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MEAN PERFORMANCE AND PHENOTYPIC STABILITY OF SOME FABA BEAN (*Vicia faba*, L. VAR.MAJOR) GENOTYPES UNDER FOUR DIFFERENT LOCATIONS IN EGYPT.

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ABSTRACT

Ten faba bean genotypes var. major were evaluated over eight different environmental conditions i.e.Ismailia Alexandria, Qalubia and Sohag locations in a combination with two seasons of 2001/2002 and 2002/2003 to investigate mean performance and phenotypic stability for some green and dry yield characters and its components. The eight field trials were conducted using randomized complete block design with four replications.The obtained data were subjected to analysis of variance and the stability methods out line by Eberhart and Russel (1966).

Mean performance of some genotypes through various environments revealed high potential response for favorable environments conditions. Moreover, other genotypes showed high potential response under unfavorable environments. Line (K_1) appeared to be performed well under favorable environment conditions for pods weight/ plant and number of both seeds/pod and pods/plant and Giza Planka for pod length and 100-seeds weigh. On the other hand, line (K_5) was performed well under unfavorable environmental condition for pod length and pods weight /plant. The most highly stable genotypes for yield and its attributed characters were line (K_1), line (K_7), line (K_8) and Giza Planka cv. These results are of great importance to breed high yielding and more stability faba bean varieties under varied environments.

INTRODUCTION

Faba bean (*Vicia faba*, L.) is an important leguminous winter vegetable crop. It cultivated allover Egypt in large scale along the Nile valley i.e., Upper (South) and Lower (Delta) Egypt, in addition to the new reclaimed sandy soil areas.

The largest problem that faces faba bean cultivation is the unconsistency of productivity, which differs from season to another as well as, from region to region (Zayed, 1995) Therefore, the mean performance and stability evaluation of newly released commercial or promising genotypes in various yield trials across different environments and seasons are considered important for the breeder to determine the differential responses of these genotypes to environmental changes. Thus, the significance's of genotype x environments interaction (linear), the predictable component of variation for particular characters, could be described as differential response of the genotypes to various environmental conditions (Allard and Bradshaw,1964; Falconar, 1981; Dantuma *et al.*, 1982; Singh *et al.*, 1984 ; Hussein *et al* ., 1993 ; Alkaddoussi, 1996 and Zayed *et al.*, 1999). The study of interaction between genotype x environment not only helps in planing programs, but also enables identification of highly responsive and high yielding genotypes suitable for cultivation under the largest range of environmental conditions, where the genetic potential of genotype could be fully exploited through breeding program to improve faba bean productivity.

Eberhart and Russel (1966), suggested both linear and non-linear components of genotype x environment should be used in judging the stability of various varieties and described on ideal variety as one with highest yield over a wide range of environments, a regression coefficient of 1 and deviation mean squares of 0 (zero). Moreover, the stability of various faba bean genotypes over environments were previously investigated by yassin (1973); picard and Berthelem (1980); Guen and Berthelem(1981);Robertson (1985) ; Ibrahim and Buckenbauer (1987); El-Defrawy *et al* . (1994) and Alkaddoussi (1996). The main objectives of the present investigation was to study mean performance and phenotypic stability of ten faba bean genotypes (major) for green, dry yield and some of its components across eight different environments (i.e., four locations during two winter successive growing seasons).

MATERIALS AND METHODS

Ten faba bean (*vicia faba,* L.) belonging to var. major were employed to study mean performance and phenotypic stability during two successive winter growing seasons i.e., 2001/2002 and 2002/2003. Eight field trials were carried out at four different locations, two in each location, in soils and climatic factors i.e., Sabahia (Alexandria), Kanater (Qalubia), El-kassassein (Ismailia) and Shandaweel (Sohag). Sabahia, Kanater and Shandaweel research stations are clay in soil, meanwhile, El-kassassein is sandy in soil texture. The above mentioned research stations are branches of Horticulture Research Institute, Agriculture Research Center (ARC) in Egypt. Seed of faba bean cultivars i.e., Aquadolce and Giza planka were obtained from Legumes Section, Institute of Field Crops, Agriculture Research Center (ARC), Egypt, whereas the other eight feba bean genotypes were newly released by Ahmed (1993) at El-Kassassein Research Station. The seeds of 10 feba bean genotypes were sown in a randomized complete block design with four replicates. Sowing date was on 20th October at both winter growing seasons (2001/2002) and (2002 /2003). The experimental plot consisted of 5 rows, each was 3m length and 60cm apart. Seeds were sown at rate of two seeds hill at both sides of the ridge to obtain plant density of 140.000 plant/fed (optimum density). The recommended agricultural practices in faba bean production were applied at proper time.

