Identification study of *Vicia faba* genotypes based on seed properties and mineral content

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Abstract

The presented research was conducted at Vegetable Research Farm, Horticulture and Landscape Design, Agriculture and Forestry College, Univ. of Mosul. The research examines the mineral concentration and protein in fifteen genotypes of faba bean, which were sowing under Mosul condition using RCBD design with three replicates for each genotype. The result showed that the mineral element concentration was considerable variation amongst the genotypes ; genotype (S 2009, 140) gave a high value in the number of seeds in each pod, while genotype (S 2008, 096) was supervised in seed diameter, genotype S2009,81 gave a high value in seed length. At the same time, the genotype (S 2009, 175) was supervise compared with the other genotypes under the study, in the other hand the genotype (S 2008, 034) gave the high value in the seed weight plant^{-1}, The genotype (S 2009, 140) supervised in Fe percentage which was given a high value (5.275%) comparative with the other genotypes, while the genotype (Aguadulce) gave high value such as K percentage (4.1%), the genotype (S2009,40) supervised in Ca percentage (1.75%) comparative with the other genotypes under the study, in addition to the genotypes (S 2009, 116, S 2009, 81,S 2008, 034) gave the zero (0.0%) percentage in Mn., while the genotype (S 2008, 096) gave the high value in Pb percentage (8.710%).The genotype (ILB 1814) was supervised in N percentage and protein, which were (4.9 and 30.625%) respectively.

Key words: Faba bean, seed properties, Mineral element,protein

Introduction

Faba bean (*Vicia faba* L.) comes from most significant legumes seed and one of the best resources of the protein, cellulose, starch, and minerals (23), for human and animals feed in Africa as general and Sudan as specific where it considers the main meal at breakfast (13).Faba bean (*Vicia faba* L., 2n = 2 x = 12) has been considered as one of the most significant pulse crops in Iraq; it's plant edin the entire Iraqi land. Faba bean represents one of the proper rotation crops with the cereals (5)and has to be one of the components of sustainable system offarming. The faba bean is one of the annual legumes that are botanically referred to as the *Vicia faba* L., is a very old crop that is grown by man and it's utilized as one sources of the protein in human diet, as forage and fodder crop for the animals, and available nitrogen in biosphere (31).It has been defined as one of the rich sources of the minerals, protein, crude fiber and vitamins, pulses have been considered as one of the health foodson high percentage of the proteins that range from 23% to 37 %, and besides the vitamins and other nutrients,in addition to containing amount of starchy and sugary materials (4,8 and 21). The total area that has been cultivated from it in worldwide has reached in 2014, 2.4 million hectares (12)**.** Genotypes in the faba beans vary within themselves in a wide range of the phenotypic properties according to the growth and flowering dates, color, ripeness, and pod and leaf shapes. In the characteristics that are related to the seed, yield, and its elements (18 and 26). Seed yield has been defined as one of the complex characters, determined by a wide range of the yield components or associated parameters (32 and 27) have stated that primary yield components, directly affecting yield, have been the number of the pods in each one of the plants, the number of the seeds in each one of the pods, and size of the seed. Through their researches, numerous scholars found that yield in the beans, influences by numerous aspects, is dependent upon the genetic variations and that genetic analyses is significant for giving information concerning the studied characteristics (1,16,19 and 22). Considerable differences have been noticed in several seeds in each plant and the weight of theseedsin the case of evaluating for faba bean genotypes improved were considerably different from the other 3 genotypes in the weight of the seed (10 and 30) in his results of variance analysis have shown that the genotypes that have been studied were considerably different for all the characteristics. For the weight of 100 seeds, diameter, and length of the seed (9) founded there was significant in 100 seeds weight in faba genotypes**.** The field evaluations have shown that the genotypes of the faba bean have shown enough variations for their thoughtful agronomic parameters. genotypeshave been L251 and L252 for many seeds per plant and the maximal seed yield per plant (11 and 28) have recorded in their study, the analysis showed variance genotypes of faba bean had differed significantly between themselves inthe number of Seed Pod^{-1}, 100 Seeds Weight (gm),and Seeds Yield

(t ha^{-1}). (29) found that the 15 genotypes of faba bean were significant variation in seed diameter (cm), seed length(cm), 100 Seed weight (gm), Seeds weight plant^{-1} (cm), Total seeds yield (kg h^{-1}). The aim was to identification of *Vicia faba* genotypes based on seeds properties and mineral content

