Zagazig J. Agric. Res., Vol. 42 No. (2) 2015
http:/www.journals.zu.edu.eg/journalDisplay.aspx?Journalld=1&queryType=Master

GENERAL AND SPECIFIC COMBINING ABILITY EFFECTS FOR YIELD AND ITS COMPONENTS IN MAIZE DIALLEL CROSSES

Mohamed A. Hager*, E.F. El-Hashash and M.A.M. Ali

Agron. Dept., Fac. Agric., Al-Azhar Univ., Cairo, Egypt

ABSTRACT

A half diallel cross comprising seven inbred lines were studied for six traits to determine combining ability in parents and their F_1 crosses. This study have focused attention on procedural aspects for exploiting combining ability in order to predict hybrid performance and identifying F_1's to be utilized in maize breeding programs. The mean squares of genotypes were highly significant for all studied traits during the two seasons. Mean performance of most single crosses were higher than the parents for all studied traits during the two seasons. The hybrid L155 x L176 was the best mean performance for most studied traits. Based on the general combining ability (GCA) effects the parents L155 and L206 were identified as good combiners for most yield and yield component traits in diallel analysis during 2011 and 2012 seasons. These parents can be used in pedigree breeding for incorporation of desired traits. The SCA effects for hybrid combinations L155 x L207 for ear length, L212 x L232 for number of kernels/row, L155 x L172 for number of rows/ear, L207 x L212 for number of kernels/ear and L155 x L176 for 100-kernel weight and grain weight/ plant were found to be the best specific combinations. Grain yield/plant showed a highly significant positive association with other studied traits *i.e.*, ear length, number of kernels/row, number of rows/ear, number of kernels/ear, 100- kernel weight and grain weight/plant during the two seasons, hereby improving grain yield in corn is possible through selection for the previous traits.

Key words: Diallel, hybrid, genotypes, crosses, kernels, rows.

INTRODUCTION

Corn (*Zea mays* L.) plays a significant role in human and livestock nutrition world-wide. Hybrid maize cultivation is also becoming popular among the farmers. Its production has increased significantly in the country because of high demand of the fast growing poultry feed industry. Corn inbred lines are developed from segregating base populations due to self-pollination, through visual selection among and within ear-to-row progenies and testing for performance in hybrid combinations (Hallauer, 1990). Combining ability of line or inbred is the ultimate factor determining future usefulness of the lines for developing hybrids. Sprague and Tatum (1942) gave the concept of combining ability, and the two expressions of combining ability *i.e.*, general (GCA) and specific (SCA) combining ability have had a significant impact on evaluation of genotypes and population improvement. They defined GCA as the average performance of a line in hybrid combinations with number of genotypes. Specific combining ability (SCA) is the average performance of a specific cross combination expressed as deviation from the population mean. Corn breeders hence are very ardent in determining the genetic potential of their new inbred parents in hybrid combinations for two reasons. First, inbred parents may be identified which form good individuals in specific combinations which is commonly referred as specific combining ability (SCA) of inbred parents. Secondly, it is to locate the inbred lines performing very well when crossed with series of other inbred parents which is referred as general combining ability (GCA) of the parents (Sprague and Tatum,

*Corresponding author: Tel. :+201002183093
E-mail address: Mohamedhager@yahoo.com

1942). Dhillion (1975) had pointed out that the combining ability gives useful information on the choice of parents' in terms of expected performance of the hybrids and their progenies. Also, the parents having high GCA could be useful for producing transgressive segregants (Jagtap, 1986). Furthermore, the better SCA estimate will be the most promising in obtaining lines for inter population hybrid synthesis. Combining ability has a prime importance in plant breeding since it provides information for the selection of parents and also provides information regarding the nature and magnitude of involved gene action (Kiani *et al.*, 2007). Testing and selection of superior inbred lines for their combining ability for hybrid production demands a great amount of effort. When a high number of inbred lines are tested, the possible number of hybrid combinations to be evaluated is tremendously high. This poses a lot of practical difficulties in conducting extensive yield tests. Kambe *et al.*, (2013) reported that most inbred lines were good general combiners for yield and yield attributing characters. Among the hybrids, some hybrids exhibited highest significant SCA effects over checks for yield and yield attributing traits. Khan *et al.*, (2014) mentioned that combining ability analysis for yield and yield components traits showed that GCA and SCA effects were highly significant and significant, respectively.

