Annals of Agric. Sc., Moshtohor.
Vol. 32(1):95-107, 1994

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

By

Sedhom, S.A.
Dept. Agron. Fac. Agric. Moshtohor, Zagazig Univ. Egypt.

ABSTRACT

This investigation was undertaken during three successive summer seasons to study the combining ability of some traits of maize and their interactions with growing years. A half diallel set of crosses involving seven inbred lines were evaluated in this study. Significant year mean squares were detected for all of the studied characters except for number of rows/ear, plant height, and silking date. Significant mean squares of crosses for all traits were obtained in both seasons as well as the combined analysis. Also, appreciable crosses by year interactions were detected for all characters. Significant g.c.a. and s.c.a. variances were obtained for most of the studied traits in both seasons and the combined data. The additive genetic variance was predominant in the inheritance of ear diameter and plant height, whereas non-additive gene effects were prevailing for grain yield/ plant and number of grains/row in the three studied cases. Significant interaction effects between both general and specific combining ability and planting dates were detected for grain yield/plant, number of rows/ear, number of grains/row and plant height. The parental line MR4 seemed to be the best combiner for grain yield/plant, ear length, and silking date. Inbred line MR5 was the best combiner for ear diameter and it was among the best combiners for grain yield/plant and ear length. The highest desirable s.c.a. effects were recorded in the crosses: (K 64 x G 224 D) for grain yield/plant and ear diameter, (G 224 D x MR5) for ear length, (G 507 A x MR5) for number of rows/ear, (G 251 B x MR5) for plant height, (G 507 A x K 64) for ear height, and (G 507 A x G 251 B) for silking date. The increases in grain yield/plant relative to D.C. 204 (35.28% and 30.08%) were detected for the cross (G 507 A x MR5) in the first season and the combined analysis, respectively.

INTRODUCTION

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), Mohamed (1989), and El-Hosary and Sedhom (1990).

On the contrary, El- Hosary (1985) , Nawar (1985) and Sedhom (1992) reported that the non-additive effects were more biased by interaction with environment than additive effects.

The present work was undertaken during three summer seasons with the following objectives: a) to estimate the magnitude of both types of combining ability and their interaction with growing year, and b) to determine the relative increase of grain yield in 21 single crosses over the check variety D.C. 204.

MATERIALS AND METHODS

The plant materials for this study included seven inbred lines of maize representing a wide range of variability in most of the studied traits. Five of them ,i.e., G 224 D, G 507 A, K 64, G 251 B and G 307 A were obtained from Maize Research Section, Field Crop Research Institute, Agricultural Research Center, Egypt. Another two inbred lines (MR4 and MR5) were developed by the author from the composite variety Giza 2. In 1990 summer season, the seven inbred lines were split planted in May 20, 30 and June, 10 to overcome the differences in flowering times among the parental lines. All possible cross combinations without reciprocals were made at the Agricultural Research Center, Faculty of Agriculture, Moshtohor. The resultant 21 crosses along with a check (D.C. 204) were planted in a randomized complete block design with three replications in the two successive seasons of 1991 and 1992. The panting dates for 1991 and 1992 seasons were June 5 and June 12, respectively. In both seasons, each plot consisted of 2 ridges of six m length and 70 cm. width. Hills were thinned to one plant and spaced 30 cm. apart. Plots irrigated eight times during each growing season and fertilized at a rate of 120 kg N/fed (one feddan= 4200 m^2). The other cultural practices were performed as recommended for the area. Data were recorded in both seasons for grain yield/plant, ear length, ear diameter, number of rows/ear, number of grains/row, plant height, ear height, and silking date. Grain yield was adjusted to 15.5% moisture content.

The ordinary statistical analysis was performed for each growing season. Thereafter, homogeneity of error variance was tested before applying the combined analysis for both seasons. General and specific combining ability were calculated using Method 4 Model 1 of Griffing (1956) for each experiment and for both seasons. The relative increases in grain yield per plant over the check variety D.C 204 was also calculated.

RESULTS AND DISCUSSION

The analysis of variance for all traits in each season as well as the combined analysis are presented in Table (1). Test of homogeneity revealed that the error variances for the two seasons were homogenous, therefore combined analysis was processed. Years mean squares were significant for all of the studied traits except for number of rows/ear, plant height and silking date. Mean values of the first season were relatively higher than those of the second one for most traits. 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. Also, the interactions between crosses and year mean squares were significant for all of the studied characters. These interactions with years could be a result of different ranking of genotypes from year to another.

