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BREEDING FABA BEAN FOR ENVIRONMENTAL STRESS CONDITIONS

1- SELECTION UNDER WATER STRESS, HERITABILITY AND DROUGHT SUSCEPTABILITY INDEX.

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ABSTRACT

Twenty-eight faba bean genotypes were evaluated for yield and its components under three water irrigation and rainfed experiments at F_4 and F_5 generations during the two growing seasons (2000/2001–2001/2002) at Maryout Research Station, Desert Research Center.

All genotypes varied significantly with respect to all studied characters for the two generations under the three water irrigations and rainfed conditions.

Genotypes no. 18, 19 and 15 gave the highest mean values for seed weight per plant under the three different environments in the F_5 generation.

Heritability value in broad sense at the F_5 generation was high for 100-seed weight, no. of pods/plant, seeds yield/plant and no. of seeds/plant under the second water irrigation and rainfed conditions (Exp. 2). This result indicated the importance of selection for drought tolerance at the late recombination.

Genotypes no. 8 and 9, 8, 16 followed by Giza-402 and no. 3 had the highest tolerance (DSI-C) for all traits under study, respectively.

Key words: ***Faba bean, Selection, Heritability, Genotypes, Drought, Susceptibility Index, Rainfed***

INTRODUCTION

In Egypt, water stress is a dominante factor at most of the new reclaimed Egyptian land. Rainfed environments are characterised by their diversity and unpredictability. Small-grained cereals and some legumes are sometimes cultivated under rainfed condtions. Plant breeding in the present time will have to continue efforts for increesing crop yields. New varieties loss dependent on agrochemicals and which make better use of crop inputs, and provide crops and varieties with a wider range of end-uses. Selection for drought tolerance has been impeded due to tack reliable, effective and rapid physiological screening techinques (Blum *et al.* 1981). Genetic system controling drought tolerance mechanismes are complex and inadequantely understood. Therefore plant breeders attempting to select for drought tolerance, are still largely guided by seed yield and the plant stability under dry conditions (Yang and Baker 1991). Sprint *et.al* (1977), reported that water supply is the most factor affecting faba been yield and its variability. However, this crop considered as drought sensitive and highly responsive to irrigation. Faba bean genotypes responded differentially to water regimes and stresses as reported by; Darwish (1996), Omar *et al.*, (1998 a and b) and El-Hosary *et al.*, (2002).

The objectives of this study were to determine the genetic beheviour for four cultivars, three lines and 21 genotypes of faba bean at F_4 and F_5 generation under three types of water stress at Maryout Research Station, North West Coast region, Egypt.

MATERIAL AND METHODS

The study was conducted during 2000/2001 and 2001/2002 seasons at Maryout Research Station, Alex. Governorate, Desert Research Center (DRC). The soil is sand clay loam, non saline (Ec. 4.83 ds/m), calcareuas (27.73 % $CaCO_3$) and 0.81% organic mater. The amount of mean rainfall were 110 and 211 mm (table 1) for the two growing seasons, respectively.

Table 1 . Monthly means rainfall of Maryout Research Station at the two growing seasons. (rainfall measurment unit at Maryout Research station DRC).

Month	2000/2001	2001/2002
October	59.94	21.37
November	6.35	3.81
December	5.32	72.39
January	28.70	82.55
February	8.38	22.35
Mars	0.76	3.81
April	0.00	4.61
Total	109.45	210.88

The materials used traced back to a diallel cross set involving seven parents of wide divergent origins of faba bean .i.e. Giza 461, Giza Blanka (Nubaria-1), Giza 402, Giza 2, Moshtohor 102, Moshtohor 103 and

Moshtohor 127 conducted in 1995/96 season, F_1 and F_2 segregation are evaluated at last study in 1996/97 and 97/98 seasons respectively. The last three lines were developed by the plant breeding program at Dept. of Agron., Fac. Agric. Moshtohor, Zagazig Universty Egypt (El-Hosary, 1989). The other varieties belong to Agriculture Research Center (ARC). The 21 segregation F_4 and F_5 population along with parental genotypes were evaluated during the two seasons 2000/2001 and 2001/2002 respectively.

Selected plants from F_3 generation were sown at 20th November 2000 in the three experiments using a randomized complete block design with three replications. The first experiment (normal) was irrigated monthly in addition to the natural rainfall. The second experiment, (dry + supplemental irrigation) dry sowing method was used with one supplemental irrigation at sowing and after which left to grow under natural rainfall conditions. However, the third experiment (dry), dry method of sowing was used without any supplemental irrigation.

In each experiment, plot consisted of ten ridges and each ridge was 2 meter long and 50 cm width. Hills were spaced by 20 cm with one seed per hill in one side of the ridge. Each ridge was planted by individual plant from ten selected plants of the last generation.

The fields were fertilized using calcium superphosphate at the rate of 20 kg of P_2O_5 per feddan before sowing. Hoeing was applied when necessary.

Seeds for four cultivars and other genotypes, which were used in this study, selected from F_3 generation and are using in the F_4 and so.

In each expriment data of number of pods per plant, number of seeds per plant, 100-seed weight and seed yield per plant were recorded on ten individual plants chosen from each plot. The data were analyzed on individual plant mean basis. The ordinary analysis of variance for R.C.B.D. was performed according to Snedecor and Cochran (1967). Similar procedures were repeated with F_5 populations in 2001/2002 season.

