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GENETICAL ANALYSIS OF DIALLEL CROSSES IN MAIZE (*Zea mays* L.) OVER TWO YEARS

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ABSTRACT

This work was undertaken during three successive seasons to evaluate combining ability and heterosis for 8 inbred lines of maize. A half diallel crosses among 8 new developed inbred lines of maize (*Zea mays* L.) were evaluated for nine quantitative characters. Year mean squares were significant for all traits except for ear length. Hybrid mean squares were significant for all traits in the two growing seasons as well as the combined data. Significant hybrids by years mean squares were detected for all studied characters except for no. of kernels/row and shelling %. Mean squares associated with general and specific combining ability in combined data were significant for all traits. Also, high G.C.A./S.C.A ratios which largely exceeded the unity were obtained for ear length, ear diameter, no. of rows/ear, 100-kernel weight and grain yield/plant in combined analysis. Significant interactions mean square between years and general combining ability was detected for all traits except for ear height, ear diameter and grain yield/plant. Whereas, significant interaction mean squares between years and S.C.A. were obtained for plant and ear heights, ear diameter, no. of rows/ear and grain yield/plant. The best combiners parental lines were: P_3 for 100-kernel weight, P_4 for no. of rows/ear and grain yield/plant, P_5 for ear diameter and no. of rows/ear and P6 for plant height, ear length, no. of kernels/row and grain yield/plant. The most desirable S.C.A effects were detected for the crosses: P_1xP_6 for plant height; P_2xP_4 for ear height, ear length and no. of kernels/ row; P_1xP_5 for ear diameter and P_3xP_7 for shelling %, 100 kernel weight and grain yield/ plant. The highest mean values for grain yield/plant were detected in the crosses P_2xP_4, P_3xP_7 and P_4xP_6 in the combined analysis. Three crosses, namely, P_2xP_4, P_3xP_7 and P_4xP_6 expressed highly significant and positive heterotic effects for grain yield over both seasons being 16.68, 17.24 and 19.72, respectively.

Key words: Combining ability, diallel analysis, heterosis

INTRODUCTION

Maize (*Zea mays* L.) is considered one of the most important cereal crops in the world. It ranks the third after wheat and rice of the world production. This crop is used for human consumption as well as animal feeding. It also used in industrial purposes such as manufacturing starch and coking oils. Therefore increasing the productivity of such crop is the main target of corn breeders. To achieve this target more information is needed for the successful breeding programs such as the relative amount of genetic variance components and their interaction with environment for yield and its components. The diallel cross is of common usage in this respect for its power and versatility. With this method the resulting total genetic variation is partitioned into the effects of general and specific combining ability (G.C.A. and S.C.A.). The magnitude of genetic components for a certain character would depend mainly upon the environmental conditions under which the genetic materials will be evaluated. Therefore, many efforts have been devoted by maize breeders to study the interaction between environment and the genetic components. Matiznger *et al.* (1959) concluded that the additive genetic variance was more affected by genotype X environment interaction than the non-additive variance for grain yield per plant. The same conclusion was reached by Abdel- Sattar (1986), Galal *et al.* (1987) and El-Hosary and Sedhom (1990). On the contrary, Nawer (1985) and Sedhom (1992) reported that the non-additive effects were more biased by interaction with environment than additive effects.

The objective of the present investigation was to estimate general and specific combining ability and their interaction with growing year and to determine the relative increase of grain yield in 28 single crosses over to the check variety S.C.10.

