ESTIMATION OF VARIABILITY-CORRELATION AND PATH COEFFICIENT ANALYSIS FOR YIELD AND YIELD COMPONENTS OF FABA BEAN GENOTYPES

Payman A. A. Zibari **Zhiyan A. Teli** **Mohammed A. Hussain**
Prof. **Assist. Prof.** **Prof.**
Dep/ Horticulture **Dep. Field Crop**
Coll. of Agric. Engin. Scien., University Duhok
Payman.abdullah@uod.ac zhiyan.teli@uod.ac dr.mohammedali1953@uod.ac.

ABSTRACT

Four genotypes of faba bean *Vicia faba L.* (Aknadcge, FlIP-17-078FB, FLIP-17-072FB and Fiedo were carried out during 2020-2021 winter season in year under four levels of phosphorus (0.0 18,36 and 54 Kg ha^{-1}) at the farm of field crops department, college of Agricultural Engineering science, University of Duhok, the experiment unit ranged in factorial within randomized complete block design with three replications. The result show significant effect of faba bean genotypes for all studies traits except plant height and main branches per plant and number of seed per plant, while the phosphorus level exhibited highly significant effect on all studies traits except plant Height and main branches the interaction between genotypes and phosphorus levels show significant effect for days to flowering, pod length, 100 seed weight and number nodes per plant and the rest traits exhibited non-significant. The fedo genotypes was superior in pod weight, 100 seed weight, number of nodules plant^{-1} and number of pods plant^{-1}. The seed yield gave positive correlation with number of nodules plant^{-1} (0.742, 0.751) phenotypic and genotypic and positive correlation with 100 seed weight (0.673 and 0.694).

Keywords: genotype, heritability, gene action.

تقدير تحليل تباين و الارتباط و معامل المسار للحاصل ومكونات الحاصل للتراكيب الوراثية للباقلاء .

پيمان عزيز عبدالله زيبارى **ژيان عسكر تيلي** **محمد علي حسين الفلاحي**
استاذ **استاذ مساعد** **استاذ**

المستخلص

زرعت اربعة تراكيب وراثية من الباقلاء(Aknadcge وFlIP-17-078FB و FLIP-17−072FB وFiedo) خلال الموسم السنوي لعام 2020 – 2021 تحت اربعة مستويات من الفسفور (0.0 و 18 و 36 و 54 كغم هكتار) في حقل كلية علوم الهندسة الزراعية / جامعة دهوك في تجربة عاملية باستعمال تصميم القطاعات العشوائية الكاملة وبثلاث مكررات. اظهرت النتائج وجود تاثيرات معنوية للتراكيب الوراثية على جميع الصفات باستثناء ارتفاع النبات وعدد الافرع وعدد البذور لكل نبات كما اظهرت مستويات الفسفور تاثيرا معنويا على جميع الصفات باستثناء ارتفاع النبات وعدد الافرع لكل نبات واظهرت التداخل بين التراكيب الوراثية والمستويات المختلفة من الفسفور تاثيرا معنويا على عدد الايام الى التزهير وطول القرنة ووزن 100 بذرة وعدد العقد في النبات ولم تظهر الصفات الاخرى تاثيرا معنويا. تفوق التركيب الوراثي Fedo في وزن القرنات ووزن 100 بذرة وعدد العقد في النبات وعدد القرنات للنبات. كما اظهر الحاصل ارتباطا معنويا موجبا مع عدد العقد في النبات مظهريا وراثيا حيث اعطى 0.637 و 0.694.

