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PHENOTYPIC AND GENOTYPIC STABILITY OF SOME FABA BEAN (*Vicia faba* L.) VARIETIES

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ABSTRACT

Eleven faba bean varieties were evaluated for seed yield/fad, number of pods/plant, 100-seed weight and leaf chlorophyll content under twelve diverse environments which are the combinations of 3 seasons x 2 plant population densities x 2 locations. Phenotypic and genotypic stability were computed according to Eberhart and Russell (1966) and Tai (1971), respectively.

The stability analysis of variance revealed highly significant differences among genotypes, environments as well as GXE interaction for all studied characters. Partitioning the GXE interaction into two components, i.e heterogeneity and remainder mean squares indicated that the heterogeneity mean squares proved to be highly significant and was greater in magnitude in comparison with the remainder one for seed yield/fad, number of pods/plant and 100-seed weight. Thus, the major portion of differences in stability was due to the linear function. The remainder mean square was also highly significant for number of pods/plant, 100-seed weight and leaf chlorophyll content with specific great contribution for leaf chlorophyll content, indicating that non-linear component of GXE interaction was operating.

Phenotypic stability parameters revealed that, faba bean genotypes: Giza 402 and Giza 461 were classified as highly adapted to favourable environments for seed yield/fad and number of pods/plant, as well as Giza 714 for 100-seed weight and leaf chlorophyll content. Whereas, Giza Blanca and Giza 429 performed well under Khattara region as less favourable conditions for seed yield/fad . The most desired and stable genotype was Giza 843 for seed yield/fad, number of pods/plant and leaf chlorophyll content; Giza 957 for seed yield/fad and leaf chlorophyll content; Giza 714 and Improved Giza 3 for seed yield/fad and Giza Blanca for 100-seed weight.

Genotypic stability of Tai's procedure showed that Giza 429 was the nearly perfect stable genotype for seed yield/fad and Giza Blanca was the same for 100-seed weight. The most average stable genotypes were: Giza 461 for seed yield/fad and leaf chlorophyll content as well as Giza 714 for seed yield/fad, number of pods/plant and 100-seed weight. Faba bean varieties Giza 1,Giza 3, Giza 843 and Giza 957 had above average degree of stability for seed yield/fad and Giza 2 for leaf chlorophyll content.

In conclusion, it is evidence that the most desired and stable varieties for seed yield/fad were Giza 843, Giza 957,Giza 714 and Improved Giza 3 at both phenotypic and genotypic levels.

Key words: ***Faba bean, GXE interaction, Phenotypic, Genotypic, Stability parameters.***

INTRODUCTION

Faba bean (*Vicia faba* L.) is the most important pulse crop, which is used mainly for human food and animal feeding. The most important drawback affecting the production of faba bean is its yield instability. The yield of instable varieties fluctuates greatly among seasons and locations.

This instability may be due to the genetic makeup, environmental conditions and/or their interactions. Therefore, it is of importance to identify a genotype to be released as a cultivar for wide cultivation. A number of statistical methods are now known for estimating stability. Hereby performance yield tests at different locations, treatments in different years are used to estimate phenotypic and genotypic stability or to analyze genotype X environment (GXE)-interactions, which are strongly related to stability. Significant advances have bean made in the measuring and understanding of this interaction. The form of regression analysis for GXE interaction was proposed by Yates and Cockran (1938) and latter was modified and used by Finlay and Wilkinson (1963), Rawe and Andrew (1964) and again by Eberhart and Russell (1966) who added together the sums of squares for environments and GXE interactions, and repartitioned them.

The term of "phenotypic stability" is often used to refer to fluctuations in the phenotypic expression of yield, while the genotypic composition of the varieties or populations remains stable. Since, stability of yield defined as the ability of genotypes to avoid substantial fluctuations over a range of environments. Eberhart and Russell (1966) suggested that the regression (b) of varietal mean performance on an environmental index and the deviations from regression (S^2_d) might be considered as two parameters for measuring the phenotypic stability of the genotype.

