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ESTIMATES OF GENETIC COMPONENTS FOR SOME CHARACTERS IN FABA BEAN (*VICIA FABA L.*)

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ABSTRACT : Six local geneotypes of faba bean (Sakha 1, Sakha 2, Nubarya 1, Giza 714, Giza 461 and Giza 3) were crossed in half diallel excluding reciprocal, to estimates the genetic components using three methods i.e., Hayman (1954), Jones (1956) and Griffing (1956) for some characters i.e., plant height, number of pods/plant, number of seeds/pod, 100-seed weight and seed weight/plant. This investigation was carried out during, 2002/2003 and 2003/2004 winter seasons at Tag. El-Ezz Researched Station, Dakhlia Governorate Agriculture Rereach Center (ARC) . In the second season 2003/2004 the obtain F_1's with the six parents of faba bean were evaluated in a randomized complete block design with three replicates. The results indicated that the importance of additive and dominance gene effects in the genetic control for all studied characters. The average degree of dominance $(H_1/D)^{0.5}$ was more than unity for all characters, except plant height. The ratio $(H_2/4H_1)$ were close to theoretical value for grain weight/plant, suggesting equal distribution of positive and negative alleles among parental genotypes. Heritability in narrow and broad sense were hight for plant height and 100-seed weight whereas, heritability was low (less than 40%) for the remaining characters in narrow sense.

Analysis of variance for combining ability indicated significant mean squares of gca and sca for all studied characters. General combining ability effects (gca) indicated that faba bean

cultivars (Sakha 1, Sakha2 and Giza3) were good combiners for plant height and seed weight/plant. Results of sca effects indicated that cross combinations i.e., Sakha1 × Sakha 2, Sakha 1 × Noubarya 1, Noubarya 1 × Giza461 and Giza 714 × Giza 461 had good sca effectes and displayed bair amount of heterotic effects.

Key words: wheat, diallel, genotype, additive, dominance, inheritance.

INTRODUCTION

Faba bean *(Vicia faba, L.)* is one the most important legume crops in Egypt that has the potential to provide the Egyptian pepole increasing demand for plant protein enhances. So, the responsibility of plant breeders are to bridge this gap through improving and developing high yielding faba bean genotypes as a quick and cheap solution in the present time. Diallel cross design is widely and extensivily used for estimating the types of gene action. Many researchers used diallel technique to obtion genetic information about yield and its components in faba bean to help in planning correct and effective breeding program to improve seed yield and yield components .

In this respect, Poulsen (1977) and El-Hosary (1983) indicated that the dominance and additive gene effects played the major role in the inheritance of yield and its components in faba bean. El-Hady (1988), El-Hady *et al.*, (1991a) El-Lithy (1996) Helal (1997) and Salama and Manal Salam (2001) found that the non additive genetic components was more important in the inheritance of 100-seed weight and number of seeds/plant and number of pods/plant.

El-Lithy (1996), Helal (1997), and Abdalla *et al.*, (1999) used the diallel in faba bean and indicated that the major part of variation was due to additive gene effects for number of pods/plant, number of seeds/plant and seed yied/plant.

MATERIALS AND METHODS

This investigation was carried out at Tag El-Ezz

Research Station, Dakhlia Governorate (ARC) during 2002-2004, using six local genotypes of faba bean which are given in Table (1) were crossed in all possible combinations, excluding reciprocals to obtain F1's seeds. In 2003-2004 growing season the 15 F_1's seeds and six parental genotypes were sown in 1st November 2003. A randomized complete block design with three replicates was used. Each plot consisted of 6 ridges; The ridge was 3m length and the distance between plants were 20cm and 60 cm. between ridges. The plot area was 10.8 m^2. Seeds were sown at in hills two seed/hill at both sides of the ridge. The recommended agricultural practices for faba bean production were applied at the proper time.

Data of the following traits were recorded on 10 guarded and competitive plants chosen at random from each plot. plant height (cm.), number of pods/plant, number of seeds/pod, 100-seed weight (g) and seed yield/plant (g).

Biometrical analysis.

The obtained data were subjected, firstly, to the usual analysis of variance. Assessment and quantifying the types of gene action were computed according to Hayman, (1954), Jones (1956) and Mather and Jinks, (1982). General and specific combining ability effects and variance were estimated using Model 1, Method 2 of Griffing (1956) for studied characters.

