J. of Plant Production, Mansoura Univ., Vol. 11 (7):633-637, 2020

Journal of Plant Production

Journal homepage: www.jpp.mans.edu.eg
Available online at: www. jpp.journals.ekb.eg

Nature of Gene Action and Heterosis for Yield and it's Related Traits in Faba Bean (*Vicia faba*L.)

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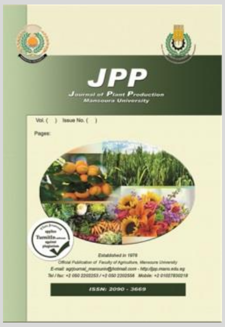

ABSTRACT

The present investigation was carried out during growing seasons 2016-2017 and 2017-2018 at Field Crops Department, College of Agricultural Engineering Sciences, University of Duhok-Iraq, using five genotypes of Faba bean using half-diallel mating crosses according Randomized Complete Block Design (RCBD) with three replications to study combining ability ,gene action and heterosis for yield and its related component traits, the analysis of variance founded to be highly significant mean square for all studied traits. General combining ability and specific combining ability mean squares were highly significant for all tested traits. The results showed that parents Po6-oo3FB and Po6-oo9 FB were the best general combiners, crosses Po6-oo3FB x Po6-oo9FB and Po6-oo3FB x Po6-o13FB exhibited significant specific combining ability effects for most of traits, crosses Po6-oo3FB x Po6-oo9FB, Po6-oo3FB x Po6-o13FB and Po6-oo9FB x Po6-o13FB showed the best heterosis over mid- parent and better parents in desirable direction for studied traits, broad sense heritabilities (h^2.B.S.) were high for all traits, indicated that small effect of environmental conditions on inheritance of these traits , and hence suggested that the traits improvement can be obtained through selection methods of breeding.

Keywords: Faba bean, Combining ability, gene action and heterosis.

INTRUDUCTION

Faba bean (*Vicia Faba* L.) is considered as one of the main legume crops in Iraq, it's widely has an important role in the world because of high protein, starch, cellulose and other minerals for humans and animals.in addition Fababean is the most efficient fixers of atmospheric nitrogen (Haciseferogullari *et al*., 2003; Alghamidi, 2007; and Ibrahim, 2010).

Genetic improvement of economic traits of Faba bean depends on nature and magnitude of genetic variability which involved in the inheritance of such traits which can be estimated by using diallel crosses technique that production of new genetic combination , great offers have been directed to improve the yield and it's components in Faba bean. Heterosis and combining ability provide a good information which helpful for breeders to identify the best combiners which may be hybridized either to exploit heterosis or to build up favourable fixable gene (Farag and Afiah, 2012; Abdulla *et al*., 2015; and Rabie and El-Emam, 2015).

Superiority of hybrids for the yield of seeds and it's components are accompanied with the huge of heterotic effects in the important yield attributes, including plant's number of branches, number of pods/ plant, number of seeds/ pods and the weight of hundred seeds. These heterotic factors may range from significantly positive to significantly negative for different traits according to the genetic make-up of the parents (El-Hady *et al*., 2006) and (Kanhaiya *et al*., 2019). Various values of heterotic effects were achieved by many research workers for important traits in Faba bean with desirable heterosis values for seeds yield and their components (Steling, 1997; Bashoot, 2000; Attia and Salem, 2006; and El-Banna *et al*., 2014).

The role of GCA (general combining ability) and SCA (specific combining ability) in the inheritance of seed yield were studied by many research workers (Salama and Salem 2001, and Hossam 2010). Significant GCA values were recorded for the number of branches/ plant, number of seed/ pod and the weight of hundred seeds, while SCA was recorded for the yield components. Tantawy *et al*., (2007) noticed that the values of (GCA) and (SCA) were significantly higher for the yield component indicating the importance of rule of additive and non-additive gene action in the inheritance of these traits.

The current investigation aimed to study the heterosis and combining ability to understand the type of gene action which controls the inheritance of yield and its components traits of Faba bean.