Concepts of "genotypic stability" are either biological or agronomic (Becker 1981). Biologically, a genotype with minimum total variance under different environments is considered stable (Hanson 1970). An agronomically, stable genotype has a minimum interaction with environments but responds favourable to improving environments (Eberhart and Russell 1966). Several definitions of stability have been given according to these concepts (Marquez-Sanchez 1973,Francis and kannenberg 1978 and Lin *et al* 1986). In this connection, Tai (1971) proposed a method of genotypic stability analysis. The GXE interaction effect of a variety is partitioned into two components. They are the linear response to environment effects, which is measured by a static α, and the deviation from the linear response which is measured by another static λ. A perfect stable variety has $\alpha = -1$, $\lambda = 1$ and a variety with average stability has $\alpha = 0$, $\lambda = 1$ whereas, the values $\alpha < 0$, $\lambda = 1$ will be referred to above average stability and the values $\alpha > 0$ and $\lambda = 1$, as below average stability. Tai's (1971) approach is similar to that of Eberhart and Russell (1966) in attempting to determine the linear response of a cultivar to the environmental effects, but Tai's model differs in the estimation of statistics determining stability. Theoretically, it involves an extension of the conventional mathematical model used for the analysis of variance, and it estimates the potential of a genotype to stabilize its performance over various environments.

Many investigators studied stability of faba bean genotypes under different environments, and recorded significant GXE interaction for seed yield and its attributes (Dantuma *et al* 1983, Nassib *et al* 1986, Ibrahim and Rukenbauer 1987, Abdalla *et al* 1998, Darwish *et al* 1999 and Omar *et al* 1999). However; insignificant GXE interaction have been reported for leaf chlorophyll content by Hafiz and Abd El-Mottaleb(1998).

Based on the method of Eberhart and Russell (1966) and Tai (1971), eleven faba bean genotypes have been evaluated under twelve diverse environments to estimate their relative phenotypic and genotypic stability for seed yield and some related characters.

MATERIALS AND METHODS

Eleven faba bean genotypes were evaluated for seed yield/fad and some related characters under twelve environments which are the combinations of 3 growing seasons X 2 plant population densities X 2 locations to estimate both phenotypic and genotypic stability. Thus, two repeated field experiments were carried out during the three growing 1997/98, 1999/2000 and 2000/2001 seasons. The first experiment was conducted at Experimental Farm of Zagazig University representing clay soil and the second one was performed at Khattara Farm representing sandy soil. The evaluated faba bean genotypes were, Giza 1, Giza 2, Giza 3, Improved Giza3, Giza Blanca, Giza402, Giza 429, Giza 461, Giza 714, Giza843 and Giza957 and the seeds were obtained from Legumes Section, Institute of Field Crops, Agriculture Research Center (ARC), Giza, Egypt. In both experiments, the eleven faba bean genotypes were grown under two plant population densities i.e. 22 and 33 plants/m^2 A randomized complete block design with three replicates was used. The first plant density (22 plants/m^2) was obtained from planting both sides of ridges in hills 30 cm apart and two plants/hill. Whereas, the second plant population density (33 plants/m^2) was obtained from planting both sides of ridges in hills 20 cm apart and two plants/hill. The seeds of faba bean genotypes were planted on November 3^{rd}, 5^{th} and 8^{th} in Zagazig and on November 5^{th}, 7^{th} and 10^{th} in Khattara region during the three growing seasons, respectively . Plot area was $9m^2$ and consists of 5 ridges, 3m long and 60 cm width. The recommended agricultural practices for faba bean production under each location were applied. At flowering, leaf chlorophyll content was estimated using SPAD-502 apparatus (Castelli *et al* 1996). However, data of number of pods/plant,100-seed weight and seed yield (ard/fad) were collected at harvest.

A regular analysis of variance was applied for each experiment according to Snedecor and Cochran (1969). The combined analysis of variance was performed and joint regression analysis was computed to study GXE interaction which partitioned into heterogeneity and residual terms (Perkins and Jinks 1968).

The phenotypic and genotypic stability were performed on the pooled data of the eleven varieties under twelve environments according to Eberhart and Russell (1966) and Tai (1971), respectively.

RESULTS AND DISCUSSION

Stability analysis

Stability analysis of variance (Table 1) showed that the mean squares of environments were highly significant, suggesting that the environments under study were different. Genotypes mean squares were found to be highly significant, indicating that faba bean varieties were different in genes controlling seed yield and its related characters. Highly significant GXE item was detected for the studied characters, provide evidence that the studied faba bean genotypes differed in their response to the environmental conditions. In this respect, significant differences among environments, genotypes and GXE interaction items were recorded for seed yield and its attributes (Dantuma *et al* 1983, Nassib *et al* 1986, Ibrahim and Rukenbauer 1987, Abdalla *et al* 1998, Darwish *et al* 1999 and Omar *et al* 1999). However, insignificant GXE interaction was reported for leaf chlorophyll content by Hafiz and Abd El-Mottaleb(1998).