The mean performance of F_1 hybrids in each season as well as the combined analysis were presented in Table (2). Results indicated that the highest mean values for grain yield/plant and number of rows/ear were detected in the cross (G 507 A x MR5) in the combined analysis of the two growing seasons. Whereas, the cross (G224 D x MR5) produced the highest mean performance for ear length and ear diameter in the combined data. Also, the cross (G 507 A x K64) was the best combination for dwarfness since it expressed the lowest values for plant and ear heights in the combined analysis. The single cross (G 507 A x G 251 B) seemed to be the best cross among the studied hybrids for earliness. This is because it exhibited the lowest values for date of silking in the combined data of the two growing seasons.

The 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 for ear length in the first season and silking date in the second season. Also, significant specific combining ability s.c.a. variances were obtained for all traits except for ear height in the first season. It is clear that, the significant g.c.a. mean squares were accompanied by significant s.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 diameter and plant height in both seasons and the combined data; for ear height in the second season and the combined analysis; and for silking date in he first season and the combined

Table (1): Ordinary analysis of variance and combining ability for all traits in two summer seasons and their combined.

S.O.V	d.f single year	d.f comb.	Grain yield/plant Y1	Grain yield/plant Y2	Grain yield/plant Comb.	Ear length Y1	Ear length Y2	Ear length Comb.	Ear diameter Y1	Ear diameter Y2	Ear diameter Comb.	No. of rows/ear Y1	No. of rows/ear Y2	No. of rows/ear Comb.
Years (Y)		1			2331.5*			10.57*			36.16*			1.72
Blocks in years	2	4	870.3	1594.8	1232.6	0.72	2.69	1.71	3.4	0.23	1.83	4.1	0.11	2.11
Genotypes	20	20	3121.7**	1781.3**	3949.0**	9.15**	18.57**	19.39**	28.43**	31.75**	34.69**	6.21**	5.72**	8.10**
GCA	6	6	2710.8**	926.1**	1836.6**	2.93	11.02**	9.58**	41.34*	43.74**	68.63**	4.80*	5.96**	6.82**
SCA	14	14	3297.8**	2147.8**	4854.4**	11.81**	21.82**	23.59**	22.89*	26.61**	20.14**	6.82**	5.62**	8.64**
Genotypes x (Y)		20			954.0**			8.33**			25.49**			3.83**
GCA x (Y)		6			1800.4**			4.37			16.45			3.94*
SCA x (Y)		14			591.3**			10.03**			29.36**			3.80**
Error	40	80	213.8	201.2	207.5	1.56	2.57	2.07	9.3	4.5	6.9	1.79	1.56	1.67
G.c.a./s.c.a.			0.82	0.43	0.38	–	0.51	0.41	1.81	1.64	3.41	0.70	1.06	0.79

! D1 and D2 means first and second year, respectively.

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

Table (1):Cont.

S.O.V	d.f single year	d.f comb.	No. of grains/row Y1	No. of grains/row Y2	No. of grains/row combined	Plant height Y1	Plant height Y2	Plant height combined	Ear height Y1	Ear height Y2	Ear height combined	Silking date Y1	Silking date Y2	Silking date combined
Years (Y)		1			150.05**			442.03			2195.8**			14.00
Blocks in years	2	4	6.37	16.52	11.45	111.4	13.8	62.6	293.8	86.3	190.1	7.64	7.94	7.79
Genotypes	20	20	99.40**	58.01**	98.52**	1733.8**	1777.0**	2751.5**	508.2**	532.5**	791.7**	19.42**	17.09*	25.86**
GCA	6	6	86.44**	45.78*	46.86*	3426.2**	3167.6**	5669.0**	1138.9**	1117.6**	2038.8**	40.41**	6.51	29.44**
SCA	14	14	104.95**	63.25**	120.66**	1008.5*	1181.0**	1501.2**	237.9	260.4*	257.3*	10.43*	21.62**	24.32**
Genotypes x (Y)		20			58.89**			759.3*			249.0*			10.65*
GCA x (Y)		6			85.36**			924.8*			267.7			17.48*
SCA x (Y)		14			47.54**			687.4*			241.0			7.73
Error	40	80	20.18	16.49	18.34	419.5	341.9	380.7	147.8	130.4	139.1	4.68	7.57	6.13
G.c.a./s.c.a.			0.82	0.72	0.39	3.39	2.68	3.78	–	4.5	7.9	3.87	0.30	1.21

[1] D1 and D2 means first and second year, respectively.

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

Table (2): Mean performance of all crosses for eight characters in maize in both seasons and their combined analysis.

