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ESTIMATION SOME GENETIC PARAMETERS, COMBINING ABILITY AND HETEROSIS IN PEA (*Pisum sativum*) USING HALF DIALLEL CROSS.

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ABSTRACT

Experiment of half diallel cross among six pea cultivars was conducted during may 2013. The varietal triats for F1 cross and parents with control were carried out during spring 2015 at the field college of agriculture, university. Duhok using Randomize Complete block Design with three replication. The results were revealed that the general combining ability, and specific combining ability showed significant variance for all traits except days to 50% flowing, No. of plant^{-1} and 50-grain weight. Also, heritability in broad sensc exhibited high value of whole studied traits except days to 50% flowering, whereas the heritability in narrow sesen gave high value for dray weight plants and 50-grain weight, while chlorophyll exhibited moderate value and other traits gave low value of heritability.

KEY WORDS: Genetic parameters, Combining ability , Heterosis , pea (*Pisum sativum*), Half diallel cross

INTRODUCTION

Pea (*Pisum sativum* L.) Pea is a self-pollinated crop, diploid having 14 chromosome (2n=14). Pea is originated in Near East and Mediterranean regions. It is one of the most world's oldest crops cultivated as early as 9,000 years ago for human foods and animals feed (Canada, 2010). Peas is one of the four of the most important cultivated legume and largest world's legume crop in the production after soybean, peanuts and dry beans (Yoshida *et al.*, 2007 and Smykal *et al.*, 2012). Pea genomics have well been studied ever in since, pioneering work of Gregor Mendel in nineteenth century. Pea have certain features such as easy of cultivations, distinguishable phenotypic characters that infuriate Mendel to choose pea for his experimental study and maintain the pea as a main focus of modern genetic analysis. Many morphological traits have a simple inheritance and played a great role in increasing of pea quality and quantity (Samatadze *et al.*, 2008). An access to wide range of cultivars and have many variability in the germplasm collection ensures better chance of producing new varieties by breeders (Pallavi *et al.*, 2013). The most powerful tool, is diallel analysis for characterizing the genetic architecture, for plant materials and estimating the general combining ability of parent and the selection of high specific combining ability for the exploitation of heterosis (Sarker *et al.*, 2002). Diallel analysis is helpful for intersecting the suspect of the GCA and SCA. This analysis is very helpful to predict additive and dominance effects of a population which can then be used to predict the genetic variability and heritability (Syukur *et al.*, 2010). Al-Hamdany, (2014) reported that the General Combining Ability was significant for plant height, seed yield, 100 seed weight and pods weight but non-significant for seeds pod^{-1}, while SCA for most characters was significant in pea. Tawfiq. and Abdulla. (2014) carried out genetic analysis between seven pea in a half diallel crosses and showed that the variance due to specific combining ability was larger than that of general combining ability height, number of branches plant^{-1} except number of days to 50% flowering, while the GCA\SCA variance ratio to be more than one in most studied traits, indicat the importance of additive gene effect in the inheritance of all characters. When a hybrid has high heterosis it is assumed that the two parents are more genetically diverse than the parents of hybrids with low or no heterosis, (Hallauer and Filho, 1988). Kosev,(2014) conducted a field

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study on breeding and genetic assessment of some quantitative charecters in pea and showed the highest positive value of heterosis for number of seeds pod^{-1}, plant height and (Tawfiq and Abdulla, 2014) obtained negative heterosis for number of days to 50% flowering, when study the genetic analysis of pea. The main objective of the present study is to determine the hybrid which have high yield by using half diallel cross and estimate the effect of general combining ability for parents and specific combining ability for hybrids, and some genetic parametirs.

MATERIAL AND METHODS

This study was conducted out at experimental at the field College of Agriculture, University of Duhok, from period Nov 2013-May 2015, using six cultivars of pea, according to (table 1).

Table (1): Genetic material used in experiment:

No.	Cultivar name	Source of seeds
1	Tendrilla	UK
2	Hurst green	UK
3	Jumbo	UK
4	Boogie	UK
5	Kelv edoa	UK
6	Local cultivar (Determinate)	Duhok university

Six cultivars seeds and 12 hybrids were taken from first year Nov 2013, in next season on the 20th of November 2014, the F_1hybrids with parents were arranged in Randomized Complete Block Design (R.C.B.D) with three replication in experimental field, each block was consisted of 18 treatment (6 parents + 12 hybrids). Each cultivars planted in (rows) of 2.5m (long) at 75cm between rows (1 row for dry seed yield and 2 other rows for vegetative measurement). One seed per hole were sown with spacing 25cm between plant to plant in rows.

