

## PERFORMANCE AND PHENOTYPIC STABILITY OF SOME FABA BEAN (*Vicia faba*, L.) GENOTYPES UNDER TWO SOWING DATES

Salama, S. M. and S.S. Awaad

Cen.Lab. of Design and Stat. Anal. Res., Agric. Res. Center, Giza, Egypt.

### ABSTRACT

Eight faba bean genotypes (*Vicia faba*, L.) i.e. Sakha 1, Sakha 2, Nubaria 1, Giza 461, Giza 716, Giza 714, Giza Planka and Giza 3 were evaluated at the Tag EL-Ezz Research Station, Dakhliya Governorate during 2002/2003 and 2003/2004 winter growing seasons, using two sowing dates. The mean performance, phenotypic stability and interrelationship between various characters were computed using Eberhart and Russel (1966) formulae. The studied characters were; plant height, number of branches/plant, number of pods/plant, number of seeds/pod, 100-seed weight and seed yield/plant. Results indicated that significant genotype X environments and the variance due to genotypes X cultivars (linear) for plant height, number of seeds/pod, 100-seed weight and seed yield/plant. Significant genotype X environments interactions and the variance due to genotypes and environments were significant for all characters. The correlation coefficient between mean performance and coefficient of variance (C.V.) were insignificant for all studied characters. The cultivars Giza 3 and Sakha 1 appeared to be performed well under fluctuating environment conditions for seed yield/plant. Positive and significant correlation coefficient were recorded between seed yield/plant and all studied characters, except plant height and between number of seeds/plant with both of number of branches and pods/plant.

These results coupled with stability parameter "b" are of great importance of bread high yielding of faba bean and more stable varieties.

### INTRODUCTION

In Egypt, faba bean (*Vicia faba*, L.) is the most important food legume crop that has the potential to improve the Egyptians increasing demand for plant protein. It was the main of eating of pupils specially in breakfast, therefore the responsibility of plant breeders to bridge this work through improving and developing high yielding and quality of faba bean genotypes. Many researcher used more than technique to obtain genetic information about yield and its components in faba bean, stability one of these. Stability may depend upon holding certain morphological and physiological character. The effect of GXE on the relative performance and stability of genotypes. Across environment is of great attention that it forms a challenging difficulty to the breeder when improving and developing superior genotypes (Eberhart and Russel, 1966). The effect of environmental stress on plant metabolism and thereby reduction both growth and development of crop are still not completely understood (Pessaraki, 1994). In addition, Comstok and Moll (1963) stated that GXE interaction have been shown to reduce progress from selection. Many researches on faba bean carried to study inheritance and environmental conditions i.e. Yassin (1973); Ibrahim and Ruckenbauer

(1987) ; Polignana *et al.* (1989) ; EL-Defrawy *et al.* (1994) ; AL-Kaddoussi (1996) ; Salama and Manal, Salem (2001) and Salama and Mohamed (2004).

## MATERIALS AND METHODS

Four field experiments, including eight cultivars of faba bean (*Vicia faba*, L.) were undertaken at Tag EL-Ezz Research Station, Dakhliya Governorate, Agricultural Research Center (A.R.C.), Egypt, during the two successive winter growing seasons (2002/2003 and 2003/2004) in two sowing dates, the first at 1<sup>st</sup> November and the second at 1<sup>st</sup> December. The main target of this research work is to investigate the mean performance, stability and correlation between studied characters of eight faba bean genotypes under study *i.e.* Sakha 1, Sakha 2, Nubaria 1, Giza 461, Giza 71, Giza 714, Giza Planka and Giza 3.

The eight faba bean genotypes were sown in a randomized complete block design with four replications. The experimental plot consisted of 6 ridges. The ridge was 3 m length ; plant to plant distance was 20 cm and 60 cm between ridges. The plot area was 10.8 m<sup>2</sup>. the recommended agricultural practices in faba bean production were applied at the proper time. At the harvest time, ten guarded plants from each treatment in every replication were randomly taken to measure the following characters: plant height (cm), number of branches/plant, number of pods/plant, number of seeds/pod, 100-seed weight (g) and seed yield/plant (g).

