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ESTIMATION OF GENETIC VARIABILITY IN FABA BEAN (*Vicia faba* L.) GENOTYPES UNDER NEW RECLAIMED SOIL IN NORTH DELTA

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ABSTRACT

The Present investigation was conducted to the study the inheritance of some quantitative traits on faba bean (*Vicia faba* L.) as well as evaluation of ten genotypes with two check cultivars (Sakha1 and Giza 843). A randomized complete blocks Design (RCBD) with four replicates, was used two field experiments were carried out at Tag EL-EZZ Agricultural Research Station, Dakahlia Governorate during 2007/2008 and 2008/2009 seasons. The analysis of variance had significant effects on faba bean seed yield and yield components, so the results cleared the presence of genetic variability among studied genotypes. In relation to the mean performance both faba baen genotypes 1556/914/2001 and 1423/653/2000 gave the highest values of number of branches/plant(4.10 and 4.13), number of pods/plant (16.73 and 16.60) and seed weight(g)/plant(24.40 and 23.33) than those other tested faba bean genotypes and reflected on faba bean seed yield /faddan (13.85 and 13.25 ardab). In addition, both faba bean genotypes out yielded the check cultivar, Sakha 1 by 28.1 and 29.1% for number of branches/plant ,25.5 and 24.5% for number of pods/plant and 18.6 and 13.4% for seed yield/ faddan, respectively. These findings could be useful to select high yielding materials to exploit in the breeding program. The analyses of parameters of genetic variability showed little difference between GCV and PCV for number of pods/plant (21.0,22.3) and 100-seed weight (11.5,12.8).Indicating a little influence of environmental effect on these characters. However, PCV was higher then GCV for seed yield (ardab/fad.) and seed weight/plant, suggesting a significant environmental effect, which is not unexpected for such agronomic characters. On the other hand, high heritability and very high GA% value were obtained for plant height (80.7, 1300%), reflecting that the trait could be further improved through individual plant selection. The results clearly show that positive and significant correlation between number of branches/plant and number of pods/plant(0.906), and also between seed weight/plant and seed yield/faddan, while the correlation coefficient between remaining studied characters was non significant. Significant correlation between characters indicating the selection in both characters was affected with the other characters and these are important for breeding programs.
Keywords: Variability, genetic parameters, new reclaimed soils, faba bean

INTRODUCTION

Faba bean (*Vicia faba* L.) is one of the most important food legume crops as a source of plant protein and 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 bean, 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 for improving the average yield per unit area .The new varieties are important to produce high seeds and straw yield, also resistance to diseases such as chocolate spot and rust. Raising early maturing and high yielding faba bean cultivars such as Sakha 1 and Giza 843 were quick and satis factory ways for

increasing faba bean productivity in EGYPT. Many investigators had high variability among faba bean genotypes for yield and its components (EL-Hosary and Sedhom 1991; Dawwan and Abdel-Aal, 1991, Gomaa,1996 and Hussein *et al.*,1999). They showed high value of genotypic and phenotypic variance for number of seeds/plant, low while it these values were for number of seeds/pod similar results with Roupakias and Tai (1986) and Abbas (2004).One of the major aims of agricultural policy in Egypt are to increase the cultivated areas by horizontal expansion, to cope with the over increasing demands of the over growing population. To achieve the horizontal expansion aim, the desert lands are more consumed. Among of these lands the areas locates in the Eastern and Western sites of the Nile Delta. So, one of the main objectives of the current work is expanding the faba bean growing area and exploring the best faba bean genotypes which had the high yielding potentiality and more adapted under the new reclaimed soils. Consequent, an active research has been carried out in order to achieve self-sufficiency in faba bean by solving problems related with new agronomical techniques, yield stability and resistance to biotic and abiotic stress. As a result, the targets of the present study is to: i) evaluation of some genotypes for yielding ability under new reclaimed soil, ii) measure variability and genetic parameters and iii) calculate the correlation coefficients among traits of genotypes.

