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DIALLEL CROSSES FOR IMPROVING FABA BEAN (*VICIA FABA* L.) UNDER RAINFED CONDITIONS I. YIELD AND YIELD COMPONENTS

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ABSTRACT: The present study was conducted during 1988/1999 and 1999/2000 seasons to estimate the types of gene action components of genetic variance for yield and yield attributes of faba bean. A half diallel set of crosses involving seven parental varieties namely, Giza blanka ,Giza 717 Triple white , Giza.643, Giza–461, Moshtohor–109 and Moshtohor –103 were utilized and grown under normal irrigation and rainfed conditions .

The parents and their 21 F1 crosse were evaluated in a randomized complete block design experiment with three replications at Maryout Research station (Alex. Governorate). Data were recorded on individual plant basis, and analyzed by the procedure developed by Griffing (1956).

Significant genotype mean squares were obtained for all traits in both environments. Mean squares due to parents were significant for all studied traits under both normal and rainfed irrigation except number of seeds/plant and 100-seed weight. Mean squares associated with general combining ability (G.C.A) and specific combining ability (SCA) were significant for all studied trails .

It is likely to mention that the additive gene action was more pronounced compared with the dominance for both number of seeds/plants and seed yield/plant and these were true under both normal irrigation and rainfed conditions.

The parental varieties Giza blanka and Giza 717 gave significant positive gi (GCA effeds) for yield and one or more of its attributes in normal irrigation and rainfed. The combination Giza blanka X Giza 461 and Giza 717 X Mosht-ohor 103 appeared to be the best promising for breeding to increase seed yield per plant which gave significant positive Sij (SCA effects) for yield and some of its attributes in both environments.

Key words: crosses, varieties, rainfed, drought, heterosis, combining

INTRODUCTION

Faba bean (*vicia faba* L.) is a protein crop for temperate regions in Egypt, there is a possibility of increasing the cultivated area. Therefore, it is important to obtain higher yielding varieties through breeding programs for the new reclaimed areas under rainfed conditions. The breeder should know the type of gene action of the quantitative traits because this is the main determinate in choice of selection and breeding procedures. Drought tolerance or resistance in native plant species is often defined as survival, but in crop species it should be defined in terms of productivity (Passioura 1983) . Fischer and Maurer (1978) noted that quantification of drought tolerance should be based on seed yield under dry conditions in the absence of an understanding of specific mechanisms of tolerance. Therefor, there is a need to look at the methods that has been used to quantify drought tolerance.

Although heterosis in self fertilized crops and especially in faba bean has not been exploited yet, several investigators detected significant heterosis , general and specific combining ability for yield and its attributes (El-Hosary etal 1997) . However, different and in sometimes contradicting results were obtained in this concern . Therefor, the aim of the present study was to estimate gene action , heterosis , general and specifice combining ability in F1 of faba bean diallel cross for certain quantitative characters in an attempt to improve yielding potentiality of Egyptian faba bean under normal irrigation and rainfed conditions .

MATERIALS AND METHODS

This study was carried out in wire greenhouse in the headquarters (1998/99) at Maryout Research Station, Alex. Governorate (1999/ 2000) Desert Research Center (DRC) where the soil is sandy clay loam, non-saline (Ec 4.83 ds/m), calcareous (27.73% $CaCO_3$) and 0.81% organic matter. Seven parents of wide divergent origins of faba bean were used in the present study, i.e., Giza blanka (P_1), Giza-717 (P_2), Triple white (P_3), Giza-643 (P_4),Giza–461 (P_5), Moshtohor-109(P_6)and Moshtohor -103 (P_7). The last two lines were produced from plant breeding program at Dept. Agron Fac. Agric Moshtohor, Zagazig Univ., Egypt (EL-Hosary, and Sedhom 1988).

Adiallel cross set involving the seven parents was made in winter of 98/99 in a wire cages under normal conditions of Desert Research Center, Matariya, and Cairo. In 1999/2000 season. Two experiments were conducted, each experiment included the seven

parents and their 21 F_1 hybrids, which were sown on 20th November,1999 in a randomized complete block design with three replications .