The regression approach partitions GXE interaction into two components i.e. heterogeneity and the remainder. It is evident that both heterogeneity and the remainder exhibited highly significant values in all the studied characters, except the remainder portion for seed yield/fad The heterogeneity mean squares were highly significant when tested against the remainder mean square for seed yield/fad, number of pods/plant and 100-seed weight, suggesting that there were differences in regression coefficient values among the genotypes. Since, the major portion of differences in stability was due to the linear regression and not to the deviation from the linear relationship for these characters. Thus, according to Perkins and Jinks(1968), highly significant GXE interaction can be accounted for a linear regression on the environmental effects. However, in case of leaf chlorophyll content, the magnitude of the remainder was about two times larger than the magnitude of heterogeneity mean square, indicating that the major portion of stability was attributed to the deviation from the linear relationship.

Table 1.The joint regression analysis of variance for the studied characters.

Source	d.f	Seed yield (ard/fad)	No. of pods/plant	100-Seed weight	Leaf chlorophyll content
Environments (E)	11	73.302**	310.423**	252.601**	32.263**
Reps within environ.	24	9.896	19.791	495.397	2.099
Genotypes (G)	10	9.960**	128.548**	1936.377**	55.019**
GXE	110	1.802**	32.897**	49.625**	8.977**
Heterogeneity	10	6.046**	100.459**	79.459**	4.428**
Remainder	100	1.377	26.140**	46.642**	9.431**
Pooled error	240	1.255	7.156	23.069	0.891

** Highly significant at 0.01 probability level.

Phenotypic and genotypic stability

The estimates of phenotypic and genotypic stability parameters have been computed according to Eberhart and Russell (1966) and Tai (1971), respectively for evaluating the eleven faba bean varieties for seed yield/fad, number of pods/plant, 100-seed weight and leaf chlorophyll content (Tables 2 and 3).

Seed yield (ard/fad)

The regression coefficient is a measure of the linear response or the adaptability of a genotype to different environments (Langer *et al* 1979). As shown in Table (2) "b" value varied from 0.542 (Giza429) to 1.829 (Giza461).

The regression coefficient deviated significantly from unity (b>1) in faba bean genotypes Giza 402 and Giza 461, indicating higher production potential in favourable environments. Otherwise, the "b" value was deviated significantly from one and less than unity (b<1) in Giza Blanca and Giza 429 which appeared to be more adapted to less favourable environments. In this respect, Darwish *et al* (1999) emphasized that Giza Blanca proved to be more adapted under newly reclaimed sandy soil condition. The response to environment as measured by the regression technique was found to be highly heritable and controlled by genes with additive action (Hayward and Lawrence 1970).

In the case of the insignificant "b" value, the deviation from regression "S^2_d" is considered most appropriate for measuring phenotypic stability, because it measures the predictability of genotypic reaction to various environments (Becker *et al* 1982).

It can be seen that, the deviation from regression "S^2_d" was very small and did not deviate significantly from zero in Giza 1, Giza 3 , Improved Giza 3, Giza Blanca, Giza 402, Giza 461, Giza 714, Giza 843 and Giza 957 varieties which showed stability for seed yield. In this respect, Guilan Yue *et al* (1990) reported that the deviation from regression seemed to be very important for estimating the stability. Whereas, Giza 2 and Giza 429 appeared to be more sensitive to the fluctuating environmental conditions.

Table 2. Means and phenotypic and genotypic stability parameters for seed yield and number of pods/plant of the eleven faba bean varieties grown under twelve environments.

