ESTIMATION VARIABILITY AND SOME GENETIC PARAMETERS FOR YIELD AND ITS COMPONENTS IN PEA GENOTYPES UNDER DIFFERENT PHOSPHOROUS LEVELS.

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ABSRACT

This study aimed to estimate variability and some genetic parameters for yield and yield components in pea (*Pisum sativum L.*) genotypes under different phosphorous levels. A field experiment was carried out at the field of Horticulture Department, College of Agricultural Engineering Sciences, Duhok University, on the 1st of November 2021. the experiment unites layout according to split-plot arrangement, the main plots include phosphorus levels (0, 18, 36, and 54 kg ha^{-1} P_2O_5 and the subplot represented the thirteen genotypes within RCBD. The results exhibited that phosphorus levels were highly significant for all traits except biological yield, also the genotypes show highly significant the with exception of harvest index, while the interaction between phosphorus levels and genotypes was highly significant for all studied traits except harvest index and pod length. The rate of 54 kg ha^{-1} P_2O_5 gave the highest value for the number of pods 281.359), length pod 3.94, 500 seed weight 86.54, biological yield 361.55, harvest index 10.82 and yield seed per plant 23.30. The local variety was superior in leaf area 808.08mm, length pod 10 cm, 500 seeds weight 25.369, also the genotype (1) gave the highest yield per plant 44.0367 kg ha-1 P_2O_5, for the interaction between genotypes and phosphorus levels of genotype (2).

Keywords: genotypes, heritability, genetic advance, variation.

Part of the M.Sc. thesis of the 1st author.

تقدير التباين وبعض المعالم الوراثية للحاصل ومكوناته في نبات البزاليا تحت مستويات مختلفة من الفسفور

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المستخلص

الهدف من هذه الدراسة هو لتقدير التباين وبعض الصفات الوراثية للحاصل ومكونات الحاصل للطرز الوراثية للبازلاء تحت مستويات مختلفه من الفوسفور, وتم تنفيذ التجربه وفق تصميم الالواح المنشقه الالواح الرئيسيه تكونت من مستويات الفسفور(0, 18, 36, و 54 كغم / هكتار من (P2O5) الالواح الثانويه تضمنت الطرز الوراثية الثلاثة عشر, أجريت هذه التجربة الحقليه في قسم البستنه بكلية علوم الهندسة الزراعية بجامعة دهوك في تشرين الثاني 2021 . أظهرت النتائج أن لمستويات الفسفور ذات تاثير عالي على جميع الصفات باستثناءالحاصل البيولوجي ، كما أظهرت الطرز الوراثية تأثيرا معنوية عاليا باستثناء معامل الحصاد، بينما كان التداخل بين مستويات الفسفور والتراكيب الوراثية معنوياً عاليا لجميع الصفات المدروسة باستثناء دليل الحصاد وطول القرنات. المستوى 54 كجم هكتار من P2O5 أعطى اعلى معدل لعدد القرنات 281.359، وطول القرنات 3.94 سم، و وزن 500 بذرة 86.54 غم، والحاصل البيولوجي 361.55، ودليل الحصاد 10.82، وحاصل البذور للنبات الواحد 23.30 غم ، بينما كان الصنف المحلي متفوق في مساحة الورقة 808.08 مم ، طول القرنة 10 سم ، وزن 500 بذرة 25.369 غم ، كما أعطى التركيب الوراثي (1) أعلى محصول للنبات 44.036 كجم هكتار.

الكلمات المفتاحية:اصناف, توريث, توريث المتقدم, التباين.

***جزء من اطروحة الماجستر للباحث الاول**

Received:12/10/2021, Accepted:19/1/2022

INTRODUCTION

Pea (*Pisum sativum L.*) is an essential vegetable crop grown in temperate and subtropical areas of the world for its tender and immature seeds. It's consumed as fresh vegetables in the grown season, while dried seeds are used as pulses during the off-season (10). Many peas are processed (canned, frozen, or dehydrated). It's a rich source of protein, vitamins (A and C), carbohydrates, minerals like magnesium and calcium, an antioxidant compound, and dietary fibers. Pea protein is limited in sulfur-containing amino acids (methionine and cysteine) but rich in lysine. (6). It is a good source of essential amino acids in the form of proteins (23 - 25%) with a high nutritional grade (12), rich in Ca, P, and Fe (20). Pea contains 20 - 25% starch, 4 - 10% sugar, 0.6 - 1.5% fat, and 2 - 4% minerals. It is predominantly a cash crop of the world constituting about 40% of the total pulse trade (1). Heritability act as a predictive tool in expressing the reliability of phenotypic traits and thus high heritability traits can aid in the effective selection of species characters and create the future breeding program. The analysis of the relationship helps in evaluating the existing relationship between the yield and components. The study of genetic variability and interrelationships is of great value in the selection of the preferred characters of field pea genotypes to increase seed yield.