The first experiment was normally irrigated every 45 days in addition to the rainfall. In the second experiment, dry method of sowing was used and one supplemental irrigation at sowing, then after, plants were left to grow under rainfall conditions. The amount of rainfall was 132 mm along the growing season. In both experiments, fertilization in the level of 100 kg P_2O_5/fed was added before sowing. All other agricultural practices were carried out as usual in the conventional faba bean fields. In each experiment, each plot consisted of three ridges Hills were spaced at 20 cm with one seed per hill in one side of the ridge.

The studied characters:

In each experiment, data of studied traits were recorded on 10 individual guarded plants chosen at random from each plot. Studied characters were; number of pods per plant, number of seeds per plant, seed yield per plant (g) and 100-seeds weight.

The obtained data for each trait were analyzed on individual plant mean basis. An ordinary analysis of variance was firstly performed according to Snedecor and Cochran (1967). Heterosis was also determined according to Paschal and Wilcox (1975) for individual crosses as the percentage deviation of F_1.

Mean performance from the better parent (BP) as follows:

$$\text{Heterosis} = \frac{\bar{F}_1 - \bar{BP}}{\bar{BP}} \times 100$$

General and specific combining ability estimates were obtained by employing Griffing's(1956) diallel cross analysis designated as model -1method-2.from each experiment

RESULTS AND DISCUSSION

Table (1) shows mean squares and combining ability for yield and yield attributes from the F1 generation under normal irrigation and rainfed conditions. The mean square values of all traits under normal irrigation were higher significant than those of rainfed environment, it is important to mention that highly significant difference were detected between the studied faba bean genotypes for yield and its attributes. These results were true under both conditions, indicating the wide diversity between the used parental materials. Data in table (1) show that mean squares of crosses were significant for all the studied traits, revealing an overall differences between these hybrids. Such results indicate that these hybrids performed in the same way in each environment as mentioned before the parents under both conditions.

Table (1): Mean squares from ordinary analysis and combining ability for all the studied traits from the F_1 generation under irrigated and rainfed.

S.O.V.	d.f Single	No. of pods/plant		No. of seeds/plant		Seed yield/plant		100-seed weight (g)	
		Irrigation	Rainfed	Irrigation	Rainfed	Irrigation	Rainfed	Irrigation	Rainfed
Reps. In Env.	2	3.63	7.74	31.88	133.18	49.10	4.95	10.81	7.53
Genotypes(G)	27	162.91**	100.60**	844.13**	343.91**	703.43**	190.63**	192.50**	199.10**
Parents(P)	6	140.55**	28.79**	332.79**	188.17*	307.01**	126.81**	290.37**	398.69**
Crosses (C)	20	138.47**	114.05**	962.23**	355.12**	842.06**	193.79**	121.36**	109.96**
P x C.	1	785.80**	262.30**	1550.2**	1054.13**	309.37**	510.31**	1028.05**	784.42**
Error	54	16.90	7.51	35.01	68.22	23.49	10.48	19.19	20.98
G.C.A.		53.20*	27.87*	569.19**	220.92**	438.18**	113.03**	62.88**	95.44**
S.C.A.		54.61**	35.14**	199.15**	84.27**	176.28**	49.41**	64.53**	58.08**
Error term	54	5.63	2.50	11.67	22.74	7.83	3.49	6.39	6.99
G.C.A/S.C.A		0.97	0.79	2.86	2.62	2.49	2.29	0.97	1.64