RESULTS AND DISCUSSION

1. Jones method.

In Table (2) results indicated that the both additive (a) and dominance (b) gene effects (Jones 1956) were significant for all studied characters, indicating improtantace the additive (a) and dominance (d) genetic variance in the genetisat characters. The importance of additive and dominance gene effects were found by El-Hosary (1983), and Salama and Manal (2001).

When the dominance component (b) was partitined to its components of b_1, b_2 and b_3, the results revealed that these components were highly significant

for all studied traits, except b_2 for plant height. Significant of the "b_1" itm indicated that the means of F_1's and parent were significantly different. Thus, dominance deviations of genes are predominantly acting in one direction i.e., dominance is undirectional. The "b_2" item which refer to the mean dominance deviation of F_1's from their mid parent value over arrays. The "b_3" item which test that part of dominance that is unique to each F_1.

2. Hayman method

The genetic variance partitioning to its constituents parts of additive (D) and dominance (H_1 and H_2) gene effects (Hayman, 1954) Table (3) indicated that both additive and dominance gene effects controling the studied characters, the itms for these characters were significant. These results are in agreement with those of El-Lithy (1996) Helal (1997), Abdalla *et al.*, (1999) and Salama and Manal (2001). The magnitude of (H_1 and H_2) components were larger than (D) ones for all characters, except plant height. The "D" value was more than H_1 and H_2 indicated that genetic variation accounted in great part to fixable gene effects for this character.

The "F" value was negative in all studied characters suggesting that decreasing alleles were more frequent than increasing ones in the studied parents.

The h^2 value was significant for all studied characters except number of seeds/pod and indicated that the effect of dominance was to Homozygosity of loci and that the direction of dominance was positive.

The derived parameter $(H_1/D)^{0.5}$ was less than one for plant height, showing the importance of additive gene action in the gentics of this character but for the remaining characters it was more than one indicated that the dominance gene effect was the great role for controling these characters. These results are in confined by thoses of Mohamoud (1977), El-Hady *et al.*, (1991 a and b) and Salama and Manal (2001). The frequency distribution of positive and negative alleles was far away from 0.25 for all studied characters. The quantity of (K_D/K_R) was less than unity for all studied

characters indicated that additive gene were more frequent. Heritability in narrow sense was more than 50% for plant beight and 100-seed weight, while above 95% in broad sense for those characters but for the remaining characters, it was less than these value, thus selection in later generations would be effective for improve these characters.

3. combining ability studies.

Combining ability analysis Table (4) proved evidence for involvement of additive (gca) and non additive (sca) genetic variance controlling the studied characters. The ratio of gca / sca was less than one for number of pods/plant, indicating the predominant role of non-additive gene effects in the inheritance of this character. These results are supported by Abdalla *et al.*, (1991) and Salama and Manal (2001).

General combining ability are shown in Table (5) and indicated the parental genotypes Sakha 1 and Sakha 2 were good general combiners, sineit had positive and significant (gca) for all studied characters. This parents possessed additive gene effects which increase seed yield, while Giza714 and Giza 461 may be suggested that this genotypes contained most decreasing alleles at most loci for these characters.

Table (6) showed (sca) effects results provide evidence for the presence of considerable amount of heterotic effects sepcific to Sakha 1 × Sakha2 and Sakha 1 Noubarya 1 for number of seeds/pod, 100-seed weight and seed weight/plant, Sakha 1 × Giza 714, Sakha 1 × Giza 3 and Sakha2 × Giza 461 for nuumber of seeds/pod and 100-seed weight, noubarya 1 × Giza 461 and Giza714 × Giza461 for number of pods/plant and seed weight/plant, it showed that stable crosses and valuable as a promising one for improving grain yield.

Figures (1 to 5) show the relationship between (Wr) and (Vr). The regression value was significant for all studied characters. Regression line intersected the Wr axis below the origin point, for all characters, except plant height the regression line intersected above the origin point, indicating partial dominance and the improtance of

Table (1) : Pedigree and origin of the studied parental genotype

Serial number	Genotype	Pedigree	origin
1	Sakha 1	716 / 724 / 8 × 620 / 283 / 85	Egypt
2	Sakha 2	Reina Blanca × 461 / 845 / 83	Egypt
3	Nubarya 1	Selected from variety Giza Blanca (derived from spanich genotype, Reina Blanca).	Egypt
4	Giza 714	4628 / 908 / 83 × 503 / 453 / 83	Egypt
5	Giza 461	G3 × ILB 938	Egypt
6	Giza 3	cross (Giza 1 × Dutch introduction 29)	Egypt

Table (2) : Mean squares of half diallel analysis of variance for studied 0 characters in half diallel 6×6 of faba bean (Jones, 1956).

