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ESTIMATION OF COMBINING ABILITY AND HETEROSIS IN SOME MAIZE INBRED LINES FOR THE IMPORTANT TRAITS

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ABSTRACT

The present investigation aimed to evaluate some maize inbred lines for their combining ability and its behavior over different environmental conditions with respect to the important traits. Therefore, possible combinations in a half diallel fashion were made among five inbred lines. The parental lines and their crosses were evaluated in two years, 2001 and 2002 at Farm of Sakha Agricultural Research Station for the following traits: days to 50% silking, plant height, ear height, no. of kernels/row, no. of rows/ear, ear length, ear diameter and grain yield per plant. The obtained results could be summarized in the following: The variances among genotypes and their partitions; inbreds, crosses and inbreds versus crosses were highly significantly different for all the studied traits in the two years and combined, indicating that the parental lines are different in their genetic constitutions. However, years and their interactions with genotypes and their partitions mean squares were significant for most of studied traits. Both general (GCA) and specific (SCA) combining ability mean squares were highly significant for all the studied traits in the two years and combined, indicating the contribution of additive and non-additive gene action in the genetic expression of these traits. Furthermore, the SCA mean squares were larger in magnitude than the corresponding values of GCA mean squares, which were verified by GCA/SCA ratio with values less than unity for all the studied traits except no. of rows/ear. This suggested the predominance of non-additive (dominance) genetic variance in the inheritance of the studied traits except for no. of rows/ear, which was mainly controlled by additive genetic variance. The inbred line L-7041 proved to be the best general combiner among the inbred lines in breeding toward developing early and increasing of number of rows/ear. While, the inbred lines Sd-7 and Sd-34 were the best general combiners for producing high yielding genotypes. Also, the results revealed that it is not necessary that parents having high general combining ability effects would also contribute to high SCA effects. Thus, the crosses (Gz-628 x L-8084), (Sd-7 x L-7041) and (L-7041 x L-8084) were defined as superior combinations, which showed the highest SCA and heterotic effects in most of studied traits.
In conclusion, judging by heterotic values general and specific combining ability as well as genetic variance components, the production of corn hybrids is the best breeding program for the improvement of these traits.
Key words: maize, combining ability, heterosis

INTRODUCTION

Combining ability analysis supply the breeders useful information regarding choice of parents for developing superior hybrids and/or determine the most effective breeding methods and supply the breeding program with important information concerning the inheritance of grain yield and other desirable traits. Hallauer and Miranda (1981) which stated that both general and specific combining ability effects should be taken into consideration when planning the maize into breeding program to produce and release new inbreds and crosses. Spaner *et al.* (1996), Abd El-Maksoud (1997), Paul and Dehanth (1999), Venkatesh *et al.* (2001) and El-Shenawy *et al.* (2003) estimated general and specific combining ability and their role in the inheritance of grain yield and other economical traits. They found that both GCA and SCA effects were important in the inheritance of the studied traits. On the other hand, Ochieng and Compton (1994), Abd El-Maksoud (1997), Desai and Singh (2000), Galal *et al.* (2002) reported that non-additive (dominance) genetic variances play the major role in the genetic expression in most of studied traits. The present investigation was carried out to evaluate some maize inbred lines for their combining ability in order to determine the most suitable breeding program for handling these materials to improve maize production.

MATERIALS AND METHODS

Genetic materials:

The genetic materials used in this investigation included five genetically divers inbred lines. The name, pedigree and origin of these lines are shown in Table 1. These inbred lines were provided by Maize Research Section, Sakha Agricultural Research Station. All possible combinations between these lines without reciprocal were made in 2000 season to obtain ten single crosses.

Table 1: The name, pedigree and origin of the parental inbred lines

Inbred Name (designation)		Pedigree	Origin
Sids – 7	(Sd-7)	Derived from American Early Dent	U.S.A.
Sids – 34	(Sd-34)	Derived from American Early Dent	U.S.A.
Giza – 628	(Gz-628)	Derived from Tepalcingo No.5 (Tep-5)	Mexico
L - 7041/6-6	(L-7041)	Derived from S.C. 36 x 132	Egypt
L - 8084/3.1.1.2.2.1	(L-8084)	Derived from S.C. 58 x 93	Egypt

Experimental procedure:

During 2001 and 2002 seasons, the five inbred lines and their ten F1,s were evaluated at farm of Sakha Agricultural Research Station using a Randomized Complete Block Design with four replications. Plot size was one row, each row were six m. long, 80 cm apart with spacing 25 cm between hills to obtain population density of 21000 plants per feddan. All cultural practices were applied as a recommended for maize cultivation. Data recorded on 50% silking date (days), plant height (cm), ear height (cm), no. of kernels/row, no. of rows/ear, ear length (cm), ear diameter (cm) and g rain yield per plant (gram).