MATERIALS AND METHODS

This study was carried out at Field Crops Departments, College of Agricultural Engineering Science, Duhok University in two growing seasons of 2016-2017 and 2017-2018. Five diverse genotypes of Faba bean (Table 1) were used in this study. In the first growing season the seed of parents were sawn and crossed in a half-diallel making design to produce 10 F1 hybrids. In the second growing season all genotypes (5 parents + 10 F1 hybrids) were sawn in randomized complete block design with three repplications on 20th November. Seed were planted in hills, 20cm apart. Each genotype was represented by on row 4m length and 60 cm in between; all recommended agricultural practices were followed to raise a good crop. Five plants were randomly sample from each row to measure the following traits: plant height (cm), number of days 50% flowering, number of branches per plant, number of pod per plant, pods length (cm), number of seeds per pod, seeds yield/plant (g). and 100-seed weight (g). Data were subjected to analysis of variance in order to test the significance of differences according to (Al-Zubaidy and Al-Falahy, 2016).

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DOI: 10.21608/jpp.2020.110412

The heterosis effects of F_1 were estimated as percentage over mid and better parents according to (Singh and Khanna, 1975) as following formula:-

$$\text{Mid parents heterosis (Relative heterosis)} = \frac{F1-Mid\ parent}{Mid\ parent}\ x100$$

$$\text{Better parent heterosis (Heterobeltiosis)} = \frac{F1-Better\ Parent}{Better\ Parent}x100$$

According to (Griffing, 1956 method 2 model 1) sum of square for genotypes was partitioned in to sources of variance due to GCA and SCA, the variances of GCA (σ^2g) and SCA (σ^2s), were estimated on the basis of the expected mean squares for all traits, additive σ^2A and dominance σ^2D genetic variance were estimated according to (Matzinger and Kempthoren, 1956). Heritability in broad and narrow senseS were estimated according to the (Falconer, 1989) as the following formula:-

$$h^2_{b.s} = (\sigma^2A + \sigma^2D) / (\sigma^2A + \sigma^2D + \sigma^2e)\ x100$$

$$h^2_{n.s} = (\sigma^2A) / (\sigma^2A + \sigma^2D + \sigma^2e)\ x100$$

The expected genetic advance was estimated according the following formula:-

$$G.A = h^2_{n.s}\ x\ I\ x\ \sigma p$$

Where:

G.A = genetic advance I = selection index

σ p = standard variance of phenotype .

The value of expected genetic advance considered according (Ahmad and Agrawal, 1982).

Table 1. Name pedigree and origin of five Faba bean genotype.

No.	Entry	pedigree	Origin
1	Po6-oo3FB/ FL	2000/DSO/o4o5 HBP/71o6/B7/DT	ICARDA
2	Po6-oo9FB/ FL	Selection from ILB1814	=
3	Po6-o11FB/ FL	2000/DSO/o4o5 HBP/7038/B7/DT	=
4	Po6-o13FB/ FL	2000/DSO/o4o5 HBP/7486/B7/DT	=
5	Aquadulce	ILB1266	Spain

RESULTS AND DISCUSSION

Analysis of Variance:

Analysis of variance of genotypes, general and specific combining abilities presented in Table 2, showed highly significant mean squares of genotypes for all studied traits, this provides that a wide genetic variability for studied traits which can be exploit in Faba bean breeding program. The general and specific combining abilities mean squares were highly significant for all tested traits, indicating the both of (GCA) and (SCA) were very important in the inheritance of these traits, while the mean squares due to GCA and SCA variances ratios were more than one for all studied traits, indicating that these traits were under additive genetic control, similar results were found by (Salama and Salem, 2001 and Abdulla *et al*., 2015).

Table 2. Mean squares variance of Faba bean genotypes for studied traits.

S.O.V	d.f.	Plant Height (cm)	50% Flowering	No. of Branches /Plant	No. of Pods / Plant	Pod Length (cm)	No. of Seeds / Pod	seed yield/ plant (g)	100 seed weight (g)
Rep.	2	2.542	0.615	0.294	0.283	0.392	0.072	1.661	43.505
ENTRIES	14	204.397**	198.892**	4.766**	30.118**	28.341**	3.199**	7897.994**	1887.220**
Parents	4	202.905**	153.976**	3.064**	24.929**	18.662**	2.369**	7804.851**	3633.527**
Pars. vs. Hyb.	1	7.022*	1.587*	3.080**	1.708*	0.093	0.000	163.917**	41.752**
Hybrids	9	226.991**	240.777**	5.710**	35.581**	35.781**	3.924**	8798.733**	1316.135**
Error	28	1.066	0.2461	0.071	0.318	0.099	0.057	0.688	0.812
GCA	4	621.030**	550.984**	10.864**	65.837**	65.223**	7.742**	21681.831**	6186.486**
SCA	10	37.744**	58.055**	2.327**	15.831**	13.588**	1.382**	2384.459**	167.513**
Ø GCA/ Ø SCA		16.454	9.491	4.668	4.159	4.800	5.602	9.093	36.931