الكلمات مفتاحية: تركيب وراثية و نسبة التوريث و الفعل الجيني

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INTRODUCTION

Faba bean (*Vicia faba L.)* is one of an important legume crop grown in many parts of the world, including China, which is the largest producing and consuming country, followed by Ethiopia (1,2,15). The total production of dry faba bean for this crop in Iraq for year 2016, 400 tan (14 and 15), Faba bean genotypes differed in morphological characteristics, one of the difficulties that plant breeders face is choosing parents to know genetic variability of the important characteristics such as yield and yield components, which cauld be used as a criteria for solution (1, 10). The success of the breeding program depends on mainly on the selection of superior genotypes, this dependence on the amount of genetic variability present in the original population, therefore, identifying this variability in the faba bean population is important to improve this crop. (2 and 13). Estimation of the variance components of quantitative traits useful in choosing an appropriate and effective method for genetic improvement (35). the development of new genotype requires some knowledge about the genetic variation presents in the estimation of variability due to heritable components is very important because, it could be a guide for selection of parents for crop *Vicia faba L.* improvement (33). Also, the knowledge about the genetic variation is most important for high yield selection and help to understand the correlation between yield and its components, and the genetic variability about agronomic traits is the key component of breeding program. researchers (28,22 and 21) revealed indicated that significant differences were noted among different genotypes through genetic variation studied between yield and yield components in faba bean genotypes. Regarding to heritability estimates provide a good information about genetic attribute which will be transmitted to successive generation and constitute efficient guide for breeder in the choice of parents for faba bean improvement program, also the estimate heritability alone with genetic advance can help in predicting the seed yield under selection than heritability alone, the positives correlated between yield and its components are requires for effective yield components breeding increasing seed yield in faba bean. Several researcher (3, 4, 5, 8, 9, 10,11, 20 and 21) revealed that the lack or low rates of phosphorus in the soil is one of the factors negatively affect growth and seed yield of faba bean, phosphate can readily be rendered unavailable to plant roots as it is the most immobile of the major plant nutrient. The objectives of this study were to estimate variability, some genetic parameters, correlation and path coefficient analysis in four faba bean genotypes under different phosphorus levels.

MATERIALS AND METHODS

The study was carried out at the farm of field crops department. College of Agricultural Engineering Sciences, University of Duhok during fall growing season in year 2020-2021 for estimation variability, some genetic parameters, correlation and path coefficient analysis in faba bean under Duhok conditions. The study consists of four faba bean genotypes (Aknadcge, FLIP 17-078 FB, FLIP 17-072 FB and Fiedo). The seeds of each genotype were sow 30.11.2020. Each genotype was planting at two lines, 3 M long for each row) with 0.25 m between the row. Four phosphorus, levels were applied at sowing date with rates (0, 18, 36, 54 kg ha^{-1} P_20_5). All treatments arranged in factorial experiment using a randomize complete block design (RCBD) with three replications. The some chemical and physical of soil and rainfall presented in Table1. The data was recorded on five plants for each genotype, the studied traits represent PH plant height, POH, first pod height, MP. Main branches, DF. Days to soy flowering, NSP=number of seeds pod^{-1} lowest 100 seed weight, NNP=number of nodules plant POW= weight of pods plant and TY=total yield. The data were analysis according to the design using SAS statistical software, the estimation of some genetic parameter's correlation and pathway analysis as follow:

$$r= \frac{\sum XY - \frac{(\sum X)(\sum Y)}{n}}{\sqrt{\sum X^2 - \frac{(\sum X)^2}{n} X \sqrt{\sum Y^2 - \frac{(\sum Y)^2}{n}}}}$$

n= number of the treatment (sample size)

r= correlation coefficient value.

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

$$\mathbf{rG} = \frac{\sigma g\, xy}{\sqrt{\sigma^2\, gx.\ \sigma^2\, gy}}$$ According to (1 and 6)

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

Heritability values in broad sense less than 40 % were considered low, 40 to 60 % medium and more than 60% were considered high.

$$H.b.s = \frac{\sigma^2 G}{\sigma^2 p} \times 100$$

Table 1. Sample Soil properties and rain fall in season (2020-2021).