Statistical Analysis:

The analyses of variances were done separately for each season as well as the combined data over both seasons according to Steel and Torrie (1980). The sum of squares among 15 genotypes (five inbred lines and ten single crosses) were partitioned into three sources; Inbreds (I), crosses (C) and inbred versus crosses (I vs. C). The genetic analyses for the diallel crosses were computed according to Griffing (1956) method-II, model-I as described by Singh and Chaudhary (1985).

RESULTS AND DISCUSSIONS

Analysis of variances for combining ability of the five inbred lines and their 10 single crosses for all studied traits in 2001, 2002 and their combined are presented in Table 2. Mean squares of genotypes and their partitions into inbreds (I), crosses (C) and inbred versus crosses (I vs. C) were significant for grain yield/plant (gram), silking date (days), plant height (cm), ear height (cm), number of kernels/row, no. of rows/ear, ear length (cm) and ear diameter (cm) traits in the two years and their combined with exception crosses in the case of silking date in the growing season 2002. Therefore, the comparison between the means of these genotypes and their partitions of this genotypic variance to its components are valid. However, years and their interactions with genotypes and their partitions (I, C and I vs. C) were significant for all the studied traits, except for lines x years for silking date, plant height, ear height and grain yield/plant; I vs. C x Y for no. of kernels/row, no. of rows/ear and ear length and C x Y for ear height and ear diameter. These results indicated that the genotypes and their partitions were differed in their performances in different environmental conditions for most studied traits. These results were in a close agreement with those of Ho *et al.* (1994), Abd El-Maksoud (1997), Galal *et al.* (2002) and Mosa (2003). The GCA and SCA mean squares were highly significant for all the studied traits in the two years and their combined, indicating the contribution of additive and non-additive gene action in the genetic expression of the previous traits. These results agree with those of Abd El-Maksoud (1997), Paul and Dehanth (1999), Zelleke (2000), Venkatesh *et al.* (2001) and El-Shenawy *et al.* (2003).

The obtained results revealed that the SCA mean squares were larger in magnitude than the corresponding values of GCA mean squares, which were verified by GCA/SCA ratio with values less than unity for all the studied traits with exception no. of rows/ear. This finding indicated that the non-additive genetic variances play the major role in the inheritance of all the studied traits except no. of rows/ear. In this respect, Ochieng and Compton (1994), Spaner *et al.* (1996) Abd El-Maksoud (1997), Desai and Singh (2000), Galal *et al.* (2002) and El-Shenawy *et al.* (2003) observed the same direction for most of yield component traits. Meanwhile, the GCA and SCA interacted significantly with years for all the studied traits except for SCA x Y for plant height and ear height and GCA x Y for grain yield per plant. Similar results were obtained by several investigators, among them Jay and Hallauer (1997), Zelleke (2000) and Galal *et al.* (2002).

The estimates of general combining ability effects of the five inbred lines for the studied traits in 2001, 2002 and their combined data are shown in Table 3. High positive values would be favorable except for silking date and ear height, where high negative effects would be useful from breeders point of view.

Table 2: Analysis of variance for heterosis and combining ability of the five inbreds and their 10 single crosses for the yield and other traits in 2001, 2002 and combined