*** and ** significant at 0.05 and 0.01 level of probability respectively.**

Mean Performance:

The mean values of different Faba bean genotypes is presented in Table 3, and showed that P_2 was the tallest plants withe value (82.033 cm), whereas the shortest were P_5 and P_4 with (70.26 and 71.43cm), respectively. Regarding number of days 50% flowering, P_4 possessed the earliest plant with (76.28 days), while P_5 were the latest in flowering (91.50 days). P_2 recorded the highest number of branches and number of pods per plant with values of (6.45 and 20.367), respectively. For pod length, P_2 recorded the maximum value with (18.983 cm) and minimum value for P_3 with (12.800). The results showed that the lowest number of seeds per plant was recorded for P_5 with (3.383) and the highest number for P_2 with (5.560), with high seed yield (150.163g). The result for 100-seed weight indicated P_1 had the highest weight (187.003g), while P_5 showed the lowest value (95.127g). It could be noticed that the genotype P_2 is superior in number of branches per plant, number of pods per plant, pod length, number of pods, number of seeds per pod, and seeds yield per plant, followed by P1 for 100-seed weight. Among the crosses for plant height, crosses (1x2, 2x4, 2x5) had the tallest plant recorded (84.83, 82.35 and 82.71 cm) respectively, whereas the shortest plant belong to crosses (3x4 and 3x5) with values of (61.45 and 63.467 cm), respectively. Regarding number of days to 50% flowering, crosses (3x5 and 1x5) recorded latest plant (95.163 and 94.467days), while the earliest plant belong to the cross 2x4 with (67.300 days). For number of branches per plant the crosses 1x2 and 1x4 recorded the highest number of branches (7.18 and 6.66) respectively, while the lowest value for cross (4x5) with (2.610 branches). Regarding to number of pods per plant cross (1x4) had the highest number (21.95 pods) and the lowest number for cross 3x4) with (12.300 pods), for pod length both crosses (1x4) and (2x4) recorded the tallest pods (21.00 cm) and (21.55 cm) respectively, while shortest pod belong to cross (3x4) with value of (12.13 cm). With respect to number of seeds per pod, the results showed that cross (2x4) had the highest value (6.730 seeds) and the lowest value for cross (1x3) with (3.160 seeds). Regarding of seed yield per plant, cross (1x4) recorded the highest value with (180.340 g) and the lowest value recorded by cross (3x5) with (44.130 g). For 100-seed weight, cross (1x2) had the highest weight with (161.567 g) and the lowest for cross (3x5) with (103.067g). It could be noticed that the cross (1x4) was superior in number of branches per plant, number of pods per plant, pod length and number of seeds per pod, followed by crosses (1x2, 1x4 and 2x3) in number of branches per plant. Similar results were obtained by (Attia and Salem 2006; Fikreselassie and Seboka 2012; and El-Banna *et al.* 2014).

Combining Ability

Estimate values of general combining ability effects (gi) of each parent for all traits were given in Table 4. The results indicated that P_1 was the best combiner for plant height, number of branches per plant, number of pods per plant, pod length, number of seeds per pod, seed yield and 100-seed weight, while P_2 was good combiner for all studied traits followed by P_3 for pod length, number of seeds per pod and seed yield per plant, the result indicated that the P_1 and P_2 exhibited useful general combining ability effects could be utilized in breeding programs to improve the studied traits.

Table 3. Mean performance of five Faba bean genotype and F1 generation for studied traits.