MATERIALS AND METHODS

Two field experiments were carried out in the Experimental Farm at Tag EL-EZZ Agricultural Research station, Dakahlia Governorate in the two winter growing seasons 2007/2008 and 2008/2009, to study and evaluate ten faba bean genotypes with two check cultivars (Sakha 1, Giza 843) *i.e*, 943/1151/9, 1569/600/2002, 1426/711/2000, 1565/856/2004, 1556/914/2001, 1709/1069/2004, 1233/848/99, 1195/691/99, 1557/992/2001 and 1423/653/2000,varied in their origin and morphological characteristics. Its chosen from faba bean germplasm collection in food Legumes Research Station, Agricultural Research Center ,Giza Egypt, the preceding summer crop was rice(*Oriza sativa* L.) in two seasons. Soil samples at the experimental sites were collected from the surface layer (0-30 cm) after harvesting summer crops in two growing seasons. Mechanical and Chemical analysis are presented in Table (1): Calcium superphosphate (15.5%P_2O_5) at the rate of 200 kg/fad. Was added at the land preparation and prior to faba bean seeding nitrogen fertilizer was applied at the rate of 15kgN/fad. before the first irrigation. Potassium sulphate 48 % (K_2O) with the second irrigation. Other cultural practices were followed as recommended for faba bean crop.

A randomized complete block design with four replicates was used. The experimental unit included five ridge with 60 cm width apart, and 3.5 m length occupying an area of 10.5m^2 *i.e* 1/400 faddan. The planting took place on both sides of the ridge at recommended seed rate (23 plants/m^2) in double seeded/hill, 25 cm apart between hill, the sowings were in November 1st and 5th in both seasons respectively.

Table (1): Mechanical and chemical analysis of the soil at the experimental soil during 2007/2008 and 2008/2009.Growing seasons.

Mechanical analysis		
Character	**2007/2008**	**2008/2009**
Course sand %	3.60	4.01
Fine sand %	10.00	9.80
Silt %	34.20	36.20
Clay %	51.10	49.99
Soil Texture	Clayey Loam	Clayey Loam
Chemical analysis		
Character	**2007/2008**	**2008/2009**
Soluble cations (mg/100g soil)		
Na^{+}	14.00	12.90
K^{+}	0.23	0.25
Ca^{++}	13.08	15.00
Mg^{++}	7.14	8.10
Soluble anions(mg/100g soil)		
HCO_3^{-}	0.52	0.48
Cl^{-}	15.54	14.75
SO_4^{-}	18.42	16.80
EC (ppm)	2632.20	2439.60
EC (m moh)	4.10	3.80
PH	8.10	7.90

Classification of soil Salinity 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)**

Studied Characters

At harvest ten plants were randomly chosen from each plot for the determination the following characters:

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).

The plants in the two ridges ($4.2m^2$) of the experimental unit were harvested collected together, labeled, threshed and seeds were separated. The seeds and straw yields were recorded by Kg/m^2 converted into seed yield in ardab/fad. and straw Ton/fad. then calculated the two following characters:-

6-Seed yield (ardab/fad.) ardab=155kg
7-Straw yield (Ton/fad.)

Statistical Analysis: Combined analysis of the two seasons was carried out whenever of homogeneity of variance detected according to Steel and Torrie (1980). Data for the two growing seasons were statistically analyzed using Mstatc Computer Program. Broad sense heritability (H) was estimated by

using variance components variances (σ^2g and σ^2ph) method (Fehr, 1987).The genotypic and phenotypic was calculated from the partitioning the expected mean squares (Table 2) as follows:

Table 2: Expectation of mean squares (M.S) for the analysis of variance for separate and combined analysis.