Phosphorus is one of the plants' most important major nutrients, considered an important nutrient for the formation and translocation of carbohydrates, fatty acids, glycosteroids, and another essential intermediate compounds. The main effect of phosphorus application is observed in the root system of plants. Phosphorus induces lateral and root fibrous formation, resulting in more nodule bacteria and finally increasing the nitrogen fixation rate in leguminous crops (32). The aim of this study is to estimate genetic and phenotypic variability, estimate genetic parameters such as heritability and genetic advance, and determined the promising field pea genotypes under different phosphorus levels.

MATERIALS AND METHODS

A field experiment was carried out at the field of Horticulture Department, College of Agricultural Engineering Science, Duhok University, on the 1st of November 2021. the experiment unites layout according to RCBD within a split-plot design, the main plots include phosphorus levels (0, 18, 36, and 54 kg ha^{-1} P2O5 and the subplot represented the thirteen genotypes. A uniform dose of phosphorus levels was applied at the time of sowing. the width of each replication (7m), the length (60m), and the distance between each replication (2m). Each replication consists of (48) rows Each mini block consists of (4) rows (levels of Phosphorus) The distance between each row (75) cm, with plant-to-plant spacing (50 cm), and between each block (2M) respectively. Therefore, when plants reach the maturity stage following plant traits were studied; the number of pods $plant^{-1}$, pod length(cm), Weight 500 seeds (gm), Biology yield, Harvest index, leaf area(mm), and Total seed yield plant. The influence of treatment on field pea and differences among treatments were analyzed using the analysis of variance procedure for split-plot design in randomized blocks. The mean values were subjected to statical analysis to work out ANOVA for all the characters. All the recommended horticultural practices and plant protection measures were followed uniformly from time to time to raise a healthy crop (15).

Table 1. genetic materials used in the experiment

	Genotype	Pedigree
1.	Bang-45	JFVFPQkjOOVN8
2.	Bang-31	JFVFPkVEPc71j
3.	Bang-15	JFVFPIqk7yPUI
4.	Bang-37	JFVFPbsDZuojK
5.	Bang-43	JFVFPWzJy5i0F
6.	Bang-44	JFVFPM4hNfKjC
7.	Bang-26	JFVFP5VA6kjWI
8.	Bang-3	JFVFPbYC3alof
9.	Bang-9	JFVFPtn25vbwF
10.	Bang-4	JFVFPN1i441mj
11.	Bang-32	JFVFPiVNWsuAc
12.	Bang-41	JFVFPK24qsgls
13.	Local Variety	
Split plot design used (Phosphorus) main plot and pea genotypes split-plot		

Genetic advance

$GA = K \times h^2$

b.s σp

K. selection in density 10% = 1.76

σp = phenotypic standard deviation

GA as percent

GA%=$\frac{GA}{y^-}$X100

Low less than 10

Medium 10 – 30 %

High more than 30%

X 100 Gcv = $\frac{\sqrt{\sigma^2 g}}{y^-}$

X100 Pcv = $\frac{\sqrt{\sigma^2 P}}{y^-}$

Estimation of the genotypic and phenotypic relationship (r G and rp)

rG = $\frac{\sigma g\ xy}{\sqrt{\sigma^2\ gx.\ \sigma^2\ gy}}$ According to (

rp = $\frac{\sigma\ ph\ X\ y}{\sqrt{\sigma^2\ x.\ \sigma^2\ phy}}$

where σg xy = genetic covariance between variable x and y

σ p xy = phenotypic variance

σ^2g = genetic variance

σ^2 ph = phenotypic variance

RESULTS AND DISCUSSION

Table (2) shows the analysis of variance for phosphorus rate (0,18, 36,54), varieties, and interaction between phosphorus and varieties. The results revealed that the phosphorus rate was highly significant for the number of pods plant $^{-1}$, leaf area, 500 seed weight, and total seed yield per plant and significant for pod length and biological yield, and non-significant for harvest index. The varieties show high significance in all traits except the harvest index. while for interaction between phosphorus levels and varieties was highly significant for all traits except pod length and harvest index. similar findings have been reported by (6, 24, 27,32).

Table 2. Analysis of variance for some traits of pea plant (*Pisum sativum*) under different phosphorus levels

S.O.V	d.f	Traits						
		Number of pods plant^{-1}	Leaf area (cm)	Pod length (cm)	500 seeds weight (g)	Bio-yield Kg(ha^{-1})	HI (%)	Total seeds yield plant (kg/ha^{-1})
r	2	330.59	38.98	0.34	2.93	105.19	0.01	12.86
p	3	62135.54**	2581.71**	0.23*	181.61**	19.01*	0.005	1490.94 **
r(p)	6	91.05*	4.44*	0.10*	7.19*	2.12*	0.004	8.32*
V	12	41318.84**	144128.78**	40.94**	546.62**	78.13**	0.054	524.60**
PV	36	3377.46**	3117.68**	0.090	8.59**	39.18**	0.010	49.08**
error	96	134.44	7.28	0.09	2.40	2.97	0.009	3.18
total	155							

