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INHERITANCE OF SOME ECONOMIC CHARACTERS IN PEANUT (*Arachis hypogaea* L.)

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ABSTRACT

The aim of this study is to determine combing ability and gene action for yield components in peanut. A diallel cross, without reciprocals, among five parent was done in 2004 season. The parents and their 10 F's$_1$ were sown in 2005 at the experimental station of the Agricultural Research Center (ARC), Ismailia. Results reveald positive and significant heterobeltioisis in all characters. Both additive are non- additive gene actions were important to control the expression of all the studied characters (i.e, the additive genetic variance was important than dominance genetic variance for all most studied characters) . The GCA was greater than that of the SCA for all studied characters. Both P_2 (cona) and P_5 ($N.A_{623}$) seem to be good combiners for most characters. Two crosses ($P_1 \times P_2$ and $P_2 \times P_3$) showed significant effect for most of desired characters including seeds weight.. The estimates of heritability in broad (h^2_b) sense were larger than their corresponding valuse in narrow sense (h^2_n) for all studied characters.

Key wards: ***Peanut, Heterosis, General combing ability, Gene action, Heritability.***

INTRODUCTION

The peanut or groundnut (*Arachis hypogaea* L.) is one of the most important oil seed crops not only in Egypt but also in other parts of the world. In Egypt, it is used mainly as a confectionary crop rather than an oil seed crop. Consequntly, in creasing seed yield is the main objective of peanut breeding programs in our country.

Information on variation, heritability and nature of gene action controlling the various agronomic and physiological characters of any crop plant are of crucial importance to breeders in elaborating the suitable breeding program for the improvement of this crop. The genetic components in different peanut material of some economic characters were studied.Vindhiyavarman and Raveendran (1994), Francies and Ramaling (1999), Mathure *et al* (2000) and Rudraswamy *et al* (2001) repored the predominance of non- additive gene action for number of pegs, number of pods, pods yield, number of kernels, kernel yield, number of main axis, number of primary branches, number of secondary branches, number of nodes on main axis and oil content. However, the role of additive gene action for pods weight was reported by Varman (1998). Whereas, epistatis (i.e.,intergenic interaction) also plays an important role in controlling number of matyre pods per plant (Vindhiyavarman 2001).

Heritability estimate is useful in predicting the expected genetic advance from selection in segregating peanut populations. Estimates of heritability for peanut traits were reported by several researchers (Rudraswamy *et al* 1999, Ayub- Khan *et al* 2000 and Yogendra- Prasad 2002).

The aims of this work were to get information about the nature and magnitude of gene action and heritability for yield and its components for five peanut lines utilizing data from thier diallel crosses.

MATERIAL AND METHODS

The present work was conducted at the experimental station of the Agricultural Ismalia, during two successive seasons (2004 and 2005). In the first season, five parental peanut pure lines and cultivars were chosen to repressnt awid range of variability in most of the economic characters. Table (1) shows the parents used and their origin.

Table1. Parent of diallel crosses and their origin.

Parent	Name	Origin
1	Giza 5	Egypt
2	Cone	USA
3	Giza 6	Egypt
4	Ismalia 1	Egypt
5	Line 623	Egypt

They were crossed in all possible combinations excluding reciprocals to obtain hybrid seeds from 10 F_1 crosses.

In 2005 season, the parents and their 10 F_1 hybrids were sown in a randomized complete block design with three replications. Each block contained 10 F_1 hybrids and the five parents, making 15 entries per block. Each entry was planted in a single row plot, 4 m long and 60 cm apart. Plants were spaced 20 cm apart within row. All the data of the parents and F_1' s were recorded on an individual plant basis from a random sample of five plants per plot for parents and F_1' s. Characters studed were; stem height, number of pods / plant, pods weight / plant, seeds weight / plant, 100 pods weight, 100 seeds weight, shelling percentage and oil percentage. Estimates of combining ability (GCA and SCA) were computed according to Griffing 's method 2 model 1(Griffing 1956). Partitioning of genetic variance were calculated according to the procedure outlined by Hayman (1954). Hetrobeltiosis percentage was determined for individual crosses deviation from better parents according to Bhatt (1971).