Source of variation	Degree of freedom	Mean of squares	Expectation M.S
Replication	(r-1)	Mr	
Genotypes	(a-1)	Ma	$\sigma^2e+\sigma^2g$
Error	(r-1) (a-1)	Me	σ^2e

Were: r is the number of replications; a is the number of genotypes.σ^2g and σ^2e refer to genotypic and error variance, Respectively. The perfinent mean squares expectation (Table 2) as follows σ^2g =(Ma-Me)/r, and $\sigma^2ph = \sigma^2g+\sigma^2ge/r+\sigma^2e/r$, were σ^2e=Me. Broad sense heritability(H) was calculated as follows: H=(σ^2g/σ^2ph)×100

Data regarding the above mentioned traits were averaged and subjected to analysis of variance (Panse and Sukhatme, 1984). The genotypic and phenotypic coefficients of variation (GCV and PCV %) for each character were calculated by using the following formula:

GVC= ($\sqrt{\sigma 2g}/\bar{x}$)× 100 and PCV= ($\sqrt{\sigma 2p}/\bar{x}$)×100, were

$\sigma^2 g$ = The genotypic variance.

$\sigma^2 p$ = The phenotypic variance, and

$\bar{x}$ = The grand mean of the trait.

Genetic advance estimates were calculated using the standard methods given by Steel and Torrie (1980). All data collected were subjected to standard analysis of variance procedures (Snedecor and Cochran, 1982). The treatments were compared using the least significant differences (L.S.D) according to the procedure out lined by Waller and Duncan (1955). The estimates of phenotypic correlations were obtained by using the formula given by Comstok and Mill (1963).

RESULTS AND DISCUSSION

A. Analysis of variance:

The significance mean squares of 12 genotypes for all studied characters traits are presented in (Table 3). The results cleared the presence of highly significant differences were recorded among all genotypes (ten genotypes and two check cultivars) for all studied traits in two seasons and combined analysis. This finding indicated the existence of genetic variability among studied genotypes. This result indicated the importance of genotypes environment interaction when sowing in different seasons was every genotype adapted and requires specific season's environment condition. The over all mean of seed yield was 10.85 and 11.29 ardab/fad. For 2007/2008 and 2008/2009 growing seasons respectively, while it was 11.92 ardab/fad.

For combined analysis, while the cores pending yield in 2007/2008 reached 10.85 ardab/fad. The second season was warmer during vegetative growth stage(November and January) compared to the first season were the average monthly maximum temperature in these three months in the second season reached (27,24.5 and 23.2℃, respectively).The cores pending temperatures in the first season were (25,212 and 19.5℃, respectively).The second season was warmer during flowering and pod filling stages in (February and March), were the average monthly maximum temperatures in these months were 20.5 and 22.5℃ in the second season. While, it was 18 and 20.5℃ in the first season, respectively. It seems that accumulation of dry matter was higher at pod-filling stage in the second season compared with the first season; this gives the highest number of pods/plant, seed weight/plant and straw yield (Ton/fad.). Several researchers have reported seasonal and environmental effects on faba bean characters Roupakias and Tai, (1986), Hussein *et al.* (1999), Abbas (2004) and Hamdi, *et al.* (2004).The analysis of variance of the studied genotypes, for every individual season as well as combined analysis (Table, 3) indicated the highly significant differences among genotypes for all studied characters during growing seasons year effect includes fluctuation in weather condition. There for it is important to test a set of genotypes in a series of seasons to obtain more information about breading materials. Link *et al.* (1994b) reported that, the estimate of the genotypic standard was 75%and heritability was 0.75 as well as environmental means ranged from 72.7to73.6%.