### Biometric analysis

Two way analyses of variance was performed for different characters through the two growing seasons according to Steel and Torrie (1980). Differences among various cultivars were tested by Duncan's (1955). Performed of stability for studied characters of faba bean genotypes under 4 environments (2 seasons X 2 sowing dates) according to Eberhart and Russel (1966) method. The relationship between studied characters using correlation coefficient (*r*) over four environments. Coefficient of variability (C.V.) was estimated for the various genotypes over environments stability criterion.

## RESULTS AND DISCUSSION

Analysis of variance (Table 1) indicated that the mean square among the genotypes were highly significant for all studied characters. While, the environment were significant for all characters, except 100-seed weight. Highly significant genotypes X sowing dates interaction were significant for plant height, number of seeds/pod, 100-seed weight and seed yield/plant (g), suggesting these characters are influenced by changes in the environments. The variance due to environments (linear) were significantly different for all characters, except 100-seed weight. The interactions between genotypes X environments (linear) component of variation of stability were significant for plant height, number of seeds/pod, 100-seed weight and seed yield/plant,

suggesting that these cultivars are differential response of genotypes to various agro-climates. Significant of genotypes X sowing dates interaction are agree with those reported by EL-Muraba *et al.* (1987), EL-Defrawy *et al.* (1994) and AL-Kaddoussi (1996) and these contradicting results with Ibrahim *et al.* (1981) and EL-Farouk *et al.* (1982).

**Table 1: Variance due to stability parameter for studied characters in some Egyptian faba bean genotypes.**

Source of variance	D.F.	Plant height (cm)	No. of branches /plant	No. of pods /plant	No. of seeds /pod	100-seed weight (g)	Seed yield/plant (g)
Cultivars (C)	7	36.326**	0.264**	12.543**	0.110**	174.326**	23.550**
Environments (E)	32	110.612**	0.273**	32.163**	0.183**	2.651	100.160**
C X E	2114	16.711**	0.115	1.825	0.062*	16.832**	17.280**
Environment + C X E	2416	39.555**	0.106*	8.534**	0.101**	14.563**	18.361**
Environment (Linear)	1	281.340**	0.110*	100.340**	0.473**	5.931	269.372**
C X E (Linear)	7	16.230**	0.090	1.851	0.075**	8.212**	18.539**
Polled deviation	168	12.483**	0.023	3.862**	0.043	23.651**	13.765**
<b>Genotypes</b>							
Sakha 1	2	19.581**	0.081	0.852	0.036	0.073	10.183**
Sakha 2	2	24.932**	0.076	2.361*	0.025	3.680	6.583*
Nubaria 1	2	20.323**	0.071	2.078*	0.014	11.770**	23.670**
Giza 461	2	13.816**	0.263**	3.851*	0.211**	13.710**	15.762**
Giza 716	2	8.771	0.514**	1.111	0.072*	35.410**	5.323
Giza 714	2	7.822	0.232**	7.232**	0.053	25.110**	8.513**
Giza Planka	2	16.485**	0.130*	2.850*	0.071*	11.320**	4.721
Giza 3	2	17.333**	0.212**	1.623	0.141**	10.170*	8.152**
Polled Error	64	3.91	0.020	0.321	0.010	3.820	1.680

Coefficient of variability (C.V.) as criterion decreasing stability (Table 2 and 3) indicated that the values of coefficient of variability varied from character to character and from genotype to another, it was ranged from 12.35 to 44.87 % for plant height, 8.37 to 42.65 % for number of branches/plant, 8.59 to 37.55 % for number of pods/plant, 3.68 to 18.88 % for number of seeds/pod, 5.42 to 35.66 % for 100-seed weight and 11.77 to 33.25 % for seed yield/plant. It could be seen from the obtained results that, the stable genotypes are Giza 3 for plant height, Giza 461 for number of branches/plant and 100-seed weight, Nubaria 1 for number of pods/plant, Giza 716 for number of seeds/pod, Giza 714 for seed yield/plant.