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

Also ,as mention befor the general and specific combining ability for all the studied traits were highly significant in normal irrigation and rainfed condition. Analysis of variance for combining ability as outined by Griffing (1956) model-1 model-2 in each experiments for all the studied traits is presented in table (1) . The mean squares associated with general combining ability (G.C.A) and specific combining ability (S.C.A) were significant for all the studied traits . It is evident that both additive and non additive gene effects were involved in determining the performance of single cross progeny. Also , when GCA/SCA ratio was calculated , it was found that all traits except number of pods plant in both environments and 100-seed weight under irrigation experiment exhibited GCA/SCA ratio exceeded the unity, indicating the predominance of additive and additive X additive types of gene action in the inheritance of such traits , For the exceptional case of number of pods/plant under rainfed irrigation, low GCA/SCA ratio less than unity was detected. Such results indicated that non additive type of gene action was more important than additive one in controlling this trait. The magnitude of additive and non additive types of gene action were similar for number of pods/plant and 100-seed weight under irrigation experiment . The genetic variance was previously reported to be mostly due to additive type of gene action for yield and yield attributes by Abo EL . Zahab *et al* (1994), Helal (1997), El-Hady *et al* (1998),Omer *et al* (1998) and El-Rafaey *et al* (1999) .

The mean performance of genotypes and F1 hybrids in normal irrigation and rainfed conditions are presented in table (2) :Giza blanka gave the highest values for seed yield / plant, number of seeds/plant and 100-seed weight in both environments, mean while, it had moderate values for other traits. Also Giza 717 ranked the second for100-seed weight and seed yield/plant while Triple white, variety gave moderate values for most traits .

The parents Giza461 Moshtohor 103 and109 gave low values for all the studied traits under both normal irrigation and rainfed conditions. The cross Triple white X Giza 461 showed significant higher mean values in both irrigation conditions followed by cross Giza blanka X Moshtohor 109 under normal irrigation and cross Giza 717 X Triple white while under rainfed , the cross Moshtohor 103 and 109 and each of Giza 717 , Triple white , and Giza 461 as well as Giza 643 gave the lowest

Table (2): Genotypes mean performance for the studied traits under normal irrigation and rainfed conditions .

Genotypes		No. of pods/plant		No. of seeds/plant		Seed yield (g/plant)		100-seed weight	
		Irrigation	Rainfed	Irrigation	Rainfed	Irrigation	Rainfed	Irrigation	Rainfed
Giza blanka	(P_1)	20.533	14.967	59.933	39.833	65.586	40.178	109.433	100.867
Giza-717	(P_2)	9.867	7.767	44.600	32.533	43.262	30.538	97.000	93.867
Tripe-White.	(P_3)	20.467	15.867	31.167	18.233	27.344	13.474	87.733	73.900
Giza-643	(P_4)	26.400	13.767	59.900	28.600	48.140	20.335	80.367	71.100
Giza-461	(P_5)	23.800	13.967	43.233	27.867	35.754	21.448	82.700	76.967
Moshtohor-109	(P_6)	32.167	17.333	41.700	17.100	36.529	12.432	87.600	72.700
Moshtohor-103	(P_7)	20.133	15.867	40.500	25.300	36.342	19.995	89.733	79.033
$P_1 \times P_2$		30.400	19.233	96.933	51.267	81.489	31.639	84.067	62.300
$P_1 \times P_3$		32.333	12.833	97.000	38.833	84.292	29.190	86.900	75.167
$P_1 \times P_4$		28.067	14.100	48.500	38.600	38.978	28.783	80.367	74.567
$P_1 \times P_5$		30.867	23.267	77.100	65.667	64.430	50.548	83.567	76.967
$P_1 \times P_6$		42.933	16.700	61.167	23.333	39.881	14.700	65.200	63.000
$P_1 \times P_7$		28.833	20.433	62.933	39.833	50.514	28.879	80.267	72.500
$P_2 \times P_3$		38.600	31.733	54.933	45.733	47.389	35.123	86.267	76.800
$P_2 \times P_4$		27.167	15.700	53.400	31.467	44.785	25.415	83.867	80.767
$P_2 \times P_5$		25.233	16.833	51.933	40.267	49.371	30.576	95.067	75.933
$P_2 \times P_6$		20.433	15.767	53.667	42.433	43.739	33.649	81.500	79.300
$P_2 \times P_7$		18.933	16.133	73.633	36.533	65.092	31.699	88.400	86.767
$P_3 \times P_4$		27.367	20.800	44.267	24.767	36.225	17.857	81.833	72.100
$P_3 \times P_5$		47.333	38.033	43.100	33.133	34.580	25.126	80.233	75.833
$P_3 \times P_6$		25.767	16.467	40.467	29.200	33.938	32.893	83.867	78.400
$P_3 \times P_7$		25.200	15.233	58.167	31.133	45.738	22.115	78.633	71.033
$P_4 \times P_5$		26.633	16.200	36.900	30.833	31.894	24.040	86.433	77.967
$P_4 \times P_6$		24.800	12.967	46.967	35.833	39.311	28.344	83.700	79.100
$P_4 \times P_7$		30.833	14.500	55.333	18.233	41.610	12.508	75.200	68.600
$P_5 \times P_6$		26.233	14.033	26.533	17.867	21.049	13.638	79.333	76.333