RESULTS AND DISCUSSION

Mean performance of parent and F_1's

The results showed significant differences among genotypes (parents and F_1 crosses) for all studied traits except shelling percentage. The mean performance of the five parents and 10 F_1 hybrids for the traits is presented in Table (2).The hybrids showed higher means for all traits. Means for stem height, number of pods /pl., pods weight / pl., seed weight / pl., 100 pods weight, 100 seeds weight, shelling percentage and oil percentage were 18.7 cm, 18.2, 29.6 g, 25.1g, 155.8g, 76.7g, 85.6% and 46.4% in parents, respectively. Meanwhile in hybrids were 20.4 cm, 22.7, 38.5 g, 33.2 g, 157.2 g,, 92.1 g, 86.0% and 47.8%, respectively. Besides, the upper limits of ranges for hybrids were higher than upper limits of the parents for all characters except 100 pods weight and shelling percentage.

Table 2. Mean performance of five lines and their 10 F_1 's for differe characters.

genotypes	Stem height (cm)	No. of pods/ plant.	Pods weight/pl ,(g)	Seed weight (g)	100 pods weight (g)	100seeds weight (g)	Shelling percentage	Oil percentage
P_1	14.6	16.5	26.2	20.8	90.1	65.9	82.0	43.1
P_2	17.1	23.4	35.2	29.8	173.7	75.3	84.0	41.7
P_3	18.5	16.5	28.5	22.8	192.7	72.7	81.6	45.9
P_4	21.1	15.2	27.1	22.3	172.3	81.3	85.9	49.4
P_5	22.2	19.5	31.2	29.6	150.0	88.3	95.0	51.9
1×2	18.6	21.5	38.3	33.0	175.3	92.0	86.3	47.0
1×3	22.5	19.3	36.7	27.6	156.3	76.0	79.7	44.9
1×4	15.8	16.9	26.8	23.0	135.3	77.3	85.5	46.3
1×5	23.6	22.1	36.0	33.1	112.7	88.7	93.4	50.1
2×3	20.3	29.7	48.7	44.9	169.3	86.3	91.9	47.3
2×4	18.4	19.0	31.9	26.0	180.3	87.0	81.1	45.2
2×5	16.0	22.1	37.6	32.5	182.3	84.3	83.2	44.5
3×4	18.9	16.4	26.0	22.0	168.0	82.3	87.7	50.0
3×5	22.9	21.9	38.7	32.7	168.0	81.3	81.0	50.5
4×5	26.5	19.8	34.5	31.8	144.0	89.0	90.6	52.1
Parental mean	18.7	18.2	29.6	25.1	155.8	76.7	85.6	46.4
Parental range	14.6-22.2	15.2-23.4	26.2-35.2	20.8-29.8	90.1-192.7	65.9-88.3	81.6-95.0	41.7-51.9
Hybrids mean	20.4	22.7	38.5	33.2	157.2	92.1	86.0	47.8
Hybrids range	15.8-26.5	16.4-29.7	26.0-48.7	22.0-44.9	112.7-182.3	76.0-92.0	79.7-93.4	44.5-52.1
L.S.D.0.05	3.7	3.2	4.3	5.6	24.5	7.9	8.2	3.3

Heterobeltiosis

Percent heterobeltiosis (relative to the better parent) for studied traits are presented in Table (3). Significant positive hetrobeltiosis effects relative to better parents values may be considerdas favourable for most characters under investigation. However, for stem height, the model plant height in peanut is not fully known to judge the value of hybrids with negative or positive heterosis. Fortunately, F_1 crosses with either negative or positive magnitude are shown in the present crosses.

