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PRODUCTIVITY OF SOME FABA BEAN (*Vicia faba*, L.) GENOTYPES IN NORTH EGYPT

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ABSTRACT

The aims of this study were to evaluate and estimates the genetic variation for 8 faba bean (*Vicia faba*, L.) genotypes for three performance and yield potential at Tag EL-Ezz Research station, Dakahlia Governorate. The eight genotypes were Sakha 1, Giza 3, 92/112/836, 93/1151/943, 96/738/1033, 93/1200/948, 99/961195 and 2000/651/1423. the studied character were plant height, number of branches/plant, number of pods/plant, seed yield/plant, 100 seed weight, number of seeds/pod, seed yield (ardab/fad) and straw yield (t/fad). The sowing date was November 1st in the two growing seasons. Results indicated that, significant differences occurred among seasons due to the variation in weather conditions which affected on yield and performance of genotypes. The genotype 93/1151/943 was the highest significant for seed yield over all genotypes (10.01 ardab/fad) increase of 49 % over the yield of Giza 3. The cultivar Sakha 1 gave the high seed yield after genotype 93/1151/943 compared with the other genotypes. Seed yield ranged from 8.29 to 9.48 ardab/fad for 91/1121/836, 96/738/1033, 93/1200/998, 99/691/1195 and 2000/651/1423. The genotype 93/1151/943 increased in seed and straw yields/fad. High phenotypes coefficient of variation, broad sense heritability, together with genetic advance are showed for seed yield/plant, suggesting that pronounced progress should be expected from selection among genotypes for yield character in North Egypt.

INTRODUCTION

Faba bean (*Vicia faba*, L.) is one of the most important food legume crops in Egypt is a source of plant protein and carbohydrates, seeds are considered as an important source of plant protein for its constitution in different popular delicious Egyptian food. Also, faba bean could be harvested in an immature condition to be eaten and cooked as green beans. In addition, straw yield of faba bean is national interest since great quantities are needed for animal feeding. Faba bean has taken the attention of geneticists and agronomists improve the average yield per unit area. The new varieties are important to produce high yields from seeds and straw/faddan and are resistance to diseases such as choculat spot and botrytis faba. Raising early maturing and high yielding faba bean cultivars such as Sakha 1 and Giza 3 were quick and satisfactory ways for increasing faba bean in Egypt (Dawwan and Abdel-Aal, 1991 ; EL-Hosary and Sedhom, 1991 and Hussein *et al.*, 1999). Many investigators had high variability among faba bean genotypes for yield and its components (EL-Hosary and Sedhom, 1990 ; Dawwan and Abdel-Aal, 1991 and Gomaa, 1996), high value of genotypic and phenotypic variance for number of seeds/plant, low value for number of seeds/pod.

MATERIALS AND METHODS

Eight faba bean genotypes varied in their origin and characteristics were randomly chosen from faba bean germplasm collection at Agricultural Research Center, Giza, Egypt. The genotypes were grown at the Experimental Farm at Tag EL-Ezz Research Station, Dakahlia Governorate in the two winter seasons 2002/2003 and 2003/2004. The sowing date was November 1st in the two seasons. The mechanical and chemical analysis in the experimental sites are presented in Table 1. Normal agricultural practices were applied. A randomized complete block design with four replications was used.

Studied characters:

At harvest, Ten guarded plants were randomly chosen from each plot to determine the following characters:

Table (1): Mechanical and chemical analysis of the soil at Tag EL-Ezz Research Station in Dakahlia Governorate during the two growing seasons.

Mechanical Analysis	Value	Chemical Analysis	Value
		Soluble cations (mg/100 g soil)	
Course Sand %	3.60	Na +	14.0
Fine Sand %	9.71	K +	0.23
Silt %	33.60	Ca ++	13.08
Clay %	52.20	Mg ++	7.17
Soil texture	Clay-silt	**Soluble anions (mg/100 g soil)**	
		HCo_3^-	0.52
		Cl^-	15.54
		So_4^-	18.42
		EC (ppm)	2632.2
		EC (m moh/cm^2)	4.1
		pH	8.1

Classification of soil salinity according to United States "Salinity Laboratory Staff (1954)":

1- **EC = less than 1280 ppm (salinity free).**
2- **EC = 1280 – 2240 ppm (low salinity).**
3- **EC = 2240-4160 ppm (medium salinity).**
4- **EC = higher than 4160 ppm (high salinity).**

1- Plant height (cm): measured from the soil surface to the top of the plant.
2- Number of branches/plant.
3- Number of pods/plant.
4- Seed weight/plant (g).
5- 100-seed weight (g).
6- Seed yield (ardab/fad): weight of seeds harvested from each plot and converted to ardab/fad (ardab = 155 kg).
7- Straw yield (t/fad): it was calculated by subtracting seed yield fom the total yield for each plot and converted to ton per faddan.