Genotypes	Plant Height (cm)	50% Flowering	No. of Branches/Plant	No. of Pods /Plant	Pod Length (cm)	No. of Seeds /Pod	seed yield/plant (g)	100 seed weight (g)
				Parents				
1	78.883 b	89.600 d	5.317 ef	16.083 c	18.067 c	5.017 cde	147.137 e	187.003 a
2	82.033 a	79.333 g	6.450 a-d	20.367 ab	18.983 b	5.560 bc	150.163 d	136.200 g
3	60.967 e	90.933 cd	4.083 g	13.200 def	12.800 ij	3.817 g-j	55.313 k	113.163 k
4	71.433 cd	76.283 h	4.000 g	14.750 cd	15.917 e	4.733 def	82.177 h	122.250 i
5	70.267 cd	91.500 bc	4.717 fg	13.650 def	14.767 f	3.383 ij	41.093 m	95.127 n
				Crosses				
1×2	84.833 a	78.917 g	7.183 a	19.183 d	19.850 b	5.850 b	175.050 b	161.567 b
1×3	64.167 c	92.833 b	6.117 b-e	12.700 ef	13.050 hij	3.167 j	56.783 k	147.093 e
1×4	77.900 b	76.833 h	6.667 ab	21.950 a	21.000 a	5.417 bcd	180.340 a	154.093 c
1×5	73.067 c	94.467 a	5.417 ef	14.683 cd	13.950 fgh	4.483 efg	90.287 g	141.217 f
2×3	77.033 b	89.723 d	6.617 abc	18.617 b	16.883 d	3.650 hij	99.643 f	151.083 d
2×4	82.350 a	67.300 i	5.800 cde	19.517 b	21.550 a	6.733 a	166.253 c	129.000 h
2×5	82.713 a	90.397 cd	5.617 de	14.300 de	15.683 e	4.000 f-i	63.360 i	115.790 j
3×4	61.450 e	87.717 e	4.067 g	12.300 f	12.133 j	4.317 e-h	59.897 j	117.323 j
3×5	63.467 e	95.163 a	4.583 fg	13.167 def	14.217 fg	3.483 ij	44.133 l	103.067 m
4×5	68.567 d	85.933 f	2.617 h	13.817 def	13.717 ghi	3.950 ghi	56.507 k	107.687 l

Table 4. Estimates of general combining ability effects of each (gi) of each parent for studied traits.

Parents	Plant Height (cm)	50% Flowering	no. of Branches/Plant	no. of Pods / Plant	Pod Length (cm)	no. of Seeds / Pod	seed yield/ plant (g)	100 seed weight (g)
1	2.583**	1.068**	0.617**	0.767**	0.994**	0.275**	29.926**	26.473**
2	7.335**	-4.253**	0.917**	2.434**	2.130**	0.618**	31.054**	5.311**
3	-7.372**	4.647**	-0.307**	-1.733**	-2.163**	-0.682**	-30.882**	-6.825**
4	-0.931**	-6.346**	-0.650**	0.253	0.458**	0.408**	5.728**	-5.723**
5	-1.615**	4.884**	-0.576**	-1.721**	-1.418**	-0.620**	-35.826**	-19.236**
S.E.(gi)	0.349	0.168	0.090	0.191	0.106	0.081	0.280	0.305
S.E.(gi - gj)	0.552	0.265	0.143	0.302	0.168	0.128	0.443	0.482

*** and ** significant at 0.05 and 0.01 level of probability respectively.**

Estimated values of specific combining ability effects (sij) presented in Table (5) shown that five crosses exhibited positive significant SCA effects, for plant height, number of days to 50% flowering. Three crosses recorded desirable negative significant SCA effects (1x2, 1x4, and 2x4), four crosses (1x2,1x3,1x4 and 2x3) showed desirable positive significant SCA effects for number of branches per plant, four crosses for number of pods per plant, while for pod length five crosses showed positive significant SCA effects, while for seed yield per plant five crosses (1x2, 1x4, 2x3, 2x4 and 3x5) recorded positive significant SCA effects, and three crosses (1x4, 1x5 and 2x3) showed desirable positive SCA effects for 100-seed weight. The significant desirable SCA effects for cross reflected non-additive type of gene action. The parents that gave a significant desirable GCA effect indicated that the contribution of this parent increases the importance of traits in their crosses, while the hybrids with highest positive SCA effects means the ability of this parent in transferring such traits to most of its crosses. The resultS are in agreement with Bahoot, 2000; Hossam 2010; Ibrahim 2010; and Abdullah *et at.,* 2015.