In the present study, diallel analysis was used to determine the behavior of high yield maize lines and crosses, based on the effects of GCA and SCA, respectively for economic yield traits.

MATERIALS AND METHODS

Plant Material and Experimental Layout

The research work pertaining to study the combining ability in single crosses of corn was carried out during 2010, 2011 and 2012, at Seds Research Station, Bine-Swief Governorate, Egypt. The seven yellow parental lines as follows: L 155, L 172, L 176, L 206, L 207, L 212 and L 232. The source of these strains (SX 12564 USA, india CM 202, PF-10-, Turkya 24, Sd x 614, MF 902, Sd121, respectively). During the first season (2010), the seven parents were sown and crossed in a half diallel fashion to produce 21 single cross hybrids. In 2011 and 2012 seasons, the seven parental varieties and 21 single crosses were evaluated in a randomized complete blocks design (RCBD) with three replications. Each block contained 30 plots. Plot size was one row, 6 meters long and 70 cm apart. Hills were spaced at 30 cm and thinned to one plant per hill. All the recommended cultural practices of corn production in the area were done as usually. Ten plants (except two border plants) were harvested to determine yield and yield components traits. The data were recorded in the field and laboratory for all guarded plants of each population to evaluate the performance of the studied traits.

Traits Measurement and Statistical Analyses

Data were recorded for ear length (cm), number of kernels/row, number of rows/ear, number of kernels/ear, 100- kernel weight (g) and grain weight/plant (g). The analysis of variance and orthogonal contrast comparisons were carried out using the statistical methods by Cochran and Cox (1957). The parents and the one set of F_1 are then analyzed according to Griffing (1956) Method II Model I as outlined by Singh and Chaudhary (1979).

RESULTS AND DISCUSSION

Analysis of Variance

The mean squares obtained from analysis of variance for parents and single crosses are presented in Table 1. Mean squares for the genotypes showed highly significant differences for all studied traits during the 2011 and 2012 seasons. This depicts considerable differences among the parents and their hybrids. The total genetic variability could be partitioned to general combining ability and specific combining ability. In this respect Gautam *et al.* (2013) and Kambe *et al.* (2013) mentioned that, the mean sum of squares for genotypes were highly significant, which indicated the diverse performance of different cross combinations for yield and yield components traits. Analysis of variance of genotypes revealed highly significant differences for 100 kernel weight and grain yield traits (Khan *et al.*, 2014).

Table 1. Analysis of variance for all studied traits during 2011 and 2012 growing seasons

S.O.V	d.f	Ear length	No. of kernels/row	No. of rows/ear	No. of kernels/ear	100-kernel weight	Grain weight /plant
				2011 growing season			
Replications	2	2.61*	512.10**	21.53**	6511.00**	3.10	670.66**
Genotypes	27	25.53**	167.20**	3.75**	47995.10**	73.51**	6100.30**
Error	54	1.90	5.70	0.87	2180.90	5.90	390.22
				2012 growing season			
Replications	2	0.69	11.04**	0.77	500.20**	7.90**	26.84
Genotypes	27	11.83**	161.11**	5.66**	47127.00**	72.40**	11122.91**
Error	54	0.57	3.96	0.65	1351.80	4.30	470.29

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

Mean Performance

The *per se* performance was considered as the first important selection index in the choice of parents, and the parents with high per se performance will result in superior hybrids. The mean performance of the parents and hybrids were estimated from the data of two years for yield and yield components traits and illustrated in Tables 2 and 3. The mean performance values of parents and hybrids displayed significant or highly significant differences for all studied traits during the two seasons. In general, significant differences were recorded between means when compared with the LSD values.