S.O.V	D.F.	Plant height (cm)	Number of pods / plant	Number of seeds / pod	100-seed weight (g)	seed yield / plant (g)
a	5	928.66**	1.652**	0.089**	858.42**	102.38**
b	15	546.33**	2.861**	0.066**	692.39**	52.76**
b_1	1	1654.22**	3.998**	0.369**	482.34**	234.85**
b_2	5	23.65	2.852**	0.029**	221.32**	29.78**
b_3	9	60.22**	0.752*	0.038*	210.36**	12.96**
Error	40	23.52	0.310	0.011	18.752	5.32

Table (3) : Additive (D), dominance (H) and environmental (E) genetic components and derived parameters for half diallel of 6×6 faba bean studied characters according to Hayman (1954).

Characters parameter	Plant height (cm)	Number of pods/plant	Number of seeds/pod	100-seed weight	seed yield / plant (g.)
D	561.66** ± 1.58	0.741** ± 0.03	0.077** ± 0.004	576.261** ± 0.43	17.62** ± 0.40
H_1	458.22** ± 4.02	3.552** ± 0.08	0.166** ± 0.055	672.32** ± 1.09	66.31** ± 1.023
H_2	369.31** ± 3.60	3.35** ± 0.07	0.154** ± 0.049	554.31** ± 0.97	65.12** ± 0.916
F	-7.86* ±3.83	-0.11 ± 0.08	-0.002 ± .052	-3.62** ± 1.04	-7.83** ± 0.954
h^2	488.5** ± 162.2	0.501** ± 0.05	0.031 ± 0.033	351.24** ± 0.65	24.38** ± 0.617
E	18.54** ± 0.60	0.523** ± 0.01	0.041** ± 0.008	12.31** ± 0.165	4.26** ± 0.15
Derived parameters					
$(H_1/D)^{0.5}$	0.813	2.189	1.468	1.08	1.939
$H_2/4H_1$	0.201	0.236	0.232	0.206	0.246
K_D/K_R	0.986	0.935	0.982	0.994	0.999
T_n	0.759	0.238	0.364	0.698	0.393
T_b	0.959	0.707	0.672	0.975	0.874

Table (4) : Mean squares of general (gca) and specific (sca) combining ability for the studied characters in half diallel 6×6 faba bean genotypes.

Characters s. o. v.	D.F	Plant height (cm)	Number of pods/plant	Number of seed/pod	100-seed weight (g.)	seed yield / plant (g.)
g. c. a.	5	928.66**	1.652**	0.089**	858.42**	102.38**
s. c. a.	15	546.33**	2.861**	0.066**	692.39**	52.76**
Error	40	23.52	0.310	0.011	18.752	5.32

Table (5) : General Combining ability (g c a) for the studied characters in half diallel 6×6 faba bean genotypes.

Characters Parents	Plant height (cm)	Number of pods/plant	Number of seeds/pod	100-seed weight(g.)	seed yield / plant (g.)
Sakha 1	5.362**	-0.278	0.102**	6.580**	2.36**
Sakha 2	6.824**	-0.367*	0.131**	7.261**	3.410**
Noubarya 1	-4.625**	0.212	-0.041	2.681	1.320
Giza 714	-6.821**	-0.651**	0.109**	1.413	-3.513**
Giza 461	-8.526**	0.119	-0.040	-9.413**	-6.522**
Giza 3	7.785**	0.965**	-0.261	-8.522**	2.944**
S. E.	1.56	0.179	0.034	1.396	0.743

Table (6): Specific combining ability in faba bean for the studied characters.