Table 5. Estimates of specific combining ability effects of each (sij) of each parent for studied traits.

Crosses	Plant Height (cm)	50% Flowering	no. of Branches/Plant	no. of Pods / Plant	Pod Length (cm)	no. of Seeds / Pod	seed yield/ plant (g)	100 seed weight (g)
1×2	1.640*	-3.694**	0.367*	0.097	0.556*	0.452**	16.195**	-2.328**
1×3	-4.320**	1.323**	0.524**	-2.220**	-1.952**	-0.930**	-40.136**	-4.666**
1×4	2.973**	-3.684**	1.417**	5.044**	3.377**	0.229	46.811**	1.233*
1×5	-1.177	2.719**	0.093	-0.248	-1.797**	0.324*	-1.689**	1.869**
2×3	3.795**	3.533**	0.724**	2.030**	0.746**	-0.790**	1.595**	20.486**
2×4	2.671**	-7.897**	0.250	0.944*	2.791**	1.202**	31.596**	-2.698**
2×5	3.718**	3.970**	-0.007	-2.298**	-1.199**	-0.502**	-29.744**	-2.396**
3×4	-3.522**	3.620**	-0.260	-2.106**	-2.333**	0.086	-12.825**	-2.240**
3×5	-0.822	-0.163	0.183	0.735*	1.627**	0.281*	12.965**	-2.984**
4×5	-2.162**	1.600**	-1.440**	-0.601	-1.494**	-0.342*	-11.271**	0.535
S.E (Sij)	0.712	0.342	0.184	0.389	0.217	0.165	0.572	0.622
S.E (Sij-Sik)	1.352	0.650	0.350	0.739	0.412	0.313	1.086	1.180

*** and ** significant at 0.05 and 0.01 level of probability respectively.**

Heterosis

Estimates of heterosis over mid parents for studied traits presented in Table 6. Results showed that five crosses exhibited significant positive heterosis for plant height were ranging from 2.742 to 6.563. For number of days to 50% flowering, three crosses significantly flowered earlier than the other crosses with significant negative heterosis values ranging from (-5.550 to -10.508 %). For number of branches per plant, five crosses recorded highest positive heterosis ranged from (0.575 to 2.008 %) and number of pods per plant ranged from (0.958 to 6.533%) as a positive significant values of four crosses, while for pod length four crosses recorded significant positive values with (0.992 to 4.100%), regarding number of seeds per pods three crosses scored highest positive values ranged from (0.542 to 1.587%), while dry seed yield per plant only three crosses exhibited significant positive values (26.400 to 65.683%) and two crosses for 10- seed weight (25.553 to 26.402%).

Table 6. Estimates of heterosis over mid-parents for studied traits.

Crosses	Plant Height (cm)	50% Flowering	no. of Branches/ PLant	no. of Pods / Plant	Pod Length (cm)	no. of Seeds / Pod	seed yield /plant (g)	100 seed Weight (g)
1×2	4.375**	-5.550**	1.300**	0.958*	1.325**	0.562**	26.400**	-0.035 n.s.
1×3	-5.758**	2.567**	1.417**	-1.942**	-2.383**	-1.250**	-44.442**	-2.990**
1×4	2.742**	-6.108**	2.008**	6.533**	4.008**	0.542**	65.683**	-0.533 n.s.
1×5	-3.083**	9.050**	-0.167 n.s.	-2.325**	-2.925**	0.012 n.s.	-5.342**	25.553**
2×3	5.533**	4.590**	1.350**	1.833**	0.992**	-1.038**	-3.095**	26.402**
2×4	5.617**	-10.508**	0.575**	1.958**	4.100**	1.587**	50.083**	-0.225 n.s.
2×5	6.563**	4.980**	0.033 n.s.	-2.708**	-1.192**	-0.472**	-32.268**	0.127 n.s.
3×4	-4.750**	4.108**	0.025 n.s.	-1.675**	-2.225**	0.042 n.s.	-8.848**	-0.383 n.s.
3×5	-2.150*	3.947**	0.183 n.s	-0.258 n.s.	0.433 n.s.	-0.117 n.s.	-4.070**	-1.078 n.s.
4×5	-2.283*	2.042**	-1.742**	-0.383 n.s.	-1.625 **	-0.108 n.s	-5.128 **	-1.002 n.s.

