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GENETIC BEHAVIOUR OF SOME FABA BEAN (*Vicia faba* L.) GENOTYPES AND ITS CROSSES

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ABSTRACT

The present investigation was carried out under insect free cage at Giza Research Station, ARC, Egypt, during 2003/04 to 2005/06 seasons, to study the genetic behaviour of four crosses and their respective parents for seed yield/plant (g) and some of its components. Data revealed that genotype Misr 2 possessed the highest number of pods (13.8) and seeds (40.6) per plant. Nubaria 1 exhibited the heaviest 100-seed weight (105.0 g) followed by Giza 716 (85.7 g). Nubaria 1 and Giza 716 manifested the highest seed yield per plant (32.2 g) and (24.3 g), respectively. With respect to tested crosses, results revealed that one F_1's, Misr 2 x Giza 716 possessed the highest values of each number of pods, seeds, 100-seed weight as well as seed yield/plant. Results revealed that the observed F_1's and F_2's were significantly higher than arithmetic (AF_1) and (AF_2) in all crosses for different studied characters. Potence ratio as a degree of dominance (h_1) for F_1 were significantly differed from zero and higher than unity in Misr 2 x Giza 716 for number of pods, seeds per plant, 100-seed weight and seed yield/plant, indicating the presence of over-dominance effects toward higher parents. Results revealed that all studied crosses exhibited significant or highly significant positive heterosis over mid (MP) and higher-parents (HP) for various characters in most cases. Values of inbreeding depression revealed that two crosses; Giza 461 x Misr 2 and Misr 2 x Giza 716 expressed significantly or insignificant positive inbreeding depression in F_2 for number of pods, seeds along with 100-seed weight and seed yield per plant. Moderate to high estimates of heritability in broad sense were detected for all studied characters among tested crosses under investigation and ranged from 81.64 to 95.73 for pods; 61.11-95.13 for seeds; 32.12-97.97 for 100-seed weight and 62.29-95.43 % for seed yield per plant.

INTRODUCTION

Faba bean (*Vicia faba* L.) is one of the most ancient cultivated esculents and it suffers from narrow genetic variability (Abdalla, 1982). Faba bean is a partially cross-pollinated crop, and displays a considerable amount of heterosis and inbreeding depression (Lawes *et al*., 1983). The genetic improvement of various traits depends on the nature and magnitude of genetic variability in addition to hybridization which offers new recombinations and release raw material for improvement and helps the breeder to identify the best combiners to be crossed either to exploit heterosis or to build up the favourable fixable genes. Seed yield is a complex trait and is quantitatively inherited with low heritability value (Bond, 1966). Therefore, yield itself may not be the best criterion for selection, so breeding for high yielding ability is associated with yield and its components *viz.*, number of pods and seeds per plant as well as seed size (Rawlands, 1955).

Manifestations of heterotic and inbreeding depression effects ranged from significantly positive to significantly negative values (El-Hady *et al.*, 1991; El-Hady *et al.*, 1998; Abdalla *et al.*, 2001; Attia *et al.*, 2001 and Attia and Salem, 2006). Poulsen (1979) stated that the decreased yields after three generations of selfing occurred due to inbreeding depression and reduced autofertility and he mentioned that inbreeding depression alone reduced yield by 11 %. The low heritability and consequent limited genetic advance for yield in response to selection has led many scientists to search for characters which are associated with yield but are relatively highly heritable. Bond (1966) reported that components of yield were in general nearer to additivity than yield. Poulsen (1977) stated that although the major part of the variation in seed yield was detected as additive genetic advance, the dominance effects played also a considerable role in the inheritance of this trait. El-Hosary *et al.* (1983) found the additive effect component to be less affected in case of yield and its components. On the other hand, El-Hady *et al.* (1991), El-Hady *et al.* (1998), Abdalla *et al.* (2001), Attia *et al.* (2001) and Attia and Salem (2006) reported that non-additive effects was more important for number of pods and seeds as well as seed yield per plant than additive. Moreover, the additive variance was important for 100-seed weight. Heritability estimates provide a measure of relative importance of genetic components to the phenotypic variation and the latter being the sum of genetic and environmental variations. It expresses, the extend of resemblance between relatives and allow the determination of the response to selection and thus, is of a great importance in breeding programs (Falconar, 1981). Several studies were conducted to estimate heritability using different materials and methods and reported that heritability values were high for 100-seed weight and low to moderate for seed yield along with number of pods and seeds per plant (Bond, 1966; Poulsen, 1977; El-Hady *et al.*, 1991, El-Hady *et al.*, 1998; Abdalla *et al.*, 2001; Attia *et al.*, 2001 and Attia and Salem, 2006).