Soil	Unit	Depth (0-30) cm	Month	Rainfall mm
PH		**7.97**	**11/2020**	**25.1**
Ec	**ds.m^{-1}**	**0.45**	**12/2020**	**40.5**
A variable N	**mg.kg^{-1}**	**105.95**	**1/2021**	**83.0**
A variable P	**mg.kg^{-1}**	**4.84**	**2/2021**	**19.20**
O. M	**g.kg^{-1}**	**17.4**	**3/2021**	**40.8**
Sand	**g.kg^{-1}**	**72.53**	**4/2021**	**2.0**
Silt	**g.kg^{-1}**	**430.17**		
Clay	**g.kg^{-1}**	**496.12**		
Soil Texture		**Silt Clay**	**Mean**	**35.10**

RESULTS AND DISCUSSION

The results of combine analysis of variance or the all traits were presented in Table 2. Significant effects of faba bean genotypes were shown for all studied the traits understand except POH, MB and NSP, while high significant effect of PH, DF, NPP, PL, 100 SWT, NNP, WTP and TY, also the phosphorus exhibit highly significant effects on all traits with exception POH and MB whereas, the interaction between genotypes and phosphorus level gave significant effect for DF, PL 100 SWT and NNP and the others characters exhibited non-significant effect. For the CV% the largest value 18.42% was recorded for MB while, the lowest value 0.53 was obtained in DF similar results were obtained by (11, 21, 22, 23,25, 26 and 30).

Table 2. Mean square of combine analysis of variance for all the traits studies of four faba bean genotypes under different phosphorus levels.

		MS										
S.O.V	**Df**	**PH**	**POH**	**N.B**	**D.F**	**N.P.P**	**P.L**	**N.S.P**	**100swt**	**N.N.P**	**POW**	**TL**
Replication	**2**	**48.72**	**37.20**	**0.85**	**1.02**	**0.52**	**0.04**	**0.31**	**16.02**	**1.27**	**30.06**	**300625.00**
Genotypes (G)	**3**	**148.54 ****	**7.58**	**0.46**	**64.52 ****	**105.63 ****	**2.37 ****	**0.22**	**677.05 ****	**292.38 ****	**178.02 ****	**17802**. 08.33**
Phosphorus (p)	**3**	**192.26 ****	**2.33**	**1.95**	**1002.99 ****	**340.48 ****	**60.27 ****	**2.83 ****	**1850.00 ****	**55.94 ****	**282.57 ****	**28257** 63.88**
G x P	**9**	**14.77**	**3.25**	**0.20**	**2.46 ****	**1.55**	**2.33**	**0.19**	**42.35 ****	**4.62 ***	**0.98**	**983796**
Error	**30**	**14.77 *****	**1.63**	**0.35**	**0.46**	**1.74**	**0.66**	**0.19**	**3.64**	**1.98**	**2.95**	**2951389**
C. V. %	**47**	**7.98**	**16.58**	**18.42**	**0.53**	**5.00**	**7.05**	**12.13**	**2.48**	**12.60**	**5.08**	**5.08**

PH= plant heigh, POH= pod height, MB= number of main branches, DF= days to 50% of flowering, NPP= number of pods plant $^{-1}$, PL= pod length, N S P= number of seed pod^{-1}, S W T=100 seed weight, NNP= number of nodules plant-1, POW= weight of pods plant $^{-1}$, TY= total yield * and ** significant at 0.05 and 0.01 levels respectively.

The results in Table 3 show the mean genotypes and some agronomic traits under different levels of phosphorus fertilizer. For plant height the tallest plant among genotypes was obtained by Aknadege at 18 k ha^{-1} P_2O_5 with value (55.77 cm), whiles the shortest plant was recorded by Fllp 17-072F13 at the 48 k ha^{-1} p205. Concerning to POH, the FLLP 17-072F 13 was obtained the maximum value (15.49 cm) without phosphorus application, fertilizer 48 kha^{-1} P_2O_5 all AKnadcge gave the minimum POH (10.72 cm). For N. B. the Aknadege recorded the maximum N. B. at zero phosphorus application, while the minimum obtained by FLIP 17-072 FB with value 2.22 at 48 kg ha^{-1} P2O5. As the resulting for DF the earliest genotype was recorded by FLIP 17-072 FB at no phosphorus application whereas, the latest flowering exhibited by Aknadege at 48 kgha^{-1} P2O5. Regarding the N POP, the Fildo at 48Kg ha^{-1}P_2O_5 and the same genotype recorded the lowest N POP at zero phosphorus application. For N. P.P, the Fli 17-072FB recorded the maximum NPP with value (15.93) and the minimum value 9.61 exhibited by Aknadege at 48 kgha^{-1} P_2O_5.