Broad sense Heritability (h^2_{bs}) was estimated by using variance components method (Fehr, 1987).

Data of yield and its components were used to estimate the drought susceptibility index (DSI) as suggested by Saulescu *et al.*, (1995) as follows:

DSI = S/NS

Where S and NS yield with stress conditions and normal irrigation.

RESULTS AND DISCUSSION

Mean squares for seed yield and its components of 28 faba bean populations under three different environments are presented in Table 2 (a and b).

Significant genotypic mean squares were obtained for all traits at all experiments in two generations. These results indicate the wide diversity between the genotypes used in the present study. El-Hossary *et al* (2002) found that the mean square values of all traits under normal irrigation were significant higher than those of rainfed environment. Highly significant differences were detected between the studied faba been genotypes, also for yield and its attributes. This was true under both conditions indicating the wide diversity between the used parental materials.

F_4-generation

The data in Table (3) include the measurments obtained for all traits under the three irrigation treatments. Generally, the mean performance for all genotypes were decreased from, Exp. I through Exp. 2 to Exp. 3. This result is due to the deficiency of soil moisture and the variation for the quantity and time of rainfall during the different growth stages of faba bean.(Table 1).

Data presented in Table (3) indicated that the differencs between genotypes under three types of water regime. The percentages of reduction between Exp.I to Exp. II were 28.4, 37.0, 40.96 and 6.21%. Whereas, the percentages of reduction between Exp. II to Exp. III were 59.72, 70.83, 75.71 and 16.72% for No.of pods/plant, No. of seeds/plant,seed yield/plant and 100- seed weight, respectively.

Genotypes no.19, 19, 5 and 21 gave the highest mean values for no. of pods, no.of seeds, seed yield/plant and 100-seed weight respectively under normal irrigation (Exp. I). Whereas, the genotype M-127 for all traits and genotype no. 21 for seed yield/plant and 100-seed weight (g) surpassed significantly compared with other genotypes under Exp. II. However, genotype no. 4 for number of pods and seeds/plant, no. 8 for seed yield/plant and no. 2 for 100-seed weight, showed significant higher values than other genotypes under Exp. III.

Abdalla and Fischbeck (1992) evaluated 209 local genotypes (Land races) from 18 governorate of farmar's who never used the improved varieties and founded that, variation occurred in the traits of yield and yield components, land-races were either superior or inferior in yield to the

Table 2 (a and b) . Mean squares for seed yield and its components of faba bean genotypes under three different environments from the F_4 and F_5 generations:

a: F_4 - generation

S.O.V	d.f	No. of pods / plant			No. of seeds / plant			100 – seed weight (g)			Seeds yield / plant (g)		
		Exp. I	Exp. II	Exp. III	Exp. I	Exp. II	Exp. III	Exp. I	Exp. II	Exp. III	Exp. I	Exp. II	Exp. III
Rep.	2	261.44 **	44.39 **	0.94	4201.42 **	443.35 **	5.08	141.15 **	119.44 **	43.86 **	4694.29 **	667.63 **	11.48
Genotypes	27	102.11 **	57.63 **	10.63 **	1630.52 **	612.58 **	54.53 **	120.19 **	79.63 **	39.20 **	901.38 **	385.34 **	19.21 *
Error	54	18.75	6.61	2.46	303.43	74.71	14.05	17.02	15.22	9.67	235.06	49.52	5.04

b: F_5 – generation

S.O.V	d.f	No. of pods / plant			No. of seeds / plant			100 – seed weight (g)			Seeds yield / plant (g)		
		Exp. I	Exp. II	Exp. III	Exp. I	Exp. II	Exp. III	Exp. I	Exp. II	Exp. III	Exp. I	Exp. II	Exp. III
Rep.	2	185.12 **	93.04 **	3.78	849.75 *	186.17 *	24.59	25.45	63.5 **	3.75	421.78 **	61.96	26.55
Genotypes	27	123.72 **	219.54 **	13.66 **	1043.01 **	1028.96 **	92.93 **	125.14 **	265.10 **	42.18 **	1029.97 **	928.56 **	76.70 **
Error	54	20.57	3.97	2.27	109.11	37.93	15.32	30.74	2.82	9.71	74.95	24.69	16.19

*and ** indicates significant at 0.05 and 0.01 levels of probability, respectively.

Table 3. Mean performance and heritability (h^2) of F_4 -generation for seed yield and its components of faba bean genotypes under three different environments.