Variety	Seed yield (ard/fad)								Number of pods/plant							
	$\bar{X}$	b	S^2_d	α	λ	Degree of stability			$\bar{X}$	b	S^2_d	α	λ	Degree of stability		
						0.99	0.95	0.90						0.99	0.95	0.90
1-Giza 1	9.316	0.799	0.162	-0.385†	0.809	+++	+++	+++	13.867	0.251**	22.361**	1.002†	1.895	+	+	+
2-Giza 2	8.131	0.795	1.854*	-0.704†	3.088*	+	+	+	12.517	0.629	16.708**	0.876†	4.344*	+	+	+
3-Giza 3	9.680	0.717	0.281	-0.967†	2.049	+++	+++	+++	17.480	1.362	28.822**	1.264†	6.921*	+	+	+
4-Improved G. 3	10.778	1.087	0.653	-0.374	1.913	++	++	++	12.125	0.558**	27.349**	-0.227	1.127	+++	+++	+++
5-Giza Blanca	11.558	0.669*	0.985	0.687†	3.165*	+	+	+	15.575	1.326	7.400	0.591†	2.745*	+	+	+
6-Giza 402	10.746	1.683**	0.389	0.868†	19.070*	+	+	+	21.083	2.099**	33.518**	1.359†	5.361*	+	+	+
7-Giza 429	10.108	0.542**	1.534*	-1.003†	1.741	**Nearly perfect**			14.650	0.525**	33.817**	0.981†	3.206*	+	+	+
8-Giza 461	9.333	1.829**	1.189	-0.124	1.248	++	++	++	18.514	1.488*	31.740**	0.947†	3.806*	+	+	+
9-Giza 714	11.183	1.133	-0.219	-0.212	1.812	++	++	++	13.008	0.381**	7.627	0.198	1.397	+++	+++	+++
10-Giza 843	12.019	0.845	0.616	-0.541†	1.213	+++	+++	+++	17.816	1.143	9.906	0.460†	1.314	+	+	+
11-Giza 957	11.691	0.893	0.743	-0.389†	1.256	+++	+++	+++	21.208	1.219	16.190*	-0.239	1.750	+++	+++	+++
General mean	10.419								16.168							
L.S.D $_{0.05}$	1.393								4.281							

***and **denotes significant at 0.05 and 0.01 levels of probability, respectively**

***λ value greater than Fa value derived from F-table with n_1=10, n_2=240 and a=0.05**

† α value significantly from α=0 at the 0.05 probability level.

+++ Genotypes with above average degree of stability .

++ Genotypes with average degree of stability.

+ Unstable genotype.

A simultaneous consideration of the three stability parameters (X, b and S^2_d), evidenced that the most stable and high yielding genotype was Giza 843 followed by Giza 957, Giza 714 and Improved Giza 3. In this connection, Eberhart and Russell (1966) described the stable genotype which having high mean performance over environments, with "b" value approaching near unity and the deviation from regression as minimum as possible (S^2_d =0).

Concerning the genotypic stability (Table 2), it is evident that, the great variation in λ statistics suggested that the relatively unpredictable component of the GXE interaction variance may be much more important than the relatively predictable component of variation α, for the studied genotypes which showed different degrees of stability (Tai 1971).

As illustrated in Fig. (1) the average stability area contained faba bean varieties: Improved Giza 3, Giza 461 and Giza 714. Among those, Improved Giza 3 and Giza 714 gave higher seed yield (10.778 and 11.183 ard/fad, respectively) than grand mean (X=10.419 ard/fad). Giza 843 and Giza 957 exhibited high yield potentiality, however Giza 1 and Giza 3 were below the level of grand mean, but they showed above average stability as revealed by α estimates deviated significantly from zero with λ not deviated significantly from one. Giza 429 gave relatively low yield but showed nearly perfect stability. However, Giza 2, Giza Blanca and Giza 402 were unstable.

So, it may be possible to select a high yielding cultivars which show relatively low level of instability such as Giza Blanca (X=11.558 ard/fad, α=0.687† and λ= 3.165*) as a source of high yielding genes to be crossed with below average yielding and stable cultivars such as Giza 429 (X=10.108, α= -1.003† and λ= 1.741) as a source for stability genes and practice selection for genotypes with both high yield and good stability. However, it has to be kept in mind that stable genotypes are generally low yields than instable ones.

Number of pods/plant

Table (2) displays phenotypic and genotypic stability parameters for number of pods/plant.

The estimates of phenotypic stability parameters for number of pods/plant indicated that the regression coefficient "b" values varied from 0.251 (Giza 1) to 2.099 (Giza 402). The "b" estimates deviated significantly from unity (b>1) in Giza 402 and Giza 461, thereby they could be grown under improved environments. Whereas, faba bean genotypes Giza 1, Improved Giza 3, Giza 429 and Giza 714 may be classified as highly adapted to stress environments (b<1).