Table 3. Hetrobeltiosis % of the studied traits for F_1 crosses.

crosses	Stem height(cm)	No. of pods/pl.	Pods weight(g)	Seed weight (g)	100 pods weight (g)	100seeds weight (g)	Shelling percentage	Oil percentage
$P_1 \times P_2$	8.8	-8.1*	8.8**	10.7**	0.92	22.2**	2.7	9.0**
$P_1 \times P_3$	21.6**	17.0**	28.8**	21.1**	-18.9**	4.5	-2.8	-2.2
$P_1 \times P_4$	-25.1**	2.42	-1.1	3.1	-21.5**	-4.9*	-0.5	-6.3**
$P_1 \times P_5$	6.3	13.3**	15.4**	11.8**	-24.9**	0.5	-1.2	-3.5*
$P_2 \times P_3$	21.6*	26.9**	38.4**	50.7**	-12.1**	14.6**	9.4**	3.1
$P_2 \times P_4$	-21.7**	-18.8**	-9.4**	-12.8**	3.8	7.01**	-5.6**	-8.5**
$P_2 \times P_5$	-27.9**	-5.56	6.8*	9.1*	5.0	-4.5*	-12.1**	-14.3**
$P_3 \times P_4$	-10.4**	-0.61	-8.8**	3.5	-12.8**	1.2	2.2	1.2
$P_3 \times P_5$	3.1	12.3**	24.0**	10.5*	-12.8**	-7.9**	-14.7**	-2.7
$P_4 \times P_5$	19.36**	1.34	10.6**	7.4	-16.4**	0.8	-4.6*	0.4

*** and * * indicate significant at 5% and 1% level 0 probability, respectively.**

Four crosses showed positive and highly significant hetrobeltiosis for number of pods /pl.. The most desirable and significant hetotic effect for number of pods / pl. was obtained by the cross ($P_2 \times P_3$).

With respect to seed weight /pl., six out of ten crosses exhibited significant or highly significant positive heterobeltiosis, one of them was ($P_2 \times P_3$). It exhibited the maximum positive heterobeltiosis in shelling percentage. This cross out-yielded their higher parent by (50.67%).

For 100 pods weight, none of the crosses revealed significant and positive hetrotic value.

Three crosses revealed a highly significant positive hetrobeltiosis with respect to seed weight.

The highest hetrobeltiosis effect (9.40%) with respect to shelling percentage was shown by the cross ($P_2 \times P_3$).

Regarding oil percentage, one cross ($P_1 \times P_2$) showed highly significant positive deviation from the better parent. Similar results were reported by El- Sawy and Abde-Hakim (1999), Jayalakshmi *et al* (2000) and El- Sawy (2006).

Combining ability

The analysis of variance for general and specific combining ability was significant or highly significant for all studied traits (Table 4). These results indicated the importance of both additive and non-additive components of genetic variance in the inheritance of these characters. The magnitude of GCA for all studied characters indicates that for all studied characters additive type of genetic variance is more prevalent. The ratio of both estimates exceeded the unity for all studied characters. This indicates that most of the genetic variation among the investigated genotypes for the all traits appears to be additive. Thus, selection could be effective for improving these traits. The importance of additive and non –additive gene action for such characters were also reported by El-Sawy and Abde-Hakim (1999), Francies and Ramalingam (1999), Varman (2000a and b), Ruraswamy *et al* (2001) and El-Sawy (2006).

Table 4. Mean squares for general (GCA) and specifi (SCA) combing ability and their ratio.

S.O.V	Stem height (cm)	No. of pods/pl.	Pods weight(g)	Seed weight (g)	100 pods weight (g)	100seeds weight (g)	Shelling percentage	Oil percentage
GCA	57.2**	80.0**	177.1**	6305.4**	178.5**	336.9**	78.1*	357.6**
SCA	26.6**	25.6**	93.0**	724.1**	99.1**	134.8**	68.7*	114.6*
GCA/SCA	2.1:1	3.1:1	1.9:1	8.7:1	1.8:1	2.5:1	1.1:1	3.1:1

Data given in Table (5) shoed that P_2 (CONA), from USA had highly significant positive GCA effects (g_i) for number of pods/plant, pods weight /plant, seed weight/plant and 100 pods weight. Thus, this stock proved the best potential for improving these traits. Moreover, P_5 (line 623) could be considered as agood source for improving stem height, seeds weight /plant, 100 seeds weight, shelling percentage and oil percentage. It could be observed that the previous conclusion was in harmony with the mean performance of parental genotypes indicating the efficiency of phenotypic performance for detecting the potentiality of parents for inclusion in cross breeding programs.