The present investigation was conducted to determine the nature of gene action and relative magnitude of heterosis and inbreeding depression, in addition to estimate heritability values of seed yield/plant along with three traits namely; number of pods/plant, number of seeds/plant and 100-seed weight.

MATERIALS AND METHODS

The present investigation was carried out under insect free cage at Giza Research Station, ARC, Egypt, during 2003/04, 2004/05 and 2005/06 growing seasons, to study the mode of gene action and estimate some genetic parameters such as heterosis, inbreeding depression and heritability percentages for seed yield/plant (g) and some of its components. Four faba bean genotypes, i.e. Giza 716, Misr 2, Nubaria 1 and Giza 461 were used as parental genotypes in the current investigation. These genotypes are briefly described in Table (1).

Table (1): Origin and some characteristics of four faba bean genotypes.

Genotype	Origin	Special remarkable characters
Giza 716	FCRI, ARC, Egypt	Early maturing and resistant to foliar diseases
Misr 2	FCRI, ARC, Egypt	Resistant to *Orobanche*
Nubaria 1	FCRI, ARC, Egypt	Recommended for planting in newly reclaimed lands at Nubaria, large-seeded type and resistant to foliar diseases
Giza 461	FCRI, ARC, Egypt	Resistant to foliar diseases

Four cross combinations among the four faba bean genotypes were made in 2003/04 growing season i.e. (I) Giza 461 x Misr 2, (II) Nubaria 1 x Misr 2, (III) Misr 2 x Giza 716 and (IV) Misr 2 x Nubaria 1. In 2004/05 season, re-hybridizations were made and F_2 seeds were raised from selfed F_1 plants. In the third season, (2005/06) plant materials of F_1 and F_2 as well as their respective parental genotypes were sown under insect free cage at Giza Research Station. Seeds were took place in rows 3 m long, 50 cm apart and 20 cm between hills. The number of plants per plot varied from 25 plants in parents and F_1 to 250 plants in F_2's. At harvest all guarded individual plants were taken from each plot and the following traits were recorded; number of pods per plant, number of seeds per plant, seed yield/plant (g) and 100-seed weight (g).

All data were subjected to statistical analyses. Means (arithmetic and geometric), standard errors and coefficient of variability were determined. Measurements of heterosis and heritability values were also estimated.

The theoretical (arithmetic and geometric) means corresponding to additive and non-additive gene action were calculated according to (Burton, 1951).

Additive gene action: Theoretical arithmetic $(\overline{AF_1}) = \frac{\overline{P}_1 + \overline{P}_2}{2}$

Theoretical arithmetic $(\overline{AF_2}) = \frac{\overline{P}_1 + 2\,\overline{F}_1 + \overline{P}_2}{4}$

Non-additive gene action:

Theoretical geometric $(\overline{GF_2})$ = antilogarithm of $\frac{\text{Log}\,\overline{P}_1 + 2\log\overline{F}_1 + \log\overline{P}_2}{4}$

Degree of dominance h_1 and h_2 for the studied characters in the F_1 and F_2 were calculated using the potence ratios according to Romero and Frey (1973) as follows:

$$h_1 = \frac{\overline{F_1} - \overline{MP}}{\overline{HP} - \overline{MP}}$$

$$h_2 = \frac{2^* (\overline{F_2} - \overline{MP})}{\overline{HP} - \overline{MP}}$$

Where: $\overline{MP}$ = mid parent and HP = higher parent

Potence ratio = 0, indicate absence of dominance, partial dominance is considered when ratio between ± 1. Complete dominance is indicated when ratio equal ± 1. Overdominance is indicated if ratio exceeded ± 1

Broad-sense heritability (H%) estimates were calculated as follows:

$$H\%\,(I) = \frac{\delta^2 F_2 - \delta^2 F_1}{\delta^2 F_2} \times 100 \qquad \text{(Burton, 1951)}$$

$$H\%\,(II) = \frac{\delta^2 F_2 - \delta^2 E}{\delta^2 F_2} \times 100 \qquad \text{(Allard, 1960)}$$

Where the environmental variance ($\delta^2 E$) = $\frac{\delta^2 P_1 + \delta^2 P_2 + \delta^2 F_1}{3}$

