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GENETICAL STUDIES OF EARLINESS, YIELD AND YIELD COMPONENTS IN FABA BEAN

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ABSTRACT

A field experiment was conducted during 2003/2004, 2004/2005 and 2005/06 growing seasons at Faculty of Agric. Menufiya Univ. Heterosis, potence ratio, inbreeding depression, gene action, heritability and predicted genetic gain for earliness, yield and yield components in the three crosses (M. 103 x ILB 938 (1), (T.W.) x Nubaria I (11), and Giza 40 x Giza 461 (III) were studied, using the six populations.

1. Results obtained showed significant positive heterotic effects for yield and yield components in three crosses: however, highly significant negative heterotic effects were detected for flowering date.
2. Inbreeding depression estimates were conflicting to heterosis estimates except for flowering date in the three crosses, 100-seed weight and maturity date in the first and second crosses and filling period and no. of branches / plant in the second cross.
3. Over dominance towards the higher parent was found for plant height in the three crosses, no. of pods plant and 100-seed weight in the first and second crosses, no. of branches in the second and third crosses and filling period in the frist crosses. While, over dominance towards the lower parent was found for filling period in the first and second crosses partial dominance towards the lower parent has been detected for rest traits except no. of branches/plant in the third cross. Complete dominance towards the higher parent for flowering date in the third cross.
4. Additive genetic effects were significant for all traits: while, dominance effects was significant for all traits except no. of branches in the first cross.
5. Additive x additive and dominance x dominance types of gene action was found to be significant in must traits.
6. Heritability estimates in broad sense were moderate to high with values between 49.9%, for plant height to 97.1% for seed yield/plant in the second cross, while, heritability estimates in narrow sense, were moderate to high for all traits in the three crosses except plant height in the second cross and no. of pods/plant in the third cross, with values between 19.92 for plant height in the second cross to 79% for filling period in the first cross.
7. The predicted genetic advance from selection was rather high for no. of branches/plant and seed yield/plant in the three crosses, and for no. of pods/plant in the first and second crosses. Also, the predicted genetic advance

from selection was rather moderate for no. of pods/plant in the third cross, while, it was low for remain traits.

Key words: Faba bean, heritability, additive, dominance, gene effect, genetic advance.

INTRODUCTION

Faba bean (*Vicia faba* L.) is one of the most important economic leguminous crops in Egypt. It is used mainly for human feeding also it's a cheep protein source.

Improvement of earliness and highly yield potential are the primary objective of faba bean breeding programs.

Faba bean seed yield, as extremely complex character, is the results of many growth function of the plant. Basic to progress improving quantitative traits in plants is the relative importance of type gene action involved. After dividing the genotypic variance into additive, dominance and epistatic variances by Fisher (1918). Many genetic models were introduced to estimate the different genetic effects (Hyman and Mather, 1955).

Estimation of genetic variance is very essential among the basic information required for the breeders. Partitioning of the genetic variance should definitely help the breeders. If most of the genes controlling yield proved to be mainly of additive nature the crosses, the improvement of yield could be achieved by simple selection. Poulsen (1977) studied that although the major part of the variation in seed yield was detected as additive genetic variance, dominance effects also played important role in the inheritance of this trait. El-Hosary (1981), El-Refaey (1999), Farag and Darwish (2005), and Attia, Sabah (1998), and Attia, Sabah *et al.*, (2006). Reported that both additive and non additive genetic effects controlled the genetic systems for yield traits.

El-Hosary (1981), El-Hady (1988) and Mohamed (2001) found that both additive and dominant gene effects were the mostly contribution for flowering date and other yield components. Manifestations of heterotic effects ranged from significantly positive to significantly negative values (Poulesen, 1977, El-Hady, 1988, Mohamed, 2001, Darwish *et al.*, 2005). Heterosis may be occur in some hybrids in spite of there is insignificant difference between the parents involved in these crosses (Gad El-Karim, 1988).

The main objective of the present work was to study the main genetical aspects of earliness yield and its components three in intervarietal crosses of faba bean.