of pods/plant under both normal irrigation and rainfed condition , the cross Giza blanka X Giza 717 gave the highest number of seeds/plant . However , the cross Giza 641 X Moshtohor 109 showed the lowest one in this respect . However , the cross Giza 717 X Giza 461 and Moshtohor 109 X Moshtohor 103 had heavier 100-seed weight than the other crosses in under normal irrigation but, under rainfed irrigation the crosses Giza 717 X Moshtohor 103 and Giza 717 X Giza 461 gave significant higher 100-seed weight than that other crosses . Regarding seed yield/plant the two crosses Giza blanka X triple white Giza blanka X Giza 717 showed significant higher mean values compared with other crosses under normal irrigation . Generally , the crosses Giza blanka and each of Giza 717 , Giza 461 and Triple white , gave the highest seed yield/plant in both environments i.e normal irrigation and rainfed conditions and these results indicated that the parents Giza blanka , Giza 717 and 461 as well as Triple white , had the best ability to seed productivity under any condition at water deficit or normal condition and so that it could be used in program of improving and selection for yield and its attributes under drought condition .

Heterosis expressed as the percentage deviation of F1 mean performance from better parent average values for all traits studied under normal irrigation and rainfed conditions are presented in table (3).

With respect to number of pods/plant, the crosses Triple white X Giza 461, Giza 717 X Triple white, Giza blanka X Giza 717 had positive and highly significant heterotic effects relative to better parents in normal irrigated and rainfed condition. However, the crosse Giza blanka X Moshtohor 103 exhibibted positive and significant heterotic effcct relative to better parents and these was true in both environments Significant positive heterotic effects for number of pods/plant over the better parents were recorded by Abul-Naas *et al* (1991), AboEl-Zahab *et al* (1994) and Helal (1997)

For number of seeds/plant, the crosses Giza blanka X Giza 461, Giza 717 X Triple white and Giza 717 X Moshtohor 103 had significant positive heterosis relative to better parents in both environments i.e. normal and rainfed irrigations. Significant positive heterotic effects for number of seeds/plant were recorded by Abo El-Zahab etal 1994 and Helal (1997)

Table (3): Percentage of heterosis in the F_1 generation over better parent for the studied Traits under irrigated and rainfed conditions .