Table 3. mean genotypes of four faba bean for yield and some agronomic characters at different phosphorus levels

	PH					POH					N.B				
	V1	V2	V3	V4	mean	V1	V2	V3	V4	mean	V1	V2	V3	V4	mean
P0	51.72	48.66	43.44	52.55	51.1	14.6	14.83	15.44	12.94	12.45	3.77	3.11	2.66	3.44	3.69
P1	55.77	51.22	44.22	52.55	50	12.66	12.66	14	12.22	13.45	3.66	2.77	2.88	3.11	3.22
P2	54	53.11	43.77	47.66	42.25	13.33	13.38	13.33	12.88	13.93	3.66	3.77	3.11	3.55	2.72
P3	43.11	47	37.55	44.11	49.05	10.72	12.94	12.88	14.22	13.06	3.66	3.22	2.22	3.33	3.36
Mean	49.09	50.77	49.63	42.94	48.1	14.46	12.88	13.36	12.69	13.33	3.2	3.11	3.52	3.11	3.42
L.s.d.p			5.68					3.25					0.79		
L.s.d.v			5.11					2.08					0.58		
L.s.d.pv			10.22					4.17					1.16		

	D.F					N.N.P					N.P.P				
	V1	V2	V3	V4	mean	V1	V2	V3	V4	mean	V1	V2	V3	V4	mean
P0	135	111.62	124.66	129	137.83	22.33	19.33	30.33	19	26.16	9.83	10.83	13.5	11.16	10.27
P1	137.33	115.33	125.66	130.33	115.91	24.66	22.66	21.33	33.33	22.83	10.83	10.5	14.83	11.6	10.17
P2	138.33	116.66	127	130.66	126.75	27.33	23.33	24.33	35.66	22.58	10.83	10.8	15.16	11.16	14.85
P3	140.66	120	129.33	132.33	130.58	30.33	25	26.66	36.66	34	9.61	9.2	15.93	9.16	10.77
Mean	12.508	127.16	128.16	130.66	127.77	22.75	25.5	27.66	29.66	26.34	11.33	11.85	11.91	10.97	
L.s.d.p			13.08					4.85					7.87		
L.s.d.v			16.99					1.64					3.46		
L.s.d.vp			13.99					3.29					6.93		

The results in Table 4 show that the NSP from this table noted that FLIP 17-072 F13 gave the maximum NSP (4.40) at level 48 kg ha^{-1} P_2O_5, while the minimum value was recorded by Aknadege at different rate of phosphorus application with value (3.00). For 100 SWT the highest value 99.66g was recorded by,the genotype fiedo at level 48 kg ha^{-1} P_2O_5 whereas the smallest record 57.0 g by FLI17-078 FB at zero phosphate fertilizer. Concerning the NNP the fiedo genotypes gave the maximum value (19.0) at level 48 kg ha^{-1} P_2O_5, while the minimum value was exhibited by FLIP 17-078 F13 at zero phosphorus application , from the results the phosphorus plays important roles in no dulation and biologicate nitrogen fixation, photosynthesis and nutritional value of legummes including faba bean. For pow the genotypes fiedo gave the largest pow with value (42.33g) at 36 kg ha^{-1} P_2O_5 whereas the lowest value (24.0 g) was recorded by FLIP 17-078 FB at zero phosphorus application. From this table we also noticed that the highest seed yield 4400 kg ha^{-1} P_2O_5 was produced by Fiedo at 46 kg ha^{-1} P_2O_5, while the lowest seed yield 2400 kg ha^{-1} P_2O_5 recorded by FLIP 17-078 F13 at zero phosphorus application. The increasing seed yield depend on the increase in main components, So that the fiedo genotype was superior in POWT, 100 SWP, NNP and N. P.P. These traits were more effected by addition of phosphate fertilizer and the kind of genotypes and So that effected in seed yield. Similar results were obtained by several authors (16, 9, 27, 33, 37, 38 and 40).