MATERIALS AND METHODS

This study was carried out during three successive winter seasons of 2003/04, 2004/05 and 2005/06 at the Farm of Agric. Faculty of Agric. Menofiya University at Shibon El-Kom. Six broad beans (*Vicia faba* L.) genotypes were chosen, each cv., possessed at least one or two of the characters to be studied (Table 1). Six faba bean genotypes namely; Lines Moshtoher (M.)103, ILB 938, TW, Nubaria 1, Giza 40 and Giza 461 were used to generate the experimental materials used in this study.

The T.W., Lin (M.) 103 and Rebaia 40 were early on securance, while the ILB 938 and Nubaria 1 were late and resistance to diseases.

Threy intial crosses (line M. 103 x ILB 938, T. W x Nubaria 1 and Giza 40 x Giza 461) were designated in the text as the first, the scond and the third croses, respectively . and were devloped in 2003 / 04

The F_1 plants were selfed and backcrossed to each corresponding parent in 2004/2005 season to produce BC1 (F_1 x P_1) and BC2 (F_1 x P_2) generations. In the winter season of 2005/06, parents F_1, F_2, BC_1, and BC_2 populations of three crosses were evaluated in a randomized complete block design with three replications. In each replicate, three ridges were allocated to each of the non-segregating populations (P_1, P_2 and F_1), six ridges for each backcross and ten ridges for the F_2 populations. Each ridge of one side comprised of 15 hills spaced at 20 cms. apart and 60 cms. widths .

Data were recorded on all guarded plants for flowering date, maturity date, filling period, plant height, no. of branches/plant, no. of pods plant, 100-seed weight and seed yield/plant.

The genetic variance within F_2 populations was firstly estimated. If that variance is significant, various genetical parameters were then derived. Heterosis (H%), inbreeding depression (I.D. %) and heritability in broad and narrow senses were calculated according to Mather's Method, 1949. F_1 deviation (E1) and backcross deviation (E2) were estimated as suggested by Mather and Jinks (1971). In addition, the six parameters model proposed by Gamble (1962) was used to estimate different gene effects.

Table (1): Pedigree, country of Origin, Flower color and hilum color.

No	Cultivar or line	Pedigree	Country of origin	Flower color	Hilum color.
P1	M.103	Giza 1 x Bakistani 112	Egypt-moshtoher	Purple	Black
P2	ILB938	Introduceed from Colombia	Colombia	Purple	Black
P3	Triple white (T.W)	Mutation from Sudan variety	Sudan	White	White
P4	Nubaria 1	Selected from Rina Blance	Spain	Purple	White
P5	Giza 40	Selected from Ribaya 40	Egypt-Giza	Purple	Black
P6	Giza 461	Giza 3 x ILB 938	Egypt-Giza	Purple	Balck

RESULTS AND DISCUSSION

Number of plants, mean and variance values of eight studied traits for parents, F_1, F_2, BC_1 and BC_2 of the three crosses are presented in Table (2). All studied characters showed significant genetic variance in F_2 plants in the three crosses, therefore, other parameters were studied.

Heterosis, inbreeding depression (I.D%), potence ratio, F_2 deviation (E_1), back cross deviation (E_2) and gene action in the three crosses of faba bean are presented in Table (3). A highly significant negative heterotic effect was detected for flowering date in the three crosses (Table 3), reflecting the possibility of producing earlier hybrids of faba bean. Similar results were reported by E-Hosary (1981 and 1983).

Earliness, if found, is favourable to escape destructive injuries caused by stress conditions. Besides, breeding early maturity cultivars may allow intensive production. The three crosses expressed significant negative heterosis for flowering time. Hence, it could be concluded that both populations are valuable in breeding for earliness, as flowering time is a good indicator of earliness.

Heterosis and inbreeding depression result from a similar phenomenon, therefore, it is logical to anticipate that heterosis in the F_1 will be followed by an appreciable reduction in the F_2 performance. In most cases, results obtained were in agreement with this expectation.

Highly significant negative heterotic effect for filling period was detected in the third cross, while the first and second crosses showed positive significant heterosis, but insignificant inbreeding depression was detected in the first cross.

Maturity date in the third cross showed negative significant, but insignificant in breeding depression was detected. While maturity date in the first and second crosses did not show any heterosis. However, a highly significant value for inbreeding depression was detected.