Table 5. General combining ability effects for studied characters.

Parent	Stem height (cm)	No. of pods/pl.	Pods weight (g)	Seed weight (g)	100 pods weight (g)	100seeds weight (g)	Shelling percentage	Oil percentage
P_1	-1.51**	-1.02	-1.59	-2.07	-26.9	-3.61*	-095	-1.33*
P_2	-1.75**	2.74**	3.65**	3.32**	15.21**	1.30	-0.72	-2.35**
P_3	0.52	0.05	0.82	0.006	14.13**	-2.83	-1.72	0.05
P_4	0.005	-2.49**	-3.99**	-3.62**	3.44	1.02	0.16	1.22*
P_5	2.43**	0.71	1.12	2.36*	-5.87	4.12*	3.23*	2.41**
Sgi	0.45	0.67	0.90	1.18	5.18	1.67	1.72	0.57
$Sg_i - Sg_j$	0.71	1.65	1.42	1.80	8.19	2.64	2.73	0.89

Table (6) shows the estimates of SCA effects for the studied characters in ten crosses. Results indicated that three out of the ten crosses ($P_1\times P_3$, $P_1\times P_5$ and $P_4\times P_5$) showed significant or highly significant SCA positive effect for tallness and two crosses viz ($P_1\times P_4$ and $P_2\times P_3$) exhibited significant (s_{ij}) effects of shortness. Only one cross ($P_2\times P_3$) exhibited highly significant positive (s_{ij}) effects for number of pods/plant and pods weight /plant. Moreover, with respect to either seed weight /plant^{-1} or 100 seed weight, one cross ($P_1\times P_2$) showed highly significant positive SCA effects.Besides, This cross recorded also highly significant positive (s_{ij}) with respect to seed oil content. The cross ($P_2\times P_3$) exhibited highly significant (s_{ij}) positive effects for 100- pods weight. With respect to shelling percentage one cross viz ($P_2\times P_3$) showed significant positive SCA effects. Moreover, the cross viz ($P_1\times P_2$) exhibited highly significant (s_{ij}) positive effects for oil percentage

Table 6. Specific combining ability effects for studied characters.

cross	Stem height (cm)	No. of pods/pl.	Pods weight (g)	Seed weight (g)	100 pods weight (g)	100seeds weight (g)	Shelling percentage	Oil percentage
$P_1\times P_2$	-0.42	-.21	2.67	28.97**	2.95	12.46**	2.05	3.38**
$P_1\times P_3$	3.82**	0.28	3.90	11.06	0.87	0.59	-3.55	-1.12
$P_1\times P_4$	-3.16**	0.42	-1.19	0.74	-0.10	-1.95	0.36	-0.90
$P_1\times P_5$	2.96*	2.42	2.90	-12.54	4.01	6.34	5.19	1.72
$P_2\times P_3$	1.86	6.92**	10.65**	-18.06	12.78**	5.98	8.42*	2.29*
$P_2\times P_4$	0.01	-1.24	-1.33	3.63	-2.49	2.83	-4.27	-0.98
$P_2\times P_5$	-4.14**	-1.15	-0.77	14.94	-1.98	-2.97	-5.24	-2.87*
$P_3\times P_4$	-1.79	-1.15	-4.40*	-7.59	-3.18	2.26	3.33	1.42
$P_3\times P_5$	0.53	1.14	3.18	-3.27	1.54	-1.84	-6.44	0.43
$P_4\times P_5$	3.97**	1.59	3.80	11.59	4.27	2.02	1.28	1.16
s_{ij}	1.16	1.74	2.32	13.37	3.05	4.31	4.45	1.12