The parental line L206 for ear length, number of kernels/row, number of kernels/ear and grain weight/plant traits, the parent L172 for number of rows/ear and the parent L207 for 100-kernel weight trait were displayed the best mean performance during 2011 and 2012 seasons. These results indicated that the previous parental lines are the promising once in producing new maize hybrids. On the other hand, the parent L232 for ear length, number of kernels/row, number of kernels/ear, 100-kernel weight and grain weight/plant and the parent L155 for rows/ear trait were showed the lowest mean values at 2011 and 2012 seasons.

The single-crosses L155 x L207 and L155 x L206 manifested greatest mean values for ear length during 2011 and 2012 seasons. The L172 x L206 and L212 x L232 crosses were showed highest mean values for number of kernels/row during 2011 and 2012 seasons. The better mean values for number of rows/ear in 2011 and 2012 seasons were denoted by L155 x L172 and L172 x L212 crosses. The L172 x L212 and L155 x L207 crosses showed the highest mean values for number of kernels/ear trait. The single cross L155 x L176 exhibited the best mean values and excelled other genotypes for 100-kernel weight and grain weight/plant traits in the two seasons.

These results indicated the superiority of the previous single crosses, with respect to their corresponding parents. These viewpoints were kept in mind while selecting these single crosses as diverse F_1 base populations for initiating reciprocal selection for combining ability. The highest combinations indicating that importance of low and average parents in the exploitation of heterosis for studied traits. There were relatively large variations in all genotypes for these traits. Since the single cross was revealing- high potentiality it could be an indication of differences in the dominant favorable alleles distributed among the two parents are different. In the present study it was proposed to use the actual single cross performance as an indicator of genetic diversity existing between the concerned parents. Consequently, the parents involved in the previous combinations should be used in improving yield and its components and the best crosses should be used in initiated the corn breeding program.

Table 2. Mean performance for ear length, number of kernels/row and number of rows/ear of the 7 inbred lines and their 21 F_1's during 2011 and 2012 growing seasons

Genotypes	Ear length		No. of kernels/row		No. of rows/ear	
	2011	2012	2011	2012	2011	2012
L155	11.6	14.6	27.27	25.60	10.33	10.73
L172	12.8	14.1	29.60	27.93	13.67	13.67
L176	12.9	13.0	36.00	33.00	12.27	12.27
L206	14.4	15.6	37.80	36.13	13.13	13.13
L207	11.6	12.7	31.73	30.07	13.10	13.10
L212	12.9	16.0	31.67	30.33	10.87	10.87
L232	12.1	15.6	23.93	22.27	10.83	11.13
L155×L172	20.0	17.5	45.47	44.13	15.20	15.60
L155×L176	19.9	18.0	45.47	43.47	13.73	14.80
L155×L206	20.5	19.6	48.27	45.27	13.60	14.07
L155×L207	20.6	19.8	47.60	45.27	14.33	15.00
L155×L212	19.1	18.0	47.60	44.93	14.00	14.80
L155×L232	18.7	17.0	44.57	42.57	13.53	14.73
L172×L176	16.7	18.1	45.40	42.40	14.20	14.87
L172×L206	18.6	18.4	49.67	48.33	13.70	14.50
L172×L207	18.3	18.3	45.87	44.87	13.93	15.40
L172×L212	19.7	19.9	48.53	46.20	14.33	15.67
L172×L232	19.7	18.8	47.53	44.87	14.20	15.00
L176×L206	17.8	17.8	47.80	45.80	12.47	12.87
L176×L207	17.2	17.0	46.10	43.10	13.77	14.43
L176×L212	18.8	18.3	48.40	45.73	13.20	14.53
L176×L232	17.7	16.8	47.40	45.07	13.20	13.73
L206×L207	19.0	18.5	47.27	45.93	12.47	12.73
L206×L212	18.7	18.2	43.87	40.53	12.87	12.87
L206×L232	19.3	17.9	44.07	43.73	13.07	14.00
L207×L212	17.7	20.9	47.80	46.80	14.20	15.00
L207×L232	18.1	17.5	47.00	45.00	13.77	14.30
L212×L232	18.7	17.2	49.93	47.27	13.47	14.40
LSD at 5%	1.9	1.0	3.2	2.7	1.3	1.1
LSD at 1%	2.7	1.5	4.6	3.9	1.8	1.6