S.O.V	D.F	Silking date			Plant height			Ear height			No of kernels/row		
		2	2002	Comb.	2001	2002	Comb.	2001	2002	Comb.	2001	2002	Comb.
Years (Y)	1			14.4**			88981.6			34048.8			480.84*
Replications/Y	6	4.	0.3	2.5	600.8**	222.5*	411.7**	213.59*	130.5	172.1**	12.23*	3.65	7.94
Genotypes (G)	14	27	46.8**	70.3**	10580.2	12148.9	22609.6	4614.63	5408.7*	9953.1*	245.7	247.21*	472.16*
Inbreds (I)	4	10	5.4*	13.2**	3144.3*	3820.8*	6890.5*	714.73*	1210.3*	1883.8*	59.08*	99.72**	145.56*
I Vs. Crosses	1	31	616.9*	912.1**	121418*	14209**	263109	55530**	64909**	120257	2738*	2554**	5291.**
Crosses (C)	9	3.	1.9	2.5*	1569.6*	1411.5*	2873.7*	690.65*	663.4**	1283.5*	51.71*	56.34**	81.81**
G.C.A.	4	5.	4.2**	5.5**	4973.8*	5623.6*	10384.8	1489.37	2240.0*	3608.9*	151.4	153.81*	286.63*
S.C.A.	10	36	63.9**	96.2**	12822.7	14759.0	27499.6	5864.74	6676.2*	12490.8	283.4	284.56*	546.38*
G x Y	14			4.4**			119.4*			70.2*			20.77**
I x Y	4			2.3			74.6			41.2			13.24*
I Vs. C. x Y	1			24.2**			406.3**			182.9*			1.60
C x Y	9			2.7*			107.5*			70.6			26.24**
G.C.A. x Y	4			3.8**			209.6**			120.4*			18.59**
S.C.A. x Y	10			4.6**			82.2			50.1			21.62**
Pooled error	84	0.	1.990	1.18	32.62	80.13	56.37	20.32	62.69	41.5	3.99	4.04	4.02
GCA / SCA		0.	0.06	0.06	0.39	0.38	0.38	0.25	0.34	0.29	0.53	0.54	0.52
Years (Y)	1			12.0**			181.6**			9.05**			79651.5
Replications/Y	6	0.	0.3	0.4	2.6*	1.8	2.2*	0.07*	0.07*	0.07**	45.1	234.1	139.6
Genotypes (G)	14	8.	7.2**	14.6**	22.0**	28.2**	47.0**	1.28**	1.01**	2.24**	12172	7429.4*	19110.9
Inbreds (I)	4	5.	3.0**	7.1**	12.8**	28.8**	34.9**	0.10**	0.24**	0.26**	553.1*	487.5*	965.0**
I Vs. Crosses	1	48	43.7**	92.1**	232.2**	229.7**	461.9**	17.05**	11.86**	28.67**	15734	94550**	247921.
Crosses (C)	9	4.	4.9**	9.2**	2.7**	5.6**	6.3**	0.06**	0.15**	0.19**	1205.	834.5**	1752.4*
G C.A.	4	12	9.6**	21.8**	12.0**	35.2**	41.9**	0.13**	0.25**	0.34**	2081.	1427.9*	3275.1*
S.C.A.	10	6.	6.2**	11.7**	26.0**	25.4**	49.0**	1.75**	1.31**	3.00**	16208	9829**	25445.3
G x Y	14			0.64**			3.25**			0.05**			490.48*
I x Y	4			0.86*			6.72**			0.08**			75.61
I Vs. C. x Y	1			0.05			0.02			0.24**			3976.39
C x Y	9			0.61*			2.07**			0.02			287.55*
G.C.A. x Y	4			0.76*			5.27**			0.04**			234.48
S.C.A. x Y	10			0.59*			2.44**			0.06**			592.88*
Pooled error	84	0.	0.15	0.26	0.70	0.84	0.77	0.016	0 018	0.017	104.5	187.49	146.01
GCA / SCA		2.	1.55	1.87	0 46	1.38	0.86	0.07	0.19	0.11	0.13	0.15	0.13

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

Table 3: General combining ability effects of the five inbreds for the yield and other traits in 2001, 2002 and combined

	Silking date			Plant height			Ear height			No of kernels/row		
	2001	2002	Comb.	2001	2002	Comb.	2001	2002	Comb.	2001	2002	Comb.
Sd-7	0.510**	0.079	0.295	9.520**	7.706**	8.614**	5.66**	5.34*	5.50**	2.76**	2.801**	2.781**
Sd-34	-0.591**	0.233	-0.179	15.930**	20.429**	18.181**	8.05**	12.68**	10.37**	0.72	2.070**	1.394**
G-628	-0.017	0.010	-0.004	-7.720**	-6.359*	-7.040**	-2.70*	-4.95*	-3.82**	1.08*	-0.605	0.240
L-7041	-0.192	-0.651*	-0.421*	-0.229	-5.934*	-3.082*	-0.61	-3.32	-1.97	-1.30*	-1.697**	-1.500**
L-8084	0.289*	0.329	0.309	-17.50**	-15.842**	-16.673**	-10.40**	-9.75**	-10.08**	-3.26**	-2.569**	-2.914**
S.E. g_i	0.102	0.238	0.130	0.965	1.513	0.897	0.762	1.340	0.770	0.337	0.340	0.240
LSD g_i-g_j	0.324	0.754	0.406	3.06	4.78	2.81	2.41	4.24	2.41	1.07	1.08	0.75