Gene action and heritability estimates

Estimates of the genetic and environmental components of variance and other derived statistics are presented in Table (7). The additive components of genetic variability (D) were highly significant for 100 pods weight and oil percentage, indicating that the additive gene action was more important than the non-additive in controlling the inheritance of these characters. Similarly, H_2 component values were significantly positive for all characters. Theoretically, H_2 should be equal to or less than H_1 (Hayman 1954). H_1 was greater than H_2 in all traits indicating that the positive and negative alleles at the loci for these characters were not equal in proportion in the parents. Values of H_1 were grater than the respective D values for stem height, number of pods/plant, pods weight/plant, seed weight, 100-seed weight and shelling percentage, indicating the important role of dominant genetic variance. On other hand, values of D were grater than H_1 for 100-pods weight and oil percentage. This suggested that additive genetic variance was more important. Similar results were also reported by Varman (2000b) and Mathur *et al* (2000). The over-all dominance effects, as algebric sum over all the loci in heterozygous phase in all crosses (h^2), was positive and highly significant for seed weight/ plant, indicating that most of the dominance genes had positive effects.

The distribution of relation frequencies of dominant versus recessive genes (F) were positive and significant for 100 pods weight, suggested greater frequency of dominant alleles in the parents for this trait. All estimates of the environmental variance (E) were insignificant for all studied traits, except stem height and 100 pods weight, indicating that all traits have not been greatly affected by environmental factors, except stem height and 100 pods weight.

The weighted measure of average degree of dominance $(H_1/D)^{½}$ was more than unity for all characters, except 100 pods weight and oil percentage, indicating that over dominance is controlling these traits. Consequently, selection for any of these characters in segregating generations will be non effective. To improve these characters, indirect selection for characters correlated with the character in question may be of some helps.

Table 7. Estimates of genetic and environmental components values for studied characters.

Genotypes components	Stem height(cm)	No. of pods/pl	Pods weight(g)	Seed weight(gm)	100 - pods weight(g)	100 -seeds weight(g)	Shelling percentage	Oil percentage
D	9.35±2.34**	10.88±5.9	13.23±16.98	118.29±20.85	1576.09±119.24**	72.58±147.52	29.98±11.31**	18.12±2.03**
F	3.57±5.62	-3.83±14.13	-14.36±40.75	11.58±50.02	700.45±286.06*	135.38±353.88	25.25±27.14	5.17±4.87
H_1	37.05±5.64**	32.01±14.2*	114.3±40.9**	120.65.6±50.2*	1060.40±287.07**	684.36±355.14*	93.05±27.24**	15.43±4.88**
H_2	32.77±4.97**	28.93±12.5*	94.23±36.03**	106.94±44.23*	418.91±252.95**	604.35±312.92*	87.28±24.01**	14.68±4.30**
h^2	6.97±3.33*	17.97±8.4	88.51±24.2	80.28±29.71**	29.42±169.89	43.45±210.17	0.29±16.12	4.94±20.89
E	1.79±0.28*	1.86±2.08	3.16±6.01	15.65±7.37	83.58±42.15*	8.15±52.15	5.10±4.01	1.73±0.71
$(H_1/D)^{½}$	1.99	1.72	2.93	2.55	0.82	3.07	1.76	0.92
$H_2/4H_1$	0.22	0.22	0.21	022	0.19	0.22	0.23	0.24
k_D/k_R	1.21	0.83	0.69	078	1.74	1.87	1.62	1.36
$h^2/4H_2(k)$	0.21	0.63	0.94	0.75	0.04	0.07	0.01	0.34
h^2_n	0.38	0.55	0.51	0.45	073	0.05	0.20	0.65
h^2_b	0.65	0.75	0.83	0.75	0.74	0.64	0.36	0.75

The proportion (H_2 / 4 H_1) was lower than 0.25, suggesting that the positive and negative alleles were not equally distributed among the parents. The ratio of dominance and recessive genes in the parents (k_D/ k_R) was less than unity for number of pods /plant, pods weight/ plant and seed weight /plant. Meanwhile, this ratio was greater than unity for stem height, 100-pods weight, 100 seed weight, shelling percentage and oil percentage, which indicated on axcess of dominant genes in the parents for these traits.