The analysis of variance was made separately for each season then a combined analysis for the two seasons was calculated (Gomez and Gomez, 1984). Analysis of variance was done for the data. The data in

combined analysis was performed according to Sendecor and Cochran (1980) and the treatment means compared with using Least Significant Difference (L.S.D.) at 0.5 level of significance. The genetic and phenotypic variance ($^2\delta_g$ and $^2\delta_{ph}$) were calculated from results of analysis of variance as follow:

1- Genotypic variance ($^2\delta_g$) was calculated from the formula outlined by Comstok and Moil (1963).
2- Phenotypic variance ($^2\delta_{ph}$) was computed according to Mather *et al.* (1971).
3- Broad sense heritability (H) was calculated as described by Hanson (1963) using the following formula:
$H\ \% = {}^2\delta_g / {}^2\delta_{ph} \times 100$
4-The expected genetic advance under selection (G_s) was calculated from the following formula as suggested by Johanson *et al.* (1966).
$G_s = K.\ \delta_{ph}\ .\ H$

Simple correlation:

The correlation coefficient (r) was calculated according to the following equation (Sendicor and Cochran, 1980):

$r = Cov.\ xy / Sx\ .\ Sy$

where: $Cov.\ Xy = \Sigma\ (X-X`)(Y-Y`) / n-1$

Covariance xy assuming that X ⟷ Y

$Sx = \Sigma\ (X-X`)^2 / n-1$ = variance x

$Sy = \Sigma\ (Y-Y`)^2 / n-1$ = variance y

The significant for "r" was tested against its standard error Sr where:

$$Sr = \sqrt{\frac{1-r^2}{n-2}}$$ with n – 2 degrees of freedom (n = sample size)

RESULTS AND DISCUSSION

Seasonal effects:

Average and analysis of variance are shown in Table (2) and revealed that highly significant differences among seasons for plant height, seed yield (ardab/fad), straw yield (t/fad), number of pods/plant, seed yield/plant (g) and 100-seed weight (g). The over all mean of seed yield in 2003/2004 season was 10.08 ardab/fad, while the corresponding yield in 2002/2003 season recorded 7.67 ardab/fad (Table 2). The second season was warmer than the first season during vegetative growth stage (November to January), where the average monthly maximum temperature in these three months in the second season reached 29.0, 25.2 and 24.0 C°, respectively. The corresponding temperature in the first season were 27.0, 22.5 and 20. C°, respectively. The second season was warmer during flowering and pod-filling stages in February and March, where the average monthly maximum temperature in these months were 21.5 and 24.5 C° in the first season and 19.0 and 21.8 C° in the second season, respectively. It seems that

accumulation of dry matter was higher at pod-filling stage in the second seasons compared with the first season, it's gave the highest number of pods/plant, seed yield/plant (g) and straw yield in ton per faddan (Table 2). Several researchers have reported seasonal and environmental effects on faba bean characters (Roupakias and Tai, 1986 and Hussein *et al.*, 1999).

Performance of genotypes

The combined analysis of variance indicated highly significant differences among genotypes for all studied characters. Also, the genotype X season interaction had a significant effect on all studied characters, large genotype X season interaction is common in variety trials, but the genotype X year component was more effective than genotype x location interaction component in faba bean because year effect includes fluctuation in weather condition. Therefore, it is important to test a set of genotypes in a series of seasons to obtain more information about breeding materials. Link *et al.* (1994 b) reported that the estimate of the genotypic standard was 7.5 % and heritability was 0.75 as well as environmental means ranged from 72.7 to 73.6 %.

Plant height and number of branches/plant:

The average performance of plant height and number of branches/plant for each genotype over seasons are given in Table 3. Plant height ranged from 110.05 cm for Sakha 1 to 157.45 cm for 2000/691/1195 genotype and number of branches/plant ranged from 2.9 for Giza 3 to 4.08 for 961/738/1033 genotype. Also, the genotype X season interaction had a significant effect on all studied characters, except days to maturity large genotype X season interaction is common in variety trails. As an example, Jonhanson *et al.* (1955) and Link *et al.* (1994 a).