Trait / Cross	Grain yield g/plant			Ear length			Ear diameter			No. of rows/ear		
	Y1[1]	Y2	comb.	Y1	Y2	Com.	Y1	Y2	Comb.	Y1	Y2	Comb
MR4 x G507A	206.0 a	170.7 ab	188.3 ab	17.0 a-c	14.9 d-f	15.9 c-e	44.5 b-e	44.8 c-e	44.7 b-e	15.1 a-e	12.6 e-g	13.9 c-i
x K64	152.0 ef	112.3 gh	132.2 ef	16.8 a-d	11.8 f-g	14.3 c-f	42.4 c-e	38.8 g	40.6 f	13.1 d-f	12.6 e-g	12.9 g-j
x G251B	191.0 ab	160.3 a-d	175.7 a-c	17.8 ab	15.7 b-e	16.7 b-d	49.0 a-c	45.4 c-e	47.2 a-c	16.9 a	15.0 a-e	16.0 a
x G307A	196.7 ab	164.7 a-c	180.7 a-c	17.0 a-c	19.5 a	18.3 ab	49.9 ab	44.2 d-f	46.9 bc	16.5 ab	15.1 a-d	15.8 ab
x G224D	145.0 e-h	127.3 e-h	136.2 ef	14.3 e-g	13.8 d-g	14.1 ef	48.5 a-d	45.0 c-e	46.7 b-d	13.7 c-f	12.7 d-g	13.2 f-j
x MR5	160.3 c-f	178.3 a	169.3 bc	15.3 c-f	19.8 a	17.6 a-c	48.3 a-d	48.5 a-c	48.4 ab	14.4 a-f	15.7 ab	15.1 a-e
G507A x K64	108.0 i	102.3 h	105.2 g	12.7 g	10.9 g	11.8 g	39.4 c	46.2 b-e	42.8 d-f	12.5 ef	11.7 fg	12.1 j
x G251B	184.0 a-d	159.3 a-d	171.7 bc	15.3 c-f	18.1 a-c	16.7 b-d	48.3 a-d	40.6 fg	44.5 b-e	14.1 b-f	13.6 a-g	13.9 e-i
x G307A	191.7 ab	157.3 a-d	174.5 a-c	17.8 ab	12.7 e-g	15.2 d-f	45.8 a-e	40.6 fg	43.2 c-f	15.3 a-d	13.7 a-g	14.5 a-h
x G224D	158.7 d-f	117.3 f-h	138.0 ef	14.5 d-g	13.4 e-g	13.9 f	45.2 a-e	39.2 g	42.2 ef	13.6 c-f	14.0 a-f	13.8 d-j
x MR5	208.3 a	178.3 a	193.2 a	17.7 a-c	16.9 ab	17.3 a-c	49.7 ab	44.9 c-e	47.3 ab	16.4 ab	15.7 ab	16.1 a
K64 x G251B	130.7 f-i	127.7 e-h	129.2 f	14.0 c-d	14.1 d-f	14.1 e-f	43.1 b-e	42.5 e-g	42.8 d-f	12.5 ef	14.5 a-e	13.5 d-j
x G307A	166.7 b-e	175.0 a	170.8 bc	15.9 b-f	18.0 a-c	16.9 b-d	44.4 bc	45.1 c-e	44.8 b-e	14.8 a-e	15.5 a-c	15.2 ab
x G224D	188.7 a-c	177.3 a	183.0 a-c	17.7 a-c	15.4 c-e	16.5 b-d	49.0 a-c	46.1 c-e	47.6 ab	16.1 a-c	13.4 b-g	14.8 a-f
x MR5	155.7 d-f	144.7 c-f	150.2 de	16.3 b-e	14.3 d-f	15.3 d-f	45.5 a-e	46.1 c-e	45.8 b-e	12.1 f	13.2 c-g	12.7 ij
G251B x G307A	115.7 hi	160.7 a-c	138.2 ef	15.6 b-f	14.6 d-f	15.1 d-f	41.7 de	48.7 a-c	45.2 b-e	13.9 b-f	15.4 a-c	14.6 a-g
x G224D	150.7 e-g	177.3 a	164.0 cd	14.6 e-g	15.8 b-e	15.2 d-f	44.4 b-e	50.1 ab	47.2 a-c	13.1 d-f	15.9 a	14.5 a-h
x MR5	130.0 f-i	140.7 c-f	135.3 ef	13.7 fg	13.2 e-g	13.4 fg	46.5 a-d	47.7 a-d	47.1 a-c	15.4 a-d	15.8 ab	15.6 a-c
G307A x G224D	116.7 hi	146.0 b-e	131.3 ef	14.5 d-g	14.1 d-f	14.3 c-f	44.7 b-e	46.7 a-d	45.7 b-e	12.5 ef	14.2 a-e	13.4 e-j
x MR5	121.0 g-i	133.7 d-g	127.3 f	13.5 fg	13.5 e-g	15.3 fg	45.9 a-e	44.1 d-f	45.0 b-e	14.0 b-f	11.5 g	12.8 h-j
G224D x MR5	197.3 ab	183.0 a	190.2 ab	19.2 a	18.6 ab	18.9 a	51.7 a	50.2 a	50.9 a	14.6 a-f	13.8 a-g	14.2 b-i