The ratio h^2 / H_2 (k) estimates the number of gene groups controlling a character and exhibit dominance to some degree. In general, an under estimated quantity isobtained when the gene effects are not equal.

Heritability estimates in the narrow sense (h^2_n) as well as in the broad sense (h^2_b) for studied characters are presented in Table (7). It was obvious that all studied characters had high values in the broad sense except shelling percentage.

Narrow- sense heritability estimates was low for stem height, seed weight / plant, 100- seed weightand shelling percentag. Meanwhile, h^2_n was high for 100- pod weight. It was medium for number of pods/plant andpods weight/plant. Whereas,it was very medium for oil percentage. The low value of narrow sense heritabilty are due to mainly to dominanace variance components acounted for agreat portion of the genetic of these characters. Different estimates of heritability in narrow sense (h^2_n) and in the broad sense (h^2_b) was recorded by some researchers (Rudyaswamy *et al* 1999, Ayub- Khan *et al* 2000 and Yogendra *et al* 2002).

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وراثـة بعض الصفـا ت الاقـتـصاديـة فى الفــول الســودانى

محمود جـابــر الـسـبـاز - عـلى نـاصف على عبــد العال -
سـمـر أحمـد منـيـر الـشـــخـص

مـعهـد بـحـوث الـمـحاصيـل الحـقليه - قـسـم بـحـوث الـمـحـاصيـل الزيـتـيـة -
مـــركـــز الـبـحوث الزراعـية

يهـدف هـذا البحث إلـى دراسـه الـمقـدرة على الائتـلاف وتحـديـد الـفعل الجـيـنى للمحصـول و مـكـونـاته و كذلك دراسة قـوة الهجين بالـنـسبـه للاب الافضل فى كـل هـجـين. و قـد تم التهجين بين خمسة أباء متباينه فى صفاتـــهـا هى: جـيـزة٥ ، كونان ، جـيزة ٦ ، إسـماعـيـليه١ ، سلالة٦٢٣ و ذلك بنظام الهجن الـدائريه ما عدا الهجن العـكـسـية.أظهرت الـنتـائج تـفوق بعض الهجن تـفوقا موجبـا و معنويـا و ذلـك بالـنـسـبـه لصفــات المحصـول و مكوناتـه. كمـا أظهـرت النتـائج أن القـدره العامه على الائتلاف لهـا دور أكبر من القدره الخـاصه على الائتلاف لجميع الصفات الـمدروسه . و قد أوضحـت الدراسه أن الاب رقم ٢ (كونا) و الاب رقم ٥ (سلاله ٦٢٣) يعتـبر أفـضل الابـاء فـى القـدره العامـه علـى الائتـلاف لـمعظم الصفات . كما أتضح أن هناك هجنـين تفوقا فى عدد مـن الـصفات متـضمنه المحـصول ($P_1 \times P_2$) و ($P_2 \times P_3$) مما يـنصح بهـا للاسـتخدام فـى بـرامج التربيـه المـستقـبليه . و أظهرت جميع الصفات أهمية كلا من التأثير الـجـينى الراجع الى الـسـيـاده و التاثير الجـينى المضـيـف لـجـميع الـصفـات . كمـا أوضحـت الـنتـائج الـمتحـصل عـليـها أن التـأثـير الـجـينى الراجع الى الـمـضـيـف يمثل أهم مكونات الـفعل الجينـى لصفتى وزن ١٠٠ قرن ونسبة الزيـت. وقـد سـجلت جميـع الـصفـات المدروسه قـيم عاليـه لـكـفـاءة الـتـوريـث بـمـعـناهـا الـعـام.