MATERIALS AND METHODS

Eight inbred lines i.e. Moshtohor 1, M_1 (P_1), M_2 (P_2), M_3 (P_3), M_4 (P_4), M_5 (P_5), M_7 (P_6), M_8 (P_7) and M_9 (P_8) which were developed at the Department of Agronomy, Faculty of Agric. at Moshtohor, Benha Univ. were used in this study. (These parental inbred lines were isolated from different genetic resources and were at S_8 stage of inbreeding. Also, theses materials represented a wide range of variability for yield and most of its components). A half diallel set of crosses was carried out in 2002 season. The eight inbred lines were split planted in May 15^{th}, 25^{th} and June 5^{th} to avoid differences in flowering time and to secure enough hybrid seeds. The resultant 28 crosses along with a check (S.C.10) were planted in a randomized complete block design with three replications in the two successive seasons of 2003 and 2004 at the Agricultural Research and Experimental Station of the Fac. of Agric., Moshtohor. The planting dates for 2003 and 2004 seasons were May 30th and June 5th, respectively. In both seasons, each plot consisted of two ridges of six meters length and 70 cm width. Hills were spaced at 30 cm with three kernels per hill on one side of the ridge. The seedlings were later thinned to one plant per hill. The cultural practices were followed as usual for ordinary maize field in the area. Random sample of 20 guarded plants in each plot were taken to evaluate plant height (cm), ear height (cm), ear length (cm) ear diameter (cm), no. of kernels/row, no. of rows/ear, shelling %, 100-kernel weight and grain yield/plant which was adjusted for 15.5% moisture. The obtained data was statistically analyzed for analysis of variance using computer statistical program MSTAT-C. General and specific combining ability estimates were estimated according to Griffing's (1956) diallel cross analysis designated as method 4 model I for each experiment. The combined analysis of the two experiments was carried out whenever homogeneity of variance was detected (Gomez and Gomez, 1984). Means were compared by Multiple Range Test (Duncan, 1955). Heterosis expressed as the percentage deviation of the F_1 mean performance from S.C.10 was determined for grain yield/ plant.

RESULTS AND DISCUSSION

Analyses of variances for all traits in each season as well as the combined analysis are presented in Table (1). Test of homogeneity revealed that the error variance for the two seasons were homogenous, therefore combined analysis was processed. Year's mean squares were significant for all the studied traits except for ear length. Moreover, mean values of the first season were relatively higher than those of the second one for most traits (data not included). Falconer (1960) suggested that a character measures in two different environments could be regarded not as one character but as two. The physiological mechanisms are to some extent different and consequently the genes required for high productivity are also different.

Results in Table (1) showed that crosses mean squares were significant for all traits in the two growing seasons as well as the combined data. The interactions between crosses and year mean squares were significant for all of the studied characters except for no. of kernels/row and shelling %. Such results indicated that these crosses behaved in different way from one seasons to another, consequently they ranked differently in the two growing seasons. For the exceptional cases, the studied crosses responded similarly for environmental fluctuations.

Variances associated with general and specific combining abilities (G.C.A. and S.C.A.) for all traits in both seasons as well as the combined analysis are also presented in Table (1). Significant general combining ability mean squares were detected for all characters in both seasons and the combined data except ear height in the second season. Also, significant specific combining ability variances were obtained for all traits in both seasons and the combined data. It is clear that, the significant S.C.A. mean squares were accompanied by significant G.C.A. variances in most traits. This indicates that both additive and non-additive types of gene action are important in controlling the traits under study. To clarify the relative magnitude of each genetic component, the G.C.A./S.C.A. ratio was calculated. High ratios which largely exceeded the unity were obtained for ear length, ear diameter, no. of rows/ear and 100-kernel weight in both seasons and the combined data, for plant height in the first season; for no. of kernels/row in both seasons; for shelling % in the second season and for grain yield/plant in the second season and combined analysis. Such results indicated that the additive and additive X additive types of gene action were more important than non-additive effects in the expression of these traits. The importance of additive genetic variance on controlling such traits were reported by Galal *et al.* (1987), Nawar *et al.* (1988), EL-Hosary and Sedhom (1990), Abdel-Sattar (1992), Sedhom (1994), Gohar (2004), and EL-Hosary and EL-Badawy (2005).

Table (1): Mean squares from ordinary analysis and combining ability for studied traits over the two years.