Table 4. Mean genotypes of four faba bean genotype of for some agronomic traits and yield at different phosphorus levels

	N.S.P					100 SWT					N.P.P				
	V1	V2	V3	V4	Mean	V1	V2	V3	V4	mean	V1	V2	V3	V4	mean
P0	3	4	3.76	3.33	3.08	67.33	57	62	83.66	80.91	4.33	2.66	2.33	6	10.75
P1	3.33	3.86	4.1	3.86	3.93	82.33	62.33	62.66	92	63.75	11	11.33	12	16.66	9.75
P2	3	3.66	4.26	3.1	4.13	86.66	67	74.33	93.66	70.75	12.6	13	13.33	15.66	9.83
P3	3	4.2	4.4	3.2	3.73	87.33	68.66	84	99.66	92.25	15	12	11.66	19	14.33
Mean	3.52	3.79	3.5	3.7	3.63	67.5	74.83	80.41	84.91	76.91	3.83	12.75	13.66	14.41	11.16
L.s.d.p			3.25					20.19					7.87		
L.s.d.v			0.54					8.06					3.16		
L.s.d.pv			1.08					16.13					4.18		

	POW gm					TY kg				
	V1	V2	V3	V4	Mean	V1	V2	V3	V4	Mean
P0	30	24	26.66	34.66	35.33	3000	2400	2666.7	3466.7	3533.33
P1	34.66	27.33	30.66	38.66	29	3466.7	2733.3	3066.7	3866.7	2900
P2	37.66	31.66	32.66	42.33	31	3766.7	3166.7	3266.7	4233.3	3100
P3	39	33	34	44	39.91	3900	3300	3400	4400	3991.67
Mean	28.83	32.83	36.08	37.5	33.81	2883.33	3283.33	3608.33	3750	3381.25
L.s.d.p		8.10					810.20			
L.s.d.v		2.96					296.82			
L.s.d.pv		6.93					593.64			

Table 5. exhibited the phenotypic and genotypic correction between pairs of traits studied, there is appositive significant coefficient correlation among seed yield (TY) and NPP, 100 SWT and NNP. And negative correlation coefficient between NNP and POH whereas positive correlation with NNP (0.742 ,0.751, phenotypic and genotypic), also positive correlation with 100 SW , (0.673 and 0.694) . For 100 SW, this trait correlated a positive and significantly with NPP (0.751 and 0.703) for phenotypic and genotypic respectively, while the NSP correlated a positive significantly with POH. The PL was negative significantly correlation with PH and MB, while the MB positive significantly correlated with PL. We conclude from Table 6 the TY showed an apparently positive significantly phenotypic and genotypic correlation with NPP, 100 SW and NNP. These result agreed with many of researchers who obtained the coefficient correlation among total TY and yield components (12, 17, 29, 32, 33, 34 and 36).