***, ** significant effect at probability at 0.05 and 0.01 respectively, (r)= replication, (P)=phosphorus, (V)=variety**

The data represented in Table (3) reveal the effect of different levels of phosphorus (0, 18, 36, 54). For the number of pods plant $^{-1}$ the (54 kg ha^{-1}) levels of phosphorus a show significant effect with values (281.359), and the lowest value (183.769) was obtained by (0) levels. Whereas for leaf area the maximum value (506.9915) was recorded by (36 kg ha^{-1}) levels. While pod length shows no significant effect at all levels. For 500 seeds weight, biological yield, and harvest index, the high values were recorded at (54 kg ha^{-1}) levels were (86.5485, 361.550, and 10.8226) respectively. The maximum value (38.6274) at the (54 kg ha^{-1}) level recorded for total seed yield it can be calculated from this table that the (54) level shows a significant effect for most traits the present finding was supported by (26), who reported that phosphorus significantly enhances the weight of yield. The Table clearly shows that the high concentration had a high effect on most of the traits. Table (3) clearly shows that the highest concentration had a high effect on most of the traits, Therefore, there is a positive relationship between significant differences and high concentration, whenever the concentration has high, that leads to highly significant differences. Increases in these parameters by application of phosphorus could be due to the fact that is a positive correlation between phosphorus and these parameters Because the soil of the region is poor for phosphorus. These results are in close agreement with those of (3,13, 20, 23,25, 29, 32).

Table 3. Effect of different phosphorus levels on yield and some growth traits in pea plant

P-levels	Traits						
	Number of pods plant^{-1}	Leaf area (cm)	Pod length (cm)	500 seeds weight (g)	Bio-yield Kg(ha^{-1})	HI (%)	Total seeds yield plant (kg/ha^{-1})
0	183.769 c	488.3081 c	3.79915 a	81.5585 c	311.821 c	7.5196 c	38.6274 A
18	235.359 b	493.0009 b	3.782\05 a	82.935 c	329.309 bc	9.351 b	32.3344 B
36	237.590 b	506.9915 a	3.90598 a	84.6374 b	335.641 b	9.6422 b	30.5990 c
54	281.359 a	492.5128 b	3.94017 a	86.5485 a	361.550 a	10.8226 a	23.5905 D

***, ** significant effect at probability at 0.05 and 0.01 respectively**

Table (4) represents the effect of varieties on yield and some growth yield traits. The largest value (299.167) was obtained by varieties (5) for the number of pods plant $^{-1}$, followed by varieties (6,7, and 12) with values (295.667, 286.917, 808.083, and 261.083) respectively. For leaf area, the maximum value was obtained by variety (13), and the minimum value (380.625) was recorded by variety (2). The high value for variety (13) (10.000 and 25.3617) were recorded for pod length and 500 seed weight. While for biological yield the variety (7) showed the highest values were (423.08) and the minimum value for this trait (249.08) by variety. The same Table shows the largest harvest index exhibited in variety (11) with value (11.6444) followed by (6,12, and 13) with recorded values (11.2960, 10.8060, 10.5876) respectively. Concerning total yield the variety (1) had the highest value (44.0367) and the variety (13) had the lowest value (21.2050). from this table, its noted that the variety 13 shows the maximum value for leaf area, pod length and 500 seeds weight. The studied from different research indicated that pea cultivars vary greatly in size and shape of pods. The variable increases in yield components and consequently the grain yield of pods as a result of different genotypes have been reported by (18,22). Also, the most of traits were significantly influenced by interaction between varieties and fer

Table 4. Effect of varieties on yield and some growth traits in pea plant

Genotype	Traits						
	Number of pods plant^{-1}	Leaf area (cm)	Pod length (cm)	500 seeds weight (g)	Bio-yield Kg(ha^{-1})	HI (%)	Total seeds yield plant (kg/ha^{-1})
1	228.583 e	446.819 f	3.2778 b	12.5333 i	249.08 e	9.2496 d	44.0367 A
2	182.500 g	380.625 j	3.3750 b	14.4600 h	274.00 e	7.6822 e	37.5458 B
3	191.250 g	403.192 i	3.4167 b	14.5950 h	279.67 e	7.9898 e	35.8308 C
4	234.750 e	459.092 e	3.2917 b	15.1883 g	344.67 cd	8.1986 e	35.3275 C
5	299.167 a	545.600 c	3.3194 b	14.8492 gh	370.18 bc	9.5844 d	35.0467 C
6	286.917 b	474.908 d	3.2361 b	15.3150 fg	331.92 d	10.5876 c	34.2717 C
7	261.083 c	574.539 b	3.2500 b	16.3033 de	423.08 a	8.3600 e	31.1617 D
8	245.417 d	473.019 d	3.3611 b	15.8742 ef	346.35 cd	8.9949 d	28.9717 E
9	218.500 f	546.144 c	3.3750 b	16.5283 d	367.75 bc	7.8692 e	28.9433 E
10	259.917 c	448.917 f	3.4722 b	16.8292 d	385.92 b	9.0771 d	28.7967 E
11	263.667 c	433.055 h	3.3472 b	17.7517 c	321.06 d	11.6444 a	23.0808 F
12	295.667 ab	443.650 g	3.4167 b	18.5600 b	388.54 b	11.2960 ab	22.5233 Fg
13	81.333 h	808.083 a	10.0000 a	25.3617 a	267.33 e	10.8060 bc	21.2050 G