Highly significant positive heterotic effect to mid-parents value was found for no. of pods/plant and 100-seed weight in the three crosses, no. of branches/plant and seed yield/plant in the first and second crosses, and plant height in the second cross. These results are in close harmony with El-Tabbakh and Ibrahim (2000), Farag and Helal (2004), Farag and Darwish (2005) and Attia, Sabah *et al.* (2006). Number of days to flowering, number of days to maturity and filling period are the main characters for earliness. Hence, heterotic decrease shown in any of the three characters may lead to considerable earliness increase in hybrids. Also, no. of branches/plant, no. of pods/plant and 100-seed weight are the main components for seed yield/plant. Hence, heterotic increase shown in any of the three components may lead to considerable yield increase in hybrids as shown in Table (3).

Table (2): Number of plants, mean (X) and variance (S^2) values for the six populations of the faba bean crosses for the studied traits.

Cross	Population	No. of plant	Days to flowering		Days to Maturity		Maturity Period (days)		Plant height (cm.)		No. of branches/ plant		No. of pods/plant		100-seed weight (gm)		Seed yield, Plant (gm)	
			X	S^2	X	S^2	X	S^2	X	S^2	X	S^2	X	S^2	X	S^2	X	S^2
M. 103 x ILB 938	P_1	40	50	2.66	157	1.23	104	2.87	104.1	15.3	2.73	0.77	26.5	23.23	71.93	21.1	61.88	42.6
	P_2	40	100	2.76	173	0.51	78	3.08	94.3	12.2	5.14	1.79	38.6	15.3	63.71	20.5	25.0	17.36
	F_1	40	65	1.06	161	2.67	97	4.69	105	18.0	4.00	1.03	73.0	24.9	80.8	10.1	154.6	44.13
	F_2	400	51.6	8.66	151	20.4	98	37.1	93.6	90.1	3.82	4.33	23.9	95.6	83.3	158.8	64.3	713.4
	BC_1	120	55	5.24	155	8.07	100	7.82	86	24.2	1.6	2.15	26.0	51.6	62.2	37.8	65.1	637.93
	BC_2	130	75	6.07	165	3.67	90	12.73	95	50.2	8.3	2.56	70.6	54.2	52.4	31.2	72.82	95.6
TW x Nobaria 1	P_1	40	52	2.23	140	1.53	88	2.56	80.6	22.3	2.22	3.56	31.5	27.4	52.8	27.5	56.9	5.42
	P_2	40	85	3.2	172	2.0	127	1.59	83.0	28.9	3.5	1.59	27.2	21.8	76.1	11.6	68.9	23.1
	F_1	40	65	1.5	156	2.05	110	1.64	103	16.4	4.20	2.22	40.4	23.2	82.6	10.11	89.91	8.36
	F_2	400	55.1	5.61	145	16.04	96.4	6.74	80	43.7	4.42	8.23	22.3	72.3	101.3	71.6	54.54	424.9
	BC_1	120	53	4.71	150	3.69	98	3.91	81.6	39.2	3.0	3.69	29.9	51.1	58.3	36.61	43.749	34.9
	BC_2	130	65	3.82	165	5.32	101	4.49	106	30.7	6.0	3.67	73.0	32.8	78.3	29.81	53.34	149.9
Rebaia 40 x Giza 461	P_1	40	55	2.05	165	1.23	110	4.1	121	14.4	3.0	0.82	38.8	13.1	54.6	5.94	62.2	37.94
	P_2	40	60	1.64	162	3.69	102	3.7	120	10.3	4.2	01.39	29.0	10.56	82.3	5.44	86.56	10.5
	F_1	40	55	3.10	153	2.77	98	2.87	122	6.2	5.3	1.56	32.3	8.2	72.4	6.92	63.7	15.56
	F_2	400	49.6	7.2	155.8	11.39	103	24.73	103	72.7	4.0	3.65	21.2	25.2	59.8	20.12	21.2	47.42
	BC_1	120	52	3.7	164	4.6	112	6.05	112	22.7	2.5	2.77	20.0	16.8	83.4	10.12	61.82	20.3
	BC_2	130	50	4.28	160	5.35	110	8.64	130	20.2	6.0	2.02	29.8	19.5	61.2	13.01	70.39	27.2

Table (3): Heterosis, inbreeding depression, potence ratio (P), F_2 deviation (E_1), back cross deviation (E_2) and different types of gene actions for the studied traits in three crosses of faba bean.