Genotypes	No. of pods/plant			No. of seeds/plant			100 – seed weight (g)			Seeds yield / plant (g)		
	Exp. I	Exp. II	Exp. III	Exp. I	Exp. II	Exp. III	Exp. I	Exp. II	Exp. III	Exp. I	Exp. II	Exp. III
P_1 (Giza 461)	38.1 d-i	28.7 d-h	12.00 b-g	152.4 d-j	100.5 c-h	30.03 b-h	67.03 g-j	64.97 d-g	60.90 abc	102.04 f-j	65.52 e-i	18.34 a-g
P_2 (Giza Blanca)	43.9 b-e	20.2 k	8.77 hij	175.5 b-e	76.3 j	25.97 d-i	70.27 d-j	67.87 c-g	53.20 g-j	124.47 a-i	51.77 i	13.81 hij
P_3 (Giza 402)	29.9 j	24.8 g-k	11.63 b-i	119.5 j	86.8 hij	29.10 c-h	78.20 b-e	73.90 abc	59.77 a-e	93.91 ij	63.44 f-i	17.50 b-h
P_4 (Giza 2)	35.6 e-i	28.3 d-h	11.60 b-i	142.5 e-j	99.1 c-i	29.80 b-h	66.73 h-k	63.47 efg	52.90 hij	95.42 ij	62.99 ghi	15.66 e-j
P_5 (M – 102)	40.4 c-i	28.9 d-h	12.50 b-g	161.7 c-i	104.4 c-h	31.17 b-g	73.93 c-i	68.47 c-g	55.10 c-j	119.82 b-i	69.43 c-h	17.16 b-i
P_6 (M – 103)	39.3 c-i	30.9 b-f	10.33 e-j	157.3 c-i	108.4 b-e	26.43 d-i	77.63 b-e	73.80 abc	57.83 b-i	121.87 a-i	80.18 bcd	15.26 f-j
P_7 (M – 127)	47.3 abc	38.6 a	14.30 abc	189.3 abc	131.2 a	36.17 abc	78.10 b-e	72.70 a-d	57.93 b-i	148.40 ab	95.45 a	21.00 abc
(1) P_1 X P_2	41.3 b-i	28.1 d-i	13.03 a-e	163.1 c-i	98.2 d-i	32.47 b-e	67.43 g-j	62.63 fgh	59.20 a-h	110.66 d-j	61.27 ghi	19.35 a-f
(2) P_1 X P_3	33.7 g-j	29.9 b-g	9.77 f-j	134.8 g-j	103.9 c-g	25.13 e-i	78.43 bcd	71.47 a-d	64.23 a	105.59 f-j	74.13 b-g	16.10 d-j
(3) P_1 X P_4	40.8 b-i	31.4 b-e	8.57 ij	163.2 b-i	110.8 bcd	23.00 hi	84.03 ab	72.93 abc	61.97 ab	136.90 a-e	81.01 bc	14.04 g-j
(4) P_1 X P_5	43.9 b-e	35.4 ab	15.60 a	175.9 b-e	123.9 ab	39.40 a	66.00 ijk	62.93 fgh	54.80 c-j	116.06 c-i	78.19 b-e	21.41 ab
(5) P_1 X P_6	49.2 ab	31.1 b-e	11.37 c-j	196.9 ab	109.7 bcd	29.17 b-h	75.87 c-f	71.43 a-d	60.07 a-d	149.59 a	78.20 b-e	17.48 b-h
(6) P_1 X P_7	43.2 b-f	24.5 h-k	8.47 ij	172.7 b-f	89.2 f-j	24.73 f-i	74.00 c-i	68.97 c-g	60.13 a-d	127.86a-h	61.70 ghi	14.87 f-j
(7) P_2 X P_3	42.2 b-g	30.1 b-f	11.73 b-h	168.8 b-g	105.4 c-f	29.33 b-h	64.30 jk	61.20 gh	61.80 ab	108.88 d-j	64.58 e-i	18.17 a-h
(8) P_2 X P_4	42.9 b-g	32.7 bcd	14.50 ab	171.5 b-f	115.4 bc	36.53 ab	77.10 b-e	72.60 a-d	60.60 a-d	132.81 a-f	83.73 ab	22.11 a
(9) P_2 X P_5	33.0 g-j	24.1 h-k	12.70 a-f	132.1 hij	87.2 g-j	31.80 b-f	80.53 abc	73.23 abc	63.40 ab	106.77 e-j	63.80 f-i	20.32 a-d
(10) P_2 X P_6	38.1 d-i	22.0 jk	9.47 g-j	152.3 d-j	77.0 j	24.13 ghi	78.10 b-e	73.80 abc	52.67 ij	118.92 b-c	56.94 hi	12.68 ij
(11) P_2 X P_7	38.9 c-i	26.2 e-j	11.80 b-h	155.6 c-i	91.6 e-j	29.80 b-h	68.10 f-j	63.03 e-h	53.40 f-j	105.94 f-j	57.87 hi	15.87 d-j
(12) P_3 X P_4	38.7 d-i	24.4 h-k	10.93 d-j	154.9 c-i	85.5 hij	27.37 e-i	81.43 abc	76.90 ab	58.43 a-i	126.67 a-i	63.02 f-i	15.94 d-j
(13) P_3 X P_5	34.2 g-j	23.1 ijk	8.23 j	136.8 f-j	82.6 ij	20.90 i	74.63 c-h	71.10 a-e	58.90 a-i	102.66 f-j	58.72 hi	12.31 j
(14) P_3 X P_6	32.8 ij	26.8 e-j	10.23 e-j	131.1 ij	91.9 d-i	25.63 e-i	75.27 c-g	71.03 a-e	55.43 c-j	98.78 hij	65.27 e-i	14.20 g-j
(15) P_3 X P_7	44.2 b-e	30.9 b-f	11.37 c-j	176.7 b-e	107.9 b-e	28.67 e-h	74.00 c-i	71.47 a-d	59.60 a-f	131.35 a-g	77.13 b-f	17.06 b-i
(16) P_4 X P_5	34.9 f-j	29.1 c-g	12.43 b-g	139.9 f-j	101.9 ch	30.90 b-g	71.47 d-j	67.97 c-g	54.50 d-j	99.87 hij	69.35 c-h	16.82 b-i
(17) P_4 X P_6	29.4 j	22.9 ijk	12.27 b-g	117.6 j	83.1 ij	30.70 b-g	70.07 e-j	66.37 c-g	53.43 f-j	82.59 j	55.42 hi	16.41 d-j
(18) P_4 X P_7	46.2 bcd	33.1 bcd	10.10 f-j	184.7 bcd	115.8 bc	25.30 e-i	74.77 c-h	69.73 b-f	58.03 b-i	138.51 a-d	80.73 bc	14.68 g-j
(19) P_5 X P_6	54.9 a	31.7 b-e	13.33 a-d	219.5 a	111.1 bcd	33.37 a-d	57.77 k	55.57 h	50.87 j	127.18 a-h	62.05 ghi	16.98 c-i
(20) P_5 X P_7	40.2 c-i	28.1 d-i	12.50 b-g	160.9 c-i	98.3 d-i	31.27 b-g	72.70 d-i	68.03 c-g	53.80 e-j	117.27 c-i	66.87 d-h	16.77 c-j
(21) P_6 x P_7	41.5 b-h	34.9 abc	13.13 a-e	166.1 b-h	122.2 ab	33.23 a-d	86.13 a	78.27 a	59.37 a-g	142.54 abc	95.28 a	19.81 a-e
Mean	39.96	28.6	11.52	159.75	100.58	29.34	73.72	69.14	57.58	57.10	69.44	16.87
h^2		72.02	52.51	59.31	70.59	48.88	66.89	58.85	50.44	48.58	69.33	48.36