***, ** significant effect at probability at 0.05 and 0.01 respectively**

Table (5) shows the effect of the interaction among genotypes and different levels of phosphorus. For the number of pods $^{-1}$, the result exhibit that the highest value (418.667) obtained by V5L4, followed by (366.000, 3545.333, and 319.667) for V7L4, V12L4, V12L3) respectively. The maximum value for leaf area recorded by interaction V13L3 with value (815.000), while minimum value recorded by interaction V3L2 with value (348.800). concerning pod length, the largest value of interaction was noticed in V13L4 and V13L3 with recorded values (10.5556 and 10.2778), whereas the lowest value obtained by interaction V4L2 with value (3.000). in the same Table the highest value for 500 seed weight was an exhibited by interaction (V13L4) with a value (27.1367), followed by the interactions (V13L3, V13L2, and V13L1) with obtained values (26.1567, 25.5300, and 22.6233) respectively. For the biological yield, the maximum value (555.67) was obtained by interaction (V714), whereas the minimum value was obtained by interaction (V1L1) with a value (243.33). the presented data in the same Table shows that the highest value for harvest index was obtained by interactions (V11L3 and V5L4) with values (12.9599 and 13.1025) followed by interactions (V12L3, V11L4, and V12L4) with values (12.6118, 12.4359 and 12.2648), while the lowest value for the same trait was (14.9587) for the interaction (V4L1). For total seed yield plant^{-1}, the interaction (V5L4) recorded the highest value (51.867), whereas the lowest value (12.850) was recorded by interaction (V1L1). Regarding to the interaction between genotypes and phosphorus levels on yield exhibited a highly significant effect on all traits. From the results in the same Table, an application of phosphorus levels might have an advantage in enhancing studied parameters, An increase in the most studied yield component when treated with the different rates of phosphorus significantly enhanced all studied growth traits, which could be related to the effect of these levels in improving almost all growth and yield contributing characters. The same results were found by other researchers (2,7,16,32).

Table 5. Effect of interaction between genotypes of the pea plant and phosphorus levels on yield and some growth traits in pea plant

Traits							
Combination	**Number of pods plant^{-1}**	**Leaf area (cm)**	**Pod length (cm)**	**500 seeds weight (g)**	**Bio-yield Kg(ha^{-1})**	**HI (%)**	**Total seeds yield plant (kg/ha^{-1})**
V1 L1	**138.667**	**407.500**	**3.2222**	**11.5800**	**243.33**	**5.2797**	**12.850**
	°b	**°a**	**cd**	**° b**	**j**	**w**	**Z**
V1 L2	**288.000**	**463.833**	**3.2222**	**12.2000**	**243.00**	**11.5607**	**28.093**
	f-i	**r**	**cd**	**° ab**	**j**	**b-d**	**o-t**
V1 L3	**252.667**	**432.611**	**3.2222**	**13.0467**	**253.00**	**10.4285**	**26.380**
	m-p	**x-z**	**cd**	**° z-a**	**j**	**d-j**	**r-u**
V1 L4	**252.667**	**483.333**	**3.4444**	**13.3067**	**257.00**	**9.7294**	**25.000**
	o-r	**n**	**cd**	**a-z**	**ij**	**g-l**	**t-v**
V2 L1	**139.333**	**385.111**	**3.5000**	**13.8200**	**247.00**	**6.2405**	**15.410**
	°b	**° c**	**cd**	**x-z**	**j**	**u-w**	**Yz**
V2 L2	**180.333**	**387.889**	**3.2222**	**13.8567**	**278.67**	**7.1636**	**19.960**
	a-z	**° c**	**cd**	**wz**	**g-j**	**s-v**	**Wx**
V2 L3	**189.333**	**393.333**	**3.3333**	**15.1267**	**279.33**	**8.1958**	**22.890**
	v-y	**°b**	**cd**	**q-x**	**g-j**	**m-t**	**Vw**
V2 L4	**189.333**	**356.167**	**3.4444**	**15.0367**	**291.00**	**9.1289**	**26.560**
	r-t	**° d**	**cd**	**q-x**	**f-j**	**i-p**	**q-u**
V3 L1	**161.667**	**386.500**	**3.3333**	**13.9233**	**250.33**	**7.1999**	**18.023**
	°a	**° c**	**cd**	**wz**	**j**	**s-v**	**Xy**
V3 L2	**165.000**	**348.800**	**3.6111**	**14.3700**	**279.67**	**6.7765**	**18.947**
	a-z	**° e**	**c**	**t-y**	**g-j**	**t-v**	**X**
V3 L3	**173.000**	**431.700**	**3.4444**	**14.6067**	**289.33**	**6.9934**	**20.233**
	a-z	**yz**	**cd**	**s-y**	**g-j**	**t-v**	**Wx**
V3 L4	**265.333**	**445.767**	**3.2778**	**15.4800**	**299.33**	**10.9892**	**32.890**
	k-n	**t**	**cd**	**o-v**	**e-j**	**c-g**	**j-m**
V4 L1	**130.333**	**462.944**	**3.2778**	**14.3333**	**301.33**	**4.9587**	**14.943**
	°b	**r**	**cd**	**u-z**	**e-j**	**w**	**Z**
V4 L2	**249.333**	**473.222**	**3.0000**	**15.1867**	**344.00**	**8.8076**	**30.297**