With respect to "S^2_d", it was low and insignificant in Giza Blanca, Giza 714 and Giza 843, indicating that these genotypes were more stable. However, the other faba bean genotypes proved to be unstable as revealed by significant S^2_d.

Summarizing the three stability parameters for the individual genotypes, it can be reported that Giza 843 proved to be the most desired genotype for number of pods/plant, since it had greater number of pods/plant over grand mean (16.168), "b" value not deviating significantly from unity with lower and insignificant S^2_d. Therefore, it could be grown under wide range of environments.

With respect to the estimates of genotypic stability parameters α and λ, Figure 2: illustrated that faba bean genotypes: Improved Giza 3, Giza 714 and Giza 957 were located in the area of above average stability. Among those, only Giza 957 attained the greatest number of pods/plant over the grand mean (Table 2). However, faba bean genotypes Giza 1and Giza 843 were located in the area of below average stability with high number of pods/plant for Giza 843. Otherwise, the remaining genotypes: Giza 2,Giza 3, Giza Blanca, Giza 402, Giza 429 and Giza 461 had extreme and significant λ values, indicating that these genotypes were unstable. These results suggest that the relatively unpredictable component of GXE interaction variance (λ) may be more important than the relatively predictable component of variation (α) (Tai 1971).

100-Seed weight(g):

According to Eberhart and Russell method, data presented in Table (3) show that "b" value ranged from 0.186 (Giza 957) to 1.696 (Giza 3), and it deviated significantly from unity ($b>1$) for Giza 2, Giza 3 and Giza 714. Hereby these genotypes are more suited to rich environments. On the other hand, the regression coefficients deviated significantly from one and less than unity ($b<1$) in Giza 1, Giza 402 and Giza 957, which indicate good performance under stress environments.

The deviation from linear regression as indicated by S2d was found to be low and insignificant for Giza 1, Giza 2, Giza Blanca, Giza 429 and Giza 461, suggesting that these genotypes show high degree of stability, and vice versa for Giza 3, Improved Giza 3, Giza 402, Giza 714, Giza 843 and Giza 957, which were unstable.

It is interested to note that, varieties Giza Blanca and Giza 429 had high mean values over general mean and showed average stability and wide adaptability to agro-climatic growing seasons. However, the remaining faba bean genotypes are sensitive ones.

Table 3. Means and phenotypic and genotypic stability parameters for 100 seed weight and leaf chlorophyll content of the eleven faba bean varieties grown under twelve environments.

variety	100-seed weight (g)								Leaf chlorophyll content							
	$\bar{X}$	b	S^2_d	α	λ	Degree of stability			$\bar{X}$	b	S^2_d	α	λ	Degree of stability		
						0.99	0.95	0.90						0.99	0.95	0.90
1-Giza 1	60.844	0.545**	7.472	0.663†	3.821*	+	+	+	35.625	0.347**	-0.009	-0.280	1.845	++	++	++
2-Giza 2	66.148	1.595**	12.093	-0.910†	6.759*	+	+	+	35.775	0.574**	-0.114	-0.583†	0.861	+++	+++	+++
3-Giza 3	70.425	1.696**	82.306**	-1.894†	8.164*	+	+	+	40.083	0.936	6.443**	1.294†	9.440*	+	+	+
4-Improved G. 3	65.767	1.340	30.354*	-0.308	8.445*	+	+	+	38.692	2.122**	2.937**	1.380†	7.840*	+	+	+
5-Giza Blanca	96.422	0.936	7.777	-1.080†	0.937	Nearly perfect			35.958	0.671	0.738	-0.242	1.737	++	++	++
6-Giza 402	65.208	0.280**	50.297**	-0.433	1.202	++	++	++	36.692	1.136	1.314	0.627†	0.094	+	+	+
7-Giza 429	74.348	1.436	0.305	-0.769†	4.356*	+	+	+	39.200	0.999	3.837**	0.682†	3.342*	+	+	+
8-Giza 461	70.981	0.971	8.753	2.000†	14.000*	+	+	+	40.283	0.139**	0.833	-0.319	1.883	++	++	++
9-Giza 714	78.800	1.541**	31.378*	-0.273	1.472	++	++	++	34.950	2.031**	2.648**	1.400	5.163*	+	+	+
10-Giza 843	80.252	0.748	27.472*	-0.128	1.688	++	++	++	40.467	1.038	1.376	0.604†	7.700*	+	+	+
11-Giza 957	81.388	0.186**	109.623**	-2.000†	2.080*	+	+	+	39.600	1.149	0.068	1.012†	1.916	+	+	+
General mean	73.689								37.938							
$L.S.D_{0.05}$	7.686								1.511							

*and **denotes significant at 0.05 and 0.01 levels of probability, respectively

*λ value greater than Fa value derived from F-table with n_1=10, n_2=240 and a=0.05

† α value significantly from α=0 at the 0.05 probability level.