*** and ** significant at 0.05 and 0.01 level of probability respectively.**

Estimates of heterobeltosis (heterosis over better parent) for studied traits in Table (7) showed that two crosses (1x2 and 4x5) exhibited significant positive heterobeltosis with (2.800%) for plant heights. While for number of days to 50% flowering, seven crosses recorded negative significant values ranged from (-1.103 to -12.033%) as earlier crosses. For number of branches per plant, three crosses scored significant positive values (0.733 to 1.350%), regarding number of pods per plant, cross (1x4) recorded the highest positive value with (5.867%); and three crosses for pod length ranges from (0.867 to 2.933%) and two crosses (1x4 and 2x4) for number of seeds per pod with (0.400 and 1.173%) respectively. The positive significant values of heterobeltosis for dry seed yield per plant recorded by three crosses ranged from (16.090 to 33.203%); while for 100-seed weight, significant negative values recorded by all crosses. In general, the crosses (1x2, 1x4 and 2x4) showed desirable heterosis (over mid-parent and better-parent) indicating that these crosses were superior in almost of studied traits. It could be suggested that heterosis effects for yield were associated with yield components traits, the different value of heterosis might be due to genetic diversity of parent with non-allelic interaction which decrease or increase the heterosis expression. These results are in agreement with those reported by El-Hady *et al.* 2006; Ibrahim 2010; Abdullah *et al.* 2015; and Kanhaiya *et al.* 2019.

Table 7. Estimates of heterosis over better parents for studied traits.

Crosses	Plant Height (cm)	50% Flowering	No. of Branches/Plant	No. of Pods / Plant	Pod Length (cm)	No. of Seeds / Pod	seed yield/ plant (g)	100 seed Weight (g)
1×2	2.800**	-10.683**	0.733**	-1.183**	0.867**	0.290 n.s.	24.887**	-25.437**
1×3	-14.717**	1.900**	0.800**	-3.383**	-5.017**	-1.850**	-90.353**	-39.910**
1×4	-0.983**	-12.767**	1.350**	5.867**	2.933**	0.400*	*33.203**	-32.910**
1×5	-5.817**	2.967**	0.100 n.s.	-1.400**	-4.117**	-0.533**	-56.850**	-45.787**
2×3	-5.000**	-1.210**	0.167 n.s.	-1.750**	-2.100**	-1.910**	-50.520**	14.883**
2×4	0.317 n.s.	-12.033**	-0.650**	-0.850 n.s.	2.567**	1.173**	16.090**	-7.200**
2×5	0.680 n.s.	-1.103**	-0.833**	-6.067**	-3.300**	-1.560**	-86.803**	-20.410**
3×4	-9.983**	-3.217**	-0.017 n.s.	-2.450**	-3.783**	-0.417*	-22.280**	-4.927**
3×5	-6.800**	3.663**	-0.133 n.s.	-0.483 n.s.	-0.550*	0.100 n.s.	-11.180**	-10.097**
4×5	2.800**	-5.567**	-2.100**	0.167 n.s.	-2.200**	-0.783 **	-25.670 **	-14.563**

*** and ** significant at 0.05 and 0.01 level of probability respectively.**

Gene Action

The results in Table (8) show that the magnitude of the additive genetic variance (6^2A) were more than of dominance variance (6^2A) for all studied traits, except of dry seed yield and 100-seed weight, revealing that the additive gene action played a major role in inheritance of such traits which means that this traits can be improved by selection methods of breeding. This agreed with Fikreselassie and Seboka (2012) and Praveen *et al.*, (2017).

Average Degree of Dominance and Heritability

Table (8) showed that the values of average degree of dominance were more than one for number of branches per plant, number of pods per plant, pod length, and number of seeds per pods indicating that these traits were controlled by over dominance gene effect while for plant height, number of days to 50% flowering, dry seed yield per plant and 100-seed weight were less than one, pointing that there are a partial dominance gene effect controlling these traits.

Table 8. Estimates of genetic parameters, heritability, and genetic advance for studied traits.