	n-q	op	d	p-w	b-h	k-o	m-p
V4 L3	255.333	467.533	3.4444	15.4267	349.67	9.0081	31.503
	m-o	qr	cd	o-v	b-h	j-p	l-o
V4 L4	304.000	432.667	3.4444	15.8067	383.67	10.0200	38.443
	d-g	x-z	cd	l-s	bc	e-k	c-g
V5 L1	183.333	552.600	3.1667	14.0400	353.00	5.8261	20.570
	w-z	h	cd	w-z	b-h	w	Wx
V5 L2	312.667	541.933	3.3333	14.8767	357.07	10.4248	37.227
	d-f	i	cd	r-x	b-h	d-j	d-h
V5 L3	282.000	573.367	3.5000	15.0067	374.67	8.9842	33.660
	h-l	g	cd	q-x	b-e	j-q	i-l
V5 L4	418.667	514.500	3.2778	15.4733	396.00	13.1025	51.867
	a	k	cd	o-v	bc	a	A
V6 L1	237.000	492.133	3.1111	14.2167	302.33	8.9152	26.950
	o-r	m	cd	v-z	d-j	k-q	p-u
V6 L2	291.667	463.667	3.2222	15.0100	333.00	10.5261	35.060
	f-i	r	cd	q-x	c-i	d-i	h-k
V6 L3	305.333	473.833	3.2778	15.9000	339.67	11.4387	38.853
	d-g	op	cd	k-s	b-h	b-e	c-f
V6 L4	313.667	470.000	3.3333	16.1333	352.67	11.4704	40.447
	d-e	pq	cd	h-r	b-h	b-e	b-d
V7 L1	215.000	613.700	3.3889	15.6433	362.00	7.4441	26.950
	r-u	c	cd	n-u	b-f	r-u	p-u
V7 L2	228.333	602.367	3.2778	15.9733	387.67	7.5274	29.180
	q-s	d	cd	l-s	bc	q-u	n-r
V7 L3	235.000	504.289	3.1667	16.5567	387.00	8.0322	31.083
	o-r	l	cd	h-p	bc	o-t	l-o
V7 L4	366.000	577.800	3.1667	17.0400	555.67	10.4363	49.873
	b	f	cd	f-m	a	d-j	A
V8 L1	223.667	437.333	3.3333	15.7100	317.67	8.8479	28.100
	r-t	v-x	cd	m-t	c-j	k-r	o-t
V8 L2	232.667	404.467	3.3333	15.5467	358.07	8.0852	28.940
	o-q	°a	cd	o-v	b-g	n-t	n-r
V8 L3	229.000	535.911	3.2778	16.3700	352.67	8.5128	29.993
	q-s	j	cd	h-q	b-h	l-s	m-q
V8 L4	296.333	514.367	3.5000	15.8700	357.00	10.5337	37.613
	e-h	k	cd	k-s	b-h	d-i	d-h
V9 L1	203.333	502.330	3.2222	15.5733	365.33	6.9344	25.337
	t-w	l	cd	o-v	b-f	t-v	s-v
V9 L2	208.667	578.667	3.4444	16.2400	364.00	7.4469	27.103
	s-v	f	cd	h-r	b-f	r-u	p-u
V9 L3	210.000	585.278	3.3889	16.9600	368.00	7.7406	28.483
	s-v	e	cd	f-n	b-f	p-t	o-s
V9 L4	252.000	518.300	3.4444	17.3400	373.67	9.3548	34.963
	n-p	k	cd	e-i	b-e	h-o	h-k
V10 L1	233.333	434.800	3.4444	16.0767	382.67	7.8411	30.000
	o-r	xy	cd	i-r	b-d	p-t	m-q
V10 L2	263.000	444.933	3.4444	16.7067	383.67	9.1560	35.127
	l-n	tu	cd	g-o	bc	i-p	g-k
V10 L3	269.667	441.000	3.4444	17.0933	387.00	9.5304	36.880
	j-n	u-w	cd	e-l	bc	g-n	e-i
V10 L4	273.667	474.933	3.5556	17.4400	390.33	9.7809	38.180
	i-m	o	c	e-h	bc	f-l	c-h
V11 L1	196.667	436.620	3.2222	17.2500	302.33	8.9791	27.140
	u-x	w-y	cd	e-j	d-j	j-p	p-u
V11 L2	280.333	441.800	3.2222	17.2067	316.22	12.2027	38.593
	h-l	t-v	cd	e-k	c-j	a-c	c-f
V11 L3	285.333	446.033	3.5000	18.1500	319.67	12.9599	41.427
	g-k	t	cd	d-f	c-j	a	Bc
V11 L4	292.333	407.767	3.4444	18.4000	346.00	12.4359	43.023
	f-i	° a	cd	de	b-h	ab	B
V12 L1	249.667	435.1	3.5556	18.0467	373.33	9.6502	36.023
	n-q	xy	cd	d-f	b-e	g-m	f-j
V12 L2	278.000	453.100	3.2778	18.0167	376.00	10.6573	40.070
	h-l	s	cd	d-g	b-e	d-h	b-e