Materials and Methods

This research has been performed at Vegetable Research Farm, Horticulture and Landscape Design, Agriculture and Forestry College, Univ. of Mosul. It was conducted throughout the autumn growing season in the year 2018/2019 for Identification study of *Vicia faba* genotypes based on seed properties and mineral content. Under the conditions of the city of Mosul / Iraq, the study contained (1) genotypes (Table 1). The seed for each genotype was planted on 14/11/2018, each genotype was planted at two lines (3 m for each line) on 20 cm between the seed and 40 cm within the line under drip irrigation, in a randomized complete block design (RCBD) with three replicates for all genotypes. Also, all the genotypes for three replicates take the same level of fertilizer as 30 kg N ha^{-1}, 60 kg K ha^{-1} as K_2So_4, and 60kg P ha^{-1} as P_2O_5. (21). The data was recorded on ten plants for each plot forthree replicates via representing the number of seeds in each one of the pods, the diameter of the seed (cm), length of the seed (cm), 100 Seeds weight (gm), Seeds weight /plant (cm), Total seeds yield (kg/ha.), andthe percentage of a mineral elements N. P. K. Ca. Fe, Zn. Pb. Mn and Protein. The data have been analyzed dry seeds based on the design with the use of SAS statistical software (29), using Duncan's multiple range test (DMRT) was using to compared the mean value at the 5% propability level .

Figure -1- The seeds of 15 genotypes of *Vicia faba* before sowing in the field.

Table (1): Line of *Vicia faba*L. genotypes utilized in the presented work.

No.	Entry name	Pedigree	Origin
1	S 2009, 140	C08 /Fam392 Ter 10 x B4/9012/06	ICARDA
2	S2009, 56	ILB 1814/L62/96 xSel2007 latt385-2	ICARDA
3	S 2008, 096	R. Blanka (ILB 1270) x WRB1-4	ICARDA
4	S 2009, 116	Jazeari x Sel. 2008 latt 629	ICARDA
5	Aguadulce	ILB 1266	Spain, Icarda
6	S2009,32	Zarazeri xSel2004 latt 217-2	ICARDA
7	S 2009, 81	ILB 4338 x Sel2007 latt374	ICARDA
8	S 2008, 095	WBR 2-7 x WRB 1-4 x local	ICARDA
9	S 2009, 175	ILB 1266-L28/05 x sel.99latt10418	ICARDA
10	S 2008, 034	WRB1-3 x Giza blanca	ICARDA
11	S 2009, 113	ILB 1814 L12/96 x Sel. 2008 latt 629	ICARDA
12	Local Check	Syria	ICARDA
13	S 2009, 176	ILB 1814-L1/96 x sel. 99 latt10418	ICARDA
14	S2009,40	ShamixSelllatt 2004 393-2	ICARDA
15	ILB 1814	Syrian Local Large	Syria, ICARDA

Results and Discussion:

Figure 2 Showed the seed of 15 genotypes of faba bean when seeds matured during extraction seeds from the genotypes at harvesting dry seeds.

Figure -2- The Vicia faba seeds of genotypes at harvesting the dry pods

Seeds traits:

Table 2 shows the characteristics of seeds for fifteen genotypes of pests, as the results show that the genotypes have been considerably different in the characteristics of the seeds that are represented in the number of the seeds in each pod, diameter, seed length, the weight of 100 seeds, the weight of seeds in each one of the plants and total yield per unit area. Genotype S2009,140 showed that it gave the maximal number of the seeds in each pod, which amounted to 5.47, which differed significantly with most genotypes, but did not reach the significant limit between it and those S2009,56;S.2009,81 and S2009,14, and genotype S2008,034produced the lowest number of that amounted to 4.20. As for the seed diameter, genotype S2008,096produced the highest seed diameter of 1.47 cm, while genotype S2009,56 gave the lowest diameter of 0.72 cm, and these differed significantly among themselves, as no significant differences were shown for this trait between genotypes S2009,140; S2009,116; Aguadulce and S2009,32; S2009,81; S2008,095; S2009,175; S2009,133; S2009,176; S2009,40 and ILB1814. Genotype ILM1814 also significantly exceeded the composition with some genotypes. It produced the highest seed length of 2.43 cm, while Genotype S2009,116 produced the lowest length of 1.87 cm, but no significant differences were found between genotype ILB1814 and genotypes S2009,096; Aguadulce and S2009,175. As for the trait of 100 seeds, it may appear from the same table that genotype S2009,175 gave the highest weight of 0.80 g, and this significantly outperformed genotypes S2009,140; S2008,096; S2009,116; Aguadulce; S2009,32; S2009,81; S2009,176; S2009,40 and ILB1814. While genotype Aguadulce produced the lowest weight of 0.53 g.