Cross	No. of grains/row			Plant height			Ear height			Silking date		
MR4 x G507A	36.2 a-f	30.1 c-e	33.2 b-g	179.0 e-g	204.3 b-e	191.7 c-f	87.3 d-f	90.0 b-e	88.7 e-h	65.3 d-f	66.7 c-f	66.0 f-i
x K64	33.2 a-f	25.6 ef	29.4 g-i	195.7 b-g	181.0 d-g	188.3 d-f	98.0 c-f	88.7 b-e	93.3 d-g	64.3 e-f	68.3 a-f	66.3 e-i
x G251B	40.2 a-d	30.8 b-e	35.5 a-f	222.0 a-d	222.0 a-c	222.0 ab	111.3 a-d	85.0 de	98.2 c-f	66.0 c-f	70.0 a-e	68.0 b-h
x G307A	41.7 a	33.0 a-e	37.4 a-e	216.0 a-e	217.0 a-c	216.5 a-c	105.0 b-f	82.7 d-f	93.8 d-f	68.3 a-e	67.7 a-f	68.0 b-h
x G224D	36.6 a-f	33.7 a-d	35.1 a-g	235.0 ab	200.0 b-f	217.5 a-c	128.3 a	106.7 a-c	117.5 a	68.7 a-d	67.7 a-f	68.2 b-g
x MR5	37.2 a-f	40.0 a	38.6 a-c	229.3 a-e	212.3 a-d	220.8 ab	110.3 a-e	89.3 b-e	99.8 b-f	66.3 b-f	65.7 d-f	66.0 f-i
G507AX K64	28.5 fg	21.2 f	24.8 i	170.0 g	150.7 g	160.3 g	89.0 d-f	63.3 f	76.2 h	68.0 a-f	72.3 ab	70.2 a-c
x G251B	41.2 a-c	34.2 a-c	37.7 a-d	204.7 b-g	202.3 b-f	203.5 b-e	102.0 b-f	99.3 a-d	100.7 b-f	64.0 f	64.7 e-f	64.3 i
x G307A	38.7 c-d	33.5 a-e	36.1 a-e	194.0 c-g	176.3 c-g	185.2 ef	94.0 c-f	80.7 d-f	87.3 e-h	68.0 a-f	71.7 a-c	69.8 a-d
x G224D	35.7 a-f	38.1 a-c	36.9 a-e	223.0 a-d	218.0 a-c	220.5 ab	125.0 ab	98.7 b-d	112.0 a-c	65.0 d-f	69.0 a-f	67.0 c-i
x MR5	40.1 a-d	33.7 a-d	36.9 a-e	219.0 a-d	202.7 b-f	210.8 b-e	111.0 a-d	95.0 b-d	103.0 a-e	64.3 e-f	67.0 b-f	65.7 g-i
K64 x G251B	32.6 e-g	32.1 a-e	32.3 d-h	177.3 e-g	168.7 fg	173.0 fg	90.3 d-f	72.7 ef	81.5 gh	65.3 d-f	70.0 a-e	67.7 c-h
x G307A	39.9 a-d	38.7 ab	39.3 a	177.7 e-g	199.3 c-f	188.5 d-f	84.3 f	93.0 b-e	88.7 e-h	69.7 a-c	66.7 c-f	68.2 b-g
x G224D	37.5 a-e	33.3 a-e	35.4 a-f	213.0 a-f	230.7 a-c	221.8 ab	110.0 a-e	120.3 a	115.2 ab	65.0 d-f	64.3 f	64.7 b-i
x MR5	32.7 b-g	30.5 c-e	31.6 e-h	192.3 e-g	218.0 a-c	205.2 b-e	93.7 c-f	86.3 c-e	90.0 e-h	67.0 b-f	66.3 c-f	66.7 d-i
G251B x G307A	24.6 gh	35.4 a-c	29.9 g-i	193.3 c-g	230.3 a-c	211.8 b-d	86.3 ef	91.7 b-e	89.0 e-h	70.3 ab	68.3 a-f	69.3 a-f
x G224D	20.0 h	34.3 a-c	27.2 hi	234.0 ab	247.3 a	240.7 a	105.0 b-f	109.7 ab	107.3 a-d	71.7 a	67.0 b-f	68.8 b-g
x MR5	32.2 a-f	33.4 a-e	32.8 c-h	171.7 g	180.3 d-g	176.0 fg	84.0 f	86.0 c-e	85.0 f-h	71.7 a	73.0 a	72.3 a
G307A x G224D	29.7 e-g	33.2 a-e	31.5 e-h	186.3 d-g	236.0 ab	211.2 b-e	96.7 c-f	107.7 a-c	102.2 a-e	71.3 a	71.0 a-d	71.2 ab
x MR5	32.9 a-g	26.2 d-f	29.6 g-i	173.3 fg	206.7 b-e	190.0 d-f	94.0 c-f	90.3 b-e	92.2 d-h	70.3 a	69.0 a-f	69.7 a-c
G224D x MR5	41.5 ab	35.9 a-c	38.7 ab	249.3 a	230.7 a-c	240.0 a	116.3 a-c	110.0 ab	113.2 a-c	70.0 a-c	67.3 b-f	68.7 b-g