Crosses	Plant height (cm)	Number of pods / plant	Number of seeds / pod	100-seed weight (g.)	seed yield / plant (g.)
Sakha1 × Sakha2	2.673	-2.963**	0.642**	9.24**	4.82**
Sakha1 × Nobarya1	3.765	-0.231	0.583**	12.46**	5.41**
Sakha1 × Giza 714	3.682	-6.461**	0.872**	7.85*	3.21
Sakha1 × Giza 461	8.461	5.362**	0.011	23.88**	2.44
Sakha1 × Giza 3	-0.002	2.436**	0.622**	14.17**	0.101
Sakha2 × Noubarya1	8.562*	0.265	-0.351**	-2.65	-3.62*
Sakha2 × Giza 714	6.610	-1.671**	0.524**	-2.68	3.31
Sakha2 × Giza 461	0.753	-3.050**	0.362**	8.79**	-0.52
Sakha2 × Giza3	8.641*	0.001	0.417**	7.52*	0.744
Noubarya1× Giza 714	0.232	-0.361	-0.555**	6.33*	-0.533
Noubarya1× Giza 461	-0.564	0.742	0.723**	0.52	7.820**
Noubarya1× Giza 3	-0.632	-0.981*	-0.101	0.41	2.330
Giza 714 × Giza 461	-9.622**	2.310**	0.852**	0.623	4.85**
Giza 714 × Giza 3					
Giza 461 × Giza 3	8.510*	0.644	0.751**	0.010	0.036
S. E	3.530	0.405	0.076	3.152	1.679

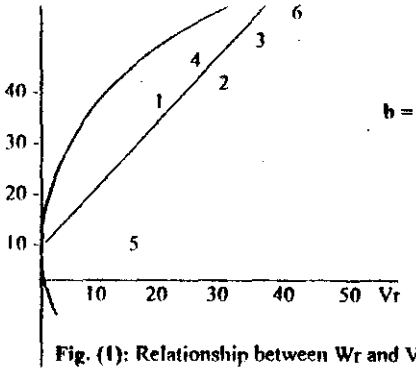

Fig. (1): Relationship between Wr and Vr for Plant height.

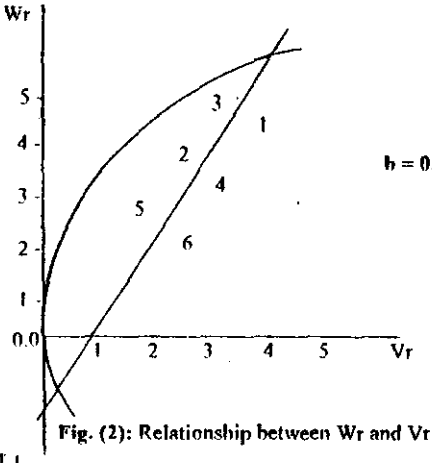

Fig. (2): Relationship between Wr and Vr for Number of pods/plant.

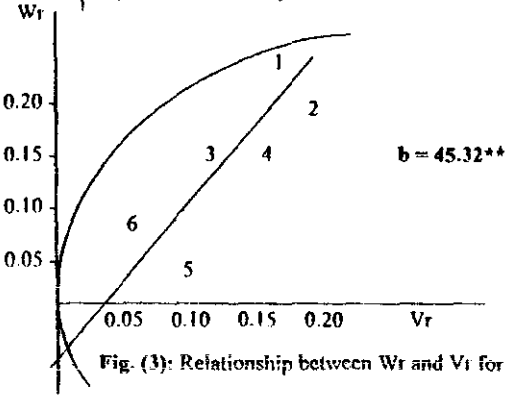

Fig. (3): Relationship between Wr and Vr for Number of seed/pod.

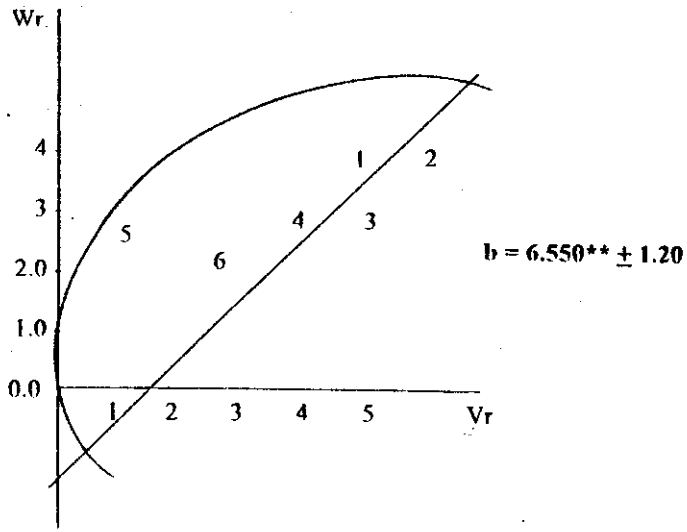

Fig. (4): Relationship between Wr and Vr for 100-seed weight (g.)