At maturity three individual plants were taken at random from each entry and data for the following traits were recorded: day to 50 % flowering, plant hight (cm), number of branchs plant^{-1} ,number of pods plant $^{-1}$, number of seeds pods^{-1}, dry seeds yield plant^{-1} 100 dry seed weight(g) and total chlorophyll percentage (it was determine by chlorophyll measurement device((chlorophyll meter)) spad-502 plus.. Heterosis was calculated for the F1 according to mid parents using:

$$\boldsymbol{Heterosis(H)\% = \frac{\overline{F}1-\overline{M.P}}{\overline{M.P}} \times 100g}$$

Where:

$\overline{\boldsymbol{F}}$ =Mean of hybrid

$\boldsymbol{M.P}$ =Mid-parents

$$\boldsymbol{M.P = \frac{P1 + P2}{2}}$$

analysis of variance for combining ability and additive (σ^2A), dominance (σ^2D) and environmental (σ^2E) were calculated according to (Griffing, 1965) method I, fixed model where:

$\sigma^2A_=$ 2Ǿ^2 G.C.A

$\sigma^2D_=$ Ǿ^2 S.C.A $\quad$ $\sigma^2E_= \frac{Mse}{r}$

Heritability:

Broad and narrow sense heritability was estimated depending on the mean square of general and specific combining abilities, and experimental error according to (Singh and Chowdhry, 1985).

$$\boldsymbol{h^2.b.s = \frac{\sigma^2 G}{\sigma^2 P} = \frac{\sigma^2 A + \sigma^2 D}{\sigma^2 A + \sigma^2 D + \sigma^2 e} = \frac{2\sigma^2 gca + \sigma^2 sca}{2\sigma^2 gca + \sigma^2 sca + \sigma^2 e}}$$

Broad sense heritability considered high when it is more than 60%, it is medium between 40% - 60% and low when it is less than 40% (Ali,1999).

$$h^2.n.s = \frac{\sigma^2 A}{\sigma^2 P} = \frac{\sigma^2 A}{\sigma^2 A + \sigma^2 D + \sigma^2 e} = \frac{2\sigma^2 gca}{2\sigma^2 gca + \sigma^2 sca + \sigma^2 e}$$

Narrow sense heritability considered high when it is more than 50%, medium in the range 20% - 50% and low when it is less than 20% (2).

Where:-

$h^2.b.s$ =Heritability in broad sense.
$h^2.n.s$ =Heritability in narrow sense.
$\sigma^2 gca$ =The variance of general combining ability.
$\sigma^2 sca$ =The variance of the effect of specific combining ability.
$\sigma^2 e$ =The variance of the effect of experimental error i.e. environmental variance.
$\sigma^2 A$ =Additive genetic variance.
$\sigma^2 D$ =Dominance genetic variance.
$\sigma^2 G$ =Total genetic variance.
$\sigma^2 P$ =Phenotypic variance (genetic and environmental variance).

To estimation the average degree of dominance ($\bar{a}$):-

$$\bar{a} = \sqrt{\frac{2\sigma^2 D}{\sigma^2 A}} = \sqrt{\frac{2\sigma^2 sca}{2\sigma^2 gca}} = \sqrt{\frac{\sigma^2 sca}{\sigma^2 gca}}$$

If $\bar{a} = 0$ indicated no dominancee.
If $\bar{a} < 1$ indicatedd partial dominance.
If $\bar{a} = 1$ indicated completee dominance.
If $\bar{a} > 1$ indicated over dominance.

The average degree of dominance ($\bar{a}$):-

$$\bar{a} = \sqrt{\frac{2\sigma^2 D}{\sigma^2 A}} = \sqrt{\frac{2\sigma^2 sca}{2\sigma^2 gca}} = \sqrt{\frac{\sigma^2 sca}{\sigma^2 gca}}$$

RESULT AND DISCUSSION

Table **(2)** shows that the analysis of variance of genotypes (cultivars+ hybrids) significant for all traits expect 50 grain weight and days to 50% flowering traits.

general combining ability was substantially significant for whole traits with exception 50 – grain weight, NO. of pod plant^{-1} and days to 50% flowering. Similar finding were recorded by Similar findings were reported by (Mitu *et al.*, 2004 and Borah, 2009).