Yield and yield components characters:

Average seed yield/plant, number of pods/plant, 100 seed weight, seed and straw yields per faddan are presented in Table 4. The genotypes 93/1151/943, 96/738/1033, 99/691/1195 and 92/1121/836 showed the highest seed yield/plant of 53.00, 48.48, 44.93 and 40.23 g, respectively with insignificant differences between them. Yield increases of these genotypes over the check variety Giza 3 were 73.3, 57.1, 47.1 and 32.0 % respectively. High seed yield/plant of these genotypes was mainly due to their high number of pods. The range of 100-seed weight was from 61.00 g for 99/691/1195 to 49.93 g for 92/1121/836. Concerning seed yield/faddan, the line 93/115/943 out yielded all tested genotypes, recording 10.01 ardab/fad, with an increase of 48.5 % over the yield of Giza 3. The genotypes Sakha 1, 2000/651/1423, 92/1121/836, 99/691/1195, 93/1200/948 and 96/738/1033 gave also relatively high seed yield/faddan, which ranged from 9.69 ardab/fad for Sakha 1 to 8.29 ardab/fad for 96/738/1033 with insignificant differences among them (Table 4). The genotypes 93/1151/943, 93/1200/948 and 99/691/1195 gave high straw yield (t/fad) all genotypes using tested, which ranged from 2.68 t/fad to for 93/1151/943 to 2.06 t/fad for 99/691/1195. These genotypes showing superiority most in characters and should be exploited in breeding program. The hybridization between the promising line (93/1151/1943 , Sakha 1, 2000/651/1423 and 99/691/1195 could be useful to select high yielding materials.

Genetic parameters of the studied characters:

Estimates of phenotypic of variation ($^2\delta_{ph}$), environmental variation ($^2\delta_E$), genetic variation ($^2\delta_g$), broad sense heritability ($^2\delta_{H\%}$) and genetic advances as percentage of mean (Gs %) for studied characters are presented in Table 5. The highest ($^2\delta_{ph}$) was observed for plant height, 100-seed weight, seed yield/plant, number of pods/plant and seed yield/fad (1284.2), (176.10), (173.59), (44.19) and (6.89), respectively in the first season. The same trend was observed in the second season and combined analysis. Also, the highest ($^2\delta_g$) was observed for plant height (989.5), 100-seed weight (33.02), seed yield/plant (7.97) and number of pods/plant (4.47) in the first season, in the second seasons were (47.93), (13.98), (20.45) and (8.047), respectively and the highest in this character also in the combined analysis (664.0), (424.796), (297.043) and (18.50), respectively and seed yield in ardab per faddan (3.728). The highest ($^2\delta_E$) was observed for plant height (295.3), 100-seed weight (143.09), seed yield/plant (166.62), number of pods/plant (39.7) and seed yield in ardab/faddan (6.66) in the first season, in the second season were plant height (503.02), seed yield/plant (659.64), number of pods/plant (44.131), seed yield in ardab/fad (22.705) and 100-seed weight (9.36) and the combined analysis were plant height (429.26), 100-seed weight (9.544), seed yield/plant (6.497) and number of pods/plant (3.86). Hence, the expected genetic advance was high for plant height (56.85), seed yield/plant (25.94), 100-seed weight (22.197), number of pods/plant (11.749) and seed yield ardab/fad (5.228) these results in the first seas..., while in the second season plant height was (44.15), seed yield/plant (51.26), number of pods/plant (12.573), seed yield ardab/fad (9.619) and 100-seed weight (4.06). Also, in the combined analysis plant height (41.141), 100-seed weight (41.987), seed yield/plant (35.100), number of pods/plant (8.075) and seed yield ardab/fad (3.715), respectively. Data in Table 5 show that heritability were high percentage in all studied characters. Heritability in broad sense was 0.770 and 0.913 in the first and second seasons, respectively for plant height, 0.820 and 0.885 for number of branches/plant, 0.858 and 0.845 for number of pods/plant, 0.634 and 0.850 for number of seeds/pod, 0.954 and 0.969 for seed yield/plant, 0.812 and 0.418 for 100-seed weight, 0.967 and 0.959 for seed yield (ardab/fad) and 0.993 and 0.778 for straw yield in the first and second seasons, respectively.