Table (3): The analysis of variance for the means of the studied characters on 12 faba bean genotypes during 2007/2008 and 2008/2009 and their combination

character	genotypes				Combined analyses	
	2007/2008	T- test	2008/2009	T- test	combined	T- test
Plant height (cm)	113.23	**	117.99	**	115.61	**
Number of branches / plant	3.33	**	3.46	**	3.41	**
Number of pods/plant	13.94	**	14.06	**	14.00	**
Seed weight /plant (g)	19.11	**	20.05	**	19.85	**
100-seed weight (g)	66.90	**	68.72	**	67.81	**
Seed yield (ardab/fad.)	10.85	**	11.29	**	11.07	**
Straw yield Ton/fad	1.645	**	1.729	**	1.687	**

B. Mean performance:

Means of faba bean yield and its components for the studied traits are presented in (Table 4).Significant differences were observed among most genotypes for measured traits. Results revealed that all are genotypes tested were significantly superior to the two check cultivars for most of studied traits under new reclaimed soils, where both faba bean genotypes 1556/914/2001 and 1423/653/2000 showed the highest values of number of branches/plant (4.10 and 4.13), number of pods/plant (16.73 and 16.60) and seed weight (g) /plant (24.40 and 23.33) than those other tested faba bean genotypes and reflected on faba bean seed yield/fad. (13.85 and 13.25 ardab/Fad.). In addition, the same both faba bean genotypes out yielded the

two check cultivars Sakha 1 and Giza 843 by 28.1 and 29.1% and 34.8 and 35.9% for number of branches/plant, 25.5 and 24.5% and 29.5 and 28.7% for number of pods/plant and 18.6 and13.4% and 27.8 and 22.2% for seed yield ardab/fad., respectively. These findings could be useful to select high yielding materials to exploit in the breeding program. Similar results were obtained by Link, *et al.* (1994a), Johanson *et al.* (1955), Kalia and Sood (2004) and El-Rodeny (2006).

Table (4): Mean performance of 12 faba bean genotypes evaluated under new reclaimed soils in North Delta (combined data of 2007/2008 and 2008/2009seasons).

Genotypes	Faba bean yield components					Faba bean yield/fad.	
	Plant height (cm)	Number of branches/ plant	Number of Pods /plant	Seed weight/ plant	100-seed weight	Seed yield (ardab/fad.)	Straw yield (Ton/fad.)
Sakha 1	101.3	3.2	13.33	20.57	73.45	11.68	1.29
Giza 843	142.8	3.04	12.9	19.12	73.38	10.84	1.83
943/1151/93	121.2	3.9	15.6	17.79	76.25	10.18	1.6
1569/600/2002	122.3	3.28	13.1	17.09	74.13	9.66	1.43
1426/711/2000	117.3	3.35	13.43	22.27	70.88	12.66	1.43
1565/856/2004	143.9	2.95	11.8	17.75	67.5	10.58	1.26
1556/914/2001	102.9	4.1	16.73	24.4	69.63	13.85	1.93
1709/1069/2004	130.9	3.31	13.43	21.92	63.25	12.45	1.78
1233/848/99	113.4	3.2	12.8	15.44	63.38	8.77	1.72
1195/691/99	113.1	3.55	15.2	21.88	65	11.18	2.04
1557/992/2001	109.6	3.46	13.98	19.1	72	10.84	2.16
1423/653/2000	96.66	4.13	16.6	23.33	64.5	13.25	2.27
L.S.D 5%	4.8	0.13	0.38	1.18	1.44	0.69	0.05
Overall mean	118	3.46	14.07	20.06	66.69	11.29	1.73
Genotype X year	**	**	**	**	**	**	**

C. Genetic parameters of the studied traits:

Genetic variability and heritability for agronomic traits of ten faba bean genotypes and two check cultivars are presented in Table (5).Significant differences among genotypes showed significant variability for seven traits studied that could be exploited in breeding. The genetic variability (Table 5) showed little difference between GCV and PCV for number of pods/plant (21.0, 22.3) and 100-seed weight (10.8, 12.3) indicating a little influence of environmental effect on these characters. Similar results were obtained by Dawwan and Abdel-Aal (1991) and Link *et al* (1994b). However, PCV was higher than GCV for seed yield (ardab/fad.) and seed weight/plant, suggesting a significant environmental effect, which is not unexpected for such agronomic characters. Similar results were obtained by EL-Hosary *et al.* (1991). The highly values of heritability in broad sense were obtained by straw yield, (95.4%), followed by number of pods/plant (88.8%), plant height (80.7%), number of branches/plant (78.8%),100-seed weight (76.4%),seed weight/plant (65.2%) and seed yield ardab/fad.(61.1%). Genetic gain (GA) that could be expected from selecting the top 5% of the genotypes as percentage of the mean, varied from 1300% for plant height to 30% for number of branches/plant. Relatively higher selection advance was expected for plant height. Larger genotypic coefficients of variation along with high