There were also significant differences between the genotypes in the weight of the seeds for each plant, where the genotype s2008,034 produced the highest weight that amounted to 172.30 grams, and this significantly outperformed the rest of the genotypes under study. The genotype S2009,32 produced the lowest weight that amounted to 99.80 grams of seeds per plant. As for the proportions of the total seed yield per unit area, it may appear from the same table that genotype S2009,40was significantly superior to genotypes S2009,140; S2009.56 and S2008,034, as the yield reached 1229.67, 958.33, 765.00, and 909.33 kg ha^{-1}, but it did not differ significantly with the rest of the genotype sunder studying. These results may be explained by the genetic factors that each genetic structure carries, which may interfere with the environmental conditions under which these genotypes were studied. The genotypes that produced the highest values in the compatible traits were compatible and adapted to the conditions in the study area. This result was in agreement with what has been mentioned from Each of (9 and 10 for seed yield; 13, 14, and 15

for seed length and diameter; 17 and 18 for 100 seed weight and seed length and diameter; 19 for 100 seed weight; 20 for the number of seeds per plant and seed yield per unit area; and 21 for seed count characteristics per pod is the weight of 100 seeds; 22 for the characteristics of the diameter and seed length, the weight of 100 seeds, the seed yield per plant andper unit area.

Table (2) The mean value regarding all *Vicia faba* L. traits throughout the growing season in the year 2018/2019

Genotypes	SN	SD	SL	100SW	SWP	TSW
1	5.47 a	1.17abc	1.97efg	0.67cde	130.40 f	958.33bc
2	4.63 b-e	0.72 d	2.03def	0.77ab	146.40 d	765.00 c
3	4.97abc	1.47 a	2.37 a	0.60ef	127.33f	1018.00ab
4	4.30 e	1.23abc	1.87 g	0.67cde	119.40 g	1051.67ab
5	4.60 b-e	1.31abc	2.40 a	0.53 f	166.47 b	1061.67ab
6	4.37 de	1.21abc	2.07 c-f	0.70bcd	99.80 i	1123.67ab
7	5.13ab	1.46ab	2.43 a	0.67cde	170.40ab	1139.67ab
8	4.77 b-e	1.22abc	2.10cde	0.63 de	139.77 e	1040.33ab
9	4.50cde	1.12abc	2.17bcd	0.80 a	109.73 h	1006.67ab
10	4.20 e	1.01 cd	2.30ab	0.77ab	172.30 a	909.33bc
11	4.67 b-e	1.11 a-d	1.93fg	0.60ef	99.43 i	1013.00ab
12	4.50cde	1.05bcd	2.20bc	0.73abc	127.13 f	1044.67ab
13	4.67 b-e	1.16abc	1.97efg	0.60ef	119.17 g	1033.33ab
14	4.93 a-d	1.28abc	2.10cde	0.67cde	109.13 h	1229.67 a
15	4.27 e	1.16abc	2.43 a	0.67cde	157.47 c	1098.33ab

SN= number of seeds/pod, D=diameter of the seed (cm),SL=length of the seed (cm), 100SW=100 Seeds weight (gm), SWP=Seeds weight /plant (cm), TSW=Total seeds yield (kg/ha.).

Percentage of mineral elements:

Table 3 shows the percentage of mineral elements represented by P, K, Ca, Fe, Zn, Pd, Mn, N, and Protein. The table shows that the genotypes of the remainder varied among themselves in the percentage of the elements involved. Also, the table shows that the percentage of P component ranged from 0.197% to 0.216%.Genotype S2009,116produced the highest percentage that amounted to 0.250%, followed by genotypes S2009,175, 0.248%, genotype ILB18140.238%, and genotype 11 0.231%, while genotype S2009,034 produced the lowest percentage of that amounted to 0.197%. The percentage of K was highest, amounting to 4.100%, followed by genotype ILB 1814, reaching 3.80%, and genotype S2009,176 containing the lowest percentage that amounted to 1.900%. As for the percentage of Ca element in the genotypes of the rest, it may appear from the table that the highest percentage of Ca element was in the seeds of genotype S2009,40, which was 1.750%, and the lowest percentage was in the seeds of genotypes Aguadulce and S2008,095, reaching 0.2505. The highest percentage of iron was in Genotype S2009,140, it was 5.275%, and the lowest percentage was in Genotype S2009,175, it was 2.856%.