Genetic advance under selection to 5 % was high for plant height in the two seasons and combined analysis, seed yield/plant and 100-seed weight for combined analysis. Heritability and genetic advance were studied by Johnson *et al.* (1955), Dawwan and Adbel-Aal (1991) and Link *et al.* (1994 b), they indicting the importance of heritability and genetic advance for yield and yield characters in the inheritance of faba bean, heritability was 0.75 as well as environmental means ranged from 42.7 to 73.6 for yield/plant, but genetic advance was lowest, it was 7.5.

The correlation coefficients of six characters in faba bean are shown in Table 6. The results clearly showed that positive and significant correlation between plant height and number of pods/plant, number of branches/plant with both of seed weight/plant, 100-seed weight and seed yield (ardab/fad),

seed weight/plant with number of pods/plant and seed yield (ardab/fad), number of pods/plant with seed yield (ardab/fad) and 100-seed weight with seed yield (ardab/fad). Therefore, selection for these characters is more effective for obtaining new higher yielding quantity. These results are in accordance with Ashmawy *et al.* (1998) and EL-Deuby and Mohamed (2002).

Table 2: Averages of the studied characters for 8 faba bean genotypes.

Character	2002/ 2003	Signific-ance	2003/ 2004	Signific-ance
Plant height (cm)	124.96	**	137.23	**
Number of branches/plant	3.23	**	3.96	**
Number of pods/plant	18.46	**	24.21	**
Number of seeds/pod	3.05	**	3.04	**
Seed yield/plant (g)	21.51	**	58.04	**
100-seed weight (g)	53.91	**	56.56	**
Seed yield (ardab/fad)	7.67	**	10.08	**
Straw yield (t/fad)	1.85	**	1.99	**

Between data of both seasons (from ANOVA).

Table 3: Averages of 8 faba bean genotypes evaluated for plant height, *number of branches/plant* at harvest.

Genotypes	Plant height (cm)	Number of branches/plant
Sakha 1	110.05	3.48
Giza 3	152.88	2.90
92/1121/836	147.95	3.18
93/1151/943	135.38	3.70
96/738/1033	126.98	4.08
93/1200/948	128.43	4.03
99/691/1195	121.15	3.53
2000/691/1195	157.45	3.98
Range	110.05 - 157.5	2.9 – 4.08
Over all mean	135.03	3.61
LSD at 0.05	20.33	0.42

Table(4): Averages of 8 faba bean genotypes seed yield/plant, number of pods/plant, 100 seed weight, seed and straw yields/fad (combined data).

Genotypes	Seed yield/ plant (g)	Number of pods/ plant	Number of seeds/pod	100 seed weight (g)	Seed yield (ard./fad)	Straw yield (t/fad)
Sakha 1	27.73	21.78	3.23	56.00	9.68	1.67
Giza 3	30.55	18.03	3.20	60.88	6.74	1.97
92/1121/836	40.23	24.45	3.55	49.93	9.16	1.79
93/1151/943	53.00	24.35	3.35	54.88	10.01	2.68
96/738/1033	48.48	22.60	3.28	53.00	8.29	1.76
93/1200/948	30.08	19.98	3.25	52.75	8.50	2.67
99/691/1195	44.93	19.23	3.30	61.00	9.11	2.06
2000/691/1195	35.23	20.20	2.88	53.38	9.48	1.48
Range	27.73-53.00	18.03-24.5	3.55-2.88	49.9-61.0	6.74-10.01	1.5-2.7
Over all mean	38.71	21.32	3.26	55.23	8.87	2.01
LSD at 0.05	5.05	2.89	0.41	4.54	1.08	0.72

Table (5): Genetic parameters for studied characters for 2002/2003 and 2003/2004 seasons with combined data.