The specific combining ability was significant in all traits except 50 grain weight and days to 50% flowering. These results are in agreement with (Bisht and Singh, 2011and Dagla *et al.*, 2013).

Table (2): Mean square of variance analysis of GCA and SCA for cultivars, F1half diallel crosses for studied traits in pea.

	Mean squares									
Source of variation	**Characters** / **df**	Grain yield plant^{-1}	No. of grain pod $^{-1}$	Weight plant^{-1}	No. of tillers	Plant Height cm	Chlorophyll	No.pod plant $^{-1}$	50- grain Weight (g)	Days to %50 Flowering
Replication	2	29.95	0.00	84.48	1.01	125.08	30.60	0.01	0.00	9.63
Genotypes	20	347.05**	1.78**	2143.52**	1.23**	90.39**	87.11**	330.71**	0.00	17.09
GCA	5	111.42**	2.93**	3280.87**	1.24*	83.58**	112.03**	44.07	0.00	2.51
SCA	15	425.59**	1.40*	1764.40**	1.23**	92.66**	78.81**	426.25**	0.00	21.95
σ^2e	40	15.93	0.61	76.80	0.36	18.16	5.64	21.20	0.00	11.43

Table **(3)** Revealed the mean value of parents and their hybrids for nine traits. In grain yield traits show that parent (5) and hybrid (1x5) gave high values (41.20) and (66.87) respectively. The heighest no. grain pod given by parent (4) and hybrid (2x4) give (8.13) and (8.80) respectively. It can be noticed that parent (5) was the highest for weight/plant and give (132.63) and (145.30) for hybrid (3x5). The large no of tiller was produced from parent (2) and hybrid (3x6) gave (3.40) and (4.80) respectively. The result provide that parent (2) had the value (77.00) and (2x4) while the longest hybrid which gave (76.30). The highest percentage of chlorophyll was given by parent (6) (45.00) and hybrid (1x2) (55.33). The largest no of pod/plant was reached (33.13) height by parent (5) and (52.30) by hybrid (1x2). The highest 50-grains weight was obtained (18.60) in parent (2) and (71.70) in hybrid (3x6). From the results above the parent (4) and hybrid (2x3) gave (136.67) and (138.67) respectively. These results were in agreement with those of (Sarawat *et al.*, 1994 and Brar *et al.*, 2012).

Table (3): Mean parents and hybrids for various studied characters.

characters / genotypes	Grain yield plant $^{-1}$	No. of grain pod^{-1}	Weight plant $^{-1}$	No. of tillers	Height of Plant	Chlorophyll	No.pod plant $^{-1}$	Weight of 50 grain	Flowering of %50
1	27.63	8.10	66.63	2.90	70.43	41.80	15.63	12.22	131.67
2	31.73	7.13	98.30	3.40	77.00	36.13	26.00	18.58	134.00
3	37.90	7.93	76.63	2.77	66.50	32.93	11.10	18.39	133.33
4	39.20	8.13	88.60	2.67	70.43	29.53	20.93	15.34	136.67
5	41.20	6.13	132.63	2.33	67.23	36.20	33.13	15.40	132.33
6	39.23	7.43	106.60	3.23	65.93	45.00	28.63	16.94	133.67
1x2	66.87	7.50	108.60	3.70	64.30	50.33	52.30	9.64	133.00
1x3	26.90	8.43	63.30	2.80	68.93	47.40	28.63	8.57	132.33
1x4	40.00	8.50	90.00	2.93	61.13	43.53	39.10	7.92	135.33
1x5	32.80	7.93	71.63	2.27	59.60	46.53	26.00	12.18	137.67
1x6	26.23	7.30	60.00	2.93	62.13	47.40	21.80	10.24	138.00
2 x3	32.55	7.60	99.93	3.17	61.30	37.10	20.80	12.38	138.67
2 x4	43.30	8.80	114.57	4.50	76.30	43.73	31.60	16.85	133.00
2 x5	38.50	8.30	118.30	3.57	72.23	46.20	28.30	13.44	137.33
2x6	27.83	5.63	65.00	3.13	62.63	39.53	17.43	17.45	137.33
3 x4	47.40	8.30	66.63	2.73	60.30	46.07	23.63	15.80	135.00
3 x5	50.80	8.30	145.30	3.87	61.80	42.30	36.13	18.69	136.00
3x6	60.70	8.10	143.30	4.80	68.63	39.60	49.80	701.67	136.67
4 x5	44.13	8.30	109.93	2.80	66.93	35.83	24.50	18.74	135.00
4x6	35.23	7.63	124.93	2.70	56.80	44.60	24.63	16.76	131.00
5x6	49.70	7.30	104.93	3.20	71.50	42.53	41.30	12.85	131.33
L.s.d %5	6.59	1.29	14.46	0.99	7.03	3.92	7.60	427.87	5.58