The correlation coefficient between mean performance and (C.V.) values of the studied characters were non significant, indicated that the (C.V.) as a parameter for measuring stability is not reliable and may be used as a quick method screening a group of genotypes. Finally and Wilkinson (1963) considered linear regression slopes as a measure of stability.

Table 2: Estimates of stability parameters for plant height, number of branches/plant and number of pods/plant of eight faba bean genotypes at two sowing dates during 2002/2003 and 2003/2004 seasons.

Characters	Plant height (cm)				Number of branches/plant				Number of pods/plant			
	X'	C.V.	bi	S <sup>2</sup> d	X'	C.V.	bi	S <sup>2</sup> d	X'	C.V.	bi	S <sup>2</sup> d
<b>Genotypes</b>												
Sakha 1	105.32	13.14	1.21	8.21	4.87	24.77	1.21	0.03	22.17	13.65	1.33	0.63
Sakha 2	101.42	39.81	1.36	3.78	4.52	25.31	1.37	0.02	21.22	14.82	1.02	0.24
Nubaria 1	93.14	22.68	1.42	21.36	3.76	26.22	1.29	0.83	17.81	8.78	0.75	1.36
Giza 461	95.11	25.78	0.65	18.11	3.24	8.37	0.75	0.96	16.18	8.59	0.88	2.00
Giza 716	91.67	39.52	0.82	7.69	2.93	42.65	0.26	1.10	15.26	19.36	1.36	1.81
Giza 714	90.66	44.87	0.31	31.41	4.98	17.88	0.37	1.51	23.22	26.44	-0.64	-0.19
Giza Planka	101.60	41.00	1.20	15.36	4.68	28.83	0.85	2.42	21.77	37.55	0.52	0.58
Giza 3	111.58	12.35	1.33	12.11	4.81	15.61	0.66	1.01	22.48	11.17	0.38	1.82
Average mean or (r) value	98.81	0.61 <sup>1</sup>	0.59 <sup>2</sup>		4.20	-0.28	0.26		20.01	0.37	-0.540	

1- Refer to (r) value between X' and C.V. 2- Refer to (r) value between X' and bi.

Table 3: Estimates of stability parameters for number of seeds/pod, 100-seed weight and seed yield/plant of eight faba bean genotypes at two sowing dates during 2002/2003 and 2003/2004 seasons.

Characters	Number of seeds/pod				100-seed weight				Seed yield/plant			
	X'	C.V.	bi	S <sup>2</sup> d	X'	C.V.	bi	S <sup>2</sup> d	X'	C.V.	bi	S <sup>2</sup> d
<b>Genotypes:</b>												
Sakha 1	3.13	12.85	1.27	0.003	81.72	8.59	2.38	32.27	39.87	16.85	1.20	4.85
Sakha 2	3.08	13.06	2.32	-0.001	93.43	7.82	4.61	25.64	38.70	12.88	1.53	4.39
Nubaria 1	2.96	8.57	2.14	0.002	94.28	6.37	5.32	11.38	30.53	31.55	1.02	15.68
Giza 461	2.82	7.62	0.65	0.012	97.25	5.42	-2.76	15.55	29.83	32.57	-0.05	12.76
Giza 716	2.64	3.68	0.87	0.041	98.33	24.83	2.85	-7.82	28.40	21.81	1.37	9.54
Giza 714	3.23	12.11	1.38	0.023	74.18	11.77	0.67	8.83	41.19	11.71	0.76	8.36
Giza Planka	3.22	18.88	-0.63	-0.012	89.94	35.66	6.89	17.34	39.33	33.25	0.53	2.85
Giza 3	3.14	16.52	0.88	0.037	67.45	10.13	12.71	11.11	40.71	19.07	0.10	19.19
Average mean or (r) value	3.03	0.55 <sup>1</sup>	0.37 <sup>2</sup>		87.07	0.15	-0.49		36.07	-0.56	-0.08	

1- Refer to (r) value between X' and C.V. 2- Refer to (r) value between X' and bi.