L- Values followed by some letter (s) are not different at P≤ 0.05of Duncan's Multiple Range Test.

improved varieties. This indicated that, its possible are improving broad bean by using selection from the local genotypes (Land races).

Heritability (h^2) values in broad sense were moderate for all studied traits at Exp.II. Whereas, low heritability were detected by all traits under the two types of experiments of water regime. These results indicated that the environment had a wide effect on the inheritance of such characters.

F_5 generation

The mean performance of genotypes at F_5 generation under three types of experimental irrigation are presented in Table (4): Genotypes are divered significantly under the three types of experimental irrigation. General mean values for all genotypes decreased from type of Exp.I to type of Exp.II and type of Exp.II to type of Exp.III

The perentages of decreases between Exp.I to Exp.II were 14.6, 35.8, 39.3 and 4.3% and between Exp. II to Exp. III were 55.2, 58.8, 59.8 and 19.5 % for number of pods/plant, number of seeds/plant, seed yield per plant and 100- seed weight respectively. This result due to the deficiency of soil mositure from type to anthor. (El.Hosary *et al.*, (2002)).

Genotypes no. 5 and 19, 5, 18 and no.3 gave the highest values for no.of pods/plant, no.of seeds/plant, seeds yield/plant and 100-seed weight under type of Exp.I, Also, genotypes no.3 and Giza Blanka, 19, 19 and no.2 gave the highest values under the Exp. II, whereas, the genotypes, M-127, M-127, no.15 and 9 and no. 12 gave the highest values for no.of pods, no.of seeds, seeds weight and 100-seed weight in the types of Exp.III. these results indicated that, genotypes which gave the highest values for yield and yield component had the best ability to seed productivity under any condition and so that it could be used in program of improving and selection for yield and its components under drought conditions.

Heritability (h^2) estimates (Table 4) were generally high for all studied traits at type of Exp.II, the highest estemated h^2 were for 100- seed weight (96.88%), followed by no. of pods per plant (94.77%), seeds yield/plant (92.43%). and no. of seeds per plant (89.70%). These results indicated that the environment had a small effect on the inheritance of such characters at the late generation. High heritability estimates for all studied traits indicated that selection based on mean would be successful in improving these traits. Abo- El Soad *et al* (1994) reported that heritability estimates differed according to the population genetic base, traits and environmental factors.

Table 4. Mean performance and heritability (h^2) of F_5 generation for seed yield and its components of faba bean genotypes under three different environments.