	No of rows/ear			Ear length			Ear diameter			Grain yield/plant (gram)		
	2001	2002	Comb.	2001	2002	Comb.	2001	2002	Comb.	2001	2002	Comb.
Sd-7	-1.076**	-0.985**	-1.030**	0.662**	1.094**	0.878**	-0.108**	-0.129**	-0.118**	5.62*	4.34	4.98*
Sd-34	-0.168	-0.097	-0.133	0.561*	1.341**	0.951**	0.072*	0.098*	0.085**	6.62**	7.320*	6.971*
G-628	0.140	0.402**	0.271**	-0..529*	-0.773**	-0.651**	0.013	0.090*	0.051*	3.94	-2.435	0.751
L-7041	0.676**	0.311**	0.494**	-0.816**	-1.000**	-0.908**	0.032	-0.025	0.004	-3.02	0.244	-1.388
L-8084	0.427*	0.369**	0.398**	0.123	-0.662*	-0.269	-0.009	-0.034	-0.021	-13.16**	-9.469*	-11.314**
S.E. g_i	0.102	0.066	0.061	0.142	0.155	0.105	0.020	0.022	0.016	1.73	2.31	1.444
LSD g_i-g_j	0.32	0.21	0.19	0.45	0.49	0.33	0.07	0.07	0.05	5.46	7.32	4.52

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

Comparison of the GCA effects of individual parental lines revealed that, L-7041 express significant desirable negative effects toward earliness for silking date, and this line followed by L-8084 were the best general combiners toward increasing no. of rows/ear, which have the highest positive significant GCA effect values. Also, the results showed that the GCA effects were negative and significant toward shorter for the inbred L-8084 followed by Gz-628 in plant height and ear height. Meanwhile, the inbred lines Sd-7 and Sd-34 were the best general combiners for grain yield/plant and the inbred lines Sd-7 followed by Gz-628 for ear diameter. Generally, the inbred line L-7041 proved to be the best combiner among these inbreds in breeding programs toward developing early genotypes. While, the lines Sd-7 and Sd-34 proved to be the best combiners for grain yield and most of its components. These results confirmed the data obtained by El-Shenawy (1995) and Metawi (1996) for the inbred lines Sd-7 and Sd-34.

The estimates of specific combining ability effects of the ten single crosses for yield and other traits in the two years 2001, 2002 and their combined are presented in Table 4. The results revealed that all studied single crosses exhibited desirable negative significant SCA effects for silking date and exhibited desirable positive significant SCA effects for plant height, no. of kernels/row, ear diameter and grain yield per plant in both years and combined. However, eight and nine out of ten crosses showed positive and significant SCA effects for no. of rows/ear and ear length. Generally, the best combinations in earliness trait resulted from crossing poor x poor (Gz-628 x L-8084) general combiners. In addition, the best combinations for no. of kernels/row, ear length and grain yield per plant resulted from crossing good x poor general combiners (Sd-7 x L-7041), while in the case of number of rows/ear, the best combinations resulted from crossing good x good general combiners (L-7041 x L-8084 and Gz-628 x L-8084) and for ear diameter resulted from crossing poor x poor general combiners (L-7041 x L-8084 and Gz-628 x L-8084). So, it could be suggested that it is not necessary that parents having high general combining ability effect would also contribute to high specific combining ability effects. These results are in agreement with those reported by Abd El-Maksoud (1997) and Mosa (2001).

The results presented in Table 5 showed that the heterotic relative to mid-parents and high parent were desirable negative and significant for ten crosses in both years and combined for silking date. This results indicated that such crosses were earlier than their mid-parents as well as the earlier parent. The values of heterosis relative to mid-parents and high parent ranged from (-6.32 to -10.26) and (-4.57 to –9.59) in the 10^{th} cross and in the 2^{nd} cross for silking date, respectively. Similar results obtained by Mohamed (1984) and Amer *et al.* (1997). Heterosis values relative to mid-parents and high parent were highly significant in the two years and their combined in ten crosses for plant height, ear height and yield as well as its components except for 1^{st}, 2^{nd} and 3^{rd} crosses when compared to high parent for no. of rows/ear, which showed positive but insignificant values. These results are in agreement with those obtained by several authors, among them El-Shenawy (1995), El-Zeir and Tolba (1999) and Mosa (2003).

Table 4: Specific combining ability effects of the 10 single crosses for the yield and other traits in 2001, 2002 and combined.