S.O.V / Trait	d.f.		Plant height			Ear Height			Ear Length (cm)			Ear Diameter (cm)			No. of rows/ ear		
	S	Comb.	S1	S2	Comb.	S1	S2	Comb.	S1	S2	Comb.	S1	S2	Comb.	S	S1	Comb.
Years		1			7529.46**			1507.20**			0.19			1.41**			20.65**
Blocks/Y	2	4	121.35	223.65	172.50	50.03	104.80	77.42	1.30	0.38	0.84	0.06	0.01	0.03	0.33	0.63	0.48
Hybrid	27	27	675.09**	741.78**	856.09**	505.31**	289.70**	594.45**	4.24**	4.81**	6.83**	0.11**	0.10**	0.14**	2.07**	3.27**	4.00**
Hybrid x Y		27			560.77**			200.55**			2.23*			0.07**			1.34**
Error	54	108	102.32	95.32	98.82	87.31	42.53	64.92	1.26	1.40	1.33	0.04	0.02	0.03	0.42	0.72	0.57
G.C.A	7	7	252.77**	154.28**	246.65**	148.28**	21.95	128.16**	2.20**	2.84**	3.35**	0.07**	0.05**	0.10**	1.02**	2.99**	3.49**
S.C.A	20	20	215.32**	279.80**	298.92**	175.49**	122.68**	222.65**	1.14**	1.17**	1.90**	0.03**	0.02*	0.03**	0.58**	0.42*	0.58**
G.C.A x Y		7			160.41**			42.07			1.69**			0.02			0.51**
S.C.A x Y		20			196.20**			75.52**			0.41			0.02*			0.42**
Error	54	108	34.11	31.77	32.94	29.10	14.18	21.64	0.42	0.47	0.44	0.01	0.01	0.01	0.14	0.24	0.19
G.C.A/S.C.A			1.17	0.55	0.83	0.84	0.18	0.58	1.93	2.42	1.76	2.84	2.11	3.92	1.76	7.04	6.03
G.C.A x Y/G.C.A					0.65			0.32			0.50			0.2			0.15
S.C.A x Y/S.C.A					0.66			0.34			0.22			0.67			0.72

Table (1): Cont,

S.O.V / Trait	d.f.		No. of kernels / row			Shelling %			100-Kernel weight			Grain yield/plant(g)		
	S	Comb.	S1!	S2	Comb.	S1	S2	Comb.	S1	S2	Comb.	S1	S2	Comb.
Years		1			247.23**			88.45*			181.04**			1134.12*
Blocks/Y	2	4	62.25	5.93	34.09	11.77	6.03	8.90	64.75	12.74	38.74	56.49	150.86	103.68
Hybrid	27	27	55.23**	54.33**	83.74**	54.77**	55.23**	96.36**	89.01**	55.99**	116.69**	1958.40**	1929.50**	3381.66**
Hybrid x Y		27			25.81			13.64			28.31*			506.24**
Error	54	108	21.00	17.72	19.36	15.55	14.59	15.07	14.92	16.56	15.74	257.38	268.61	263.00
G.C.A	7	7	21.15**	18.44**	21.28**	12.66**	30.33**	31.72**	34.48**	40.35**	57.80**	435.38**	877.16**	1170.44**
S.C.A	20	20	17.45**	17.99**	30.23**	20.2**	14.24**	32.26**	27.99**	11.07*	32.28**	728.90**	561.27**	1112.09**
G.C.A x Y		7			18.30**			11.28*			17.03**			142.10
S.C.A x Y		20			5.21			2.19			6.78			178.07*
Error	54	108	7.00	5.91	6.45	5.18	4.86	5.02	4.97	5.52	5.25	85.79	89.54	87.67
G.C.A/S.C.A			1.21	1.02	0.70	0.63	2.13	0.98	1.23	3.64	1.79	0.60	1.56	1.05
G.C.A x Y/G.C.A					0.85			0.36			0.29			0.12
S.C.A x Y/S.C.A					0.17			0.07			0.12			0.15

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

! S1, S2 and Comb. refers to first season, second season and combined data, respectively.

Significant interaction mean squares between years and general combining ability were detected for all traits except for ear height, ear diameter and grain yield/plant. Whereas, significant interaction mean squares between years and specific combining ability were obtained for plant and ear heights, ear diameter, no. of rows/ear and grain yield/plant. However, the ratio between S.C.A. X years/S.C.A. was relatively higher than that of G.C.A. X years/G.C.A. for plant height, ear height, ear diameter, no. of rows/ear and grain yield/plant. Such results indicated that non-additive gene effects were more sensitive for different growing seasons. On the other hand, the ratio of G.C.A. X years/G.C.A. was higher than of S.C.A. X years/S.C.A. for ear length, no. of kernels/row, shelling % and 100-kernel weight reveling that additive and additive X additive effects were more biased by environment more than no-additive gene action for such trait. These results are in the same line with those reported by Matzinger *et al.* (1959), EL-Hosary and Sedhom (1990) and Sedhom (1994).