Crosses	Plant Height (cm)	50% Flowering	no. of Branches / Plant	no. of Pods / Plant	Pod Length (cm)	no. of Seeds / Pod	seed yield/ plant g.	100 seed weight (g)
σ^2_A	59.044	52.451	1.028	6.240	6.202	0.732	2064.871	589.112
σ^2_D	12.226	19.270	0.752	5.171	4.496	0.442	794.590	55.567
σ^2_G	71.271	71.721	1.780	11.411	10.699	1.173	2859.461	644.679
σ^2_E	1.066	0.246	1.636	0.318	0.099	0.057	0.688	0.812
σ^2_P	72.336	71.967	1.851	11.729	10.797	1.231	2860.149	645.491
$\bar{a}$	0.644	0.857	1.210	1.287	1.204	1.098	0.877	0.434
$h^2_{B.S}$	0.985	0.997	0.961	0.973	0.991	0.954	1.000	0.999
$h^2_{N.S}$	0.816	0.729	0.555	0.532	0.574	0.595	0.722	0.913
EGA	12.149	10.820	1.322	3.188	3.303	1.155	67.567	40.578
EGA%	16.580	12.611	25.023	20.072	20.426	25.634	69.034	30.715

In the same Table, it can be noticed that the broad sense heritability (h^2.b.s) were higher than their corresponding of narrow sense heritability (h^2.n.s) indicating that additive gene action are important in determining these traits, therefor selection program would be more effective for improvement of these traits. Genetic advance values as percent were medium for all traits, except dry seed yield and 100-seed weight which were high. Similar results were reported by Toker (2007); Sheelamary and Shivani (2015); and Praveen *et al.*, (2017).

REFERENCES

Alghamid, S.S. (2007). Genetic behavior of some selected Fababean genotypes. Proc. 8th ConF. African. Crop Sci. Elminia. Egypt. Pp. 709-714.

Attia, S.M., and M.M. Salem (2006). Analysis of yield and its components using diallel mating among five parents of Fababean. Egypt J. Plant Breed.10:1-12.

Abdulla, M.M.F, M.M. Shafik, M.I. Abd. El-Mohsen, S.R.E. Abo-Hegazy, and A.M.A Saleh (2015). Investigation on Fababean (*Vicia Faba* L.). Heterosis, inbreeding effects, GCA and SCA of diallel crosses of SSP pancijuga and eu-faba. J. Amer. Sci., 11:11-17.

Ahmad, Z. and V. Agrawal (1982). Heritability and genetic advancemin triticale. Indian J. Agric. Res. No. 1: pp 19-23.

Al-Zubaidy, K.D.M and M.A.H. Al-Falahy (2016). Principles and procedures of statistic and experimental designs, Higher education presses. Iraq. Duhok University.

Bashoot, S.B.R. (2000). Breeding for high yielding ability and other agronomic characters in Fababean. Ph.D thesis Faculty of Agriculty. Assiut University, Egypt.

El-Hady, M.M., S.M.A., Olaa, A.M. El-Galaly, and M.M. Salem (2006). Heterosis and combining ability analysis of some Faba bean genotypes, J. Agric. Res. 75: 811-826.

El-Banna, M.N., S. H. Mansour, M.A.A. Nassar, and R.A. Ibrahim (2014). Genetic analysis of yield and it's components and earliness in some Faba bean (*Vicia Faba* L.) crosses. Middle East J. Agric. Res., 3940: 955-961.

Farag, H.I.A., and S.A. Afiah (2012). Analysis of gene action in diallel crosses among same Fababean (*Vicia Faba* L.) Genotypes under aryout Conditions Ann. Agric, Sci. In press.

Fikreselassie, M., and A. Seboka, (2012). Genetic variability of seed yield and related traits of elite Faba Bean (*Vicia Faba* L.) genotypes Pak. J. Bio. Sci. 3(1): 2348-7550.

Falconer, D.S. (1989). Introduction to quantitative genetics. 3rd edn. John Wiley and Sons, New York, pp 438.

Griffing, B. (1956). Concept of general and specific combining ability in relation to diallel crosses Systems. Aust. J. Biol. Sci. 9: 463-493.

Haciseferogullari, H., I. Gezer, Y. Bahtiyarea and H.O. Menges, (2003). Determination of some chemical and physical properties of Sakiz Faba bean (*Vicia faba* L. Var major). J. Food Eng., 60: 475-479.