Table 3. Mean performance for number of kernels/ear, 100-kernel weight and grain weight/ plant of the 7 inbred lines and their 21 F_1's during 2011 and 2012 growing seasons

Genotypes	No. of kernels/ear		100-kernel weight		Grain weight/plant	
	2011	2012	2011	2012	2011	2012
L155	282.2	341.79	21.7	27.7	98.3	98.2
L172	405.4	406.13	18.7	24.3	52.7	48.5
L176	438.8	433.77	22.7	26.7	73.3	76.3
L206	498.2	462.13	20.0	24.0	136.7	125.0
L207	418.8	332.67	25.7	28.3	84	108.9
L212	344.1	357.80	23.3	27.3	89	74.2
L232	255.5	255.61	16.7	21.7	38.7	42.8
L155×L172	688.9	699.88	22.7	27.0	154.6	151.1
L155×L176	625.3	598.33	36.3	41.0	210	291.1
L155×L206	653.8	615.56	31.0	34.0	194.1	216.1
L155×L207	681.4	630.73	33.7	37.7	195.3	224.4
L155×L212	657.9	616.19	28.3	33.3	180	210.2
L155×L232	598.5	637.67	26.3	32.7	135.4	221.0
L172×L176	636.2	647.20	24.3	27.3	102.4	144.8
L172×L206	676.8	677.27	28.0	31.0	117	130.3
L172×L207	633.0	612.57	22.7	23.3	154.4	122.6
L172×L212	690.6	661.00	26.7	28.7	160.5	206.3
L172×L232	669.4	700.00	24.7	28.7	94.7	183.0
L176×L206	595.4	574.29	26.7	33.7	161.1	116.8
L176×L207	630.3	612.43	33.7	36.7	114.3	217.4
L176×L212	635.8	620.72	29.7	34.0	173.6	113.0
L176×L232	622.9	630.47	27.7	29.0	150.7	202.6
L206×L207	588.2	555.17	32.3	36.7	176.1	168.4
L206×L212	560.9	562.19	35.0	37.7	153.3	204.2
L206×L232	574.5	559.11	26.0	31.0	141.7	180.1
L207×L212	676.8	711.67	26.7	31.3	155.5	169.3
L207×L232	642.6	654.40	27.0	32.7	181.4	160.7
L212×L232	666.1	643.33	32.3	36.3	185.5	225.4
LSD at 5%	63.7	50.2	3.3	2.8	27.0	29.6
LSD at 1%	91.1	71.7	4.7	4.0	38.5	42.3

Combining Ability Effects

General combining ability (GCA) effects

Estimates of general combining ability (GCA) effects of parents for different traits are presented in Table 4. The parents L 155, L 206 and L 212 for ear length; L 155, L 176 and L 206 for number of kernels/row; the parents L 172 and L 207 for number of rows/ear; L 172 for number of kernels/ear; L 155, L 176, L 207 and L 212 for 100-kernel weight and the parents L 155, L 206 and L 232 for grain weight/plant registered highly significant positive GCA effects during 2011 and 2012 seasons. For some traits, GCA effects were negative or insignificant for the parents. With regard to favorite GCA effects of parents, it could be suggested that these parents may be preferred for hybridization and selection programmers to extract desirable plant materials from segregating populations to improve majority of the studied traits. Perusal of GCA effects revealed that some parents were observed to be good combiner for yield and most yield components (Kambe *et al.*, 2013).

Specific combining ability (SCA) effects

Estimation of specific combining ability (SCA) effects based on mean performance of the best crosses during 2011 and 2012 seasons are shown in Tables 5 and 6. In the first season (2011), 15, 19, 7, 15, 9 and 13 out of 21 F_1 crosses were positive significant or highly significant SCA effects which ranged from 1.12 to 3.30 for ear length, 1.70 to 8.05 for number of kernels/row, 0.70 to 1.30 for number of rows/ear, 41.26 to 127.34 for number of kernels/ ear, 2.87 to 7.69100- for kernel weight and from 14.87 to 59.01 for grain weight/plant traits. In relation to second season (2012), the results of SCA demonstrated that, 12, 18, 11, 16, 10 and 12 out of 21 F_1 crosses were significant or highly significant and positively varied from 0.69 to 3.00, from 2.82 to 7.43, from 0.65 to 1.20, from 33.84 to 153.84, from 1.69 to 7.65 and from 22.75 to 108.85 for the same previously traits, respectively.