Character		Heterosis % "MP"	Inbreeding depression (I.D)	Potence ratio	F_2 deviation (E_1)	BC deviation (E_2)	Gene action					
							a	d	aa	ad	dd	m
Flowering date	I	-13.33**	89.60**	0.4	-18.4**	-10.00**	-20.0**	43.6**	53.6**	5.00**	-33.6**	51.6**
	II	-5.11**	15.22**	-0.21	-11.64**	-15.3**	-12.00**	12.06**	15.56**	4.50**	15.4**	55.1**
	III	-4.35**	9.82**	1.0	-6.65	-10.50**	2.00**	3.10*	5.6*	4.6**	15.9**	49.6**
Maturity date	I	-2.42	6.21**	0.5	-12.0**	-6.00	-10.0**	32.0**	36.0**	-2.00**	-24.0**	151.0**
	II	0.00	7.05**	0.0	-11.0**	3.00	-15.0**	50.0**	50.00**	1.0	-56.00**	145.0
	III	-6.42**	-1.83	7.0	-2.45	7.50**	4.0**	14.3**	24.8**	2.5**	-39.8**	155.8**
Filling period	I	6.59**	-1.03	-2.18	4.0	2.00	10.0**	-6.0*	-12.0**	-3.0**	8.0**	98.0**
	II	12.82**	12.36**	-1.32	-7.35	-8.50**	-3.0**	24.9**	12.4**	6.5**	4.6*	96.4**
	III	-7.55**	-4.90	2.0	0.80	18.00**	2.00**	24.8**	32.8**	-2.0*	-68.8**	102.8**
Plant height	I	5.86	10.83**	1.18	-8.46	-3.19	-9.0*	-6.7**	-12.52*	-13.9**	58.89**	93.6**
	II	25.96**	22.43**	17.25	-12.45**	2.83	-24.4**	76.82**	55.6**	-23.2**	-61.2**	79.9**
	III	1.24	15.98**	3.00	-18.75**	-0.5	-18.0**	75.5**	74.0**	-18.5**	-73.0**	102.5**
No. of branches/ plant	I	1.65	4.50	0.80	-0.15	1.92	-6.70**	4.59**	4.52*	-5.5**	-8.45**	3.82**
	II	46.85**	-5.24	2.125	0.89	1.94**	-3.0**	1.66	0.32	-2.36**	-4.2*	4.42**
	III	47.22**	24.53**	2.83	-0.45	-0.40	-3.50**	2.70*	1.00	-2.90**	-0.20	4.0**
No. of pods/plant	I	124.24**	67.25**	6.32	-28.87**	-8.96**	-44.6**	138**	97.6**	-38.6**	-79.65**	23.91**
	II	37.72**	44.93**	17.70	-12.62**	33.23**+	-43.04**	127**	116.9**	-45.2**	-183.4**	22.25**
	III	-4.72	34.46**	-0.39	-11.93**	-16.40**	-9.80**	13.32**	14.92**	-14.7**	17.88**	21.2**
100-seed weight	I	19.17*	-3.01	3.15	8.93	-34.14**	9.82**	-91.0**	-10.90**	5.71**	172.3**	83.3**
	II	28.10**	-22.69**	1.56	27.80**	-10.48**	-19.99	-114.03**	-132.2**	-8.32**	153.9*	101.3**
	III	5.77**	17.39**	0.284	-10.62	3.72	22.19**	53.85**	49.9**	36.1**	-57.3**	59.8**
Seed yield /plant	I	255.8**	58.44**	6.03	-34.72**	-60.05**	-7.68**	130.09**	18.96**	-26.1**	101.1*	64.2**
	II	42.98**	39.34**	4.51	-21.86**	43.39**	-110.5**	201.1**	174.1**	-104.6**	-260.7**	54.54**
	III	-14.33**	66.66**	-0.261	-47.79**	-5.84**	-8.75**	168.8**	179.5**	3.693**	-167.8**	21.24**

I – M.103 x ILB 938 II- T.W x Nubartia 1 III – Giza 40 x Giza 461

*and** verily the significance at 0.05 and 0.01 levels of probability. respectively.