Heterosis over mid-parent ($\overline{MP}$) and higher parent ($\overline{HP}$) were calculated using the following equations:

$$\overline{MP} \text{ heterosis} = \frac{\overline{F_1} - \overline{MP}}{\overline{MP}} \times 100$$

$$\overline{HP} \text{ heterosis (heterobeltiosis)} = \frac{\overline{F_1} - \overline{HP}}{\overline{HP}} \times 100$$

Inbreeding depression (ID %) estimates were calculated as percentage deviation of F_2 mean from the average of F_1

$$\text{Inbreeding depression (ID \%)} = \frac{\overline{F_1} - \overline{F_2}}{\overline{F_1}} \times 100$$

RESULTS AND DISCUSSION

I- Mean performance, ranges and coefficient of variability for yield and some of its components for faba bean parental genotypes and their crosses:

Mean, range, variance, coefficient of variability (C.V. %) and number of plants for each studied crosses and their parents are given in Tables (2 & 3). Data revealed that the parental genotype Misr 2 followed by Giza 461 possessed the highest number of pods per plant and recorded 13.8 and 11.8 pods per plant with a range of 11.0-16.0 and 10.0-13.0, respectively. However, the genotype Nubaria 1 had the lowest one with a mean value 9.5 pods/plant. Regarding number of seeds per plant, two genotypes; Misr 2 and Nubaria 1 had the highest number of seeds and recorded 40.6 and 30.7 seeds/plant with a range of 34.0-46.0 and 29.0-33.0, in the same order. Although Nubaria 1 possessed the lowest number of pods, but possesses the 2nd rank of number of seeds per plant. This result may be due to increasing number of seeds/pod. Furthermore, high mean values of 100-seed weight were detected for genotype Nubaria 1 (105.0 g) and Giza 716 (85.7 g), which recorded a range of 98.3-115.5 and 78.8-98.3 g, respectively. Such result may be due to the parental genotype Nubaria 1 that classified as large-seeded type in which seed weight being more than 1.0 g/seed. On contrary, the genotype, Misr 2 exhibited the lowest 100-seed weight (53.9 g). Moreover, the two parental genotypes Nubaria 1 and Giza 716 manifested the highest seed yield per plant (32.2 g) and (24.3 g) with a range of 28.7-35.8 and 20.8-28.5 g, in the same order.

With respect to tested crosses, results revealed that two F_1's, i.e. III (Misr 2 x Giza 716) and II (Nubaria 1 x Misr 2) possessed the highest values of number of pods, seeds, 100-seed weight and seed yield per plant and recorded 20.2 & 18.0, 56.3 & 46.0; 98.8 & 90.2 and 55.3 & 41.2 in the same order. Regarding, F_2's two crosses; III (Misr 2 x Giza 716) and IV (Misr 2 x Nubaria 1) recorded the highest number of pods and seeds per plant with a mean values of 17.6 & 16.1; and 52.8 & 47.6, respectively. On the other hand, the cross II (Nubaria 1 x Misr 2) followed by the cross III (Misr 2 x Giza 716) exhibited the heaviest seed index and recorded 96.4 g and 89.6 g, respectively.

Concerning seed yield/plant, the cross IV (Misr 2 x Nubaria 1) followed by the cross III (Misr 2 x Giza 716) possessed the highest estimates of seed yield/plant with a mean values of 42.5 and 41.6 g/plant, respectively. Such wide ranges suggests the presence of genetic variability among tested materials under investigation. The coefficient of variability and the magnitude of variance due to F_2's were higher than that of its respective parents and F_1's indicating wide genetic variability among tested crosses.

II- Nature of gene action and genetic parameters for different studied traits:

Statistics of arithmetic and geometric means, degrees of dominance as well as heterosis, heritability and inbreeding depression percentages for seed yield and its components of faba bean genotypes and their crosses are presented in Tables (4 & 5). Results revealed that the observed F_1's were significantly higher than arithmetic ones (AF_1) in all crosses for different studied characters which indicated the presence of non-additive effects controlling high values of each traits under this investigation.

There were significant differences between the observed F_2's and their arithmetic means ($\overline{AF_2}$) for all studied characters among different crosses. These results revealed that the major role controlling the inheritance of number of pods and number of seeds/plant as well as 100-seed weight and seed yield/plant may be due to non-additive portion. Insignificant differences between observed F_2's and geometric ones (GF_2) among different crosses were detected indicating that all studied traits were controlled by non-additive effects (Tables 4 & 5).