V12 L3	319.667 c-d	457.067 s	3.5000 cd	19.0767 d	387.00 bc	12.6118 ab	48.807 A
V12 L4	335.333 c	429.333 z	3.3333 cd	19.1000 d	417.81 b	12.2648 a-c	51.247 A
V13 L1	77.000 ° c	801.333 b	9.6111 b	22.6233 c	253.00 j	9.6377 g-m	24.380 Uv
V13 L2	81.667 ° c	804.333 b	9.5556 b	25.5300 b	260.00 ij	11.2279 b-f	29.190 n-r
V13 L3	82.333 °c	815.000 a	10.2778 a	26.1567 ab	276.33 h-j	10.9120 c-g	30.153 m-p
V13 L4	84.333 °c	811.667 a	10.5556 a	27.1367 a	280.00 g-j	11.4465 b-e	32.050 k-n

***, ** significant effect at probability at 0.05 and 0.01 respectively, (V): variety, (L): level of phosphorus, (°): Because of the repetition of latter's according to Duncan multiple range and the presence of 52 treatments it is necessary to put a special symbol to compare lowest value with highest value.**

Table (6) indicates the estimation of genetic parameters for all different traits. It's clear that the heritability in a broad sense was high traits for the traits pod length, 500 seed weight, leaf area, number of pods, and total seeds yield. with values (0.97475, 0.947419, 92.0019, 0.738472, 0.70153) respectively, and it was medium for biological yield harvest index ranged between (0.630662 and 0.520461). it is noticed that the expected genetic advance as a percentage was high for the traits. The number of pods plant^{-1}, leaf area, pod length, 500 seeds weight, and total seed yield plant -1 (37.56665, 37.14726, 82.65661, 31.8385 and 30.88068) respectively, while it's medium for biological yield and harvest index with (21.81364 and 18.11583) (9, 11, 18, 28,30). high genetic advance indicated that the additive gene governs these traits and selection will be rewarding for improvements of these traits. The same Table clearly shows that GCV was high for the number of pods plant^{-1}, leaf area, pod length, 500 seed weight, and total seed yield (0.738472, 0.920019, 0.974751, 0.947419, 0.70153), these results are similar to (4,5,14,19,31, 33).

Table 6. Genetic variance and some genetic parameters on yield and some growth traits in pea plant

	Traits						
	Number of pods per plant	Leaf area (cm)	Pod length (cm)	500 seeds weight (g)	Bio-yield Kg(ha^{-1})	HI (%)	Total seeds yield PL (kg/ha^{-1})
heritability	0.738472	0.920019	0.974751	0.947419	0.630662	0.520461	0.70153
GA	88.10102	183.9545	3.187931	5.244759	72.98411	1.690901	9.661892
GA%	37.56665	37.14726	82.65661	31.8385	21.81364	18.11583	30.88068
GCV	24.98029	22.13045	47.84018	18.69147	15.69611	14.34915	21.06811
PCV	29.06902	23.07234	48.45583	19.20315	19.76486	19.88989	25.15374

(GA)=genetic advance (GA%) = genetic advance as a percent of the mean, (GCV)= Genetic coefficient variation, (PCV)= coefficient variation, (ECV)= environmental coefficient variation

REFERENCES

1. Ali I, A. Rab and SA. Hussain 2002. Screening of pea germplasm for growth, yield and resistance against powdery mildew under the agro-climatic conditions of Peshawar (Pakistan). Sarhad J. Agri. 18(2): 177- 181. SJA 32 (3):455-460

2. Ali, A., Z Ali, J. Iqbal, M. A. Nadeam, N. Akhtar, H. M. Akram, and A. Sattar. 2010. Impact of nitrogen and phosphorus on seed yield of chick pea. Journal of Agricultural Research. 48(3): 25-28. Corpus ID: 97573391