	Silking date			Plant height			Ear height			No. of kernels/row		
	2001	2002	Comb.	2001	2002	Comb.	2001	2002	Comb.	2001	2002	Comb.
Sd-7 x Sd–34	-2.03**	-1.46*	-1.74**	13.64**	19.27**	16.45**	11.15**	16.15**	13.65**	3.95**	5.64**	4.79**
Sd-7 x G-628	-3.07**	-2.83**	-2.95**	34.97**	37.70**	36.33**	20.77**	21.08**	20.93**	5.38**	5.40**	5.39**
Sd-7 x L-7041	-1.78**	-2.73**	-2.25**	52.92**	57.50**	55.21**	33.19**	32.13**	32.66**	6.60**	6.76**	6.68**
Sd-7 x L-8084	-1.80**	-2.77**	-2.29**	42.67**	37.98**	40.33**	24.56**	22.42**	23.49**	4.30**	4.65**	4.48**
Sd–34 x G-628	-1.31**	-1.84*	-1.57**	25.93**	28.40**	27.17**	21.89**	22.10**	22.00**	4.66**	3.56**	4.11**
Sd–34 x L-7041	-0.99**	-2.02**	-1.50**	37.14**	39.78**	38.46**	29.81**	31.62**	30.71**	6.18**	5.44**	5.81**
Sd–34 x L-8084	-2.28**	-2.19**	-2.24**	29.14**	35.68**	32.41**	23.07**	27.13**	25.10**	4.35**	1.34	2.85**
G-628 x L-7041	-0.90**	-1.18	-1.04*	34.74**	28.70**	31.72**	24.50**	20.61**	22.56**	6.09**	3.08**	4.58**
G-628 x L-8084	-2.48**	-3.34**	-2.91**	15.99**	23.14**	19.56**	5.92*	13.78**	9.85**	4.59**	1.31	2.95**
L-7041 x L-8084	0.32	-2.33**	-1.01*	30.95**	35.98**	33.47**	20.26**	25.55**	22.91**	1.67*	8.97**	5.32**
S.E. S_{ij}	0.264	0.615	0.335	1.97	3.91	2.32	1.97	3.46	1.99	0.69	0.88	0.62
LSD S_{ij}-S_{kl}	0.72	1.69	0.91	6.82	1.07	6.28	5.39	9.46	5.39	2.39	2.40	1.68

	No. of rows/ear			Ear length			Ear diameter			Grain yield/plant (gram)		
	2001	2002	Comb.	2001	2002	Comb.	2001	2002	Comb.	2001	2002	Comb.
Sd-7 x Sd–34	0.26	0.48*	0.37*	0.85*	1.30**	1.08**	0.26**	0.22**	0.24**	43.62**	25.43**	34.53**
Sd-7 x G-628	0.25	0.003	0.13	2.00**	1.46**	1.73**	0.46**	0.33**	0.39**	33.51**	39.28**	36.40**
Sd-7 x L-7041	0.46	0.83**	0.65**	1.99**	1.97**	1.98**	0.44**	0.43**	0.43**	53.74**	37.87**	45.81**
Sd-7 x L-8084	0.88**	0.20	0.54**	-0.08	1.19**	0.55	0.30**	0.14*	0.22**	17.81**	15.82*	16.82**
Sd–34 x G-628	0.77*	0.06	0.41*	2.29**	0.62	1.46**	0.44**	0.31**	0.37**	36.95**	29.40**	33.17**
Sd–34 x L-7041	0.40	0.35*	0.38*	1.63**	2.00*	1.81**	0.41**	0.48**	0.44**	41.86**	40.39**	41.12**
Sd–34 x L-8084	-0.05	0.08	0.02	1.40**	0.11	0.75*	0.22**	0.01	0.12**	31.47**	20.99**	26.23**
G-628 x L-7041	0.51	1.49**	1.00**	1.72**	2.04**	1.88**	0.34**	0.35**	0.34**	35.20**	13.75*	24.48**
G-628 x L-8084	1.48**	1.70**	1.59**	1.40**	1.20**	1.30**	0.50**	0.40**	0.45**	42.96**	25.81**	34.39**
L-7041 x L-8084	1.38**	0.85**	1.12**	0.70	1.95**	1.33**	0.40**	0.50**	0.45**	24.99**	31.95**	28.47**
S.E. S_{ij}	0.26	0.17	0.16	0.37	0.40	0.27	0.06	0.06	0.04	4.46	5.98	3.73
LSD S_{ij}-S_{kl}	0.72	0.47	0.43	1.00	1.09	0.73	0.15	0.16	0.11	12.22	16.36	10.11