Table (2): Means, ranges, variance, coefficient of variability (C.V.%) and number of plants of four faba bean parental genotypes and their crosses for number of pods and seeds/plant.

	Mean	Range	S^2	C.V. %	No. of Plants.
Number of pods/plant					
	I (Giza 461 x Misr 2)				
P_1	11.8	10.0-13.0	1.37	9.9	25
P_2	13.8	11.0-16.0	3.36	13.3	25
F_1	18.0	16.0-20.0	2.00	7.9	25
F_2	12.9	4.0-27.0	46.86	53.1	250
	II (Nubaria 1 x Misr 2)				
P_1	9.5	8.0-10.0	0.70	8.8	25
P_2	13.8	11.0-16.0	3.36	13.3	25
F_1	13.5	8.0-18.0	19.67	32.8	25
F_2	13.7	3.0-45.0	140.46	86.5	250
	III (Misr 2 x Giza 716)				
P_1	13.8	11.0-16.0	3.36	13.3	25
P_2	9.7	9.0-10.0	0.27	5.3	25
F_1	20.2	18.0-23.0	4.57	10.6	25
F_2	17.6	8.0-27.0	36.84	34.4	250
	IV (Misr 2 x Nubaria 1)				
P_1	13.8	11.0-16.0	3.36	13.3	25
P_2	9.5	8.0-10.0	0.70	8.8	25
F_1	14.6	12.0-18.0	3.20	12.3	25
F_2	16.1	10.0-24.0	17.43	25.9	250
Number of seeds/plant					
	I (Giza 461 x Misr 2)				
P_1	25.0	24.0-26.0	0.80	3.60	25
P_2	40.6	34.0-46.0	23.70	12.0	25
F_1	46.0	36.0-56.0	64.40	17.4	25
F_2	32.3	10.0-62.0	290.00	52.7	250
	II (Nubaria 1 x Misr 2)				
P_1	30.7	29.0-33.0	1.87	4.5	25
P_2	40.6	34.0-46.0	23.70	12.0	25
F_1	37.0	23.0-57.0	140.67	32.1	25
F_2	45.1	17.0-133.0	1137.88	71.8	250
	III (Misr 2 x Giza 716)				
P_1	40.6	34.0-46.0	23.70	12.0	25
P_2	28.3	25.0-32.0	6.67	9.1	25
F_1	56.3	44.0-72.0	120.67	19.5	25
F_2	52.8	31.0-90.0	509.36	42.8	250
	IV (Misr 2 x Nubaria 1)				
P_1	40.6	34.0-46.0	23.70	12.0	25
P_2	30.7	29.0-33.0	1.87	4.5	25
F_1	39.7	26.0-61.0	93.96	24.4	25
F_2	47.6	31.0-86.0	241.60	32.7	250

Table (3): Means, ranges, variance, coefficient of variability (C.V.%) and number of plants of four faba bean parental genotypes and their crosses for 100-seed weight and seed yield/plant.

100-seed weight, g					
	I (Giza 461 x Misr 2)				
	Mean	**Range**	**S^2**	**C.V. %**	**No. of Plants.**
P_1	69.4	60.0-80.8	46.36	9.8	25
P_2	53.9	48.3-69.5	22.97	8.9	25
F_1	90.2	84.3-99.4	50.20	7.9	25
F_2	96.4	81.9-110.0	73.95	8.9	250
	II (Nubaria 1 x Misr 2)				
P_1	105.0	98.3-115.5	45.03	6.4	25
P_2	53.9	48.3-63.5	22.97	8.9	25
F_1	75.2	65.0-88.7	110.19	14.0	25
F_2	96.4	61.4-141.2	447.64	21.9	250
	III (Misr 2 x Giza 716)				
P_1	53.9	48.3-63.5	22.97	8.9	25
P_2	85.7	78.75-98.30	45.68	7.9	25
F_1	98.8	88.80-105.8	38.25	6.3	25
F_2	80.7	64.3-94.2	122.74	13.7	250
	IV (Misr 2 x Nubaria 1)				
P_1	53.9	48.3-63.5	22.97	8.9	25
P_2	105.0	98.3-115.5	45.03	6.4	25
F_1	92.7	90.0-95.1	3.12	1.9	25
F_2	89.6	66.5-113.0	153.53	13.8	250
Seed yield/plant, g					
	I (Giza 461 x Misr 2)				
P_1	17.4	15.0-20.2	3.53	10.8	25
P_2	21.8	19.4-25.7	4.58	9.8	25
F_1	41.2	33.7-48.4	31.53	13.6	25
F_2	30.6	11.0-50.8	228.88	49.4	250
	II (Nubaria 1 x Misr 2)				
P_1	32.2	28.7-35.8	8.26	8.9	25
P_2	21.8	19.4-25.7	4.58	9.8	25
F_1	27.5	20.4-40.6	80.81	32.70	25
F_2	40.5	17.7-109.0	683.29	64.50	250
	III (Misr 2 x Giza 716)				
P_1	21.8	19.4-25.7	4.58	9.8	25
P_2	24.3	20.8-28.5	7.10	11.0	25
F_1	55.3	44.9-69.4	86.04	16.8	25
F_2	41.6	25.7-71.5	245.4	37.7	250
	IV (Misr 2 x Nubaria 1)				
P_1	21.8	19.4-25.7	4.58	9.8	25
P_2	32.2	28.7-35.8	8.26	8.9	25
F_1	36.9	26.7-59.0	78.90	24.0	25
F_2	42.5	25.2-77.8	209.23	34.1	250