Estimates of general combining ability effects ($\hat{g}_i$) for individual inbred lines over the two experiments are presented in Table (2). High positive values would be of interest for all traits in question except, plant and ear heights, where high negative ones would be useful from the breeder point of view. The parental inbred line P_2 behaved as the best combiner for plant and ear heights; meanwhile it was on the average in the rest traits. The parental inbred lines P_7 and P_8 were poor combiners for most studied traits.

Table (2): General combining ability effects for all studied traits over the two years.

Trait / Inbred line	Plant height	Ear height	Ear Length (cm)	Ear Diameter (cm)	No. of rows/ ear	No. of kernels/ row	Shelling %	100-Kernel weight	Grain yield/ plant (g)
P1	0.80	5.13**	0.59*	-0.09	-0.57**	-0.28	0.39	3.29**	8.11*
P2	-8.29**	-5.87**	-0.44	-0.15	-0.82**	-0.64	0.73	0.17	-9.25*
P3	0.72	1.03	-0.42	-0.08	0.02	-1.97*	0.69	2.40**	3.07
P4	1.98	-0.38	0.22	0.02	0.42*	1.70	-0.02	-0.23	11.69**
P5	2.40	0.27	0.19	0.13**	0.33*	0.04	0.82	-0.26	0.97
P6	-4.68*	-2.16	0.68**	0.07	-0.40*	2.16*	1.56	0.41	9.20*
P7	0.58	2.73	0.01	0.05	0.71**	-0.50	-3.75**	-2.55**	-9.01*
P8	6.49**	-0.76	- 0.83**	0.05	0.30	-0.50	-0.41	-3.22**	-14.78**
LSD 5% (gi)	4.36	3.53	0.51	0.8	0.33	1.93	1.70	1.74	7.11
LSD 1% (gi)	5.78	4.69	0.67	0.10	0.44	2.56	2.26	2.31	9.43
LSD 5% (gi-gj)	6.59	5.34	0.76	0.11	0.50	2.92	2.57	2.63	10.75
LSD 1% (gi-gj)	8.74	7.08	1.01	0.15	0.66	3.87	3.41	3.49	14.26

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

The inbred line P_1 appeared to be good combiner for 100-kernel weight and grain yield/plant. The parental inbred line P_3 seemed to be good combiner for 100-kernel weight. On the contrarily, it expressed either significantly negative or non appreciable positive $\hat{g}_i$ effects for the rest traits. The parental line P_4 expressed the best combining effect for no. of rows/ear and grain yield/plant. The inbred line P_5 appeared to be good combiner for ear diameter and no. of rows/ear. The parental inbred line P_6 gave the most desirable $\hat{g}_i$ effects for plant height, ear length, no. of kernels/row and grain yield/plant. These results indicated that these parental inbred lines possess favorable genes and that improvement in yield may be attained if they are used in hybridization program.

The estimates of specific combining ability effects (S_{ij}) for all the studied traits combined over two growing seasons are presented in (Table 3). The most desirable inter-and intra-allelic interactions were presented by the combinations; P_1xP_6, P_2xP_7, P_3xP_8 and P_4xP_8 for plant height; P_1xP_6, P_1xP_7, P_1xP_8, P_2xP_4, P_4xP_7 and P_4xP_8 for ear height; P_1xP_6, P_1xP_7 and P_2xP_4 for ear length; P_1xP_5 for ear diameter; P_7xP_8 for no. of rows/ear; P_1xP_6, P_2xP_4 and P_2xP_7 for no. of kernels/row; P_1xP_5, P_2xP_4, P_2xP_8, P_3xP_7 and P_4xP_6 for shelling %; P_1xP_4, P_1xP_5, P_3xP_7 and P_6xP_8 for 100-kernel weight and P_2xP_4, P_3xP_7, P_4xP_6 and P_6xP_8 for grain yield/plant. However, the most desirable S.C.A effects were detected for the crosses: P_1xP_6 for plant height; P_2xP_4 for ear height, ear length and no. of kernels/ row; P_1xP_5 for ear diameter; P_3xP_7 for shelling %, 100 kernel weight and grain yield/ plant.