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

Table 5: Heterosis relative to mid-parents and high parent (H, M.P.% and H, H.P.%), for yield and other traits in 2001, 2002 and combined

Crosses	Years	Silking date		Plant height		Ear height		No of kernels/row	
		H, M.P. %	H, H.P. %	H, M.P. %	H, H.P. %	H, M.P. %	H, H.P. %	H, M.P. %	H, H.P. %
Cross # 1 (7 X 34)	2001	-8.12**	-5.98**	34.49**	25.24**	45.61**	41.64**	48.23**	40.00**
	2002	-8.18**	-7.68**	54.49**	37.47**	72.30**	61.23**	59.87**	54.23**
	Comb.	-8.16**	-6.77**	11.92**	18.36**	54.07**	47.96**	52.60**	49.39**
Cross # 2 (7 X 828)	2001	-9.86**	-8.87**	50.54**	44.02**	54.12**	48.77**	55.46**	46.28**
	2002	-10.59**	-10.30**	77.23**	70.44**	84.53**	69.35**	60.40**	54.14**
	Comb.	-10.26**	-9.59**	34.10**	17.49**	60.61**	53.81**	56.17**	48.03**
Cross # 3 (7 X 7041)	2001	-6.78**	-4.12**	66.49**	56.50**	76.66**	61.03**	65.57**	42.26**
	2002	-10.18**	-8.70**	108.15**	84.67**	120.26**	84.77**	93.04**	55.07**
	Comb.	-8.51**	-6.39**	7.33**	9.69**	87.36**	67.08**	72.45**	46.12**
Cross # 4 (7 X 8084)	2001	-7.65**	-6.60**	58.82**	42.90**	61.84**	45.33**	51.80**	28.09**
	2002	-10.79**	-10.28**	88.34**	63.62**	99.69**	64.66**	68.69**	43.12**
	Comb.	-9.17**	-8.78**	28.67**	28.93**	71.42**	49.95**	56.67**	33.04**
Cross # 5 (34 X 828)	2001	-8.85**	-5.72**	37.72**	23.11**	52.63**	43.45**	54.68**	54.07**
	2002	-8.42**	-8.21**	56.44**	34.53**	80.62**	56.07**	43.83**	33.53**
	Comb.	-7.61**	-6.91**	20.75**	28.17**	59.31**	46.78**	49.25**	44.41**
Cross # 6 (34X7041)	2001	-5.01**	-4.52**	48.98**	31.02**	70.36**	51.47**	66.99**	50.96**
	2002	-8.41**	-7.41**	75.91**	41.06**	111.28**	68.04**	74.65**	36.56**
	Comb.	-6.67**	-5.95**	40.59**	24.90**	81.68**	56.37**	67.15**	44.18**
Cross # 7 (34X8084)	2001	-7.75**	-6.58**	42.46**	20.35**	57.70**	38.18**	54.18**	36.71**
	2002	-9.32**	-8.30**	69.35**	33.37**	99.77**	56.40**	43.57**	18.28**
	Comb.	-8.41**	-7.43**	38.50**	45.65**	70.37**	43.97**	48.23**	28.15**
Cross # 8 (6287X7041	2001	-5.24**	-3.60**	55.17**	52.33**	67.09**	57.45**	68.53**	52.90**
	2002	-7.78**	-6.57**	81.79**	67.12**	108.85**	89.14**	65.55**	37.24**
	Comb.	-6.50**	-5.06**	46.03**	17.78**	74.17**	61.63**	63.40**	45.06**
Cross # 9 (628 X8084)	2001	-8.31**	-8.27**	41.96**	33.11**	41.90**	31.64**	57.31**	39.97**
	2002	-11.47**	-10.67**	73.07**	55.65**	91.57**	70.22**	43.28**	25.80**
	Comb.	-9.81**	-9.51**	19.46**	18.89**	53.48**	39.57**	49.32**	32.86**
Cross # 10 7041X8084	2001	-3.04**	-1.42**	57.92**	50.70**	68.67**	65.89**	50.80**	47.58**
	2002	-9.78**	-7.77**	102.32**	97.50**	138.75**	133.72**	118.53**	104.37**
	Comb.	-6.32**	-4.57**	41.29**	10.43**	85.74**	81.71**	72.50**	72.05**
LSD	2001	0.74 0.98	0.87 1.14	6.90 9.30	8.08 10.74	5.50 7.30	6.40 8.50	2.40 3.3	3.90 5.30
	2002	1.70 2.30	1.90 2.60	10.90 14.50	12.60 16.80	9.70 12.90	11.20 14.90	2.50 3.30	2.80 3.80
	Comb.	1.30 1.70	1.50 2.00	9.10 12.05	10.50 13.90	7.80 10.3	9.00 11.90	2.40 3.2	2.80 3.70