Table (4): Arithmetic and geometric means, degrees of dominance, heterosis over mid and better parents and heritability estimates of faba bean crosses for number of pods and number of seeds/plant.

Parameter	Number of pods/plant			
	I Giza 461 x Misr 2	II Nubaria 1 x Misr 2	III Misr 2 x Giza 716	IV Misr 2 x Nubaria 1
F_1 (observed)	18.0	13.5	20.2	14.6
$A\bar{F}_1$	12.80**	11.65**	11.75**	11.65**
h_1	5.20*	0.86	4.12*	1.37
$\bar{F}_2$ (observed)	12.9	13.7	17.6	16.1
$A\bar{F}_2$	15.40**	12.58**	15.98**	13.13**
$G\bar{F}_2$	15.13	12.45	15.28	12.94
h_2	0.20	1.91	5.71*	4.14*
MP Heterosis	40.63**	15.88**	71.91**	25.32**
HP Heterobeltiosis	30.43**	-2.17	46.38**	5.80
Inbreeding depression (ID %)	28.33**	-1.48	12.87**	-10.27**
Heritability % (I)	95.73	86.00	87.60	81.64
Heritability % (II)	95.21	94.37	92.58	86.12
	Number of seeds/plant			
$\bar{F}_1$ (observed)	46.0	37.0	56.3	39.7
$A\bar{F}_1$	32.80**	35.65**	34.45**	35.65**
h_1	1.69	0.27	3.55*	0.82
$\bar{F}_2$ (observed)	32.3	45.1	52.8	47.6
$A\bar{F}_2$	39.41**	36.33**	45.38**	37.68**
$G\bar{F}_2$	38.82	36.14	43.65	37.41
h_2	0.13	3.82*	5.97*	4.83*
MP Heterosis	40.24**	3.79	63.43**	11.36*
HP Heterobeltiosis	13.30*	-8.87	38.67**	-2.22
Inbreeding depression (ID %)	29.78**	-21.89**	6.22	-19.90**
Heritability % (I)	77.79	87.64	76.31	61.11
Heritability % (II)	89.78	95.13	90.12	86.70

Potence ratio as an indicator for degree of dominance (h_1) for F_1 were significantly differed from zero and higher than unity in cross III (Misr 2 x Giza 716) for both number of pods and seeds per plant, indicating the presence of over-dominance effects toward higher parents. Moreover, the estimates of h_1 were significantly differed from zero and had estimates over unity in following crosses; I (Giza 461 x Misr 2) and III (Misr 2 x Giza 716) for 100-seed weight and seed yield per plant (g). Such results indicating that over-dominance effects were involved in controlling 100-seed weights and seed yield/plant among studied materials.

Table (5): Arithmetic and geometric means, degrees of dominance, heterosis over mid and better parents and heritability estimates of faba bean crosses for 100-seed weight and seed yield/plant.