Crosses	No. of pods/plant		No. of seeds/plant		Seed yield (g/plant)		100-seed weight	
	Irrigation	Rainfed	Irrigation	Rainfed	Irrigation	Rainfed	Irrigation	Rainfed
Giza blanka × Giza-717	48.05**	28.51**	61.74**	28.70	24.25**	-20.51**	-23.18**	-38.24**
Giza blanka × Tripe-White	57.47**	-19.12	61.85**	-2.51	28.52**	-27.35**	-20.59**	-25.48**
Giza blanka × Giza-643	6.31	-5.79	-19.08*	-3.09	-40.57**	-28.63**	-26.56**	-26.07**
Giza blanka × Giza-461	29.69*	55.46**	28.64**	64.86**	-1.76	25.80**	-23.64**	-23.70**
Giza blanka × Moshtohor-109	33.47**	-3.65	2.06	-41.42*	-39.19**	-63.41**	-40.42**	-37.54**
Giza blanka × Moshtohor-103	40.42*	28.78*	5.01	0.000	-22.98**	-28.12**	-26.65**	-28.12**
Giza-717 × Tripe-White	88.60**	100.00**	23.17*	40.57*	9.54	15.01	-11.07**	-18.18**
Giza-717 × Giza-643	2.90	14.04	-10.85	-3.28	-6.97	-16.78	-13.54**	-13.96**
Giza-717 × Giza-461	6.02	20.53	16.44	23.77	14.12	0.12	-1.99	-19.11**
Giza-717 × Moshtohor-109	-36.48**	-9.04	20.33	30.43	1.10	10.19	-15.98**	-15.52**
Giza-717 × Moshtohor-103	-5.96	1.68	65.10**	12.30	50.46**	3.81	-8.87*	-7.56
Tripe-White × Giza-643	3.66	31.09**	-26.10**	-13.40	-24.75**	-12.19	-6.73	-2.44
Tripe-White × Giza-461	98.88**	139.70**	-0.31	18.90	-3.284	17.15	-8.55*	-1.47
Tripe-White × Moshtohor-109	-19.90	-4.99	-2.96	60.15*	-7.09	69.91**	-4.41	6.09
Tripe-White × Moshtohor-103	23.13	-3.99	43.62**	23.06	25.85*	10.60	-12.37**	-10.12*
Giza-643 × Giza-461	0.88	15.99	-38.40**	7.81	-33.75**	12.09	4.51	1.30
Giza-643 × Moshtohor-109	-22.90*	-25.19	-21.59*	25.29	-18.34*	39.39**	-4.45	8.80
Giza-643 × Moshtohor-103	16.79**	-8.61	-7.62	-36.25	-13.57	-38.49**	-16.20**	-13.20**
Giza-461 × Moshtohor-109	-18.45	-19.04	-38.63**	-35.88	-42.38**	-36.41**	-9.44*	-0.82
Giza-461 × Moshtohor-103	3.36	2.10	3.93	12.92	-6.20	-2.49	-15.45**	-15.90**
Moshtohor. 109 × Moshtohor-103	-19.59	-1.15	4.48	33.47	11.51	13.48	4.20	-14.97**

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

For , 100-seed weight ., non of the crosses exceeded better parent for this trait . Positive heterosis for 100-seed weight was reached before by Helal (1997) , El-Hosary (1987) and (1988) and Omer *et al* (1998) .

Concerning seed yield/plant of all combination crosses significant positive heterotic effects relative to better parent in normal irrigation were crosses Giza blanka X Giza 717 , Giza 717 X Moshtohor 103 and Triple white X Moshtohor 103. While, the crosses Giza blanka X Giza 461 .Triple white X Moshtoror 109 and Giza 643 X Moshtohor 109 revealed positive and highly significant heterotic effects relative under rainfed condition compared with the other crosses in this respect .

The components of yield for individual crosses also , showed in most cases , less heterosis than yield *Per se*. Also , the heterotic effects were lower in rainfed irrigation than those of normal irrigation . Many investigators reported high heterosis for seed yield of faba bean among them El-Hosary etal (1992) , Abd-El-Aziz (1993) and El-Hosary etal (1997).

General and specific combining ability effect:

Estimates of G.C.A. effects for individual parents in normal and rainfed irrigation are presented in table(4) : General combining found to be differ significantly from zero in all traits . High positive values would be of interest for all traits in question where high positive effects would be useful from the breeder's point of view .

The parental variety Triple white in both environments , Giza 461under rainfed and Giza blanka under normal irrigation had considerably significantly positive gi for number of pods/plant and proved to be good combines in this respect .

The two parents Giza blanka and Giza 717 could be considered as best parents in number of seed/plant and seed yield/plant under both normal and rainfed irrigation compared with the other parents in this respect .