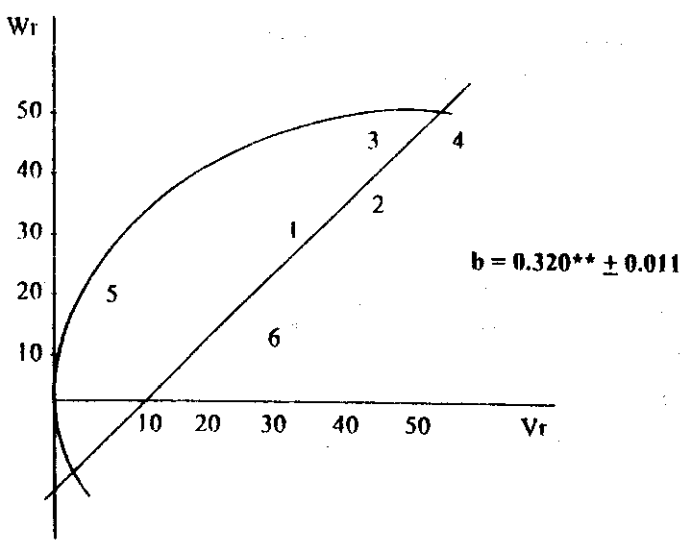

Fig. (5): Relationship between Wr and Vr for seed yield/piant(g.)

additive gene effects for this character (plant height). The parental faba bean genotypes Sakha1, Sakha2, Noubarya 1 and Giza 714 contained the highest concentration of dominant genes for these characters.

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تقدير المكونات الوراثية لبعض الصفات في الفول البلدي

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تم تنفيذ هذه الدراسة في الموسم الشتوي لإعوام ٢٠٠٢ / ٢٠٠٣ - ٢٠٠٣ /٢٠٠٤ باستخدام ستة أصناف محلية من الفول البلدي وهي سخا١، سخا٢، نوبارية ١، جيزة ٧١٤، جيزة ٤٦١، جيزة ٣ وذلك لدراسة المكونات الوراثية لبعض الصفات وهي ارتفاع النبات وعدد القرون للنبات وعدد البذور بالقرن ووزن المائة بذرة ومحصول بذور النبات وذلك باستخدام طريقة الهجين الدائرية بكل الطرق الممكنة مستبعداً الهجن العكسية وتم تقييم الجيل الأول والآباء بمحطة البحوث الزراعية تاج العز محافظة الدقهلية باستخدام تصميم القطاعات الكاملة العشوائية في ثلاث مكررات . تم تحليل البيانات إحصائياً ووراثياً باستخدام نماذج جونز ١٩٥٦، وهايمان ١٩٥٤ ، جرفنج ١٩٥٦ وأوضحت النتائج الآتي :

١- أهمية كلاً من الفعل الجيني المضيف والسيادي في وراثة الصفات المدروسة.

٢- كانت درجة السيادة أعلى من الوحدة لجميع الصفات ما عدا صفة ارتفاع النبات كانت أقل من الوحدة مما يدل على أهمية الفعل الجيني المضيف في وراثة هذه الصفة.

٣ كانت نسبة توزيع الأليلات السالبة إلى الموجبة تقارب القيمة النظرية ٢٥ ولصفة محصول الحبوب للنبات مما يدل على التوزيع المتماثل للجينات السالبة والموجبة لتلك الصفة.

٤- أظهرت النتائج أن قيمة معامل التوريث بالمعنى الضيق والواسع مرتفعة لصفتى ارتفاع النبات ووزن الـ ١٠٠ بذرة بينما كانت منخفضة في المعنى الضيق أقل من ٤٠% للصفات المتبقية.

٥- أوضحت النتائج أن التباين الراجع للقدرة العامة والقدرة الخاصة على الائتلاف كان معنوياً لجميع الصفات المدروسة.

٦- أظهرت الأصناف سخا١، سخا٢ وجيزة ٣ قدره عامة عالية على التآلف لصفات ارتفاع النبات ومحصول الحبوب للنبات وكانت الهجن سخا ١ × سخا ٢ ، سخا ١ × نوبارية ١ ، نوبارية ١ × جيزة ٤١٦ ، جيزة ٧١٤ × جيزة ٤٦١ أفضل الهجن للقدرة الخاصة على التآلف لزيادة كمية المحصول ويمكن استخدامها في برامج التربية لزيادة محصول الحبوب في الفول البلدي.