Table 5. phenotypic and genotypic correlion between pairs of traits studied

	PH	POH	N.B	DF	NPP	PL	NSP	100SWT	N.N.P	TY
TY	**0.237**	**-0.231**	**0.283**	**0.513**	**0.701***	**-0.212**	**-0.524**	**0.736***	**0,675***	**1**
	0.228	**-1.433**	**0.386**	**0.524**	**0.729***	**-0.216**	**-0.572**	**0.754***	**0.709***	**1**
NNP	**0.180**	**-0.079**	**0.214**	**0.290**	**0.742***	**-0.227**	**-0.374**	**0.673***	**1**	
	0.207	**-1.446**	**0.285**	**0.240**	**0.751***	**-0.226**	**-0.412**	**0.694***		
100SWT	**0.176**	**-0.163**	**0.332**	**0.540**	**0.703***	**-0.176**	**-0.526**	**1**		
	0.197	**-1.491**	**0.370**	**0.541**	**0.714***	**-0.172**	**-0.555**	**1**		
NSP	**-0.482**	**0.864****	**-0.563**	**-0.562**	**-0.413**	**0.462**	**1**			
	-0.581	**0.718***	**-0.764**	**-0.589**	**-0.479**	**0.704***	**1**			
P.L	**-0.706**	**0.335**	**-0601**	**-0.063**	**-0.261**	**1**				
	-0.760	**1.609****	**-0.697**	**-0.025**	**-0.252**	**1**				
IVPP	**0.242**	**-0.096**	**0.283**	**0.348**	**1**					
	0.236	**-1.587**	**0.337**	**0.349**						
IDF	**0.100**	**-0.159**	**0.352**	**1**						
	0.117	**-1.180**	**0.403**	**1**						
MB	**0.595**	**0.161**	**1**							
	0.756*	**-3.263**	**1**							
PoH	**-0.171**	**1**								
	-2.1101	**1**								
PH	**1**									
	1									

r- tabulated

***, ** significant at level 0.05 and 0.01 respectively**

Genotypic and phenotypic, direct and indirect effect of nine traits on seed yield were presented in Table (6). The number of pods plant $^{-1}$ (0.729) appears the highest positive direct effect followed by 100 swt (0.754) and number of nodules plant $^{-1}$ (0.709) for genotypic correlation with seed yield, Also the same traits showed significant phenotypic correlation with seed yield and the value were (0.701, 0.736 and 0.675 respectively. Concerning for indirect effect all traits exhibited low values indirect effect except PH, 100 SWT and number of nodules plant^{-1} and highly indirect effect between pod highly with 100 SWT and number of nodules plant^{-1} with values -0.343 and -0.378 respectively. Foe phenotypic path way analysis, all traits gave low indirect effect with seed yield except NPP, 100 SWT and NNP exhibited moderate indirect effect. These results were consistent with some reported by other (9, 15,17, 24, 26, 28, 29m and 30).

Table 6. Estimation of direct and indirect effect at genotypic and phenotypic level of nine traits on seed yield in four genotypes of faba bean under different phosphorous levels

Riy	PH	POH	M.B	D.F	NPP	P L	NSP	100 swt	NNP
0.228	0.0102	-0.02089	0.039429	0.014348	0.061045	-0.07554	0.097501	0.050094	0.049151
-1.4337	0.0099	-0.02089	-0.01700	-0.14363	-0.40947	0.159794	-0.12043	-0.37872	-0.34301
0.3863	0.0521	0.007719	-0.03231	0.049057	0.087144	-0.06922	0.12819	0.094045	0.067668
0.5242	0.1217	0.001203	-0.01168	0.021002	0.090213	-0.00257	0.098026	0.137588	0.06883
0.7293	0.2579	0.002414	-0.01572	0.017605	0.042571	-0.02507	0.080379	0.181335	0.178133
-0.2166	0.0993	-0.00776	0.015931	-0.03632	-0.00315	-0.06512	-0.011819	-0.04382	-0.05377
-0.5729	-0.1677	-0.00593	0.007109	-0.03983	-0.07179	-0.12361	0.069987	-0.14109	-0.09769
0.7543	0.2539	0.002012	-0.01477	0.019298	0.065949	0.184192	-0.01714	0.093191	0.164737
0.7094	0.2371	0.002114	-0.01432	0.014869	0.03533	0.19376	-0.02252	0.069092	0.17641