[1] Y1 and Y2 means first and second year, respectively.

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 El- Zeir (1984), Galal *et al* (1987), Nawar *et al* (1988), El- Hosary and Sedhom (1990), Abdel- Sattar (1992) and Sedhom (1993).

On the other hand, low s.c.a./g.c.a. ratios which was less than one were obtained for grain yield/plant and number of grains/row in both seasons and their combined analysis; ear length in the second season and the combined analysis; and silking date in the second season. Consequently, non-additive type of gene action was predominant in controlling such traits. Similar results were reported by Rashed (1977), Sedhom (1984), El- Hosary (1985), and Abdel-Sattar (1986).

Results in Table (1) also showed that the interaction between years and both types of combining abilities were significant for grain yield/plant, number of rows/ear, number of grains/row, and plant height. This result led to the conclusion that the magnitude of both types of combining ability were influenced by different growing seasons. However, the ratio between s.c.a x year/ s.c.a was higher than that of g.c.a x year/g.c.a for grain yield/plant, number of rows/ear, and number of grains/row. This indicates that non-additive gene effects were more sensitive for different growing seasons. On the other hand, the ratio of g.c.a x year/g.c.a was higher than that of s.c.a x year/ s.c.a for plant height revealing that additive and additive x additive effects were more biased by environment more than non-additive gene action for such trait. These results are in the same line with those reported by Matzinger *et al* (1959), El- Hosary (1989), Mohamed (1989) and El- Hosary and Sedhom (1990). Also, significant s.c.a. x year along with insignificant g.c.a. x year interactions were detected for ear length and ear diameter revealing that non-additive effects seemed to be the only component that greatly affected by different growing years. Insignificant interactions between years and both types of combining ability were obtained for ear height indicating that all types of gene action were stable over the two growing years.

Estimates of general combining ability effects ($\hat{g}_i$) for each parental line in each trait combined over two growing years are presented in Table (3). It is clear that the best combiner for grain yield/plant and ear length was the parental line MR4 since it expressed high significant and positive value for g.c.a. Moreover, this particular line (MR4) was also the best combiner for silking date, where it had a significant and negative value of g.c.a for this traits.

Highly significant and negative g.c.a. effects were recorded with line K64 for plant height and ear height. Therefore, this line appeared to be the best combiner for plant and ear heights. However this line (K64) was the worst combiner for grain yield/plant and its components. Parental line G 251 B

Table (3): General combining ability effects of parental lines for eight traits of maize combined over two years.

Parent	Grain yield g/plant	Ear length	ear diameter	No. of rows/ ear	No. of grains/ row	Plant height	Ear height	Silking date
MR4	8.79**	0.80**	0.24	0.31	1.26	5.92	2.00	-1.02*
G 507 A	6.49**	-0.40	-1.73**	-0.21	0.54	-11.05**	-2.70	-0.92*
K 64	-13.45**	-0.78**	-1.82**	-0.84**	-1.99**	-18.01**	-7.30**	-0.79
G 251 B	-4.88*	-0.34	0.13	0.58**	-1.46*	-0.05	-3.93*	0.57
G 307 A	-3.11	0.10	-0.48	0.20	0.20	-4.81	-5.63**	1.71**
G 224 D	0.86	0.01	1.42**	-0.28	0.38	24.88**	17.20**	0.17
MR5	5.42*	0.61*	2.25**	0.24	1.07	3.12	0.37	0.27
L.S.D 0.05 ($\hat{g}i-\hat{g}j$)	7.40	0.74	1.35	0.66	2.20	10.02	6.07	1.27
L.S.D 0.01 ($\hat{g}i-\hat{g}j$)	9.81	0.98	1.79	0.88	2.92	13.29	8.05	1.69