For the seed index (100-seed weight) , the two parents Giza 717 and Triple white could be considered as excellent parent in breeding program towards releasing varieties characterized by high seeds . the other parents exhibited either significant negative or insignificant gi for this trait .

Concerning seed yield/plant and its attributes , it is worth noting that the parent which possessed high gi for seed yield might be also so in one or more of yield components may not necessarily have high general combining

Table (4): Estimates of general combining ability effects for parental varieties/or lines regarding studied traits in the F_1 generation.

Parental Variety or line	No. of pods/plant		No. of seeds/plant		Seed yield (g/plant)		100-seed weight (g)	
	Irrigation	Rainfed	Irrigation	Rainfed	Irrigation	Rainfed	Irrigation	Rainfed
Giza Blanka	1.87*	-0.19	15.23**	7.95**	12.53**	4.29**	-2.35*	-4.16**
Giza-717	-4.13**	-0.81	5.25**	5.24*	6.18**	5.41**	4.05**	4.70**
Tripe-White.	2.21*	3.18**	-7.85**	-5.44*	-4.78**	-1.70*	3.25**	4.20**
Giza-643	0.01	-1.83*	-2.36*	-3.19*	-2.99*	-2.82**	-2.74*	-1.33
Giza-461	1.20	1.58*	-6.61**	1.04	-7.52**	0.57	-1.21	-0.41
Moshtohor. 109	1.41	-1.17*	-2.91*	-2.93	-0.56	-2.80**	-0.39	-1.13
Moshtohor .103	-2.57*	-0.76	-0.76	-2.67	-2.86*	-2.95**	-0.60	-1.85*
L.S.D. 0.05 $\hat{g}i$	1.47	0.98	2.12	2.96	1.73	1.16	1.57	1.64
0.01	1.96	1.31	2.82	3.94	2.31	1.54	2.09	2.19
L.S.D 0.05 ($\hat{g}i$-$\hat{g}j$)	2.25	1.50	3.23	4.51	2.65	1.77	2.39	2.50
0.01	3.0	2.0	4.31	6.02	3.53	2.36	3.19	3.34
R	**0.654**	**0.179**	**0.644**	**0.884****	**0.817***	**0.846***	**0.075**	**-0.107**

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

**** r= Correlation coefficient between the parental performance and their G.C.A. effects.***

Table (5): Estimates of specific combining ability effects for F_1 crosses regarding studied traits.