Studied characters:

Ten competitive plants were randomly taken from each plot for recording the following data:

1- Green yield was recorded after 140 days from sowing for; pods weight/ plant (gm), pod length (cm) and number of seed/ pod.

2- Dry yield was recorded at harvest time for; seeds weight / plant (gm), number of pods / plant and 100- seed weight (gm).

Statistical procedures:

The obtained data were subjected to two-way analysis of variance for different characters for each location through the two growing seasons according to Steel and Torrie (1980). Differences among means were tested by mean of L.S.D. parameter stability analysis was performed for green and dry yield as well as yield component under 8 environments. (4 locations x 2years) according to the methods outlined by Eberhart and Russel (1966).

RESULTS AND DISCUSSION

Analysis of variance (Table1) showed that the mean squares among genotypes were highly significant for most characters under study. Highly significant genotype x environment interactions were observed for the studied traits, suggesting that green and dry yield as well as, yield component attributes in faba bean genotypes are highly influenced by changes in environments. The variance due to environments (linear) were highly significant different for all the studied characters indicating that the response to environments was genetically controlled.Genotype x environment interaction (linear) component of variation of stability were also, significant for pods weight / plant, pod / length (green yield) and No. of pods /plant (dry yield),revealing the differential response of the genotypes to various agroclimates. Data of pooled deviations indicated significant variations, demonstrating that the major component differences for stability were due to deviation from the linear function. The significance of GXE interaction agree with the findings of Allard and Bradshaw (1964) Hussein *et al.* (1993), Raghab *et al.* (1994) and Alkaddoussi (1996). The occurrence of significant genotype x environment interaction allows evaluation, of genotypes for stability of mean performance across environments, i.e., different locations and growing seasons. It is obvious from Table (1) that the linear component G.XE.interaction was relatively higher than the non-linear one for all the characters except number of seeds /pod in which non–linear component was greater, indicating that the performance of genotypes for all characters except number of seed / pod could be predicted

The values of regression coefficient (b_i) which measure the genotypes performance on the environmental index (Table 2) was significant and more than 1 ($b_i > 1$) for some genotypes, such as line (K_1) for pods weight / plant, number of seed/ pod and number of pods /plant characters, indicating high potential response for these genotypes in favorable environments. On the other hand, regression coefficient was significant but less than 1 ($b_i < 1$) for pods weight/ plant as well as pod length. These results, not only was found in line (K_5) but also for dry characters (number of pods/plant) in the variety Giza planka. These genotypes appeared to be more productive under unfavorable environments. Alkaddoussi (1996) reported some genotypes of faba bean like Local Abu Hammed and Local Diayrab Nigem, to be considered as standard cultivars for faba bean cultivation under less favorable conditions.

The different genotypes used in this study did not exhibit uniform stability and responsiveness pattern for all the characters. The stability and responsiveness appeared to be specific for specific characters within a single genotype (Table 2).

Mean squares of genotype x environment linear interaction was insignificant for number of seed /pod, seed weight /plant and 100-seed weight reflecting the insignificant difference among genotypes across environments (Table2)

Table (1): Analysis of variances for the genotype x environment interaction, of the studied characters in faba bean genotypes grown in different locations and seasons.