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

exhibited highly significant and positive g.c.a effects for number of rows/ear. Inbred line MR5 was the best combiner for ear diameter and it was among the best combiners for grain yield/plant and ear length. Line G 224 D was the second best combiner for ear diameter. Parental line G 507 A appeared to be among the good combiners for silking date and grain yield/plant.

The estimates of specific combining ability for all of the studied traits combined over two growing seasons are presented in Table (4). Significant desirable s.c.a. effects were obtained for grain yield/plant (ten crosses), ear length (six crosses), ear diameter (two cross), number of rows/ear (five crosses), number of grains (four crosses) plant height (four crosses), ear height (two crosses), and silking date, (two crosses). However, The highest desirable s.c.a. effects were recorded in the crosses: (K64 x G 224 D) for grain yield/plant and ear diameter ; (G 224 D x MR5) for ear length; (G 507 A x MR5) for number of rows/ear; (K64 x G 307 A) for number of grains/row, (G 251 B x MR5) for plant height; (G 507 A x K64) for ear height; and (G 507 A x G 251 B) for silking date. In conclusion, these cross combinations would be efficient and prospective in improving grain yields in maize.

Relative increases of grain yield/plant over D.C. 204 in both years as well as the combined analysis are presented in Table (5). Results indicated that six, five, and seven single crosses expressed significant and positive increases for grain yield/plant in 1991 and 1992 seasons and the combined data, respectively. However, the highest relative increases were detected in the cross (G 507 A x MR5) in the first season and the combined data , being 35.28% and 30.08% over the check variety, respectively. Whereas, the cross (G 224 D x MR5) produced the highest increase (27.97%) in the second season.

It is worth mentioning here that the increases in grain yield (heterotic effects) were more pronounced in the crosses that involve parents of different divergent genetic origin. This is very clear in the cross (G 507 A x MR 5) which expressed the highest increase of grain yield in the first season and the combined analysis. The parents of these crosses were of wide divergent origin. The origin of the parental line G 507 A is K 64 x 213, whereas the line MR 5 was developed from the composite variety Giza- 2. However, the relative increases in grain yield were much more in the first season than the second one among most of the studied crosses. This may be due to the earlier planting of the first season.

It could be concluded that these single crosses offer a possibility for increasing grain yield of maize crop in Egypt.

Table (4): Specific combining ability (s.c.a.) effects of the studied crosses for eight traits combined over two years.

Cross	Grain yield g/plant	Ear length	Ear diameter	No. of rows/ ear	No. of grains/ row	Plant height	Ear height	Silking date
MR4 x G 507 A	16.65**	0.08	0.60	-0.45	-2.47	-7.74	-7.52	0.01
x K 64	-19.44**	-1.17*	-3.40**	-0.81	-3.67*	-4.11	1.74	0.21
x G 251 B	20.36**	0.77	1.25	0.90*	1.88	11.59	3.21	0.51
x G 307 A	18.59**	1.89**	1.67	1.10*	2.11	10.86	0.58	-0.62
x G 224 D	-29.88**	-2.24**	-0.49	-1.03*	-0.32	-17.84**	1.41	1.08
x MR5	-1.28	0.67	0.38	0.29	2.47	7.26	0.58	-1.19
G 507 A x K 64	-44.14**	-2.50**	0.78	-1.07*	-7.54**	-14.98*	-10.72**	3.90**
x G251 B	13.66**	1.92**	0.51	-0.70	4.83**	10.06	10.41**	-3.26**
x G 307 A	14.72**	0.05	-0.12	0.31	1.58	-3.51	-1.22	1.11
x G 224D	-25.74**	-1.16*	-3.02**	0.06	2.15	2.12	0.61	-0.19
x MR5	24.86**	1.60**	1.26	1.85**	1.46	14.22*	8.44*	-1.62
K 64 x G 251 B	-8.77	-0.31	-1.04	-0.46	1.99	-13.48*	-4.16	-0.06
x G 307 A	31.12**	2.17**	1.50	1.59**	7.32**	6.79	4.71	-0.69
x G 224 D	39.32**	1.83**	2.39**	1.67**	3.19*	10.42	8.38*	-2.66**
x MR5	1.92	-0.02	-0.23	-0.92*	-1.28	15.52*	0.04	-0.66
G 251 B x G 307 A	-10.24*	-0.13	0.01	-0.37	-2.56	12.16	1.68	-0.89
x G 224 D	11.62*	0.08	0.13	0.02	-5.56**	11.29	-2.82	0.14
x MR5	-21.61**	-2.33**	-0.86	0.61	-0.58	-23.68**	-8.32*	3.54**
G 307A x G 224 D	-22.81**	-1.29**	-0.76	-0.75	-2.92*	-13.44	-6.29	1.34
x MR5	-31.38**	-2.70**	-2.29*	-1.88**	-5.53**	-12.84	0.54	-0.26
G 224 D x MR5	27.49**	2.78**	1.75*	0.04	3.47*	7.46	-1.29	0.28
L.S.D 0.05 $(S_{ij}-S_{ik})$	14.80	1.47	2.71	1.31	4.39	20.03	12.11	2.53
L.S.D 0.01 $(S_{ij}-S_{ik})$	19.63	1.95	3.22	1.74	5.83	26.56	16.07	3.35
L.S.D 0.05 $(S_{ij}-S_{kl})$	12.81	1.27	2.35	1.13	3.79	17.34	10.48	2.18
L.S.D 0.01 $(S_{ij}-S_{kl})$	19.99	1.69	2.79	1.5	5.03	23.00	13.90	2.90