Seasons	Characters	$^2\delta_{ph}$	$^2\delta_E$	$^2\delta_g$	H	Gs %
2002/2003	Plant height (cm)	1284.2	295.3	989.5	0.770	56.85
	Number of branches/plant	0 89	0.73	0.16	0.820	2.06
	Number of pods/plant	44.19	39.72	4.47	0.858	11.749
	Number of seeds/pod	0.240	0.40	0.23	0.634	1.036
	Seed yield/plant (g)	174.59	166.62	7.97	0.954	25.94
	100-seed weight (g)	176.10	143.09	33.02	0.812	22.197
	Seed yield (ardab/fad)	6.89	6.66	0.33	0.967	5.228
	Straw yield (t/fad)	0.456	0.453	0.003	0.993	1.381
2003/2004	Plant height (cm)	550.95	503.02	47.93	0.913	44.146
	Number of branches/plant	0.92	0.83	0.09	0 902	1.78
	Number of pods/plant	52.178	44 131	8.047	0 845	12 573
	Number of seeds/pod	0.02	0.017	0.003	0.850	0.248
	Seed yield/plant (g)	680.09	659.64	20.45	0 969	51.26
	100-seed weight (g)	22.34	9.36	13.98	0.418	4 06
	Seed yield (ardab/fad)	23 664	22 705	0.959	0.959	9.169
	Straw yield (t/fad)	0.321	0.25	0.71	0.778	0.708
Combined analysis	Plant height (cm)	1093.3	429.26	664.0	0.604	41.141
	Number of branches/plant	0.713	0.082	0.0631	0.885	1.539
	Number of pods/plant	22.36	3.86	18.50	0.829	8.075
	Number of seeds/pod	0.141	0 078	0.063	0 446	0.345
	Seed yield/plant (g)	303.54	6.497	297.04	0.978	35.100
	100-seed weight (g)	434.34	9.544	424.79	0.978	41.987
	Seed yield (ardab/fad)	4.268	0.54	3.728	0.873	3.715
	Straw yield (t/fad)	0.798	0.127	0.671	0.840	1.545

Table (6): Simple correlation coefficient values for six characters of faba bean (averages of combined analysis for two seasons 2002/2003 and 2003/2004).

Character	1	2	3	4	5	6
1-Plant height (cm)	-	NS 0.246	NS 0.030	** 0.653	0.096	0.306
2-Number of branches/plant			* 0.532	0.142	* 0.458	* 0 480
3- Seed yield/plant (g)				** 0.556	0.099	* 0.496
4-Number of pods/plant					0 257	* 0 451
5-100-seed weight (g)						* 0 482
6-Seed yield (ardab/fad)						-

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إنتاجية بعض التراكيب الوراثية من الفول البلدى فى شمال مصر

السيد الغزالى عباس

معهد بحوث المحاصيل الحقلية – مركز البحوث الزراعية – الجيزة – مصر.

إستهدفت هذه الدراسة تقييم أداء ٨ تراكيب وراثية من الفول البلدى للوقوف على قدرتها الإنتاجية فى شمال مصر عن طريق تحديد المعايير الوراثية التى تدخل فى برامج التربية للمساعدة فى الإنتخاب لسلالات عالية الإنتاج تحت ظروف المنطقة و قد تم زراعة هذه التراكيب الوراثية فى محطة البحوث الزراعية بتاج العز محافظة الدقهلية فى موسمين للزراعة ٢٠٠٢/٢٠٠٣ ، ٢٠٠٣/٢٠٠٤.

وقد أظهرت النتائج وجود إختلافات معنوية بين موسمى الزراعة ويرجع هذا إلى الإختلاف فى الظروف الجوية التى أثرت على التراكيب الوراثية المختبرة تحت هذه الظروف وقد أظهرت السلالة (٩٤٣/١١٥١/٩٣) أعلى محصول بذرة للفدان ومقداره (١٠,٠١ أردب /فدان) متفوقاً بنسبة ٤٩% على صنف المقارنة جيزة ٣ .هذا وقد أظهرت بعض التراكيب الوراثية إنتاجية مرتفعة وهى السلالات (١٤٢٣/٦٥١/٢٠٠) ، (٨٣٦/١١٢١/٩٢) والسلالة (١١٩٥/٦٩١/٩٩) حيث كان محصولهم ٩,٤٨ ، ٩,١٦ ، ٩,١١ أردب للفدان على التوالى وقد أعطى الصنف سخا ١ إنتاجية عالية بلغت ٩,٦٨ أردب للفدان. وقد جمعت هذه السلالات بين إنتاج البذور والقش.

أوضحت النتائج أيضاً أن صفات عدد قرون النبات ، محصول النبات من البذور ووزن الـ ١٠٠٠ بذرة قد حققت أعلى التقديرات لمعامل التباين المظهرى ونسبة التوريث والتحسين الوراثى المتوقع من الإنتخاب فى خلال موسمى الزراعة والتحليل المشترك لذلك فإنه من المتوقع حدوث تقدماً ملحوظاً لهذه الصفات تحت ظروف شمال مصر.

وبناء على ذلك يمكن التوصية بزراعة هذه التراكيب الوراثية المبشرة فى شمال مصر وذلك بعد إجراء التجارب التأكيدية والتجارب الموسعة فى حقول المزارعين.