- heritability and high genetic advance provide better information than each parameter alone.

Table (5): Genetic parameters for studied characters for 2007/2008 and 2008/2009 with combined analysis

Seasons	2007/2008				2008/2009				Combined analysis			
Characters	GCV %	PCV %	H %	GA as % of mean	GCV %	PCV %	H %	GA as % of mean	GCV %	PCV %	H%	GA as % of mean
Plant height (cm)	23.4	26.2	79.7	1270	22.4	24.9	83.9	1320	23.2	25.8	80.7	1300
No. of branches/plant	18.3	20.5	79.4	20	22.5	23.7	90.1	40	20.1	22.7	78.8	30
No of pods/plant	19.1	20.9	83.2	100	22.5	23.8	90.1	150	21.0	22.3	88.8	130
Seed weight/ plant (g)	22.6	27.8	66.0	200	21.7	27.6	61.8	200	22.2	27.5	65.2	200
100-seed weight (g)	11.5	12.8	80.3	180	10.7	12.2	76.6	160	10.8	12.3	76.4	160
Seed yield (ardab/fad)	22.6	27.8	66.1	110	22.9	29.2	61.9	120	21.2	27.2	61.1	100
Straw yield (Ton/fad)	40.3	38.5	93.4	50	34.6	35.4	96.0	40	37.6	38.5	95.4	50

Therefore, characters that exhibited a high genotypic coefficient of variation heritability and genetic advance would be useful as a base for selection. Therefore, high heritability coupled with high genetic advance indicate an additive gene action and hence, possible trait improvement through selection. These results are in accordance with Abbas, (2004) and Al-Ghamdi (2007). In addition, the high heritability and very high GA% reflecting that the traits could be further improved through individual plant selection. However, the high value of heritability but low genetic advance that may be attributed to non additive gene effects, but these characters could be improved through hybridization, were studied by El-Rodeny (2006) and El-Galaly (2009). At the same trend, we can classified our results upon the heritability and GA% values to groups, the first one that had high heritability and very high genetic advance as plant height (80.7,1300%)from combined analysis. These finding reflect the possibility at trait improvement through individual plant selection. These results are in agreement with those of Mahmoud *et al.* (1984), Dawwan and Abdel-al (1991) and Ramgiry (1997).The second one had high heritability coupled with high genetic advance, as straw yield (Ton/fad.) (95.4,50%) and number of pods/plant(88.8,130%)respectively, these findings are in agreement with those of El-Refaey (1998).Moderate heritability coupled with high genetic advance for number of branches/plant (78.8,30%) and 100-seed weight (76.4,160%); whereas, for seed yield (ardab/fad.) (61.1, 100%) and seed weight/plant (65.2, 200 %), both heritability and genetic advance were low. Similar results were obtained by Khalil *et al.* (2006).

The correlation coefficient among the seven characters was studied in faba bean as shown in Table (6). The results clearly show that positive and significant correlation between number of branches/plant and number of pods/plant (0.906) and also, between seed weight/plant and seed yield/fad.

(0.938), while the correlation coefficients between remaining studied characters were not significant. Correlation between characters indicating the selection in both characters was affected with the other characters and these are important of breeding programs. These results are in agreement with those of Ramgiry (1997), AL-Ghamdi (2007) and EL-Galaly, *et al.* (2009).