As for the Zn component, the highest percentage of it was in genotype 3, amounting to 1.338, followed by genotypes S2009,140and S2009,56, the percentage was 1.266 and %.

1.220%, respectively. While the lowest percentage of this element was in genotype S2009,113, it was 0.417

Table 3: The concentrationof mineral elements and protein in 15 genotypes of faba bean during the growing season 2020/2021.

Genotypes	Mineral concentration (%)								
	P	K	Ca	Fe	Zn	Pb	Mn	N	Protein
1	0.210cd	2.500bc	0.750	5.275a	1.266	6.882a	1.009b	4.800	30.000ab
2	0.216cd	3.100ab	1.500	3.009c	1.220	5.284bc	1.531a	4.410	27.563ab
3	0.215cd	2.52bc	1.020	3.727b	1.338	8.710a	0.827b	4.600	28.750b
4	0.250a	3.000b-d	1.000	2.964bc	0.668	2.917fg	0.00e	4.700	29.375b
5	0.205e	4.100a	0.250	3.215b	1.020	1.833h	0.324d	4.500	28.125b
6	0.220bc	3.200ab	1.250	3.554b	1.063	3.415e	1.154b	4.110	25.688c
7	0.226bc	2.075bc	0.500	3.007d	0.492	6.067b	0.00e	4.310	26.938c
8	0.230bc	3.200b-d	0.250	3.420b	1.013	6.462b	0.635b	3.820	23.875
9	0.248a	2.320bc	1.250	2.856bc	1.249	3.954	1.391a	3.720	23.250d
10	0.197f	2.670bc	0.750	3.279b	1.077	3.486cd	0.00e	3.920	24.500cd
11	0.231b	3.27ab	1.250	3.367b	0.417	3.715e	0.377c	2.940	18.375e
12	0.223bc	3.050a-c	1.000	3.393b	0.661	2.818f	0.184cd	4.010	25.063c
13	0.211cde	1.900e	1.025	3.193bc	0.856	4.620c	1.723a	3.620	22.625d
14	0.209de	2.550cd	1.750	3.996b	0.693	5.443bc	0.00e	4.210	26.313bc
15	0.238b	3.800a	1.025	3.639b	0.808	7.023b	0.749a	4.900	30.625a
			n.s		n.s			n.s	

It also appears from the results of Table 3 that genotype S2008,096 contained the highest percentage of Pd, which was 8.710%, followed by genotypes S2009,140 and ILB1814 with this percentage being 6.882 and 7.023% respectively, and the lowest percentage was in the seeds of genotype S2009,116 which was 1.833%. Genotypes S2009,116; S2009,81; S2008,034 and S2009,40 were distinguished by 0.00 percent of Mn, and the highest percentage was in seeds of genotypes S2009,56 and S2009,176, which was 1.531 and 1.723%, respectively. For apercentage of N and protein in seeds of genotypes from the rest, the range is (2.940-4.900%) for nitrogen and protein, and it was (18.375-30.625%) , respectively, for genotypes S2009,113 and ILB1814. The result may explain these variations in the percentage of mineral and protein content in the seeds of introduced genotypes and cultivated under conditions of the city of Mosul to the extent to which these genotypes are adapted to the environmental conditions prevailing in the study area. In the study area represented by the temperature and humidity to the characteristics of soil in which it has been planted in terms of its fertility and its containment of various mineral elements, in addition to the genetic factors that it carries in genetic makeup and the genes that are responsible for the different metabolism processes inside the girls and in the stage of seed development in the physiological maturity and completion of growth Embryo and endosperm formation and cotyledons.This result was consistent with Alabade (2) ,Alghamdi (3)

,Brand *et al.* (6), Dawood *et al*. (7) Hamilton (14) . and who indicated in their study results that the varieties or genotypes of remnants varied with each other in the percentage of mineral element, protein in the seeds. And that the proportion of protein is under genetic control (15,17, 20 and 24).

Conclusion

This study indicates that the genotypes of pests varied among themselves in the seed characteristics and the content of mineral elements, as genotype S 2009, 140 was superior in the characteristic of the number of seeds in each pod, the protein content, the highest content of Fe, and the genotype S 2008, 034 in the seed weight of each plant and the genotype. S2009,40 in total seed yield, and that genotypes S 2009, 116;S 2009, 81; S 2008, 034 and S2009,40 were free of Mn.

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Conflict of interest

The authors have no conflict of interest.

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