The values of "b" component differed in various genotypes (Tables 2 and 3), different genotypes responded differentially to the changes environments (sowing dates). The "b" value near of unity of Sakha 1 for plant height and number of branches/plant, Sakha 2 for number of pods/plant and Nubaria 1 for seed yield/plant, indicating that average response to the fluctuating environmental conditions prevailed during the different sowing dates over years.

Genotype Sakha 1 was the highest for plant height (105.32 cm) and the average for eight genotypes 98.81 cm, Giza 714 was highest for number

of branches/plant (4.98) and the average 4.22, number of pods/plant (23.22) and the average 20.01, number of seeds/pod (3.23) and the average 3.03 and seed yield/plant (41.90 g) while the average 36.07 g. The faba bean genotypes Giza 714 was the best cultivar for yield and its component and stability. This was of great interest for favorable growing seasons as they gave high "b" value. Correlation coefficient between studied characters was shown in Table 4, indicating that positive and significant correlation coefficient between seed yield/plant and all studied characters, except plant height, number of seeds/plant with both of number of branches/plant and number of pods/plant. Positive and significant correlation between characters, indicating that the selection of characters to improve faba bean, it could be improved other characters are correlated with this character in breeding program.

**Table 4: Correlation coefficient (r) among studied characters of eight faba bean genotypes over different environments at Dakhliya location during two successive winter growing seasons.**

Characters	Plant height (cm)	No. of branches /plant	No. of pods /plant	No. of seeds /pod	100-seed weight (g)	Seed yield/plant (g)
Plant height (cm)	-	0.561	0.547	0.469	0.532	0.592
No. of branches/plant		-	0.692	0.967**	-0.773*	0.979**
No. of pods/plant			-	0.959**	-0.793*	0.990**
No. of seeds /pod				-	-0.690	0.927**
100-seed weight (g)					-	0.783*
Seed yield/plant (g)						-

## REFERENCES

- AL-Kaddoussi, A.R. (1996). Phenotypic stability and character associations among yield and its attributes under two sowing dates in faba bean (*Vicia faba*, L.). *Zagazig J. Agric. Res.*, 23: 987-998.
- Comstock, R.E. and R.H. Moll (1963). Genotype environment interaction in W.D. Hanson and Robinson (eds), *statistical genetic and plant breeding*. Natl. Acad. Sci, Natl. Res. Council Pub., 982: 164-196.
- Duncan, D.B. (1955). Multiple range and multiple F. test. *Biometrics*, 11: 1-24.
- Eberhart, S.A. and W.A. Russel (1986). Stability parameters for comparing varieties. *Crop Sci.*, 6: 36-46.
- EL-Defrawy, M.M. ; K.A. Kheiralla and R.A. Dawood (1994). Stability of faba bean genotypes in Egypt. *Assiut J. Agric. Sci.*, 25: 93-114.
- EL-Farouk, A. ; F.A. Salih and A. Khalafalla (1982). Influence of sowing dates in the performance of four faba bean varieties at different locations in Sudan. *FABIS*, 5: 18-19.
- EL-Murabaa, A.I. ; A.M. Butt ; S.A. Abedel-Aal and K.B. Salem (1987). Effect of cultivars and planting dates on faba bean performance. III- Interactions of planting dates X cultivars and correlation between characters. *Assiut J. Agric. Sci.*, 18: 215-234.