To evaluate the parents and hybrids according to their combining ability. The effect of general combining ability for hybrids was estimated in table **(4).** It is obvious that parent (1) was good combiner for No of grain pod^{-1} and chlorophyll. And its effect was negatively significant for grain yield plant^{-1}, weight plant^{-1}, No. of tillers, plant height and flowering of 50%. On the other hand parent (2) was significantly good combiner in the desirable direction with No. of tillers, height of plant, No of pod plant^{-1} and flowering of 50%, but it was significant in an un desirable direction with No. of grain pod^{-1} and chlorophyll. It was found that parent (3) had significant gca effect for grain plant^{-1}, No of grain pod^{-1}, No of tillers and in the un desirable direction for height of plant, chlorophyll and No. pod plant^{-1}. As for parent (4) its general combining ability was toward the desirable direction for grain yield plant^{-1}and No. of grain pod^{-1} and revealed un desirable direction for No. of tillers, chlorophyll and No. pod plant^{-1t}.It was noticed that parent (5) was significantly good combiner for grain yield plant^{-1}, weight plant^{-1} and No pod plant^{-1} and in an un desirable direction for No. grain pod^{-1}, No of tillers and chlorophyll. It was found that parent (6) had significant desirable gca effect for weight plant^{-1}, No. of tillers and chlorophyll and in the un desirable direction for grain yield plant^{-1}, No of grain pod^{-1} and height of plant.

Hybrid (1x2) showed specific combining ability effect in the desirable direction for grain yield plant^{-1}, weight plant^{-1}, No. of tillers, chlorophyll and No. pod plant^{-1} and in un desirable direction only for height of plant.

The effect of sca in hybrid (1x3) is show significant in desirable direction for No. of grain pod^{-1}, plant height and chlorophyll and in un desirable direction for grain yield plant^{-1}, No. of tillers plant^{-1}and days to 50% flowering. It was observed that hybrid (1x4) has a specific combining ability effect in desirable direction for grain yield plant^{-1}, No of tillers plant^{-1} and No. pod plant^{-1} and in un desirable direction for height of plant. Hybrid (1x5) showed specific combining ability effect in the desirable direction for No. of grain pod^{-1}, chlorophyll and flowering 50%. Hybrid (1x6) showed sca effect in the desirable direction for flowering 50% only and in un desirable direction for grain yield plant^{-1}, No. of grain pod^{-1}, No of tillers and No. of pod plant^{-1}. Hybrid (2x3)recorded specific combining ability effect in desirable direction for flowering 50% only and in the un desirable direction for all traits except weight$^{-1plant}$ and weight of 50 grain.. As for hybrid (2x4) it had specific combining ability effect for all studied traits except weight of 50 grain had no significant and flowering 50% in the un desirable direction. Hybrid (2x5) had sca effect in desirable direction for No. of grain pod^{-1}, No of tillers and chlorophyll. Hybrid (2x6) had specific combining ability effect in the un desirable direction for all studied traits except weight of 50 grain and flowering 50%. The effect of specific combining ability in hybrid (3x4) is show negatively un desirable direction for No. of grain pod^{-1}, weight plant^{-1}, No. of tillers and height of plant, but it was in the desirable direction for chlorophyll only. Hybrid (3x5) had sca effect in the desirable direction for all studied traits except weight of plant, weight of 50 grain and flowering 50%. The specific combining ability effect for hybrid (3x6) show positively desirable direction for all traits except chlorophyll and flowering 50% and hybrid (4x5) show positive combining ability in the desirable direction only for grain yield plant $^{-1}$and No. of grain pod^{-1} . Hybrid (4x6) had sca effect in un desirable direction for all studied traits except No. of pod plant^{-1} and weight 50 grain and in desirable direction only for chlorophyll. It was noticed that hybrid (5x6) had sca effect in desirable direction for No. of grain pod^{-1} , No. of tillers and chlorophyll. These results are in agreement with other researchers (Ceyhan and Avci, (2005); Al –Hamdany, (2014) and Dixit, (2003).