Table (6) Simple correlation coefficient values for seven characters of faba bean (average of combined analysis for two seasons 2007/2008 and 2008/2009)

Characters	1	2	3	4	5	6	7
1-Plant height	1						
2-No of branches/plant	-0.457	1					
3-No of pods /plant	-0.496	0.906	1				
4-Seed weight/pant (g)	-0.353	0.408	0.402	1			
5-100-seed weight	0.399	-0.172	-0.261	0.113	1		
6-Seed yield	-0.387	0.404	0.403	0.938	0.0839	1	
7-Straw yield	-0.245	0.434	0.520	0.136	0.381	0.110	1

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تقدير التباين الوراثي لبعض التراكيب الوراثية من الفول البلدي تحت أراضي الاستصلاح الجديدة فى شمال الدلتا

السيد الغزالي عباس و وليد محمد الرضيني عبد الحليم البلقيني
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استهدفت هذه الدراسة تقييم أداء ١٢ تركيب وراثي من الفول البلدي تحت ظروف أراضى الاستصلاح الجديدة في شمال الدلتا للوقوف على قدرتها الإنتاجية وتحديد المعايير الوراثية التي تساعد في انتخاب سلالات عالية الإنتاج تحت هذه الظروف ،التراكيب الوراثية هي سخا ١، جيزة ٨٤٣ ، ٩٣/١١٥١/٩٣٤، ٢٠٠٢/٦٠٠/١٥٦٩، ٢٠٠٠/٧١١/١٤٢٦، ٢٠٠٤/٨٥٦/١٥٦٥، ٢٠٠١/٩١٤/١٥٥٦، ٢٠٠٤/١٠٦٩/١٧٠٩، ٩٩/٨٤٨/١٢٣٣، ٩٩/٦٩١/١١٩٥، ٩٩٢/١٥٥٧/ ٢٠٠١ و ٢٠٠٠/٦٥٣/١٤٢٣ . وتمت زراعة هذه التراكيب الوراثية بمزرعة محطة البحوث الزراعية بتاج العز محافظة الدقهلية في ١ نوفمبر٢٠٠٧/٢٠٠٨ و٥ نوفمبر٢٠٠٨/٢٠٠٩ .

أظهرت النتائج وجود اختلافات معنوية بين موسمي الزراعة ويرجع هذا الاختلافات إلى اختلاف الظروف الجوية التي أثرت على إنتاجية التراكيب الوراثية تحت التقييم في هذه المنطقة فقد أعطت السلالة(٢٠٠١/٩١٤/١٥٥٦) محصول بذور بالنسبة للفدان مقداره (١٣،٨٥) في التحليل المشترك بين السنوات متفوقة بذالك على التراكيب الوراثية الأخرى تحت الدراسة، أيضا تفوقت بنسبة ١٩ و٢٨% مقارنة بصنفي المقارنة سخا ١ وجيزة ٨٤٣ في التحليل المشترك على التوالي. هذا وقد أظهرت التراكيب الوراثية (٢٠٠٠/٦٥٣/١٤٢٣، ٢٠٠/٧١١/ ١٤٢٦) إنتاجية مرتفعة تلتها التراكيب الوراثية تحت التقييم وقد جمعت هذه السلالات بين إنتاج البذور والقش.

أوضحت النتائج أيضا أن صفات عدد القرون/للنبات ،وزن بذور النبات ووزن الـ ١٠٠ بذرة قد حققت أعلى التقديرات لمعامل التباين المظهري ونسبة التوريث والتحسن الوراثي المتوقع من الانتخاب خلال موسمي الزراعة والتحليل المشترك لذالك فإنه من المتوقع حدوث تقدما ملحوظا لهذه الصفات تحت ظروف شمال الدلتا.

وبناء على ذالك يمكن زراعة هذه التراكيب الوراثية المبشرة في شمال الدلتا بعد إجراء التجارب التأكيدية الموسعة في حقول المزارعين.

قام بتحكيم البحث

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