Crosses	No. of pods/plant		No. of seeds/plant		Seed yield (g/plant)		100-seed weight (g)	
	Irrigation	Rainfall	Irrigation	Rainfedll	Irrigation	Rainfed	Irrigation	Rainfall
Giza blanka × Giza-717	5.45**	2.96*	23.15**	4.87	25.09**	-5.33**	-2.22	-14.16**
Giza blanka × Tripe-White	1.05	-7.43**	0.48	-12.38**	-8.14**	-6.12**	-20.29**	-12.95**
Giza blanka × Giza-643	-1.01	-1.16	-17.67**	0.63	-18.29**	1.63	0.86	4.14
Giza blanka × Giza-461	0.58	4.60**	15.17**	23.47**	6.95**	17.99**	2.53	5.64**
Giza blanka × Moshtohor-109	12.44**	0.78	31.37**	0.61	31.75**	1.18	5.06*	4.54
Giza blanka × Moshtohor-103	2.32	4.11	-4.84	1.35	-8.08**	1.75	-1.37	2.59
Giza-717 × Tripe-White	13.31**	12.09**	2.96	9.44*	-1.89	7.76**	-10.39**	-5.51**
Giza-717 × Giza-643	4.09	1.06	-2.79	-3.79	-5.59*	-4.45**	-2.04	1.49
Giza-717 × Giza-461	0.95	-1.22	-0.02	0.79	-9.39**	-2.43	7.63**	-4.25
Giza-717 × Moshtohor-109	-4.06	0.47	-0.72	10.22**	0.23	8.69**	-1.98	2.68
Giza-717 × Moshtohor-103	-1.58	0.43	15.84**	0.77	17.32**	5.81**	0.36	8.01**
Tripe-White × Giza-643	-2.05	2.17	3.88	11.26**	1.84	9.39**	-1.41	0.32
Tripe-White × Giza-461	16.71**	15.99**	-12.31**	-10.93**	-3.69	-7.07**	-7.30**	-3.35
Tripe-White × Moshtohor-109	-5.06**	-2.82	-2.08	4.37	-5.10*	4.12**	-3.58	-0.58
Tripe-White × Moshtohor-103	-1.64	-4.46**	-1.12	8.68*	-5.65*	2.69	6.26**	-11.06**
Giza-643 × Giza-461	-1.78	-0.84	-7.44**	-0.22	-2.01	5.04**	5.78**	3.82
Giza-643 × Moshtohor-109	-3.82	-1.32	-3.77	-2.32	-1.89	-3.05	0.37	-1.35
Giza-643 × Moshtohor-103	6.19**	-0.19	5.15	-9.11*	3.95	-7.96**	-6.06**	-4.13
Giza-461 × Moshtohor-109	-3.59	-3.66**	-0.69	1.82	-2.78	1.33	-2.76	1.48
Giza-461 × Moshtohor-103	-1.24	-1.90	-1.00	-0.10	0.44	-2.98	-6.92**	-7.17**
Moshtohor. 109 × Moshtohor-103	-0.18	1.78	8.53**	3.53	8.22**	1.88	-4.96*	-1.89
L.S.D 0.05	4.28	2.85	6.16	8.59	5.04	3.37	4.56	4.77
(S_{ij}) 0.01	5.71	3.80	8.21	11.46	6.73	4.49	6.08	6.36
L.S.D 0.05	6.35	4.24	9,15	12.77	7.49	5.00	6.77	7.08
$(S_{ij}-S_{ik})$ 0.01	8.48	5.56	12.20	17.03	9.99	6.67	9.03	9.44
L.S.D 0.05	5.94	3.96	8.56	11.94	7.01	4.68	6.33	6.62
$(S_{ij}-S_{kl})$ 0.01	7.93	5.28	11.41	15.93	9.35	6.24	8.45	8.83

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

ability effect for seed yield . In worth mentioning that gi for seed yield/ plant was largely manifested in parents showing high gi for number of seed/pant .

Significant correlation coefficient values between the parental performance (x) and its gi were obtained for number of seed/plant in rainfed and seed yield/plant in both environments i.e normal irrigation and rainfed condition . This finding indicates that the parental material gave good index of intersting performance of their general combining ability effects . Therefore , selection among the tested parental population for initiating any proposed breeding program could be practiced either on the basis of mean performance or (gi) with similar efficiency for the rest cases, insignificant correlation coefficient values were detected between the two variables . This disagreement revealed that hybrids characterized with high mean values could be expected by crossing between varieties of low performance for these cases . A rather good agreement between ranking of parental performance and their G.C.A effects was reported by El-Hosary and Sedhom (1988) and Abul -Nass *et al* (1991) .

Specific combining ability effects of the parental combinations were computed in separate environments table (5) :

The three crosses Giza blanka X Giza 717 , Giza 717 X Tripe white and Triple white X Giza 461 had positive and highly significant S.C.A for number of pods/plant under normal and rainfed irrigation

Regarding number of seed/ plant , five crosses i.e. Giza blanka and each of Giza 717 , Giza 461 and Moshtohor 109 as well as the crosses Giza 717 X Moshtohor 103 and Moshtohor 103 X Moshtohor 109 had positive and highly significant values in number of seeds/plant .but , the crosses Giza blanka X Giza 461 , Giza 717 X Triple white, Giza 717 X Moshtohor 109, Triple white X Giza 643 and Triple white X Moshtohor 109 had positive and high significantly values under rain fed irrigation . Regarding seed yield/plant , five crosses showed significantly positive S.C.A under normal irrigation . The best combinations were Giza blanka with each of Giza 717 , 641 and Moshtohor–109 as well as the crosses Giza 717 X Moshtohor 103 and Moshtohor 109 X and Moshtohor 109 X Moshtohor 103 However, the crosses Giza blanka X Giza 461 , Giza 717 X Triple white, Giza 717 X Moshtohor 109 , Giza 717 X Moshtohor 103 , Triple white X Giza 461 Triple white X Giza 643 , Triple white X Moshtohor 109 and Giza 643 X Giza 461 showed significant and positive S.C.A under rainfed condition.