Parameter	100-seed weight, g			
	I Giza 461 x Misr 2	II Nubaria 1 x Misr 2	III Misr 2 x Giza 716	IV Misr 2 x Nubaria 1
$\bar{F}_1$ (observed)	90.2	75.2	98.8	92.7
$\overline{AF}_1$	61.65**	79.45**	69.80**	79.45**
h_1	3.68	0.17	1.82	0.52
$\bar{F}_2$ (observed)	96.4	96.4	80.7	89.6
$\overline{AF}_2$	75.93	77.33**	84.30**	86.08**
$\overline{GF}_2$	74.30	75.16	82.04	83.18
h_2	8.97*	1.33	1.37	0.79
$\overline{MP}$ Heterosis	46.31**	-5.35	41.55**	16.68**
HP Heterobeltiosis	29.97**	-28.38**	15.29**	-11.71**
Inbreeding depression ($\overline{ID}$ %)	-6.87	-28.19**	18.32**	3.34
Heritability % (I)	32.12	75.38	68.84	97.97
Heritability % (II)	46.12	86.73	70.97	84.56
	Seed yield/plant, g			
$\bar{F}_1$ (observed)	41.2	27.5	55.3	36.9
$\overline{AF}_1$	19.60**	27.00**	23.05**	27.00**
h_1	9.82**	0.10	25.80**	1.90
$\bar{F}_2$ (observed)	30.6	40.5	41.6	42.5
$\overline{AF}_2$	30.40**	27.25**	39.18**	31.95**
$\overline{GF}_2$	38.31	26.98	35.65	31.26
h_2	10.00**	5.19*	29.68**	5.96*
MP Heterosis	110.20**	1.85	139.91**	36.67**
$\overline{HP}$ Heterobeltiosis	88.99**	-14.60**	127.57**	14.60**
Inbreeding depression ($\overline{ID}$ %)	25.73**	-47.27**	24.77**	-15.18**
Heritability % (I)	86.22	88.17	64.94	62.29
Heritability % (II)	94.23	95.43	86.73	87.10

Furthermore, the h_2 estimates (degree of dominance for F_2) were significantly differed from zero with values higher than unity for different crosses indicating that overdominance effects were more important for controlling the different studied characters under investigation. Results obtained by Bond (1966), Poulsen (1977), El-Hosary *et al.* (1983), El-Hady *et al.* (1991), El-Hady *et al.* (1998), Abdalla *et al.* (2001), Attia *et al.* (2001) and Attia and Salem (2006) supported the evidence that both additive and dominance gene action are the most important components controlling variation in seed yield and some of its components, i.e. number of pods, number of seeds and 100-seed weight.

Information on the genetics and gene effect of breeding materials could ensure long-term selection and better genetic improvements. The maximum progress in improving any characters would be expected in selection program when the additive gene action is the main component of genetic variance, whereas, the presence of non-additive gene action might suggest the use of hybridization program for achieving this goal.

Estimates of heterosis percentages over mid-parents (MP) and higher parent (HP) and inbreeding depression are presented in Tables (4 & 5). Results revealed that all studied crosses exhibited significant or highly significant positive heterosis over mid-parents for various characters in most cases and recorded wide ranges for number of pods (15.88-71.91 %), number of seeds (11.36-63.43 %), 100-seed weight (16.68-46.31 %) and seed yield per plant (36.67-139.91 %).

Moreover, results suggested that all tested crosses under investigation possessed significant or highly significant positive heterosis over their higher parents with a range of 30.43-46.36; 13.30-38.67; 15.29-29.97 and 14.60-127.57 % for number of pods, seeds, 100-seed weight and seed yield per plant, respectively. These results indicate that heterosis for yield was primarily due to the heterotic effects of pods and seeds/plant. Different values of heterosis might be due to the genetic diversity of the parents with non-allelic interactions, which increase or decrease the expression of heterosis. Cress (1966) stated that, even in the absence of epistasis, multiple alleles at a locus could lead to either positive or negative heterosis. Generally, potence ratio values were found to follow the same pattern of heterosis estimates in all traits among tested crosses. Pronounced and favourable heterosis was obtained by several authors for some faba bean yield components, which varied according to the cross combinations and traits (El-Hady *et al.*, 1991; El-Hady *et al.*, 1998; Abdalla *et al.*, 2001; Attia *et al.*, 2001 and Attia and Salem, 2006).