From the previous results, it could be concluded that the most desirable single cross was P_3xP_7 followed by the cross P_2 x P_4 since they expressed the highest significant and positive S.C.A effects for grain yield/ plant and at least two of its components. Therefore, these crosses would be prospective in maize breeding program.

The mean performances of the F_1 hybrids and S.C.10 for all of the studied traits in the combined analysis of the two growing seasons are presented in Table (4). Results indicated that the highest mean values for grain yield/plant were detected in the crosses (P_2xP_4, P_3xP_7 and P_4xP_6) in the combined analysis. Also the crosses P_1xP_5, P_2xP_4, P_3xP_7 and P_4xP_6 gave the highest values for shelling %. Whereas, the crosses P_1xP_4, P_1xP_5 and P_3xP_7 produced the highest means performances for 100-kernel weight. The crosses P_2xP_4 and P_1xP_6 had the best mean values for no. of kernels/row. Which the crosses P_3xP_7, P_4xP_7 and P_7xP_8 produced the highest mean values for no. of rows/ear. Also, the crosses P_1xP_6, P_1xP_7 and P_2xP_4 produced the best mean performances for ear diameter. Whereas, the crosses P_1xP_5, P_5xP_8 and P_7xP_8 were the highest mean values for ear length. The single crosses P_2xP_4 and P_1xP_6 were the best combination for dwarf-ness since it expressed the lowest value for ear height and plant height, respectively. Such variability among maize crosses were reported by several investigators. Among these are El- Hosary (1989), El- Hosary and Sedhom (1990), Sedhom (1994), Abde El- Azeem (2000), Gado *et al.* (2000) and Hammouda (2002).

Table (3): Specific combining ability effects for all studied traits over the two years.