Phenotypic correlation coefficient

Riy	PH	POH	M.B	D.F	NPP	PL	NSP	100swt	NNP
0.2376	0.0819	0.001513	-0.04745	0.019013	0.058879	-0.0161	0.049639	0.04985	0.04052
-0.2321	-0.0088	-0.01408	-0.01288	-0.02766	-0.02341	0.007654	-0.08894	-0.04605	-0.01786
0.2835	-0.0797	0.048755	-0.00142	0.060948	0.068907	-0.01372	0.058025	0.09367	0.047963
0.5134	0.173	0.009001	0.001407	-0.02808	0.084519	-0.00144	0.05785	0.1522	0.06486
0.7019	0.2428	0.019861	0.000848	-0.02262	0.060221	-0.00597	0.042518	0.198274	0.165904
-0.2128	0.0228	-0.05784	-0.00295	0.047963	-0.0109	-0.06357	-0.04762	-0.04968	-0.05094
-0.5244	-0.1029	-0.03951	-0.00761	0.044943	-0.09726	-0.10032	0.010552	-0.14845	-0.08372
0.7363	0.2818	0.014488	0.001438	-0.02649	0.093437	0.170834	-0.00402	0.054208	0.150527
0.6755	0.2235	0.01475	0.000703	-0.0171	0.050205	0.18023	-0.0052	0.038546	0.189792

Table 7 show for the studied characters the genetic variance were high for PH , DF , NPP, 100 SWT , NNP, TY and values were 14.79 , 83 ,53 ,28 , 22 , 153 , 86 , 23 , 30 and 233620 . 83 respectively while, the environment's variance were high for PH, and TY and values were 14.77 and29513.89. from the results the same table the phenotypic variance was more the variance of genotypes especially for PH and TY. For the broad sense heritability, all studied traits according to range proposed by 5) ,this due to the high values of genetic variation , this results due to importance of additive and non-additive effect of gene that control inheritability this traits . An increase in heritability, which indicates the possibility of direction provident for these characters in coming years through programs for this objective , the heritability was range from 0.36% to 0.99% .These results are consistent with previous reports from 17 , 7 and 1 .The higher value of heritability with high value of genetic advance gives a good indication of the prediction that will obtain in the selection process .The values of expected genetic advance was range between 13.64 to 35.53 this value was moderate to high according to Ahamed and Agrawall those results were agreement with (7, 15, 22, 24, 26, and 25).

Table 7. Some genetic parameters for quantitative characters in faba bean

Genetic parameters	PH	POH	MB	DF	NPP	PL	NSP	100swt	NNP	POW	TY
Vg	14.790	0.058	0.133	83.537	28.222	4.967	0.2202	153.863	4.496	23.302	233020.83
Vge	0.00034	0	0	0.666	0	0.557	0	12.903	0.882	0	0
Ve	14.776	1.635	0.358	0.465	1.743	0.6600	0.194	3.643	1.981	2.951	29513.89
Vp	15.714	0.160	0.155	83.732	28.331	5.148	0.232	157.316	4.841	23.486	234865.45
H^2	0.941	0.362	0.855	0.997	0.996	0.964	0.947	0.978	0.928	0.992	0.992
Mean	48.114	13.353	3.249	127.771	26.395	11.519	3.631	76.916	11.166	33.812	3381.25
GA	6.566	0.255	0.594	16.067	9.332	3.853	0.804	21.590	3.596	8.462	846.248
GA%	13.648	1.911	18.285	12.575	35.353	33.450	22.142	28.069	32.212	25.027	25.027

Conclusion

The study demonstrated that both faba bean genotypes and phosphorus fertilization significantly influenced most agronomic traits. Among the tested genotypes, Fedo showed superior performance in pod weight, 100-seed weight, number of nodules /plant, and pod number/ plant. Phosphorus application for flowering time, pod length, 100-seed weight, and number of nodes per plant. Moreover, seed yield was positively correlated with both nodule number and 100-seed weight, highlighting their importance as key contributors to yield improvement in faba bean production.

genotype × phosphorus interactions observed improved yield-related traits, with significant

CONFLICT OF INTEREST

The authors declare that they have no conflicts of interest.

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