As to inbreeding depression, highly significant positive values were obtained for flowering date, no. of pods/plant, and seed yield/plant in the three crosses, maturity date in the first and the second crosses, no. of pods/plant and 100-seed weight in the third cross. While, for 100-seed weight in the second cross gave highly significant negative value of inbreeding depression,. This is logic and expected since the expression of heterosis in F_1 will be followed by a considerable reduction in F_2 performance.

Over dominance for high or low parent was detected for filling period, plant height, no. of pods/plant and seed yield/plant in the three crosses, no. of branches/plant in the second and third crosses. Complete dominance for flowering in the third cross and maturity date in the second cross.

Partial dominance towards the better parent was found for no. of branches/plant in the second cross. While, partial dominance toward the lower parent was found for flowering date in the second cross and 100-seed weight in the third cross. Absence of dominance was obtained for maturity date in the second cross. The potence ratio values indicated that there were all types of dominance; i.e. over, complete, partial and no. dominance for all characters under study. Generally, potence ratio values were found to follow the same pattern of heterosis degree in all traits of the three crosses. These results of heterosis, inbreeding depression and potence ratio were supported by similar findings obtained by Bargale and Billor (1990), Melchinger *et al.* (1994), Farag and Helal (2004) and Farag and Darwish (2005).

Significant F_2 deviation (E_1) was obtained for plant height, no. of pods/plant and seed yield/plant in the three crosses, flowering date. and maturity date in the first and second crosses. This result reveals that the epistatic gene effects might have a major contribution in the inheritance of these characters.

Significant negative BC deviation (E_2) was obtained for flowering date in the three crosses, no. of pods/plant and seed yield/plant in the first and third crosses, and 100-seed weight in the first and second crosses. Concerning filling period in the third cross, and no. of branches/plant, no. of pods/plant, and seed yield/plant in the second cross they gave significant positive BC deviation (E_2).

(For estimating various types of gene effects, the variety with a high mean value in each trait was usually considered as P_1). In all traits the mean effect of parameter (m) was highly significant (Table 3). The estimates of parameter (a) are quite small in magnitude relative parameter (d) in all crosses under study (Table 3).

Additive gene effects (a) were highly significant for all studied traits in all crosses. These results indicated the potentiality of improving the performance of these traits by using pedigree selection program. The dominance effect (d) was highly significant for all studied traits in all crosses except no. of branches/plant in the second cross. Moreover, the additive gene effects were more important and greater than the dominance gene effects (Table 3). Dominance gene action would tend to favor the production of hybrids, while, for additive gene action, the significant standard selection procedures would be effective in bringing about advantageous changes in the characters.

The estimated value of additive x additive (aa) epistatic type was highly significant for all traits, except for no. of branches/plant in the second and third crosses. Also, the additive x dominance gene effect (ad) was highly significant for all traits, except maturity date in the second cross. Generally, significant one or more of the three types of epistatic gene effects were exhibited in the three crosses for all studied traits (Table 3).

The epistatic type of dominance x dominance was found to be significant for all traits under study except number of branches/plant in the third cross. Significat the epistatic type of gene action were reported by El-Hosaary, 1981, Hendawy (1994), El-Refaey (1999) and Farag and Darwish (2005).

Heritability in broad and narrow sense, genetical gain and genetic coefficient of variation (G.V.C.%) for the studied traits are presented in Table (4).

Broad sense heritability h^2 estimates ranged from 49.97% for plant height in the second cross to 97.1% for seed yield/plant in the second cross.

Narrow sense heritability (h^2n) estimates ranged from 19.92% for plant height in the second cross to 78.3% for 100-seed weigh in the first cross.

Such results agreed with those obtained from gene action studie (Table 3). Similar results were obtained by Dawwam and Abdel-Aal (1991), Hendawy (1994), Ramgiry (1997) and Farag and Darwish (2005).

