل المتعدد للصفات المورفولوجية و بعض السمات التشريحية في اللوزة لبعض الهجن الصنفية والنوعية في القطن

[٢٦]

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تهدف هذه الدراسة لتقدير القدرة العامة والخاصة على الائتلاف والفعل الجيني وقوة الهجين والانخفاض الراجع للتربية ومعامل السيادة وقد استخدم تحليل العامل المتعدد لتحديد العلاقة المشاركة بين الصفات المورفولوجية والتشريحية للوزة مع نسبة الإصابة لديدان اللوز وكذلك حساب المسافة التقسيمية والعلاقة بين التراكيب الوراثية عن طريق التحليل العنقودي وقد استخدم في هذه الدراسة خمسة أصناف من القطن المصري بالإضافة إلى ثلاثة سلالات من أقطان الابلند الأمريكية المقاومة للحشرات وقد تم التهجين بين الآباء بطريقة الهجن التبادلية الجزئية partial diallel وأجريت التجربة في محطة البحوث الزراعية بالجيزة خلال ثلاثة مواسم ٢٠٠٢، ٢٠٠٣، ٢٠٠٤.

وكانت النتائج كما يلي

وجد أن التباين الو راثي المضيف والغير مضيف يتحكم في هذه الصفات.

نسبة التوريث كانت مرتفعة بالنسبة لصفات معامل التفصيص للورقة وشكل الفص الأوسط بينما كانت متوسطة في ارتفاع النبات وعدد المساكن في اللوزة وذلك في الجيل الثاني بينما كانت منخفضة في صفة حجم الغدة.

لم تكن قوة الهجين واضحة لكل الصفات التي درست ما عدا ارتفاع النبات كما أ ن الانخفاض الراجع للتربية الداخلية لم يكن كبيرا في جميع الصفات المدروسة مما يدل على أن هذه الصفات يتحكم فيها التأثير المضيف للجينات.

كانت السيادة الجزئية هي المميزة للعلاقة بين الأ ليلات في هذه الصفات.

وجد أن أفضل الآباء قدرة على التآلف لكل الصفات تحت الدراسة كا نت السلا لتين Okra leaf و Nectariless المقاومة لديدان اللوز وان الهجين النوعي (جـ٧٠ × Okra leaf) تفوق في كل الصفات التي تم دراستها في الجيلين الأول والثاني.

تبين من التحليل المتعدد العوامل أن الصفات تحت الدراسة تجمعت في أربع محاور تمثل ٨٢,٦% من التباين الكلي.

وأشتمل المحور الأول على الصفات المورفولوجية وسمك المشيمة في اللوزة ونسبة الإصابة ويمثل٤١,٧% من التباين الكلي وأشتمل

تحكيم: ا.د عبدالمقصود محروس المراكبي
ا.د سميح إسماعيل حافظ

المحور الثاني على صفتي سمك المشيمة ونصف قطر فراغ المسكن مع نسبة الإصابة ويمثل ١٨,٥% من التباين الكلى والمحور الثالث يمثل ١١,٤% من التباين الكلى وأشتمل على صفات معامل التفصيص والقنابة مع سمك جدار المسكن والمحور الرابع يعتبر اقل أهمية ويمثل ١١% من التباين الكلى ويشمل ارتفاع النبات وسمك جدار المسكن.

أظهر تحليل العامل المتعدد زيادة قيمة معامل المشاركة لصفات معامل التفصيص والقنابة وشكل الفص الأوسط و عدد المساكن في اللوزة وكذلك لصفة سمك المشيمة مما يدل على أهميتها كمكون للتباين.

نستخلص من النتائج السابقة أن المقاومة لديدان اللوز تعتمد على الصفات التشريحية للوزة كصفة سمك المشيمة وسمك جدار اللوزة مع اعتمادها على الصفات المورفولوجية للورقة.

أظهر التحليل العنقودي أن الآباء تجمعت في مجموعتين مجموعة تمثل *barbadense* والأخرى تمثل *hirsutum* مع وجود اختلافات كبيرة في مجموعة الابلند عن مجموعة المصري.

كانت الاختلافات بين أفراد الجيل الأول والثاني أقل من الاختلاف بين الآباء و لم يتميز الجيل الأول إلى مجموعات محددة ولكن في الجيل الثاني تميز إلى ثلاث مجموعات محددة وكذلك الآباء تميزت إلى مجموعتين.