Trait / Hybrid	Plant height	Ear Height	Ear Length (cm)	Ear Diameter (cm)	No. of Rows/ ear	No. of Kernels/ row	Shelling %	100-Kernel weight	Grain yield/ plant (g)
P1 x P2	14.41**	8.78*	-0.34	0.04	0.13	-3.45	-1.19	1.09	-5.21
P1 x P3	1.90	-1.95	-0.56	0.10	0.42	2.76	1.53	-3.01	2.88
P1 x P4	20.31**	24.62**	-0.27	-0.15	-0.40	-3.39	-0.11	6.19**	8.41
P1 x P5	-4.11	1.97	-0.39	0.25**	0.65	-3.66	4.80*	5.08*	13.57
P1 x P6	-18.19**	-9.76*	1.62**	-0.14	-0.59	4.98*	-1.44	-2.68	3.60
P1 x P7	-5.63	-7.99*	1.46*	-0.02	-0.25	2.38	-0.28	-2.21	1.31
P1 x P8	-8.70	-15.67**	-1.54**	-0.08	0.04	0.36	-3.30*	-4.46*	-24.55**
P2 x P3	1.99	-1.12	-0.52	-0.04	-0.04	-1.58	-3.86*	-0.34	-11.38
P2 x P4	-9.27	-15.71**	2.05**	0.08	0.23	9.04**	5.86**	-0.56	43.44**
P2 x P5	0.64	-2.36	-0.79	-0.03	-0.61	-4.45*	-2.57	2.55	-14.37
P2 x P6	-1.44	-4.93	-0.79	0.05	0.38	-2.36	0.30	-1.27	-13.18
P2 x P7	-13.04**	5.01	-0.08	-0.04	-0.48	5.23*	-2.57	-4.21*	-5.76
P2 x P8	6.72	10.33*	0.47	-0.05	0.38	-2.44	4.04*	2.74	6.46
P3 x P4	-7.78	4.73	0.21	-0.04	-0.39	-3.85	-0.73	-0.52	-23.49**
P3 x P5	2.47	-3.43	0.57	0.04	0.28	1.83	-2.34	-4.38*	-8.56
P3 x P6	-4.24	-4.11	-0.70	0.01	-0.47	-1.05	-4.28*	-1.85	-24.82**
P3 x P7	21.28**	8.78*	0.56	0.003	0.47	-1.23	9.42**	10.26**	52.82**
P3 x P8	-15.63**	-2.90	0.44	-0.09	-0.27	3.12	0.26	-0.17	12.55
P4 x P5	0.38	-0.35	-0.42	-0.06	0.02	0.88	1.02	-1.83	-1.88
P4 x P6	13.46**	11.75**	-0.32	0.10	0.68	0.86	4.63*	3.17	30.48**
P4 x P7	-3.22	-14.89**	-0.85	0.05	0.03	-0.95	-6.14**	-3.49	-28.39**
P4 x P8	-13.88**	-10.15*	-0.41	0.01	-0.17	-2.60	-4.53*	-2.95	-28.57**
P5 x P6	1.99	-1.73	-0.12	-0.06	0.70	0.47	0.14	-1.65	-0.31
P5 x P7	-8.89	0.71	0.31	-0.24**	-0.65	2.08	-0.76	-0.57	-0.83
P5 x P8	7.53	5.19	0.83	0.09	-0.39	2.85	-0.29	0.79	12.40
P6 x P7	-3.01	1.98	-0.66	0.09	-0.11	-4.56*	-1.41	0.23	-18.32*
P6 x P8	11.44*	6.80	0.96	-0.05	-0.58	1.66	2.07	4.05*	22.55**
P7 x P8	12.51*	6.40	-0.75	0.16	0.99**	-2.95	1.75	-0.01	-0.83
LSD5% (sij)	9.65	7.82	1.12	0.17	0.73	4.27	3.77	3.85	15.74
LSD1% (sij)	12.80	10.37	1.48	0.22	0.97	5.66	5.00	5.11	20.87
LSD5% (sij-sik)	14.74	11.94	1.71	0.26	1.12	6.52	5.75	5.88	24.04
LSD1% (sij-sik)	19.55	15.84	2.27	.034	1.49	8.65	7.63	7.80	31.89
LSD5% (sij-ski)	13.18	10.68	1.53	0.23	1.00	5.83	5.15	5.26	21.50
LSD1% (sij-ski)	17.48	14.17	2.03	0.30	1.33	7.74	6.83	6.98	28.52

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

Table (4): Mean performance of the crosses and S.C. 10 for all studied traits and heterosis relative to S.C. 10 for grain yield over the two years.