Source of variation	d.f	Mean squares					
		Green yield and some attributes characters			Dry yield and some attributes characters		
		Pods weight /plant (gm)	pod length (cm)	No. Seeds / pod	Seeds weight / plant (gm)	No. Pods / plant	100-seeds weight (gm)
Genotypes (G)	9	8131.65*	3.20**	2.43**	105.47	12124*	292.13**
Environment (E)	7	158297.48*	12.49**	81.56**	2991.36**	1824.29*	5449.53**
Gen.xEnv.	63	4428..22*	1.14*	1.81*	168.83**	83.51*	115.23**
Environment+(GXE)	70	22785.14*	2.28**	9.79**	451.08**	257.59**	648.66**
Environment (linear)	1	1108082.34**	87.41**	570.91**	20939.55**	12770.02**	38146.72**
Gen.xEnv (linear)	9	11759.45**	1.79*	1.49	176.11	247.93**	139.50
Pooled deviation	60	6350.71*	0.93*	1.68*	150.85**	50..50	100.07**
Kassassein 1 (K_1)	6	2508.75	0.27	1.38	17.49	18.48	20.99
Kassassein 2 (K_2)	6	19889.49**	1.50**	4.65**	59.93	22.31	60.03
Kassassein 3 (K_3)	6	402.84	0.89	0.81	461.04**	55.59	43.93
Kassassein 4 (K_4)	6	9052.41**	0.34	0.37	42.57	27.69	89.96
Kassassein 5 (K_5)	6	2595.97	0.70	0.48	89.28	13.02	147.95**
Kassassein 6 (K_6)	6	3265.32	1.11*	2.16**	202.45*	65.36	131.98**
Kassassein 7 (K_7)	6	9298.15**	1.94**	1.42	72.99	22.81	138.52**
Kassassein 8 (K_8)	6	1661.81	0.75	1.42	221.56**	284.74**	55.01
Aquadolce	6	2484.32	0.98	2.85**	131.31	8.77	79.52
Giza Planka	6	8728.33**	0.85	1.27	209.80**	22019	232.75**
Pooled error	160	2898.63	0.47	0.72	61.76	42.28	40.22

*, ** Significant at 0.0 5 and 0.01 probability levels, respectively

Table (2): Estimates of stability for green and dry yield and some yield attributes of ten faba bean genotypes grown under different locations in both seasons of 2001/ 2002 and 2002/2003

Genotypes	Green yield and some its components characters									Dry yield and some its components characters								
	Pods weight /plant (gm)			Pod length (cm)			No. seeds/ pod			seeds weight (gm)			No. pods/plant.			100- seeds weight (gm)		
	x	bl	s^2d	x	b_i	s^2d	x	b_i	s^2d	x	b_i	s^2d	x	b_i	s^2d	x	b_i	s^2d
Kassassein 1 (K_1)	265.0	1.58*	-389.90	10.0	0.94	-0.2	5.3	1.36	0.67	45.3	0.86	-44.26	29.1	1.69**	-23.80	88.1	0.91	-19.23
Kassassein 2 (K_2)	251.4	1.36	16990.90**	10.3	0.86	1.03**	5.9	0.92	3.93**	38.9	0.75	-1.83	20.7	0.71	-19.98	89.7	0.96	19.18
Kassassein 3 (K_3)	189.9	0.76	1124.02	10.1	0.75	0.42	45	0.80	0.09	52.5	1.56*	399.30**	25.0	1.26	13.30	87.7	0.92	03.71
Kassassein 4 (K_4)	212 .0	0.94	6153.50	9.8	1.03	-0.13	44	0.90	-0.35	42.9	0.95	-19.19	22.8	0.73	-14.59	87.2	1.23	49.74*
Kassassein 5 (K_5)	170.2	0.50*	-302.70	9.5	0.25*	0.23	4.1	0.82	-0.23	42.8	0.96	27.52	22.4	0.65	-29.26	94.4	0.78	107.70**
Kassassein 6 (K_6)	232.3	1.18	366.70	9.4	0.66	0.64*	4.4	1.15	1.44**	44.4	0.81	140.7**	28.1	0.92	23.08	88.8	0.81	91.76**
Kassassein 7 (k_7)	228.8	1.03	6399.50**	10.9	1.66*	1.47**	4.4	1.00	0.71	43.5	0.90	11.24	25.5	1.02	-19.47	95.8	1.11	98.30**
Kassassein 8 (k_8)	217.1	1.03	-1236.80	10.6	1.15	0.28	4.3	1.01	0.71	43.3	0.70	159.90**	29.1	1.77**	206.46**	93.2	1.04	14.78
Aquadolce	168.3	0.61	-414.30	9.8	0.90	0.51	4.9	1.06	2.14**	44.1	1.04	69.55*	23.0	0.76	-33.52	94.6	0.87	39.29
G.planka	211.6	.02	5829.70**	11.4	1.79*	0.38	4.8	0.99	0.56	48.4	1.47	148.00**	17.0*	0.48*	-20.09	107.2**	1.38*	192.50**