Generally, from the combined data, the heterosis relative to mid-parents ranged from 7.33 to 46.03 for plant height, 53.48 to 87.36 for ear height, 48.23 to 72.50 for no. of kernels/row, 8.96 to 25.52 for no. of rows/ear, 17.19 to 42.58 for ear length, 18.08 to 30.44 for ear diameter and from 110.23 to

163.96 for grain yield per plant. While, the heterosis over high parent ranged from 9.69 to 45.65, 39.57 to 81.71, 28.15 to 72.05, 0.50 to 24.55, 12.97 to 40.56, 15.07 to 29.11 and ranged from 108.30 to 168.54 for the previous traits, respectively. Similar results were obtained by Amer *et al.* (1997).

Table 5. Continued:

Crosses	Years	No of rows/ear		Ear length		Ear diameter		Grain yield/plant (gram)	
		H, M.P. %	H, H.P. %	H, M.P. %	H, H.P. %	H, M.P. %	H, H.P. %	H, M.P. %	H, H.P. %
Cross # 1 (7 X 34)	2001	8.98**	0.59	22.43**	19.54**	23.93**	18.22**	124.77**	112.07**
	2002	9.39**	0.51	26.03**	20.45**	21.05**	12.84**	139.64**	107.14**
	Comb.	9.06**	0.50	23.57**	23.10**	22.09**	15.57**	126.17**	108.30**
Cross # 2 (7 X 628)	2001	12.29**	4.30	35.35**	20.12**	32.93**	31.86**	118.71**	115.57**
	2002	10.20**	1.73	34.31**	18.19**	27.57**	22.08**	193.04**	186.32**
	Comb.	11.21**	3.07	34.12**	18.35**	29.99**	27.26**	140.07**	140.60**
Cross # 3 (7 X 7041)	2001	12.78**	0.37	32.65**	18.18**	30.60**	27.60**	158.12**	136.72**
	2002	18.53**	10.87**	47.26**	20.12**	35.61**	33.26**	205.43**	189.06**
	Comb.	14.12**	3.06	35.41**	18.02**	30.44**	28.40**	163.96**	168.54**
Cross # 4 (7 X 8084)	2001	18.86**	9.59*	12.81**	11.45**	25.94**	23.11**	103.50**	85.48**
	2002	11.02**	2.02	29.79**	17.00**	19.89**	16.00**	150.80**	126.41**
	Comb.	14.97**	5.79**	17.19**	12.97**	22.03**	18.43**	110.23**	111.18**
Cross # 5 (34 X 628)	2001	15.01**	14.22**	40.31**	27.22**	30.55**	25.50**	116.35**	106.96**
	2002	8.89**	8.34**	22.75**	3.90	24.32**	20.95**	145.04**	107.70**
	Comb.	12.12**	11.43**	32.18**	16.25**	27.52**	23.20**	125.66**	128.47**
Cross # 6 (34X7041)	2001	10.83**	6.51**	33.07**	21.14**	28.21**	25.10**	135.84**	105.16**
	2002	12.15**	10.02**	41.29**	11.30**	33.51**	22.47**	175.38**	127.27**
	Comb.	10.37**	7.95**	34.11**	16.51**	28.68**	23.66**	143.74**	151.57**
Cross # 7 (34X8084)	2001	9.87**	9.75**	24.19**	22.73**	22.76**	19.73**	113.66**	84.80**
	2002	8.23**	8.22**	17.47**	1.72	14.08**	9.78**	133.74**	85.47**
	Comb.	8.96**	8.78**	19.20**	14.49**	18.08**	15.07**	114.40**	117.33**
Cross # 8 (6287X7041	2001	14.86**	9.65**	40.09**	39.47**	30.30**	28.32**	133.33**	111.18**
	2002	26.29**	24.52**	54.44**	41.37**	33.43**	25.57**	153.47**	145.33**
	Comb.	18.88**	15.58**	42.58**	40.56**	29.83**	29.11**	134.78**	136.75**
Cross # 9 (628 X8084)	2001	25.33**	24.32**	29.10**	15.82**	33.38**	31.41**	131.77**	108.51**
	2002	26.15**	25.52**	32.97**	29.42**	28.04**	26.60**	171.41**	150.28**
	Comb.	25.52**	24.55**	27.83**	16.59**	30.07**	28.91**	138.46**	141.42**
Cross # 10 7041X8084	2001	22.72**	18.06**	21.82**	9.71**	29.46**	29.40**	125.96**	124.44**
	2002	20.14**	17.87**	50.14**	34.10**	36.08**	29.45**	202.25**	187.47**
	Comb.	20.28**	17.83**	27.43**	14.74**	29.70**	27.85**	138.32**	139.02**
LSD	2001	0.74 0.98	0.85 1.13	1.02 1.40	1.20 1.60	0.15 0.21	0.18 0.24	12.52 16.60	14.50 19.20
	2002	0.48 0.64	0.56 0.74	1.10 1.50	1.30 1.70	0.16 0.22	0.19 0.25	16.70 22.3	19.40 25.80
	Comb.	0.62 0.81	0.71 0.94	1.06 1.41	1.23 1.63	0.16 0.21	0.18 0.24	14.65 19.39	16.92 22.39