Considering 100- seed weight. under normal irrigation . the crosses Giza 717 X Giza 461 , Giza blanka X Moshtohor 109 , Triple whit X Moshtohor 109 and Triple white X Moshtohor 103 gave the highest positve values of S.C.A while , Giza blanka X Giza 461 and Giza 717 X Moshtohor 103 showed significant positive S.C.A under rainfed . It could be concluded that previous crosses seemed to the best combinations for drought tolerance .

If crosses showing high specific combining ability effects involving only one good combine such combination would show desirable transgressive segregates , providing that the additive genetic system present in the good combiner as well as the complementary and epistatic effects present in the crosses . Therefore, the most of the previous crosses might be of prime importance in breeding to drought tolerant varieties by using traditional breeding procedure .

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التهجينات التبادلية لتحسين الفول البلدى تحت الظروف المطرية

١-المحصول ومكوناته

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أجريت هذه الدراسة خلال موسمى شتاء ١٩٩٩/٩٨ ، ٢٠٠٠/٩٩ بهدف معرفة مكونات التباين الوراثى وقوة الهجين لصفات المحصول ومكوناته للهجن المتبادلة فى اتجاه واحد بين سبعة أصناف من الفول البلدى هى جيزة بلانكا ، جيزة ٧١٧ ، Triple white، جيزة ٦٤٣ ، جيزة ٧٦١ ، مشتهر ١٠٩ ، مشتهر ١٠٣ حيث تم تقييم الآباء والهجن الناتجة تحت ظروف الزراعة المطرية ، الرى كل ٢٥ يوم فى تجربتين صممتا بنظام القطاعات الكاملة العشوائية فى ثلاث مكررات وذلك بمنطقة مربوط بمحافظة الإسكندرية . ويمكن تلخيص أهم النتائج المتحصل عليها فيما يلي:

- أظهرت النتائج المتحصل عليها تباين معنوى بين التراكيب الوراثية فى كل الصفات المدروسة سواء تحت ظروف الزراعة المطرية أو الرى العادى، هذا ولقد وجد تباين معنوى بين الآباء بكل الصفات المدروسة تحت نظامى الرى باستثناء صفتى عدد البذور/ نبات ووزن ال١٠٠ بذرة . بالإضافة إلى هذا كان التباين الراجع إلي القدرة العامة والخاصة على الائتلاف معنوياً لكافة الصفات المدروسة تحت نظامى الرى.
- أشارت البيانات المتحصل عليها تحت ظروف بيئتى الدراسة إلى أن التباين الوراثى فى صفتى عدد البذور/ نبات ومحصول بذور/ نبات يرجع إلى اثر الفعل الجينى المضيف.
- أظهرت القدرة العامة على الائتلاف لصنفى الآباء جيزة بلانكا ، جيزة ٧١٧ أثر موجب ومعنوى على المحصول وواحد أو أكثر من مكوناته تحت ظروف بيئتى الدراسة . هذا وقد أظهرت التهجينات (جيزة بلانكا X جيزة ٤٦١)، (جيزة ٧١٧ X مشتهر ١٠٣) كونهما أفضل التراكيب الوراثية الواعدة فى التربية لزيادة المحصول ومكوناته حيث أن لقدرتهما الخاصة على الائتلاف أثر موجب ومعنوى على المحصول وبعض مكوناته سواء تحت ظروف الزراعة المطرية أو المروية ، لذا يمكن الاعتماد عليهما فى برنامج تربية الفول البلدى لتحمل الجفاف.