Hossam, M.I. (2010). Heterosis, Combining Ability and components of Genetic Variance in Faba bean (*Vicia Faba* L.) Met. Env. Arid Land Agric. Sci. 21(1): 35-61.

Ibrahim, H.M. (2010). Heterosis, combining ability and components of genetic variance in Faba bean (*Vicia faba* L.). JKAU Met. Environ. Arid Land Agric. Sci 21(1): 35-50.

Kanhaiya, L., C.B. Yadav, Siva Nath, and D.K. Dwived (2019). Heterotic responses for yield and its components in Faba bean (*Vicia faba* L.) Int. J. Curr. Microbiol. App. Sci. 8(6): 662-677.

Matzinger, D.F., and O. Kempthorne, (1956). The modified diallel table with partial inbreeding and interactions with environment. Genetics 41:822-833.

Praveen, K., Bishnois, and K. Kaushik (2017) Genetic variability, Heritability and genetic advance for seed yield and other Agro-Morphological Traits in Faba Bean (*Vicia faba* L.) genotypes of different origin. Trends in Biosciences. 10(4): 1246-1248

Rabie, E. M. and A.A.M. El-Emam (2015). Evaluation of promising Fababean (*Vicia faba* L.) Genotypes for agronomic and seed technology characters in North Egypt P, (2): 145-157.

Salama, S.M., M.M. Salem (2001). Genetic analysis and combining ability over sowing dates for yield and its components in Fababean (*Vicia faba* L.). Agric. Sci. Mansora Univ. 26:3621-3629

Singh, S.K., and R. Khanna (1975). Physiological, Biochemical and genetic basis of heterosis. Adv. Agron. 27: 123-174.

Sheelamary, S. and Shivani (2015). Genetic variability and correction of Faba bean (*Vicia faba* L.) grown in New Delhi. Int. J. Ad. Tech. In Eng. And Sci. 3(1): 2348-7550.

Stelling, D. (1997). Heterosis and hybrid performance in topless fababeans (*Vicia faba* L.). Euphytica 97:73-79.

Tantawy, D.M., A.G.A. Khaled, and M.H. Hosseny, (2007). Genetic studies for some agronomic characters in faba bean (*Vicia faba* L.). Assiut J.

Toker, C. (2007). Estimates of broad sense heiritability for seed yield criteria in Fababean. Hereditas- Lund, 140: 225-227.

طبيعة الفعل الجيني و قوة الهجين للحاصل و مكوناته في الباقلاء (الفول البلدي)

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نفذت الدراسة خلال موسمي الزراعة 2016-2017 و 2017-2018 في قسم المحاصيل الحقلية, كلية علوم الهندسة الزراعية, جامعة دهوك ,أقليم كوردستان العراق و ذالك بأستخدام التهجين التبادلي النصفي بين خمسة تراكيب وراثية من الباقلاء , زرعت التجربة وفق تصميم القطاعات العشوائية الكاملة في ثلاث مكررات لدراسة المقدرة الأئتلافية , الفعل الجيني و قوة الهجين لصفة الحاصل و مكوناته , أظهرت نتائج تحليل التباين وجود فروقات عالية المعنوية للصفات المدروسة, المقدرة الائتلافية العامة و الخاصة أظهرتا فروقات عالية المعنوية حيث كان التركيبين الوراثيين (P06-003FB,P06-009FB) من أفضل الأباء بأمتلاكهما مقدرة أتحادية عامة على الأئتلاف للصفات المدروسة و يتبعه الهجينين (P06-003FB x P06-009FB) و(P06-003FB x P06-013FB) بأمتلاكهما أفضل مقدرة اتحادية خاصة على الأئتلاف , أما قوة الهجين وفقا لمتوسط الأبوين و أفضل الأبوين تميز كل من الهجن (P06-003FB x P06-009FB),(P06-003FB x P06-013FB),(P06-009FB x P06-013FB) بأمتلاكهما أفضل قوة هجين بالأتجاه المرغوب للصفات المدروسة . فيما يخص قيم التوريث بالمفهوم الضيق كانت عالية للصفات مشيرا بذالك الى قلة تأثير العوامل البيئية على توريث تلك الصفات بذالك يمكن تحسينها من خلال عملية الأنتخاب.