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

In conclusion, judging by heterotic values general and specific combining ability as well as genetic variance components, the production of corn hybrids is the best breeding program for the improvement of these traits.

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تقدير القدرة على التآلف وقوة الهجين للصفات الهامة فى بعض سلالات الذرة الشامية

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يهدف هذا البحث الى تقييم بعض سلالات الذرة الشامية لقدرتها على التالف وسلوكها تحت الظروف البيئية المختلفة للصفات الهامة. ولذلك أجريت التهجينات الممكنة بين خمسة من سلالات الذرة الشامية تبعا لنظام التزاوج النصف دائرى. وقد تم تقييم هذه السلالات بالإضافة الى العشرة هجن الناتجة بينها فى موسمين متتاليين بمحطة البحوث الزراعية بسخا للصفات التالية: عدد الأيام لظهورالحريرة لـ ٥٠% من النباتات، إرتفاع النبات، إرتفاع الكوز، عدد الحبوب بالصف، عدد الصفوف بالكوز، طول الكوز، قطر الكوز ومحصول الحبوب للنبات .
ويمكن تلخيص أهم النتائج المتحصل عليها فى الآتى:

أظهرت النتائج أن هناك إختلافا" عالى المعنوية بين التراكيب الوراثية شاملة السلالات والهجن الناتجة بينها لكل الصفات المدروسة، مما يشير الى أن هذه السلالات تختلف فى تكوينها الوراثى للصفات تحت الدراسة. كما أظهرت متوسطات المربعات للمواسم وتداخلها مع كل من السلالات والهجن إختلافا معنويا لمعظم الصفات المدروسة مما يشير الى أن هذه التراكيب الوراثية تسلك سلوكا" مختلفا" بإختلاف الظروف البيئية. بالإضافة الى ذلك كان متوسط المربعات لكل من القدرة العامة والخاصة على التآلف عالى المعنوية فى كل موسم وفى التحليل المشترك، وهذا يدل على مساهمة كل من الفعل الجينى الإضافى والغير إضافى (السيادى) فى تعبير مثل هذه الصفات، بينما كانت قيم متوسط المربعات للقدرة الخاصة على التآلف أكبر منها للقدرة العامة على التآلف لكل الصفات فيما عدا عدد الصفوف بالكوز مشيرا الى ان هذه الصفات يتحكم فيها الفعل الجينى السيادى بصفة رئيسية

بالمقارنة بين السلالات المدروسة لقدرتها العامة على التالف إتضح أن السلالة L-7041 كانت أحسن السلالات قدرة على التالف لتحسين التبكير وزيادة عدد الصفوف بالكوز بينما السلالات Sd-7 و Sd-34 كانت أحسنهم قدرة عامة على التآلف لتحسين محصول الحبوب. كما أوضحت النتائج أيضا أنه ليس من الضرورى أن الأباء عالية القدرة العامة على التآلف يجب أن تساهم فى إنتاج هجن عالية فى قدرتها الخاصة على التآلف ولذلك أظهرت الهجن L-7041 x L-8084, Sd-7 x L-7041, Gz-628 x L-8084 أعلى قدرة خاصة على التآلف وقوة هجين لأفضل الأباء في معظم الصفات. ويمكن أن نستخلص من هذه النتائج ان أفضل وسيلة لتحسين هذه الصفات بإستخدام هذه السلالات هى إنتاج الهجن.