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

Table (5): Increases in grain yield/plant relative to D.C. 204 in both seasons and the combined analysis.

Cross	Percentage of increase in grain yield		
	First year	Second year	Combined
MR4 x G 507 A	33.77**	19.35	26.82**
x K 64	-1.29	-21.45	-10.99
x G 251 B	24.03*	12.12	18.29*
x G 307 A	27.70*	15.15	21.66*
x G 224 D	-5.84	-10.96	-8.31
x MR5	4.11	24.71*	14.03
G 507 A x K 64	-29.87*	-28.44*	-29.18**
x G251 B	19.48	11.42	15.60
x G 307 A	24.46*	10.02	17.51*
x G 224D	3.03	-17.95	-7.07
x MR5	35.28**	24.48*	30.08**
K 64 x G 251 B	-15.15	-10.72	-13.02
x G 307 A	8.23	22.38	15.04
x G 224 D	22.51	24.01*	23.23**
x MR5	1.08	1.17	1.12
G 251 B x G 307 A	-24.89*	12.35	-6.96
x G 224 D	-2.16	24.01*	10.44
x MR5	-15.58	-1.63	-8.87
G 307A x G 224 D	-24.24*	2.09	-11.56
x MR5	-21.43	-6.53	-14.25
G 224 D x MR5	28.14*	27.97*	28.06**

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

REFERENCES

Abd El-Sattar, A.A. (1986): Studies on combining ability and heterosis in maize (*Zea mays* L.). M.Sc. Thesis. Fac. Agric. Moshtohor. Zagazig Univ.. Egypt.

Abd El-Sattar, A.A. (1992): Breeding studies on maize (*Zea mays*. L). Ph.D. Thesis, Fac. Agric. Moshtohor, Zagazig Univ.. Egypt.

El- Hosary, A.A. (1985): Study of combining ability in some top crosses in maize. Egypt. J. Agron. 10, (1-2): 39-47.

El- Hosary, A.A. (1989): Heterosis and combining ability of six inbred lines of maize in diallel crosses over two years. Egypt. J. Agron.. 14 (1-2): 47-58.

El-Hosary, A.A. and S.A. Sedhom (1990): Diallel analysis of yield and other agronomic characters in maize (*Zea mays*. L.). Ann. Agric. Sci., Moshtohor, Vol. 28 (4): 1987-1988.

El- Zeir, F.A.A (1984): Combining ability and heterosis of some inbred lines of maize. M.Sc. Thesis, Fac. Agric. Zagazig Univ.. Egypt.

Falconer, D.S. (1960): Introduction to Quantitative Genetics. Oliver and Boyd,Edinburg.

Galal, A.A., F.A. El- Zeir and M.A. Younis (1987): Estimation of general and specific combining ability in three sets of new inbred lines of maize. J. Agric. Res. Tanta, Univ.

Griffing, B. (1956): Concept of general and specific combining ability in relation to diallel crossing system. Aust. J. Biol. Sci., 9: 463-493.

Matzinger, D.F.; G.F. Sprague and C.C. Cockerham (1959): Diallel crosses of maize in experiments repeated over locations and years. Agron. J., 51: 346-350.