Genotypes	No.of pods / plant			No. of seeds / plant			100 – seed weight (g)			Seeds yield / plant (g)		
	Exp. I	Exp. II	Exp. III	Exp. I	Exp. II	Exp. III	Exp. I	Exp. II	Exp. III	Exp. I	Exp. II	Exp. III
P_1 (Giza 461)	35.60 c-f	23.8 g	13.57 e-i	117.6 hi	69.83 l	35.27 e-l	89.07 a-e	88.02 cd	65.00 b-g	104.51 g-j	62.67 hij	27.77 c-i
P_2 (Giza Blanca)	42.83 abc	48.20 a	11.50 ijk	159.7 a-d	109.17 c	29.90 ijk	81.46 b-g	79.28 fg	58.27 h	133.64 bcd	86.71 cde	25.33 f-i
P_3 (Giza 402)	24.60 g	26.73 eg	14.73 b-h	105.1 i	73.83 jkl	38.31 c-h	83.32 c-g	69.31 hi	69.87 abc	87.43 j	51.16 klm	28.76 b-i
P_4 (Giza 2)	30.43 efg	25.63 efg	15.33 b-f	118.7 hi	84.20 g	39.87 b-f	85.37 a-g	67.33 ij	60.40 fgh	97.97 ij	46.61 lm	36 32 ab
P_5 (M – 102)	37.30 b-f	25.73 efg	15.97 a-e	136.2 e-h	78.87 i-l	41.51 a-e	88.27 a-f	91.39 bc	64.77 b-g	129.30 c-f	78.24 ef	32.86 a-g
P_6 (M – 103)	40.93 bc	24.30 fg	14.23 e-i	155.1 b-e	71.27 kl	37.01 d-i	90.52 a-e	82.33 ef	62.70 c-h	140.06 abc	57.31 ijk	31.79 a-h
P_7 (M – 127)	45.87 ab	36.07 d	18.37 a	162.6 abc	83.60 h-k	47.75 a	83.39 c-g	87.10 cde	64.97 b-g	131.22 cde	72.77 fg	35.68 abc
(1) $P_1 X P_2$	41.03 bc	24.7 efg	14.80 b-h	142.3 c-g	78.17 i-l	38.48 c-h	83.62 c-g	71.62 hi	67.10 a-e	112.89 f-i	56.21 jkl	28.06 c-i
(2) $P_1 X P_3$	31.43 d-g	25.7 efg	13.13 e-j	125.1 ghi	93.40 e-h	34.15 e-j	81.99 d-g	97.26 a	68.80 abc	99.23 hij	91.38 c	22.11 i
(3) $P_1 X P_4$	39.30 b-e	51.23 a	10.00 k	151.1 b-e	121.13 b	26.00 k	95.64 a	63.78 j	60.87 fgh	144.40 abc	77.36 ef	26.52 e-i
(4) $P_1 X P_5$	40.26 bcd	44.03 b	17.23 a-d	159.5 a-d	121.50 b	44.81 a-d	76.19 ghi	83.70 def	64.80 b-g	115.42 e-h	101.72 b	38.01 a
(5) $P_1 X P_6$	50.03 a	26.00 eg	14.37 c-i	179.0 a	96.97 def	37.35 c-i	68.38 l	80.39 f	65.47 a.g	134.16 bcd	78.44 ef	26.12 f-i
(6) $P_1 X P_7$	41.30 bc	27.90 ef	11.93 h-k	154.0 b-e	72.80 jkl	31.03 h-k	84.56 b-g	74.41 gh	66.43 a-f	137.35 bcd	54.11 jkl	22.13 i
(7) $P_2 X P_3$	40.23 bcd	36.43 d	15.60 a-f	151.5 b-e	95.93 d-g	40.56 a-f	77.61 f-i	83.96 def	68.83 abc	120.79 d-g	80.46 ef	26.26 f-i
(8) $P_2 X P_4$	41.40 bc	25.70 efg	17.37 abc	157.1 bcd	73.80 jkl	45.15 abc	83.75 c-g	96.38 ab	69.73 abc	138.26 bc	71.07 fgh	32.77 a-g
(9) $P_2 X P_5$	31.57 d-g	26.80 eg	17.43 ab	150.7 b-f	73.63 jkl	46.33 ab	86.21 a-g	81.97 ef	71.13 a	106.37 ghl	60.33 ijk	34.47 a-e
(10) $P_2 X P_6$	37.70 b-f	41.57 b	12.20 g-k	141.6 d-g	112.43 bc	31.72 g-k	80.24 e-h	83.64 def	61.27 e-h	113.70 f-i	94.08 bc	24.81 ghi
(11) $P_2 X P_7$	37.57 b-f	41.57 b	15.10 b-g	149.2 c-f	123.10 ab	39.26 b-g	69.20 hi	73.14 h	65.27 b-g	101.55 hij	90.10 cd	27.75 c-i
(12) $P_3 X P_4$	41.07 bc	37.43 cd	13.80 d-i	149.5 c-f	96.33 def	35.88 e-i	87.92 a-f	74.04 gh	71.40 a	134.94 bcd	71.30 fgh	27.46 d-i
(13) $P_3 X P_5$	29.87 fg	42.73 b	10.53 jk	118.5 hi	109.40 c	27.39 jk	82.12 d-g	68.98 hij	68.20 a-d	97.43 ij	75.43 fg	20.99 i
(14) $P_3 X P_6$	31.40 d-g	33.97 d	13.57 d-l	129.8 fgh	101.33 cde	35.27 e-l	85.55 a-g	72.37 hi	61.53 e-h	108.09 ghi	73.30 fg	24.19 hi
(15) $P_3 X P_7$	43.80 abc	28.40 e	14.93 b-h	159.5 a-d	79.27 i-l	38.83 b-h	83.98 c-g	91.46 bc	65.57 a-g	127.85 c-f	66.55 ghi	37.30 a
(16) $P_4 X P_5$	30.23 efg	23.87 g	15.63 a-f	116.6 hi	78.77 i-l	40.65 a-f	83.08 c-g	68.80 hij	62.30 d-h	99.99 hij	41.61 m	35.14 a-d
(17) $P_4 X P_6$	29.87 fg	28.13 ef	14.90 b-h	126.1 gh	83.03 h-k	38.74 b-h	92.35 a-d	74.28 gh	60.27 fgh	104.11 g-j	58.93 ijk	27.76 c-i
(18) $P_4 X P_7$	44.87 ab	41.10 bc	12.77 f-k	162.0 a-d	105.57 cd	33.19 f-k	93.39 abc	88.85 cd	67.37 a-e	155.55 a	93.79 bc	23.27 i
(19) $P_5 X P_6$	50.93 a	42.97 b	17.67 ab	170.6 ab	132.33 a	46.27 ab	86.92 a-g	88.49 cd	58.43 h	147.98 ab	117.19 a	35.53 abc
(20) $P_5 X P_7$	35.77 c-f	25.17 efg	15.97 a-e	144.6 b-g	72.37 jkl	41.51 a-e	82.64 c-g	85.24 de	60.00 gh	113.17 f-i	61.66 hij	32.94 a-f
(21) $P_6 x P_7$	40.27 bcd	26.27 efg	15.70 a-f	150.2 c-f	88.20 e-i	40.82 a-f	94.93 ab	91.66 bc	63.07 c-h	142.7 abc	80.85 def	32.14 a-h
Mean	38.12	32.56	14.58	143.58	92.15	37.93	84.35	80.69	64.99	120.72	73.26	29.44
h^2	62.57	94.77	62.44	74.05	89.70	62.81	50.59	96.88	52.70	80.97	92.43	55.47