Trait / Hybrid	Plant height	Ear height	Ear length (cm)	Ear diameter (cm)	No. of rows/ear	No. of kernels/ row	Shelling %	100-Kernel weight	Grain yield/ plant(g)	Heterosis for grain yield/plant (g) !
P1 x P2	270.5 BG	156.0 BE	4.567 HI	17.17 EI	13.23 HI	31.67 GH	81.27 CH	37.08 BC	158.9 FJ	-12.21*
P1 x P3	267.0 DH	152.2 BG	4.700 DI	16.97 EI	14.37 CG	36.55 CH	83.95 AE	35.22 CE	179.4 CF	-0.88
P1 x P4	286.7 A	177.3 A	4.550 HI	17.90 BF	13.95 DH	34.07 DH	81.60 BH	41.78 AB	193.5 BC	6..91
P1 x P5	262.7 FI	155.3 BE	5.050 A	17.75 CF	14.90 BD	32.13 GH	87.35 A	40.65 AB	187.9 C	3.81
P1 x P6	241.5 L	141.2 GJ	4.600 GI	20.25 A	12.93 HI	42.90 AB	81.85BG	33.55 CG	186.2 CD	2.87
P1 x P7	259.3 GJ	147.8 DI	4.700 DI	19.42 AB	14.38 CG	37.63 BG	77.70 GI	31.07 DJ	165.7 DH	-8.45
P1 x P8	262.2 FI	136.7 IK	4.650 EI	15.58 I	14.27 CG	35.62 CH	78.02 FI	28.15 GJ	134.1 K	-25.91**
P2 x P3	258.0 GJ	142.0 FJ	4.500 I	15.97 GI	13.67 FI	31.85 GH	78.90 EI	34.77 CE	147.7 HK	-18.40**
P2 x P4	248.0 JL	126.0 K	4.717 CI	19.18 AD	14.33 CG	46.13 A	87.92 A	31.92 CH	211.2 AB	16.68**
P2 x P5	258.3 GJ	140.0 HJ	4.717CI	16.32 FI	13.40 GI	30.98 H	80.32 CI	35.00 CE	142.6 IK	-21.22**
P2 x P6	249.2 IL	135.0 JK	4.733 BI	16.80 EI	13.67 FI	35.20 CH	83.93 AE	31.85 CH	152.1 HK	-15.97**
P2 x P7	242.8 KL	149.8 CH	4.620 FI	16.83 EI	13.92 DH	40.12 BD	75.75 IJ	25.95 J	141.3 JK	-21.93**
P2 x P8	268.5 DH	151.7 BH	4.617 FI	16.55 EI	14.37 CG	32.45 FH	85.70 AC	32.23 CG	147.7 HK	-18.40**
P3 x P4	258.5 GJ	153.3 BF	4.667 DI	17.37 EH	14.55 CF	31.92 GH	81.28 CH	34.18 CF	156.6 GJ	-13.48**
P3 x P5	269.2 CH	145.8 DJ	4.850 AF	17.70 DF	15.13 BC	35.93 CH	80.52 CI	30.30 EJ	160.8 EJ	-11.16*
P3 x P6	255.4 HK	142.7 FJ	4.767 BH	16.92 EI	13.65 FI	35.18 CH	79.32 DI	33.50 CG	152.8 HK	-15.58**
P3 x P7	286.2 A	160.5 BC	4.733 BI	17.50 EG	15.70 AB	32.33 GH	87.70 A	42.65 A	212.2 AB	17.24**
P3 x P8	255.2 HK	145.3 DJ	4.650 EI	16.55 EI	14.55 CF	36.68 CH	81.88 BG	31.55 DI	166.1 DH	-8.23
P4 x P5	268.3 DH	147.5 DI	4.850 AF	17.35 EH	15.27 BC	38.65 BE	83.17 AF	30.22 EJ	176.1 CG	-2.71
P4 x P6	274.3 AF	157.2 BD	4.950 AC	17.93 BF	15.20 BC	40.75 BC	87.52 A	35.88 CD	216.7 A	19.72**
P4 x P7	262.9 FI	135.4 JK	4.883 AE	16.73 EI	15.67 AB	36.28 CH	71.43 J	26.27 IJ	139.6 JK	-22.87**
P4 x P8	258.2 GJ	136.7 IK	4.850 AF	16.33 FI	15.05 BC	34.63 DH	76.38 HI	26.13 J	133.6 K	-26.19**
P5 x P6	263.3 EI	144.3 EJ	4.900 AD	18.10 BE	15.13 BC	38.70 BE	83.87 AE	31.03 DJ	175.1 CG	-3.26
P5 x P7	257.7 GJ	151.7 BH	4.700 DI	17.87 CF	14.88 BD	37.65 BG	77.65 GI	29.17 FJ	156.4 GJ	-13.59**
P5 x P8	280.0 AD	152.7 BG	5.033 A	17.55 EG	14.73 BE	38.42 BF	81.47 BH	29.85 EJ	163.9 EI	-9.45
P6 x P7	256.5 GJ	150.5 BH	4.967AB	17.38 EH	14.70 BF	33.13 EH	77.75 FI	30.63 DJ	147.2 HK	-18.67**
P6 x P8	276.8 AE	151.8 BH	4.833 AG	18.17 BE	13.82 EI	39.35 BD	84.57 AD	33.78 CF	182.3 CE	0.72
P7 x P8	283.2 AB	156.3 BD	5.017 A	15.78 HI	16.50 A	32.08 GH	78.93 EI	26.77 HJ	140.7 JK	-22.27**
S. C. 10	282.2 AC	162.3 B	4.650 EI	19.28 AC	12.87 I	35.98 CH	86.68 AB	33.45 CG	181.0 CE	

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

! LSD for heterosis values were 18.42, 24.37 at 5% and 1%, respectively.