Genetic coefficient of variation (GCV%) showed high values for no. of branches and seed yield/plant in the three crosses, no. of pods/plant in the first and second crosses. Concerning no. of pods/plant in the third cross and 100-seed weight in the first cross, they gave moderate values for genetic coefficient of variation (GCV). The other traits had low values of GCV% (Table 4). (It is used alone, this will be easier when the heritability estimates and genetic gain were available (Swarup and Chaugale, 1962)). The genetic advance under selection depends on the amount of genetic variability, the magnitude of masking effect of the environment and density of selection that is practiced.

In terms of the progress expected, the effect in future generations, due to the non-additive variance, is included in study was derived by using heritability in narrow sense. The predicted genetic advance was rather moderate for no. of branches/plant no. of pods/plant, seed yield/plant in the three crosses, plant height, and 100-seed weight in the third cross, and filling period in the first cross. The other traits had low predicted genetic advance. In the present investigation, moderate heritability values were detected for all studied traits in the three crosses except plant height in the second cross and no. of branches/plant and no. of pods/plant in the third cross whereas low values were detected. Therefore, selection for these traits could be affective and satisfactory for successful breeding purposes. These results are in agreement with those found by Dawwam and Abdel-Aal (1991), El-Refaey (1999) and Farag and Darwish (2005).

Table (4): Heritability estimates, genetic advance (Δg) and genetic advance expressed as percentage of the F_2 mean (g%) and genotypic and phenotypic cofficent of variation of variance of the three crosses of faba bean for the studied traits.

Character	Cross	Hertability		Genetic advance		GCV%	PCV %
		Broad since	Narrow since	Δg	Δg %		
Flowering date	I	75.06	54.48	3.30	6.4	8.15	4.94
	II	60.19	47.9	2.33	4.24	4.25	3.3
	III	68.31	45.92	1.65	3.02	12.73	4.44
Maturity date	I	92.79	66.91	6.23	4.12	9.08	2.88
	II	88.40	75.0	6.19	4.26	8.58	2.60
	III	77.49	74.0	5.4	3.32	6.61	1.91
Filling period	I	90.44	79.0	9.91	10.11	20.24	5.91
	II	90.22	45.0	2.41	2.50	5.0	2.28
	III	85.63	70.0	7.79	6.97	14.01	4.48
Plant height	I	83.18	58.0	5.06	5.46	37.68	9.24
	II	49.92	19.50	2.71	3.39	6.79	5.85
	III	85.90	70.53	12.39	12.14	24.2	7.75
No. of branches/ plant	I	64.67	57.0	2.44	63.96	156.79	43.8
	II	70.15	55.3	3.26	73.91	147.84	54.36
	III	65.59	34.48	1.36	33.92	67.66	38.66
No. of pods/plant	I	77.88	44.6	8.98	37.58	75.3	36.10
	II	66.60	41.95	7.35	33.01	66.1	31.18
	III	57.81	29.8	2.87	13.57	27.2	18.02
100-seed weight	I	89.12	78.3	20.33	24.41	48.83	14.29
	II	77.12	53.6	9.34	9.25	18.45	7.33
	III	69.93	42.52	3.923	6.56	13.14	6.24
Seed yield/plant	I	95.14	48.52	26.72	41.03	83.11	40.55
	II	97.09	78.3	33.25	60.96	121.88	37.24
	III	54.92	49.95	7.08	33.36	66.73	24.02

The expected response to selection, which varies with the phenotypical standard deviation of population means, and which is a measure of the total variability of the trait, could therefore, reflects the total response that could be realized by breeding techniques.

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دراسات وراثية علي التبكير والمحصول ومكوناته فى الفول البلدى

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** معهد البحوث الحقلية ــ مركز البحوث الزراعية ــ مصر

أجرى هذا البحث بالمزرعة البحثية لكلية الزراعة ــ جامعة المنوفية بشبين الكوم خلال لمواسم ٢٠٠٣/٢٠٠٤م ، ٢٠٠٤/٢٠٠٥م ، ٢٠٠٥/٢٠٠٦م على ثلاث هجن من الفول البلدى وهى:

M.103 X ILB938 (I),(T.W.) X Nubaria 1 (II), and Giza40 X Giza461 (III).