Table (4): Estimation of general and specific combining ability effects of parents and hybrids for studied characters.

Characters / genotypes	Grain yield plant^{-1}	No. of grain pod^{-1}	Weight plant^{-1}	No. of tillers	Height of Plant cm	Chlorophyll	No.pod plant^{-1}	Weight of 50 grain	Flowering of %50
1	3.55-	0.19	19.88-	0.21-	0.65-	3.32	0.36	32.30-	0.53-
2	0.49-	0.28-	2.15	0.34	3.58	0.39-	0.77	28.06-	0.43
3	2.21	0.29	1.76-	0.09	1.03-	1.74-	1.88-	57.81	0.18
4	1.50	0.44	0.32-	0.14-	0.02	2.43-	1.36-	28.08-	0.15-
5	1.43	0.22-	16.40	0.22-	0.15-	0.50-	1.70	27.57-	0.06
6	1.10-	0.42-	3.40	0.14	1.77-	1.73	0.42	58.20	0.01
SE (gi-gj)	0.55	0.02	2.67	0.01	0.63	0.20	0.74	2334.53	0.40
1x2	31.79	0.18-	28.30	0.41	4.45-	5.56	23.59	22.51	1.83-
1x3	10.88-	0.19	13.10-	0.25-	4.78	3.98	2.57	64.43-	2.24-
1x4	2.93	0.11	12.16	0.13	4.06-	0.80	12.52	20.81	1.09
1x5	4.20-	0.20	22.93-	0.47-	5.42-	1.88	3.64-	24.57	3.21
1x6	8.24-	0.24-	21.56-	0.16-	1.27-	0.51	6.55-	63.14-	3.59
2 x3	8.29-	0.17-	1.51	0.43-	7.07-	2.61-	5.68-	64.86-	3.13
2 x4	3.17	0.88	14.70	1.14	6.88	4.71	4.61	25.50	2.20-
2 x5	1.55-	1.04	1.72	0.28	2.98	5.25	1.75-	21.59	1.92
2x6	9.70-	1.44-	38.58-	0.51-	5.00-	3.65-	11.34-	60.17-	1.96

3 x4	4.57	0.19-	29.32-	0.38-	4.52-	8.40	0.70-	61.42-	0.05
3 x5	8.04	0.47	32.62	0.83	2.85-	2.70	8.73	59.04-	0.84
3x6	20.46	0.47	43.62	1.40	5.60	2.23-	23.68	538.18	1.55
4 x5	2.09	0.32	4.18-	0.00	1.24	3.08-	3.42-	26.91	0.17
4x6	4.29-	0.15-	23.82	0.46-	7.27-	3.45	2.00-	60.84-	3.79-
5x6	0.22-	0.31	11.24-	0.15	2.03	1.93	1.06-	61.17-	1.33-
SE(sij-sik)	2.84	0.11	13.71	0.06	3.24	1.01	3.79	12006.17	2.04

Table **(5)** Exhibited the additive, dominance, environment and phenotypic variance. It is noticed that dominance genetic variance were higher than additive genetic variance in all studied characters. Similar results were obtained by (Sharma *et al.*, (2007); Kolia and Sood, (2009); Singh *et al.*, (2010) and Sirohi and Singh, (2013).

Table (5): Estimation of additive (σ^2 A), Dominance (σ^2 D), environmental (σ^2 E) and phenotypic (σ^2 p) variance for studied characters.

Variance	**Grain yield plant^{-1}**	**No. of grain pod $^{-1}$**	**Weight plant $^{-1}$**	**No. of tillers**	**Height of Plant**	**Chlorophyll**	**No.pod plant $^{-1}$**	**Weight of 50 grain**	**Flowering of %50**
σ^2 A	**15.83**	**0.01**	**0.00**	0.00	7.43	19.65	0.19	0.00	**0.14**
	6.86	0.18 ±	201.71 ±	0.08±	016±	6.89±	2.77±	3509.10±	0.35±
σ^2 D	**136.55**	**0.26**	**562.53**	0.29	24.84	24.39	135.32	**2201.29**	3.50
	57.93	0.20 ±	240.19±	0.17±	12.71±	10.74±	58.03±	0.00	3.14±
σ^2 E	**5.41**	**0.20**	25.60	0.12	6.05	1.88	7.07	**22411.51**	3.81
	4.11 ±	0.16±	19.83±	0.09±	4.69±	1.46±	5.47±	0.00	2.91±
σ^2 p	**157.69**	**0.48**	18411.20	0.41	38.32	45.92	142.99	0.00	7.45