+++ Genotypes with above average degree of stability.

++ Genotypes with average degree of stability.

\+ Unstable genotype.

The estimates of genotypic stability parameters of α and λ (Table 3) indicated that there were great differences among genotypes. The varieties Giza 402, Giza 714 and Giza 843 showed average degree of stability (Fig 3) with specific superiority for the two latter genotypes in 100-seed weight compared to the general mean. Giza Blanca was the most nearly perfect stable genotype for 100 seed weight, exhibited negative "α= -1.080" and "λ=0.937" within the confidence intervals of λ_0=1. The remaining seven varieties: Giza 1, Giza2, Giza3, Improved Giza3, Giza 429, Giza 461 and Giza957 exhibited significant λ values and three of them i.e. Giza 3, Improved Giza 3 and Giza 461 had most extreme λ estimates, indicating that these genotypes are unstable.

Leaf chlorophyll content

The cause of yield stability or instability are often unclear due to the diverse mechanisms of physiological, morphological and phenological aspects (Heinrich *et al* 1983). Leaf chlorophyll content is an important physiological character contributing to seed yield (Hafiz and Abd El-Mottaleb 1998). It can be noticed from phenotypic stability estimates (Table 3) that the regression value varied from genotype to another. It ranged from 0.139 (Giza 461) to 2.122 (Improved Giza 3). The regression coefficients deviated significantly from unity (b>1) in Improved Giza 3 and Giza 714 genotypes which showed good response to improved environments. However, Giza 1, Giza 2 and Giza 461 showed specific adaptability to poor environments (b<1). Faba bean genotypes Giza 1, Giza 2, Giza Blanca, Giza 402, Giza 461, Giza 843 and Giza 957 appear to be more stable as revealed by lowest and insignificant S^2_d values. Whereas, Giza3,Improved Giza3, Giza 429 and Giza 714 proved to be unstable.

It is likely to notice that, only two faba bean genotypes: Giza 843 and Giza957 ranked as the most desired and stable genotypes, and the remaining nine faba bean genotypes have been ranked as sensitive ones.

Concerning genotypic statistics, Fig. 4 illustrated that varieties: Giza 1 , Giza Blanca and Giza 461 were located in the area of average stability with high concentration of leaf chlorophyll for Giza 461 (40.283) than grand mean. Giza 2 could be classified as above average stability genotype as revealed by α value less significantly than unity (Table 3). Giza 402 gave positive and significant α value, thus it could be classified as more responsive to the environmental conditions. Giza 957 was located in the area of below average stability. The other faba bean genotypes exhibited different degrees of instability.

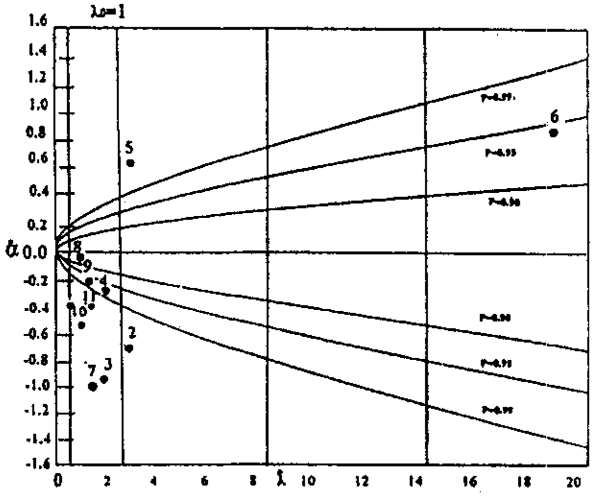

Fig. (1):Distribution of stability statistics for seed yield/fad of eleven faba bean genotypes