3. Ali, M.A., A. Ali, M.I. Ahmad, S.W. Hassan, S.R. Khan and A.A. Abid. 2014. Phosphorus effects on growth and yield parameters of mungbean. Sci. Int., (Lahore). 26(4): 1821-1824.
DOI: 10.3923/pjbs.1999.667.669

4. Al-Kummer, M. K., S. Y. H. Al-Hamadany and A. A. H. Al Juboori, 2009. Genetic variability, expectant genetic advance and phenotypic correlation for yield and its components in summer squash *(Cucurbita pepo L.).* Mesopotamia Journal of Agriculture,

37 (2): 105-
https://doi.org/10.33899/magrj.2009.27415111
5. Anhar M., Alshummary, M. Lamiaa Alfreeh and H. M. Kareem 2021. Response of faba bean cultivars (*Vicia faba* L.) to phosphorus application. International Journal of Agricultural and Statistical Sciences. DocID: https:// connectjournals.com/03899.2021.17.329.
6. Barcchiya, J., A.K., Naidu, A.K. Mehta, and A. Upadhyay, 2018. Genetic variability, heritability and genetic advance for yield and yield components in pea (*Pisum sativum L.*). International Journal of Chemical Studies, 6:3324-3327. P-ISSN: 2349–8528 E-ISSN: 2321–4902 IJCS 2018; 6(2): 3324-3327 © 2018 IJCS
7. Beza S. W., A. Antneh, F. Tesfaye, W-M. Endalcachew and A. B. irhan 2020. Response of chick pea to sulphar and zinc nutrients applications and Rhizobium incoculation in north western Ethiopia. Turkish Journal of Agriculture: Food Science and Technology Vo8, Iss10: 2040-2048.
DOI: https://doi.org/10.24925/turjaf.v8i10.2040-2048.3414
8. Chala C., A. Habtamu and H. Ibrahim. 2020. Effect of phosphorus fertilizer levels on yield and yield components of chick pea varieties. Advance in Crop Science and Technology. 8(4): 2329-2337. ISSN: 2329-8863
9. Chaudhary, H., M.K. Verma, and A. A. Sofi, 2010. Genetic variability, heritability and genetic advance for yield components in garden pea. Pantnagar Journal of Research, 8 (2): 195-197.DOI https://cabidigitallibrary.org 185.187.78.70, on 03/01/25
10. Gautam, K.K., M.M., Syamal, A.K Singh, and N. Gupta, 2017. Variability, character association and path coefficient analysis of green pod yield and its related traits in pea (*Pisum sativum L.*). Legume Research, 40:818-823.
doi10.18805/lr.v0iOF.9104
11. Gudadinni, P., V., Bahadur, P., Ligade, S.E. Topno, and V.M. Prasad, 2017. study on genetic variability, heritability and genetic advance in garden Pea (*Pisum sativum L.)* var. hortense Int.J.Curr.Microbiol.App.Sci, 6(8): 2384- 2391.
https://doi.org/10.20546/ijcmas.2017.603.282
12. Haque SR, N. Akter MAH Khan, K. Kabir and MM. Islam 2015. Yield potential of garden pea varieties at varied harvesting dates. Bangladesh Agronomy Journal 17(2): 21-28.Dio
https://doi.org/10.3329/baj.v17i2.24648
13. Hashim. F. A and K. A. Hassan. 2023. Transformation of phosphorous in gypsiferous soils as affected by different fertilizers, land use and incubation periods. Iraqi Journal of agricultural sciences, 54(5): 1364-1373. https://doi.org/10.36103/ijas.v54i5.1837
14. Jadav, K., and M. H. Sapovadiya, 2018. Combining ability for fruit yield and its component traits in ridge gourd (Luffa acutangula (Roxb.) L.). The Pharma Innovation Journal, 7(9), 62-66. ISSN (E): 2277- 7695 ISSN (P): 2349-8242 NAAS Rating: 5.03 TPI 2018; 7(9): 62-66
15. Kebede, G. Y., G. A., Haile, and T. Abo, 2021. genetic variability and associations of yield and yield related traits for fieldpea (*Pisum stivum L.*) Genotypes in Arsi Zone, Southeastern,Ethiopia. International Journal of Genetics and Genomics, 9(3), 50.
DOI
https://doi.org/10.11648/j.ijgg.20210903.12
16. Kumar, D. 2014. Production potential of chick pea as influenced by graded levels of fertilizers and bio-fertilizers under South Gujarat condition. (Doctoral dissertation, Agronomy Dept. NM College of Agriculture, Navasari Agricultural University, Navasari) 396 450.
17. Kumar, Subodh and B.P. Singh, 2011 Response of pigeonpea genotypes to levels of phosphorus and sulphur. Annals of Plant and Soil Research 13 (1): 53-55.
DOI: 10.5958/2230-732X.2016.00132.7
18. Kumari, N., J.P Srivastava,., S.K., Singh, and I.P Singh,. 2012 Heritability and genetic advance in vegetable pea (*Pisum sativum* L.) Ann. Agric Res. New Series Vol. 33 (4): 244-246.
https://doi.org/10.11648/j.ijgg.20210904.13
19. Nawab NN, GM, Subhani K, Mahmood Q. Shakil and A Saeed 2008. Genetic variability, correlation and path analysis studies in garden pea (*Pisum sativum* L.). J. Agri. Res. 46(4): 333-340. ISSN (Print): 0368-1157ISSN (Electronic): 2076-7897CABI Record Number: 20093106340\