Table **6)** Estimate the average of degree dominance and heritability in broad and narrow sense**.** Average degree of dominance were more than one for all studied traits except weight plant^{-1} and 50-grain weight. The heritability in broad sense show high value in all studied traits except flowering of 50% showed moderate heritability similar record found by (Singh *et al.*, (2007); (Pallavi *et al.*, (2013) and Tawfiq and Abdulla, (2014).

It is noticed that the heritability in narrow sense showed high value in weight plant^{-1} and weight of 50 grain and chlorophyll showed moderate heritability and other traits showed low heritability. These results are similar to the finding obtained by (Ceyhan and Avci, 2005).

Table (6): the average of dominance (ā), heritability in broad sense (h.b.s), heritability in narrow sense (h.n.s), genetic advance(GA) and expected genetic advance.

characters / **genetic parameters**	**Grain yield plant^{-1}**	**No. of grain pod^{-1}**	**Weight plant^{-1}**	**No. of tillers**	**Height of Plant**	**Chlorophyll**	**No.pod plant^{-1}**	**Weight of 50 grain**	**Flowering of %50**
Ā	2.94	5.31	0.18	14.68	1.83	1.11	12.20	0.06	5.03
h.b.s	**0.97**	**0.57**	**1.00**	**0.71**	**0.84**	**0.96**	**0.95**	**0.96**	**0.49**
h.n.s	**0.10**	**0.02**	**0.97**	**0.00**	**0.19**	**0.43**	**0.01**	**0.96**	**0.02**
GA	2.22	0.02	231.18	0.00	2.11	5.10	0.13	1345.48	0.09
GA%									

(*) Additive genetic variance negative, then equal zero.

Table **(7)** show the estimation of heterosis for the studied traits that are calculated according to the differences between the average value of the hybrids and the mean parent value. For the grain yield plant^{-1} it is clearly observed that significant and positive heterosis at 5%excisted for six hybrids (1x2, 2x4, 3x4, 3x5, 3x6 and 5x6) and at 1%level for one hybrid only (1x4).

As for No of grain pod^{-1} and weight plant^{-1} traits did not attain to significant level for all hybrids and gave positive and negative values. In the case for the No. of tillers hybrid 1x4 gave a significant and positive increase at level 1% six hybrid gave significant in desirable direction at 5% (1x2, 2x4, 3x4, 3x5, 3x6 and 5x6). Hybrid 1x4 showed significant heterosis but in undesirable direction at level 1% for height at plant and three hybrid (2x4, 3x6 and 5x6) showed significant increase in desirable direction at level 5%, while the hybrid (1x2, 3x4 and 3x5)showed significant decrease in un desirable direction at level 5%. For chlorophyll trait five hybrids show significant increase in desirable direction at level 5% (1x2, 3x4, 3x5, 3x6 and 5x6), while hybrids (1x4 and 2x4) show significant increase in desirable direction at level 1%. The similar results were found by (Ceyhan *et al.*, (2008); (Patil *et al.*, (2011); (Rai and Mishra, (2013) and (Yoshida *et al.*, 2007).

Table (7): Estimation of heterosis at mid parents for hybrids by half diallel crosses.