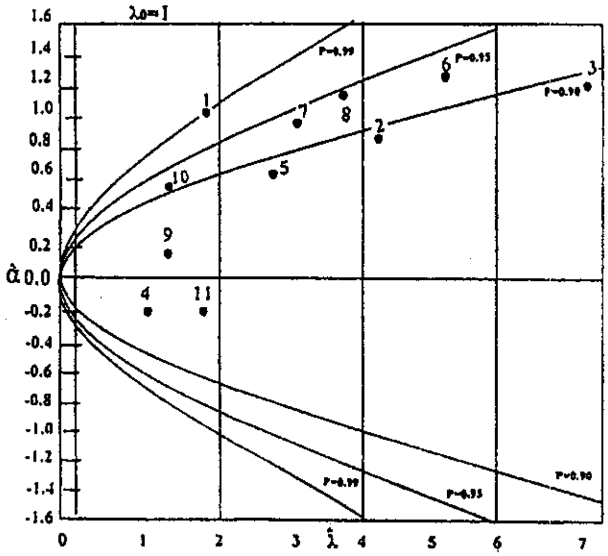

Fig. (2):Distribution of stability statistics for number of pods/ plant of eleven faba bean genotypes

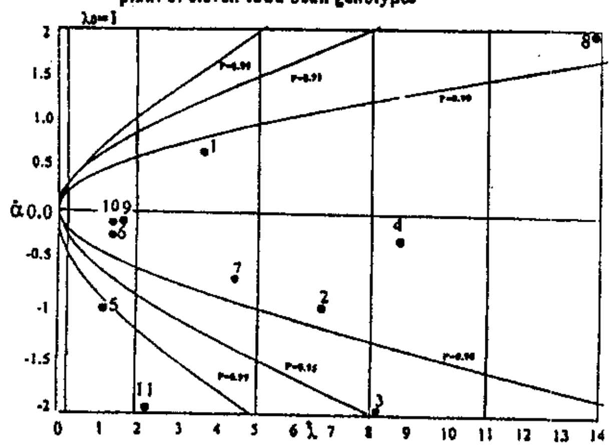

Fig. (3):Distribution of stability statistics for 100-seed weight of eleven faba bean genotypes

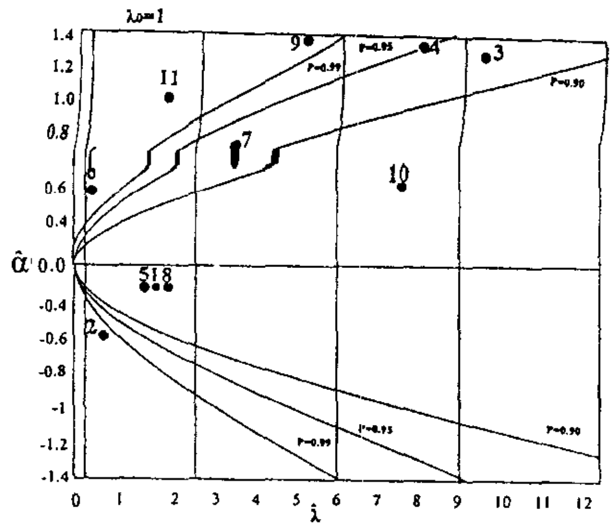

Fig. (4):Distribution of stability statistics for leaf chlorophyll content of eleven faba bean genotypes

Finally, based on phenotypic stability parameters, it could be concluded that Giza 402 characterized by high seed yield potentiality with greater number of pods/plant and Giza 461 gave relatively low yield. Both varieties showed high degree of stability and were adapted to be grown under Zagazig region as favourable environment. Whereas, Giza Blanca exhibited high mean values of both seed yield/fad and 100 seed weight and Giza 429 had relatively low yield. They classifid as highly adapted to be grown under Khattara region as stress environment. Moreover, the most desired and stable varieties for seed yield/fad were Giza 843,Giza 957, Giza 714 and Improved Giza 3 at both phenotypic and genotypic levels, therefore they could be grown under wide range of environments.

Note added by Reviewer: Giza 957 is a line that has been recently certified as variety Sakha 1.