20. atel, M.P., G.P., Richhariya, R.D Sharma, and K.N. Namdeo, 2012 Effect of fertility levels on nutrient contents and uptake of soybean genotypes. Crop Research 44 (1 and 2): 71- 74. Corpus ID: 101292101

21. Phom, C., Amet, S.P. Kanaujia, and H.P. Chaturvedi, 2014. Performance of various genotypes of pea under foothill condition of Nagaland. Annals of Plant and Soil Research 16 (4): 285-288. Doi https://www.gkvsociety.com/control/uploads/Performance%20of%20various%20genotypes%20of%20pea%20under%20foothill%20condition%20of%20Nagaland.pdf

22. Prajapati B. j., G. nitin, V. R. Gamit and H.J. Chhaganiya 2017. Effect of Integrated phosphorus management on growth, yield attributes and yield of chickpea. Agronomy Dept. NM College of Agriculture, Navasari Agricultural University, Navasari) india Fmg. And Mngmt. 2(1): 36-40. http://dx.doi.org/10.5958/2456-8724.2017.00006.6

23. Raj, P. , S. S. B. Kumar, K.N., Namdeo, Singh, Yogendra, S.S. Parihar, and M.K Ahirwar,. 2014 Effect of dual bio-inoculants on growth, yield, economics and uptake of nutrients in chickpea genotypes. Annals of Plant and Soil Research 16 (3) : 246-249. **DOI:** 10.5958/24568724.2017.00006.6

24. Rezgar. I. S and M. A. Hussain. 2024. heterosis and genetic parameters for yield and yield components in maize using half diallel cross. Iraqi Journal of Agricultural Sciences, 55 (5): 1859-1869. https://doi.org/10.36103/6m976r30

25. Saket, Sukhlal, Singh, S

26. Sarwar, M., M.E. Akhtar, S.I. Hyder and M.Z. Khan. 2012. Effect of biostimulant (Humic Acid) on yield, phosphorus, potassium and boron use efficiency in peas. Persian Gulf Crop Prot., 1(4): 11-16. https://www.ablesci.com/scholar/paper?id=8AVARLYmr

27. Seid H., Fikrte Y. and T. Fetebu. 2015. Effect of phosphorus fertilizer on yield and yield component of chick pea at Kelemeda. South wollo, Ethiopia. 1(1): 29-35. http://www.eajournals.org/

28. Singh, A.,S. Singh, and JDP, Babu, . 2011. Heritability, character association and path analysis studies in early segregating population of field pea (*Pisum sativum* L. var. arvense). International Journal of Plant Breeding and Genetics, New York, pp. 401-430. DOI: 10.3923/ijpbg.2011.86.92

29. Singh, S.P., Y. Kumar, and S. Singh, 2017 Effect of sources and levels of sulphur on yield, quality and uptake of nutrients in green gram (*Vigna radiata*). Annals of Plant and Soil Research 19(2): 143-147. https://gkvsociety.com/control/uploads/S.P.%20SINGH,%20YOGESH%20KUMAR%20AND%20SONU%20SINGH.pdf

30. Singh, Yogendra, Singh, Praveen, R.D., Sharma, G.S. Marko, and K.N. Namdeo, 2013. Effect of organic sources of nutrients on growth, yield and quality of lentil genotypes. Annals of Plant and Soil Research 15 (2): 134-137. https://gkvsociety.com/control/uploads/Effect-of-organic-sources-of-nutrients-on-growth-yield-and-quality-of-lentil-genotypes.pdf

31. Shad. R.H. Muhammad, S. N.H. Al.Hassoon and S. J.H. Dwenne 2024. A comparative study of organic and phosphate fertilizers with irrigation water quality on some soil properties and bean yield. Iraqi Journal of Agricultural Sciences, 55 (5): 505-516. https://doi.org/10.36103/wyxa9p03

32. Siphiwe L., Jude O. and O. John. 2017. Growth, yield and water use efficiency of chickpea response to biochar and phosphorus fertilizer application. Agronomy and Soil Science. 22: 2-16. DOI:10.1080/03650340.2017.1407027

33. Yadav, P., AK Singh, and CP, Srivastava, .2010. genetic variability and character association in diverse collection of Indian and exotic germplasm lines of pea (*Pisum sativum* L.). Veg. Sci. 37(1): 75-77. https://isvsvegsci.in/index.php/vegetable/article/download/733/555