Heterosis values for grain yield/plant relative to S.C. 10 are presented in Table (4). Results indicated that the three cross combinations P_2xP_4, P_3xP_7 and P_4xP_6 expressed highly significant and positive heterotic effects for grain yield over both seasons being 16.68, 17.24 and 19.72, respectively. Hence it could be concluded that these crosses offer good possibility for improving grain yield of maize. Also, the most considerable heterosis was generally detected from combinations involving parental inbred lines that are very diverse in origin and widely different in their mean performance (Table 4). Also, the crosses P_1xP_3, P_1xP_4, P_1xP_5, P_1xP_6, P_1xP_7, P_3xP_8, P_4xP_5, P_5xP_6, P_5xP_8 and P_6xP_8 had insignificant useful heterotic effects for grain yield/ plant revealing that a hybrid program based in these materials may be useful for testing under different locations. Many investigators reported high heterosis for yield of maize, Nawar *et al.* (1988), Sedhom (1994) and El-Hosary and EL-Badawy (2005).

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التحليل الوراثي للهجن التبادلية في الذرة الشامية في موسمين

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قسم المحاصيل- كلية الزراعة بمشتهر- جامعة بنها

أجرى هذا البحث لمدة ثلاثة سنوات بهدف دراسة القدرة على التآلف وقوة الهجين لمجموعة من الصفات باستخدام نظام الهجن التبادلية بين ثمانية سلالات جديدة من الذرة الشامية. ففى موسم ٢٠٠٢ تم تهجين السلالات الأبوية لتكوين ٢٨ هجين فردى. وفى الموسمين التاليين ٢٠٠٣، ٢٠٠٤ تم تقييم الهجن الناتجة مع صنف مقارنة (هجين فردى ١٠) وذلك باستخدام تصميم القطاعات الكاملة العشوائية في ثلاثة مكرارات. وتم تقدير القدرة العامة والخاصة على التآلف طبقا لـ Griffing الطريقة الرابعة والموديل الأول. وأظهرت النتائج ما يلى: كان تباين السنوات معنويا لجميع الصفات تحت الدراسة ماعدا طول الكوز. وكان التباين الراجع الى الهجن معنويا لجميع الصفات وكذلك كان التباين الراجع الى التفاعل بين الهجن والسنوات معنويا لجميع الصفات ماعدا عدد حبوب الصف ومعدل التصافى. وكان التباين الراجع الى كلا من القدرة العامة والخاصة على التآلف معنويا لجميع الصفات تحت الدراسة. وكانت النسبة بينGCA/ SCA أكثر من الوحدة لصفات طول الكوز، قطر الكوز، عدد صفوف الكوز، وزن ١٠٠ حبة، محصول الحبوب للنبات وذلك في التحليل التجميعى للموسمين معا. وكان التفاعل بين كلا من القدرة العامة والخاصة على التآلف والسنوات معنويا في معظم الصفات. وأمكن الحصول على أفضل تأثيرات للقدرة العامة على التآلف في السلالة P_3 لصفة وزن ١٠٠ حبة والسلالة P_4 لصفة عدد صفوف الكوز ومحصول الحبوب للنبات، والسلالة P_5 لصفة قطر الكوز وعدد صفوف الكوز،

والسلالة P_6 لصفة ارتفاع النبات وطول الكوز وعدد حبوب الصف و محصول الحبوب للنبات. وأمكن الحصول على أفضل تأثيرات للقدرة الخاصة على التآلف فـي الهجـن: $P_1 x P_6$ لصفة أرتفاع النبات، $P_2 x P_4$ لصفة أرتفاع الكوز وطول الكوز وعدد حبـوب الصف، $P_1 x P_5$ لصفة قطر الكوز، $P_3 x P_7$ لصفة معدل التصافى ووزن ١٠٠ حبـة ومحصول الحبوب للنبات. وأعطت ثلاثة هجن أفضل قيم للمتوسطات وقـوة الهجـين لصفة محصول الحبوب بالنسبة للهجين الفردى ١٠. وبلغـت قـيم قـوة الهجـين ١٦,٦٨% ($P_2 x P_4$)، ١٧,٥ % ($P_3 x P_7$)، ١٩,٧٢ % ($P_4 x P_6$).