Results of inbreeding depression revealed that two crosses; I (Giza 461 x Misr 2) and III (Misr 2 x Giza 716) expressed significant or insignificant positive inbreeding depression in F_2 for number of pods and seeds along with 100-seed weight and seed yield per plant with a range of 12.87-28.33; 6.22-29.78; 3.34-18.32 and 24.77-25.73 %, respectively. The absence of inbreeding depression in spite of presence of heterotic effects may be due to the presence of linkage between genes controlling such characters and for presence of additive x additive type of epistasis. These results are in agreement with those obtained by Bond (1966), Poulsen (1977 & 1979), El-Hady *et al.* (1991), El-Hady *et al.* (1998), Abdalla *et al.* (2001) and Attia *et al.* (2001).

Moderate to high estimates of heritability were detected for all studied characters among tested crosses under investigation and ranged from 81.64 to 95.73 for pods; 61.11-95.13 for seeds; 32.12-97.97 for 100-seed weight and 62.29-95.43 % for seed yield per plant. These results revealed that both additive and dominance effects are the most important components for controlling the inheritance of different characters and it is possible to breed for improving these traits through advanced generations. Similar results were obtained by Bond (1966), Poulsen (1977), El-Hady *et al.* (1991), El-Hady *et al.* (1998), Abdalla *et al.* (2001), Attia *et al.* (2001) and Attia and salem (2006).

Consequently, it could be concluded that the above-mentioned results would be of interest in faba bean breeding program for improving yield and its components, i.e. number of pods, seeds and 100-seed weight and helps breeders in choosing the parental combinations which when crossed will result in the highest proportion of desirable segregates.

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السلوك الوراثى لبعض التراكيب الوراثية من الفول البلدى وهجنها

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أجريت هذه الدراسة تحت الصوبة المانعة للحشرات الملقحة خلال موسمى ٢٠٠٣/٢٠٠٤، ٢٠٠٤/٢٠٠٥ بمحطة البحوث الزراعية بالجيزة لدراسة السلوك الوراثى لأربعة هجن من الفول البلدى ناتجة من أربعة آباء وهى جيزة ٧١٦، مصر ٢، نوبارية ١، جيزة ٤٦١ لصفات محصول النبات بالإضافة الى مكونات المحصول. أظهرت النتائج تفوق الأب مصر ٢ فى عدد القرون (١٣,٨) وعدد البذور للنبات (٤٠,٦) بالمقارنة ببقية الآباء. بينما تفوق الأب نوبارية ١ فى وزن ١٠٠ بذرة (١٠٥,٠ جم) ومحصول النبات (٣٢,٢ جم) يليه الأب جيزة ٧١٦ (٨٥,٧ جم، ٢٤,٣ جم على التوالى) . كما أظهرت النتائج الخاصة بالهجن تفوق الهجين مصر ٢ x جيزة ٧١٦ فى عدد القرون والبذور للنبات ووزن ١٠٠ بذرة مما انعكس بدوره على محصول النبات. كما أوضحت النتائج ان قيم الجيل الأول والثانى المتحصل عليها كانت أعلى من القيم النظرية لمثيلتها المتحصل عليها فى الجيل الأول والثانى. كما أوضحت النتائج ان درجة السيادة للجيل الأول كانت معنوية وتباينت من صفر الى قيم أعلى من الوحدة فى الهجين مصر ٢ x جيزة ٧١٦ لصفات عدد القرون والبذور ووزن ١٠٠ بذرة ومحصول النبات مما يشير الى وجود تأثيرات للسيادة الفائقة تجاه الأب الأعلى. كما أوضحت النتائج المتحصل عليها أن كل الهجن تحت الدراسة أظهرت قوة هجين بالنسبة لمتوسط الأبوين وكذلك بالنسبة للأب الأعلى فى غالبية الصفات تحت الدراسة. أما بالنسبة للتربية الذاتية فقد أوضحت النتائج المتحصل عليها ان الهجينين جيزة ٤٦١ x مصر ٢ ، مصر ٢ x جيزة ٧١٦ فقد اظهرا قيما موجبة معنوية فى الجيل الثانى لصفات عدد القرون والبذور ووزن ١٠٠–بذرة بالإضافة الى محصول النبات. كما أظهرت قيم المكافئ الوراثى فى المعنى الواسع قيم متوسطة الى عالية لكل الصفات تحت الدراسة والتى تراوحت من ٨١,٦٤–٩٥,٧٣ لعدد القرون، ٦١,١١–٩٥,١٣ لعدد البذور، ٣٢,١٢–٩٧,٩٧ لوزن ١٠٠ بذرة و ٦٢,٢٩–٩٥,٤٣ % لصفة محصول النبات.