- Ibrahim, K. and P. Ruckebauer (1987). Stability parameters of important characters in various types of faba bean (*Vicia faba*, L.). Information Service pp: 10-13.
- Pessaraki, M. (1994). Handbook of plant and crop stress (M. Pessaraki, ed.). Marcel Dekker, Inc New York Basel, Hong Kong.
- Polignano, G.B. ; P. Uggent and P. Perrino (1989). Pattern analysis and genotypes X environment interactions in faba bean (*Vicia faba*, L.) populations. Euphytica, 40: 31-41.
- Salama, S.M. and Manal, M. Salem (2001). Genetic analysis and combining ability over sowing dates for yield and its components in faba bean (*Vicia faba*, L.). J. Agric. Sci. Mansoura Univ., 26: 3621-3629.
- Salama, S.M. and N.A. Mohamed (2004). Estimates of genetic components for some characters in faba bean (*Vicia faba*, L.). (Under press).
- Steel, R.G.D. and J.H. (1980). Principles and procedures of statistics a biometric approach, 2<sup>nd</sup> ed. M.C. Graw, Hill Book Company, London.
- Yassin, T.E. (1973). Analysis of yield stability in field beans (*Vicia faba*, L.) in the Northern Province of the Sudan. J. of Agric. Sci. Cambridge Univ., 80: 119-124.

### السلوك الوراثي والتباين المظهري لبعض التراكيب الوراثية في الفول البلدي تحت ميعادين للزراعة

سليمان محمد جمعه سلامة ، السعيد السيد عواد  
المعمل المركزي لبحوث التصميم والتحليل الإحصائي - مركز البحوث الزراعية - الجيزة - مصر.

- أخرى هذا البحث بالمرزعة البحثية لمحطة البحوث الزراعية بتاج العز دقهلية فسي ميعادين للزراعة في الموسم الشتوي لأعوام ٢٠٠٢/٢٠٠٣ و ٢٠٠٣/٢٠٠٤ و ٢٠٠٤/٢٠٠٤ بغرض دراسة السلوك الوراثي والتباين المظهري لبعض التراكيب الوراثية من الفول البلدي وهي: سخا ١، سخا ٢، نوبارية ١، جيزة ٤٦١، جيزة ٧١٦، جيزة ٧١٤، جيزة بلانكا وجيزة ٣. وقد تم دراسة بعض الصفات وهي: ارتفاع النبات، عدد الأفرع/نبات، عدد القرون/نبات، عدد البذور/قرن، وزن ١٠٠ بذرة ومحصول البذور/نبات. وقد تم تحليل البيانات إحصائياً ووراثياً باستخدام طريقة إيرهارت وراسل (١٩٦٦). وقد أوضحت النتائج الآتي:
- ١- التفاعل بين التراكيب الوراثية ومواعيد الزراعة وكذا التفاعل بين التراكيب الوراثية والبيئة (الخطي) كان معنوياً لصفات ارتفاع النبات، عدد البذور/قرن، وزن ١٠٠ بذرة ومحصول البذور/نبات. وكان التباين الراجع للتراكيب الوراثية وكذا الراجع للتفاعل بين التراكيب الوراثية والبيئة معنوياً لجميع الصفات مشيراً إلى أن الإستجابة للتغير في الظروف البيئية تخضع للتحكم الوراثي.
  - ٢- أظهرت النتائج أن الارتباط بين متوسط سلوك الصفات ومعامل الاختلاف كان غير معنوي لجميع الصفات المدروسة. أي أنه لا يمكن الأخذ به كمقياس للتباين المظهري.
  - ٣- أشارت النتائج أن الصنفان جيزة ٣ وسخا ١ أعطت درجة عالية من الثبات تحت الظروف البيئية المتغيرة لصفة محصول البذور للنبات.
  - ٤- كان هناك ارتباط موجب ومعنوي بين صفة محصول البذور للنبات وجميع الصفات ما عدا ارتفاع النبات وكذا ارتباط موجب ومعنوي بين صفة عدد البذور بالقرن وكلا من عدد الأفرع وعدد القرون بالنبات. وهذا يظهر أنه يمكن إسقاط أصناف من الفول البلدي عالية المحصول وأكثر ثباتاً تحت الظروف البيئية المختلفة.