L- Values followed by some letter (s) are not different at P≤ 0.05of Duncan's Multiple Range Test.

The percentages for faba bean hybrids should be selected mainly according to the parameter of their generalized heritability. A high heritability characteristic indicates that it is inherited in a major proportion by the parents and less influenced by the environment.

Stress susceptibility index

Data in Table (5) indicated that, mean squares of DSI for drought resistance genotypes were highly significant for yield and its components. Such results indicated that the wide diversity between the genotypes used in this study.

Table 5. Mean squares for drought susceptibility index (DSI) at yield and yield components of F_5 generation.

S.O.V.	d.f	No. of pods/plant			No. of seeds/plant			100-seed weight (g)			Seeds yield/plant (g)		
		A	B	C	A	B	C	A	B	C	A	B	C
Rep.	2	0.14**	0.02**	0.02*	0.04**	0.02**	0.01**	0.01*	0.01*	0.004	0.03**	0.01**	0.02**
Genotypes	27	0.16**	0.02**	0.06**	0.05**	0.01**	0.04**	0.05**	0.02**	0.04**	0.06**	0.09**	0.06**
Error	54	0.02	0.004	0.01	0.004	0.001	0.002	0.004	0.004	0.002	0.003	0.001	0.003

* and ** indicates significant at 0.05 and 0.01 levels of probability, respectively.
A= DSI between Exp. I. and Exp. II. B= DSI between Exp. I. and Exp. III C= DSI between Exp. II. and Exp. III

It is know that, yield and yield components traits were exchanging quikly from season to other, and found that the seasonal effects on yield have more than the effect of variation between locations. This due to the correlation between yield and biological factors and environmental effects. Such as, insect and diseases effect and so, the levels of humidity exchange.

Drought susceptibility index (DSI) for all genotypes under study was determined on the basis of yield and its components between the three adjesent experiments (Table 6)

The genotypes no. 13 gave the best desirable (DSI-A) for number of pods/plant and number of seeds/plant. While, genotypes no. 2, 4 and 11 gave the best desirable DSI-A for seeds yield and 100-seed weight, respectively.

The parental variety Giza-402 and Giza-2 had the highest tolerance of stress environments (DSI-B) for number of pods/plant and seed yield/plant, whereas, the genotypes no. 9 gave the desirable (DSI-B) for number of seeds/plant and no. 5 followed by no. 11 for 100-seed weight.

Table 6. Drought susceptibility index (DSI) for yield and yield components of faba bean genotypes between three different environments at F5 generation.