*,** Significant at 0.05 and 0.01% probability levels, respectively.

These results reflected the difficulty of predicting the mean performance of the studied characters for different genotypes in different environments (Ragheb *et al.*, 1994). The previous results suggested that stability parameters (S^2d) may be of great importance. From Table (2) it could be seen that the value of deviation from regression (S^2d) was significant for some characters in some genotypes, indicating the instability of these genotypes for these characters. It is worth noting that variety is said to be stable if the performance of a genotype had higher mean performance and minimum deviation from regression (S^2d=o) or non-significant regression coefficient (b=1).(Eberhart and Russel, 1966).

From the above mentioned results of both (S^2d) and (b_i), the most stable genotypes appeared to be line (K_1) for seeds weight/plant and pod length; line (K_7) for number of pods/plant; line (K_8) for pods weight, pod length and 100-seeds weight and Giza Planka for number of seeds/pod. A simultaneous consideration of the three parameters (x, b_i and S^2d), individual genotypes showed that, line (K_1), line (K_7), line (K_8) and Giza planka had high yield andwere more stable, and therefore could be considered as ideal genotypes. These results are of great valuable for plant breeder to produce high yielding and more stable varieties of faba bean under varied environments.

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متوسط السلوك والثبات المظهرى لبعض التراكيب الوراثية من الفول الرومىتحت أربعة مناطق مختلفة فى مصر

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تم دراسة السلوك والثبات الوراثى المظهرى لعشرة تراكيب وراثية مختلفة من الفول الرومى فى مناطق مختلفة، وذلك لصفات المحصول الأخضر والجاف وبعض الصفات المساهمة في المحصول (مناطق الإسماعيلية – الإسكندرية – القليوبية – وسوهاج خلال الموسمين الشتويين ٢٠٠١/ ٢٠٠٢، ٢٠٠٢/٢٠٠٣) أقيمت ثمانية تجارب حقلية باستخدام تصميم القطاعات كاملة العشوائية فى أربع مكررات فى كل سطفة من المناطق.

وقد أظهرت النتائج المتحصل عليها أن بعض التراكيب الوراثية استجابت بصورة عالية للظروف البيئية المناسبة بينما كانت الاستجابة أقل فى باقى التراكيب الوراثية.

وقد أظهرت إنتاجية السلالة (١) عالية تحت الظروف البيئه المناسبة بالنسبة لصفات وزن و عدد القرون الخضراء للنبات و كذلك عدد البذور فى القرن .
الصنف جيزة بلانكا تفوق بالنسبة لطول القرن ووزن ١٠٠ بذرة .

أما السلالة (٥) فقد أظهرت تحت الظروف البيئية غير المناسبة تفوقا بالنسبة لصفتى طول القرن و محصول القرون الخضراء بالنبات .

أما عن الثبات الوراثي فقد كانت السلالات ١، ٧، ٨ الاكثر ثباتا للمحصول العالى و مكوناته و كذلك الصنف جيزة بلانكا. هذه النتائج ذات اهمية لتربية اصناف الفول الرومى ذات القدرة المحصولية العالية و على درجة عالية من الثبات تحت الظروف البيئية المختلفة