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الثبات المظهري والوراثي لبعض أصناف من الفول البلدي

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أجريت هذه الدراسة بهدف معرفة تفاعل التركيب الوراثي مع البيئة وتقدير معالم الثبات المظهري والوراثي لأحد عشر صنفا من الفول البلدي هي:جيزة ١، جيزة ٢، جيزة ٣، جيزة ٣ المحسن، جيزة بلانكا، جيزة ٤٠٢، جيزة ٤٢٩، جيزة ٤٦١، جيزة٧١٤ ، جيزة ٨٤٣ و جيزة٩٥٧. حيث تم تقدير صفات محصول بذور الفدان, عدد القرون للنبات وزن المائة بذره ومحتوي كلوروفيل الورقة لهذه التراكيب الوراثية تحت أثني عشر بيئة مختلفة تمثل التوافيق بين ثلاث مواسم زراعية ١٩٩٨/٩٧، ٩٩/٢٠٠٠و٢٠٠٠/٢٠٠١،وكثافتين زراعيتين ٢٢و٣٣ نبات/م٢ في موقعين مختلفين هما المزرعة التجريبية بكلية الزراعة جامعة الزقازيق (أرض طينية) والمزرعة التجريبية بالخطارة (أرض رملية) .

وقد أظهر تحليل تباين الانحدار وجود اختلافات عالية المعنوية بين الأصناف,البيئات والتفاعل بين التركيب الوراثي X البيئة لجميع الصفات تحت الدراسة. وأظهر تجزئ مجموع مربعات التفاعل بين التركيب الوراثي X البيئة ،أن التباين الراجع إلي عدم تجانس Heterogeneity كان معنويا وأكبر في قيمته من الجزء المتبقي لصفات: محصول البذور للفدان، عدد القرون للنبات ووزن المائة بذرة،مشيرا إلي أن معظم التفاعل الوراثي X البيئي داله خطية للقيم البيئية. وكان التباين الراجع للانحرافات المتبقية أيضا عالي المعنوية لصفات عدد القرون للنبات، وزن المائة بذره ومحتوي كلوروفيل الورقة مع ارتفاع قيمته للصفة الأخيرة مقارنة بالتباين الراجع إلي عدم التجانس ،في دلالة إلي وجود المكون غير الخطي للتفاعل بين التركيب الوراثي X البيئة.

أظهر تحليل الثبات المظهري باستخدام طريقة إيبرهارت ورسل(١٩٦٦) أن صنفي الفول البلدي جيزة ٤٠٢و جيزة ٤٦١ أكثر أقلمة لظروف البيئات الملائمة لصفتي محصول بذور الفدان وعدد القرون للنبات ،وكذلك الصنف جيزة ٧١٤ لصفتي وزن المائة بذرة ومحتوي كلوروفيل الورقة. في حين كان صنفا الفول البلدي جيزة بلانكا وجيزة ٤٢٩ أكثر إستجابة لظروف البيئات الأقل ملاءمة لصفة محصول البذور للفدان ،ومن ثم يمكن التوصية بزراعتهما تحت ظروف منطقة الخطارة كبيئة أقل ملاءمة .

وكانت أكثر الأصناف ثباتا وقبولا تحت مدي واسع من البيئات المتباينة، الصنف جيزة ٨٤٣ لصفات محصول بذور الفدان، عدد القرون للنبات ومحتوي كلوروفيل الورقة، والصنف جيزة ٩٥٧

لمحصول بذور الفدان ومحتوي كلوروفيل الورقة وكذلك الصنف جيزة بلانكا لصفتي عدد القرون للنبات ومحتوي كلوروفيل الورقة.

بينما أظهر تحليل الثبات الوراثي باستخدام طريقة تآي (١٩٧١) أن الصنف جيزة ٤٢٩ كان أكثر ثباتاً لصفة محصول بذور الفدان والصنف جيزة بلانكا لصفة وزن المائة بذره. في حين كان الصنف جيزة ٤٦١ متوسط الثبات الوراثي تحت جميع البيئات المدروسة لصفة محصول البذور للفدان ومحتوي كلوروفيل الورقة وكذلك الصنف جيزة ٧١٤ لصفات: محصول البذور للفدان ,عدد القرون للنبات ووزن المائة بذرة. ودلت النتائج أن درجة ثبات الأصناف جيزة ١ ،جيزة ٣،جيزة ٨٤٣وجيزة ٩٥٧ كانت عالية للظروف الجيدةabove average stability لمحصول بذور الفدان،و الصنف جيزة ٢ لمحتوي كلوروفيل الورقة.

وقد أظهرت أصناف الفول البلدى جيزة ٨٤٣، جيزة ٩٥٧، جيزة ٧١٤ وجيزة ٣ المحسن درجة عالية من الثبات لمحصول بذور الفدان على المستويين المظهرى والوراثى.

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