Genotypes	No. of pods/plant			No. of seeds/plant			100-seed weight (g)			Seeds yield/plant (g)		
	A	B	C	A	B	C	A	B	C	A	B	C
P_1 (Giza 461)	0.68 e-h	0.38 d-h	0.57 a-d	0.59 g-k	0.30 a-f	0.50 cde	0.99 c-f	0.73 c-g	0.74 hij	0.60 d-g	0.26 def	0.44 c-g
P_2 (Giza Blanca)	1.15 bc	0.28 gh	0.24 jk	0.68 c-h	0.19 jk	0.27 ijk	0.97 c-g	0.72 c-g	0.74 hij	0.65 def	0.19 fgh	0.29 i-l
P_3 (Giza 402)	1.12 bcd	0.61 a	0.55 a-e	0.71 b-g	0.33 a-d	0.52 b-e	0.84 ghi	0.84 a-d	1.01 ab	0.58 d-g	0.33 abc	0.56 b
P_4 (Giza 2)	0.87 d-g	0.51 a-d	0.60 abc	0.71 b-g	0.34 abc	0.47 c-f	0.79 ij	0.71 d-g	0.90 cde	0.48 h-k	0.38 a	0.78 a
P_5 (M – 102)	0.69 e-h	0.43 b-f	0.62 abc	0.58 g-k	0.30 a-f	0.53 a-d	1.04 bcd	0.74 c-g	0.71 ij	0.61 d-g	0.26 def	0.42 d-h
P_6 (M – 103)	0.61 gh	0.35 e-h	0.61 abc	0.46 k	0.24 e-k	0.52 b-e	0.91 d-i	0.69 efg	0.76 f-j	0.41 jk	0.23 d-g	0.55 b
P_7 (M – 127)	0.79 e-h	0.40 c-g	0.51 c-g	0.52 ijk	0.29 b-g	0.57 abc	1.04 bcd	0.78 b-g	0.75 g-j	0.56 fgh	0.27 cde	0.49 b-e
(1) $P_1 X P_2$	0.61 gh	0.37 e-h	0.61 abc	0.56 h-k	0.27 c-i	0.50 cde	0.86 f-i	0.81 b-f	0.94 bcd	0.51 g-j	0.25 def	0.50 bcd
(2) $P_1 X P_3$	0.82 d-g	0.42 b-g	0.51 c-g	0.79 b-f	0.27 c-i	0.36 ghi	1.19 a	0.84 a-d	0.71 ij	0.92 a	0.22 d-h	0.24 l
(3) $P_1 X P_4$	1.31 ab	0.25 h	0.20 k	0.80 abc	0.17 k	0.22 k	0.67 j	0.70 d-g	1.05 a	0.53 gh	0.19 fgh	0.35 g-l
(4) $P_1 X P_5$	1.10 bcd	0.43 b-f	0.39 f-i	0.77 b-e	0.28 b-h	0.37 f-i	1.07 abc	0.85 abc	0.77 f-j	0.89 a	0.33 abc	0.37 f-k
(5) $P_1 X P_6$	0.51 h	0.29 fgh	0.58 abc	0.54 h-k	0.21 h-k	0.38 f-i	1.18 a	0.96 a	0.81 e-i	0.58 d-g	0.19 fgh	0.34 g-l
(6) $P_1 X P_7$	0.68 e-h	0.29 fgh	0.43 d-h	0.47 k	0.20 ijk	0.43 d-h	0.89 e-i	0.79 b-g	0.90 cde	0.40 k	0.16 gh	0.41 d-h
(7) $P_2 X P_3$	0.91 c-f	0.39 c-h	0.43 d-h	0.63 f-j	0.27 c-i	0.42 e-h	1.08 abc	0.89 ab	0.82 e-h	0.67 cde	0.22 d-h	0.33 g-l
(8) $P_2 X P_4$	0.62 gh	0.43 b-f	0.68 a	0.47 k	0.29 b-g	0.62 a	1.15 ab	0.83 a-e	0.72 hij	0.52 ghi	0.24 def	0.47 b-f
(9) $P_2 X P_5$	0.87 d-g	0.55 ab	0.67 a	0.58 g-k	0.36 a	0.61 ab	0.96 c-g	0.83 a-e	0.86 def	0.57 e-h	0.33 abc	0.57 b
(10) $P_2 X P_6$	1.11 bcd	0.33 e-h	0.30 h-k	0.79 bcd	0.22 g-k	0.28 ijk	1.04 bcd	0.76 b-g	0.73 hij	0.83 ab	0.22 d-h	0.26 kl
(11) $P_2 X P_7$	1.12 bcd	0.41 cg	0.37 g-j	0.83 ab	0.26 d-g	0.32 h-k	1.06 abc	0.95 a	0.91 cde	0.89 a	0.27 cde	0.31 h-l
(12) $P_3 X P_4$	0.92 c-f	0.34 e-h	0.37 g-j	0.65 e-i	0.24 e-k	0.37 f-i	0.84 ghi	0.81 b-f	0.97 abc	0.53 gh	0.20 e-h	0.38 e-g
(13) $P_3 X P_5$	1.47 a	0.36 e-h	0.25 ijk	0.92 a	0.23 f-k	0.25 jk	0.84 ghi	0.83 a-e	0.98 abc	0.77 bc	0.22 d-h	0.28 jkl
(14) $P_3 X P_6$	1.10 bcd	0.43 b-f	0.40 fgh	0.79 bcd	0.27 c-l	0.35 hij	0.85 f-i	0.72 c-g	0.85 d-g	0.68 cd	0.22 d-h	0.33 g-l
(15) $P_3 X P_7$	0.66 fgh	0.35 e-h	0.53 e-f	0.50 jk	0.25 e-j	0.49 cde	1.09 abc	0.78 b-g	0.72 hij	0.52 ghi	0.29 bcd	0.56 b
(16) $P_4 X P_5$	0.81 efg	0.52 abc	0.66 ab	0.68 c-h	0.35 ab	0.52 b-e	0.83 ghi	0.75 c-g	0.90 cde	0.42 ijk	0.35 ab	0.85 a
(17) $P_4 X P_6$	0.95 cd	0.50 a-d	0.53 b-f	0.66 d-l	0.31 a-e	0.47 c-f	0.81 hij	0.65 g	0.81 e-i	0.57 e-h	0.27 cde	0.47 b-f
(18) $P_4 X P_7$	0.92 c-f	0.29 fgh	0.32 h-k	0.65 e-i	0.21 h-k	0.32 h-k	0.95 c-h	0.72 c-g	0.76 f-j	0.60 d-g	0.15 h	0.25 l
(19) $P_5 X P_6$	0.85 d-g	0.35 e-h	0.41 e-h	0.78 b-e	0.27 c-i	0.35 hij	1.02 b-e	0.68 fg	0.66 j	0.79 b	0.24 def	0.31 h-l
(20) $P_5 X P_7$	0.72 e-h	0.46 b-e	0.63 abc	0.50 jk	0.29 b-g	0.57 abc	1.03 bcd	0.73 c-g	0.70 j	0.55 fgh	0.29 bcd	0.53 bc
(21) $P_6 x P_7$	0.67 e-h	0.41 c-g	0.60 abc	0.59 g-k	0.28 b-h	0.46 d-g	0.97 c-g	0.66 g	0.69 j	0.57 e-h	0.22 d-h	0.40 d-i
Mean	0.88	0.40	0.48	0.64	0.27	0.43	0.96	0.76	0.82	0.61	0.25	0.43
h^2		72.02	52.51	59.31	70.59	48.88	66.89	58.85	50.44	48.58	69.33	48.36