ودرست كل من قوة الهجين ، ودليل السيادة ، والتدهور الوراثى نتيجة التربية الداخلية وتأثير الجينات ، والمكافئ الوراثى ، والتحسين الوراثى المتوقع نتيجة الإنتخاب لكل من صفتى التبكير والمحصول ومكوناته فى الهجن.

وقد استخدم فى ذلك الستة عشائر الخاصة بكل من الهجن الثلاثة هى:- P_1, P_2, F_1, F_2, BC_1, BC_2 لصفات: تاريخ التزهير ، وتاريخ النضج ، وفترة الإمتلاء ، وطول النبات ، وعدد الفروع للنبات وعدد القرون للنبات ووزن ١٠٠ بذرة، ووزن محصول البذور للنبات. **ويمكن تلخيص أهم النتائج المتحصل عليها كالآتي:**

١- كانت قوة الهجين معنوية فى الاتجاه الموجب بالنسبه للمحصول ومكوناته بينما كانت قوة الهجين معنوية وفى الاتجاه السالب بالنسبه لميعاد التزهير.

٢- كانت التغيرات الخاصة بالتدهور الناتج عن التربية الداخلية فى اتجاه مضاد مع تقديرات قوة الهجين ماعدا تاريخ التزهير فى الهجن الثلاثة. ووزن مائة بذرة وميعاد النضج فى الهجين الأول والثانى ، وفترة الإمتلاء وعدد الفروع للنبات فى الهجين الثانى.

٣- كانت السيادة فائقة فى اتجاه الأب الأكبر لصفة طول النبات فى الهجن الثلاثة وعدد القرون فى النبات ووزن ١٠٠ بذرة فى كلا الهجينين الأول والثانى ، وكذا عدد الفروع فى الهجين الثانى والثالث. وفترة الامتلاء فى الهجين الأول بينما كانت السيادة فائقة وفى اتجاه الأب الأصغر لصفة فترة الإمتلاء فى الهجين الأول والثانى. كما كانت السيادة جزئية فى اتجاه الأب الأصغر بالنسبه لبقية الحالات ماعدا عدد الفروع للنبات فى الهجين الثالث. كما كانت هناك سيادة تامة فى إتجاه الأب المتأخر لصفة تاريخ التزهير فى الهجين الثالث.

٤- كان التأثير الوراثى المضيف معنويا لكل الصفات ـ والتأثيرات الوراثية السائدة معنوية لكل الصفات عدا صفة عدد الفروع للنبات فى الهجين الثاني.

٥- كان فعل الجينات من النوع التفوقي(المضيف × المضيف) معنويا لكل الصفات عدا عدد الفروع فى الهجين الثالث كما كان فعل الجينات من النوع (المضيف × السيادة) معنويا لكل الصفات عدا فترة الإمتلاء فى الهجين الثانى والثالث كما كان فعل الجينات من النوع (السيادى × السيادى) معنويا لكل الصفات عدا عدد الفروع فى الهجين الثالث.

٦- كانت قيم التوريث بمعناها الواسع متوسطة إلى عالية وتراوحت من ٤٩,٩% لصفة طول النبات فى الهجين الثانى إلى ٩٧,١% لصفة محصول البذور للنبات فى الهجين الثانى. بينما كانت قيم التوريث بمعناها الضيق متوسطة إلى عالية فى كل الصفات ماعدا صفة طول النبات فى الهجين الثاني وعدد القرون فى النبات فى الهجين الثالث كانت منخفضه وتراوحت قيمها من ١٩,٩٢% لصفة طول النبات فى الهجين الثانى إلى ٧٩,٠% لصفة فترة الإمتلاء فى الهجين الأول.

٧- كانت النسبة المئوية للتحسين الوراثى المتوقع عالية لصفات عدد الفروع فى النبات ومحصول البذور للنبات فى الهجن الثلاثة ولصفة عدد القرون فى النبات فى الهجينين الأول والثانى ، كانت النسبة المئوية للتحسن الوراثى المتوقع متوسطة لصفات عدد القرون للنبات فى الهجين الثالث بينما كانت منخفضة فى الحالات الأخرى