characters / hybrids	Grain yield plant^{-1}	No. of grain pod^{-1}	Weight plant^{-1}	No. of tillers	Height of Plant	Chlorophyll	No pod plant^{-1}	Weight of 50 grain	Flowering of %50
1x2	125.27 **	1.53-	31.69	17.46 **	12.77- **	29.17 **	151.24	37.40-	0.13
1x3	17.90-	5.20	11.63-	1.18-	0.68	26.85	114.21	43.98-	0.13-
1x4	19.70*	4.72	15.95	5.39 *	13.20-*	22.06 *	113.86	42.53-	0.87
1x5	4.70-	11.48	28.10-	13.38-	13.41-	19.32	6.63	11.80-	4.29
1x6	21.54-	6.01-	30.73-	4.35-	8.87-	9.22	1.51-	29.77-	4.02
2x3	6.52-	0.88	14.25	2.70	14.56-	7.43	12.13	33.01-	3.74
2x4	22.09 **	15.28	22.60	48.35 **	3.50 **	33.20*	34.66	0.64-	1.72-
2x5	5.58	25.13	2.45	24.42	0.16	27.74	4.28-	20.89-	3.13
2x6	21.56-	22.65-	36.55-	5.53-	12.36-	2.55-	36.18-	1.74-	2.62
3x4	22.96 **	3.32	19.35-	0.61 **	11.93- **	47.49**	47.55	6.31-	0.00
3x5	28.45 **	18.01	38.87	51.63 **	7.58- **	22.37**	63.38	10.64	2.38
3x6	57.39 **	5.42	56.41	60.00 **	3.65 **	1.63**	150.67	3872.47	2.37
4x5	9.78	16.36	0.62-	12.00	2.76-	9.03	9.37-	21.93	0.37
4x6	10.16-	1.93-	28.01	8.47-	16.70-	19.68	0.61-	3.84	3.08-
5x6	23.58 **	7.62	12.28-	14.97 **	7.38 **	4.76**	33.73	20.53-	1.25-

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ب دەستخوڤە ئینانا پارامیتەرێن جنێتیکی، شیانێن ئێککگرتنێ و هێتێروسیس ل بەزالیادا بکارئینانا ئێککگرتنا نیڤ دوئەلیلی

پوختە

ئەڤ خاندنە هاتە ئەنجام دان ل کێلگەهێن کولیژا چاندنێ ل زانکویا دهۆکێل نوڤێمبەرا **2013** هەتا مەی یا **2015** بکارئینانا شەش جورێن جینی بێن بەزالیا و بکارئینانا ئێککگرتنا نیڤ دوئەلیلی**.** هاتە تێبینی کرن شیانێن ئێککگرتنێ بێن گشتی و تایبەت یا گرنگە ل هەمی روخساراندا**.** چبلی کێشانا **50** دانەو کولیلکدانا **50%** چ گرنگیا خو نەبوو، هەروەسا جیاوازییێن زالی بێن جێنێتیکی گەلەك بلندتربوو ژ جیاوازییێن زێدەکری بێن جێنێتیکی لهەمی سیفەتێن خاندی ژبلی کولیلکدانا **50%** شیانێن هێریتیا مامناڤەندی نیشادا**.** هەروەسا شیانێن هێریتی ل هەستێن بەرفرەهدا نرخەکا بلند نیشادا لهەمی روخسارێن خاندی چبلی کولیلکدانا **50%** شیانێن هێریتیا مامناڤەندی نیشادا، و شیانێن هێریتی ل هەستێن تەسکدا نرخەکا بلند نیشادا ل کێشانێدا بۆ هەر رووەکەك و کێشانا **50** دانە دەما کلوروفیل شیانێن هێریتیا مامناڤەندی نیشاداو روخسارێن دی شیانێن هێریتی بێن کێم نیشادان**.**

تقدير المعاملات الوراثية، الجمع بين القدرة والتغاير في البازلاء (***Pisum sativum***)
باستخدام التهجين نصف التبادلي

الخلاصة

أجريت هذه الدراسة في الحقل التجريبي لكلية الزراعة، جامعة دهوك، في نوفمبر **2013** - مايو **2015**، مستخدمة ستة انماط وراثية من البازلاء باستخدام التهجين نصف التبادلي**.** لوحظ أن قدرة الجمع العامة والمحددة تظهر معنوية في جميع الصفات باستثناء وزن **50** حبة وظهر التزهير بنسبة **50**٪غير معنوية ، كذلك التباين الوراثي السائد أعلى من التباين الوراثي المضاف في جميع الصفات المدروسة باستثناء التزهير **50**٪ أظهرت وراثة معتدلة**.** أيضا التوريث بالمعنى الواسع يظهر قيمة عالية في جميع الصفات المدروسة باستثناء ال **50**٪ للتزهيرأظهرت وراثة معتدلة، والتوريث بالمعنى الضيق أظهرت قيمة عالية في الوزن **1** نبات ووزن **50** حبة في حين أظهر الكلوروفيل وراثة معتدلة وفي الصفات الاخرى ظهر التوريث منخفض **.**