Values followed by same letter (s) are not different at 0.05.

Genotypes no. 8 and no. 8, no. 16 followed by Giza-402 and no. 3 had the highest tolerance (DSI-C) for number of pods/plant, seeds/plant, seed yield/plant and 100-seed weight respectively. El- Hosary *et al.*, (2002) reported that genotypes identified as stress tolerant using stress susceptibility index should possess tolerant mechanisms which may need to be incorporated into germplasm with higher yield potential for development of high yielding, and stress tolerant cultivars.

Saulescu *et al.*, reported that the cultivars that are superior to the average for the shoot dry weight ratio. Stressed/non-stressed include cultivars successfully grown in dry area.

From the previous results, it could be concluded that; selection genotypes that are superior to the average for yield and yield components under different environments (stressed/non-stressed) include the genotypes successfully and adapted to grown in the environmental stress conditions and are using in faba bean breeding programs for stress condition.

The reduction of seed index for some parental cultivar as like Giza balnka it could be due to the cross between other genotypes or environmental variation and or other stress conditions.

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تربية الفول البلدى لظروف الإجهاد البيئية المعاكسة

1- الانتخاب للمحصول فى الإجهاد المائى ودرجة التوريث ومعامل الحساسية للجفاف

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مركز بحوث الصحراء – قسم الأصول الوراثية – وحدة تربية النبات

يعتبر الفول البلدى أهم المحاصيل البقولية التى تستخدم كغذاء للإنسان. لذا فانه من الضرورى انتخاب تراكيب وراثية اكثر تحملا لظروف الإجهاد المائى حتى يمكن الامتداد بزراعته فى الأراضى الحديثة الاستصلاح.

لذلـــك فان هذه الدراسة استهدفت انتخاب وتقييم منتخبات فى الجيل الرابع والخامس تحت ظروف بيئية مختلفة لثلاثة من التجارب:

١- الزراعة تحت ظروف الرى الدائم كل ٣٠ يوم بالإضافة إلى كمية الأمطار خلال موسم النمو.
٢- الزراعة تحت ظروف الأمطار مع إعطاء رية زراعة فقط.
٣- الزراعة الجافة اعتماداً على مياه الأمطار فقط. وذلك خلال مواسم النمو ٢٠٠٠/٢٠٠١ ، ٢٠٠١/ ٢٠٠٢ بمحطة بحوث مريوط (محافظة الإسكندرية) التابعة لمركز بحوث الصحراء وكان متوسط معدل الأمطار خلال مواسم النمو المختلفة ١١٠ و ٢١١ مل على الترتيب.

هذا وقد أقيمت التجارب باستخدام تصميم القطاعات كاملة العشوائية فى ثلاثة مكررات وقد ســجلت النتائج على عينة من عشرة نباتات فردية اختيرت عشوائيا من كل عشيرة وتم حساب درجة التوريث بمعناها العام ومعامل الإجهاد البيئى لصفات عدد القرون بالنبات – عدد البذور بالنبات وزن الـــ ١٠٠ بذرة – محصول النبات الفردى.

هذا وقد أظهرت النتائج:

وجــود اخــتلافات معــنوية بيــن التراكيب الوراثية المختلفة تحت ظروف النمو فى البيئات المختلفة.

أظهــرت التراكيــب الوراثية رقم ١٨ ، ١٥ اعلى قيم لمتوسط محصول النبات الفردى تحت ظروف الزراعة فى البيئات المختلفة فى الجيل الخامس.

كانــت درجــة التوريــث عالية لمنتخبات الجيل الخامس لصفات وزن الـــ ١٠٠ بذرة وعدد القــرون وعدد البذور بالنبات تحت ظروف الزراعة اعتمـاداً على مياه الأمطار مع إعطاء رية الزراعة مما يشير الى أهمية الانتخاب لهذه الصفات فى الأجيال المتأخرة تحت ظروف الإجهاد المائى.

كــان تبايــن معامل الحساسية للإجهاد المائى للتراكيب الوراثية معنويا لجميع الصفات تحت الدراسة حيث أظهرت التراكيب رقم ٨ – ٩ ، ٨، ١٦ – جيزة ٤٠٢ ، ٣ اعلى قيم لمعامل الإجهاد لكل الصفات تحت الدراسة. مما يشير إلى أهمية الاستفادة من هذه التراكيب فى برامج تربية الفول لتحمل الجفاف أو انتخابها فى الأجيال الانعزالية المتأخرة كسلالات جديدة تحمل صفة تحمل الجفاف.

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