Mohamed, A.A. (1989): Genetic studies through diallel of maize inbred lines. M.Sc. Thesis, Fac. Agric. Cairo, Univ., Egypt.

Nawar, A.A. (1985): Hybrid vigor and combining ability and their interactions with years in maize (*Zea mays*, L.). Minufiya J. Agric. Res., 10: 115-132.

Nawar, A.A., F.A. Hendawy, H.A. Dawwn and A.A. El-Hosary (1988): Study of the reciprocal effects on the performance of double-cross hybrids under two nitrogen levels in maize. Proc. 3 rd Egypt. Conf. Agron., 1,1- 13.

Rashed, M.A. (1977): Genetic studies on corn (*Zea mays*, L.). M. Sc. Thesis, Fac. Agric., Ain Shams Univ., Egypt.

Sedhom, S.A. (1984): Study on late wilt disease resistance in maize. Ph.D. Thesis, Fac. Agric. Moshtohor, Zagazig Univ., Egypt.

Sedhom, S.A. (1992): Development and evaluation of some new inbred lines of maize. Proc. 5 Th.Conf. Agron.; Zagazig Vol. (1): 269-280.

Sedhom, S.A. (1993): Estimation of genetic variance components in a composite variety of maize. Egypt. J. Appl. Sci. 8 (7): 553-561

التحليل الوراثي للهجن التبادلية في الذرة الشامية خلال موسمين زراعين

سيدهم أسعد سيدهم

قسم المحاصيل – كلية الزراعة بمشتهر – جامعة الزقازيق (فرع بنها)

أجري هذا البحث بمحطة البحوث والتجارب الزراعية بكلية الزراعة بمشتهر خلال ثلاثة سنوات متتالية لدراسة القدرة العامة والخاصة علي التآلف وتفاعلهم مع السنوات وكذلك قوة الهجين لمجموعة من الهجن التبادلية ناتجة من التهجين بين سبعة سلالات نقية من الذرة الشامية ، حيث تم تقييم الهجن الفردية مع صنف مقارنة (هجين زوجي ٢٠٤) في موسمين زراعيين , وكان التصميم المستخدم في كل موسم هو القطاعات الكاملة العشوائية في ثلاثة مكررات . وتم تسجيل القراءات التالية : ميعاد ظهور النورة المؤنثة , أرتفاع النبات , أرتفاع الكوز , طول الكوز , قطر الكوز , عدد صفوف الكوز . عدد حبوب الصف , ومحصول الحبوب للنبات . وقد أظهرت النتائج مايلي :–

– كان التباين الراجع الي السنوات معنويا لجميع الصفات تحت الدراسة ماعدا تاريخ ظهور الحريرة , أرتفاع النبات , وعدد صفوف الكوز .

_ كان هناك تباين معنوي واضح للهجن في كل موسم وفي الموسمين معا وكذلك تفاعل الهجن مع السنوات لجميع الصفات المدروسة .

_ أظهرت النتائج أيضا أن تباين القدرة العامة والخاصة علي التآلف كان معنويا لمعظم الصفات في كل موسم وفي التحليل التجميعي للموسمين معا . وكان الجزء الأكبر من الاختلافات الوراثية يرجع الي فعل الجنيات المضيف بالنسبة لصفتي أرتفاع النبات وقطر الكوز في كل موسم وفي الموسمين معا، بينما كان التأثير غير المضيف هو الاكثر أهمية بالنسبة لصفتي عدد حبوب السطر ومحصول الحبوب للنبات في كلا الموسمين وفي التحليل التجميعي . وكان تفاعل كلا من القدرة العامة والخاصة علي التآلف مع السنوات معنويا لصفات محصول الحبوب للنبات ، عدد سطور الكوز ، وعدد حبوب السطر ، وارتفاع النبات .

_ أظهرت السلالة الأبوية مشتهر٤ أفضل قدرة علي التآلف لصفة محصول الحبوب للنبات وطول الكوز ، وتاريخ ظهور الحريرة . وكانت أفضل الهجن الفردية هي (جيزة ٥٠٧ أ × جيزه ٢٥١ب) لصفة تاريخ ظهور الحريرة , (K 64 × جيزه ٢٢٤ د) لصفتي قطر الكوز ومحصول الحبوب للنبات.

_ أمكن الحصول علي اعلي قوة للهجين (٣٥،٢٨ ، ٣٠،٠٨ ٪) من الهجن الفردية(جيزه ٥٠٧ أ × مشتهر ٥) بالنسبة لمحصول الصنف القياس (هجين زوجي ٢٠٤) ، في الموسم الأول والتحليل التجميعي للموسمين علي الترتيب