These results revealed that, the SCA effects of the hybrids L155 x L207 for ear length, L212 x L232 for number of kernels/row, L155 x L172 for number of rows/ear, L207 x L212 for number of kernels/ear and L155 x L176 for both 100-kernel weight and grain weight/plant traits were found to be the best specific combinations. The attained results may be due to the presence of a considerable non-allelic gene action. On the other hand, the significantly negative estimates of SCA revealed the presence of undesirable types in the remaining combinations. These results as well as general combining ability confirm that the parental general combining ability effects were generally unrelated to specific combining ability effects estimates for their respective crosses. Most of the crosses with high SCA have at least the highest one GCA parent. Therefore, high × low, low × high and in some cases high × high GCA parents performed well in SCA determination and revealed also the best mean performance. Ivy and Hawlader (2000) reported that good general combining parents do not always show high SCA effects in their hybrid combinations. On the contrary, Paul and Duara (1991) stated that the parents with high GCA always produce hybrids with high estimates of SCA. Roy *et al.* (1998) also found significant positive SCA effects in high × low general combiners. Therefore, after analyzing the F_1 hybrids through combining ability with reasonable SCA variance, the medium type of heterosis in such specific cross combinations may have some stability and such promising F_1 hybrids can also be used for hybrid corn productions.

When both GCA and SCA effects are significant for trait, this indicate that both additive and non-additive gene action are important in controlling such trait. Two factors are considered important for the evaluation of inbred lines in hybrid maize production, the characteristics of the line itself and the behaviour of the line in a particular hybrid combination (Malik, 2004). As a basic principle, Sprague and Tatum (1942) emphasised that SCA is more important than GCA among selected inbred lines. Aliu *et al.* (2008) added that SCA as an indicator for the predominance of genes having dominance and epistatic effects while GCA as indicative for the predominance of genes having largely additive effects.

Karayaa *et al.* (2009) detected that several hybrids had significant negative SCA and significant positive SCA for grain yield. Khalil *et al.* (2010) noticed that, the GCA and SCA effects were significant for the yield traits. Most crosses showing significant positive sca effects and highest magnitude of economic heterosis for grain yield trait (Izhar and Chakraborty, 2013).

Table 4. General combining ability effects (GCA) of 7 parental inbred lines for the studied traits during 2011 and 2012 growing seasons

Inbred lines		Ear length	No. of kernels/row	No. of rows/ear	No. of kernels/ear	100-kernel weight	Grain weight/plant
				2011 growing season			
P1 (155)		0.45**	0.99**	-0.12	-12.78	0.81**	18.01**
P2 (172)		0.07	-0.77**	0.75**	24.50**	-3.12**	-23.89**
P3 (176)		-0.46**	0.86**	-0.11	4.26	1.03**	-9.03**
P4 (206)		0.52**	1.31**	-0.19	6.76	0.51	12.52**
P5 (207)		-0.43**	-0.55	0.28**	11.63	1.44**	-8.53**
P6 (212)		0.05	-0.62	-0.26	-1.00	1.22**	-9.11**
P7 (232)		-0.19	-1.22**	-0.36**	-33.36**	-1.89**	15.25**
LSD at	0.05	0.41	0.71	0.28	13.9	0.72	5.9
	0.01	0.62	1.08	0.42	21.2	1.1	9.0
				2012 growing season			
P1 (155)		0.44**	1.20**	-0.05	-3.91	1.58**	27.09**
P2 (172)		0.07	-0.10	0.83**	32.56**	-3.57**	-25.71**
P1 (155)		0.44**	1.20**	-0.05	-3.91	1.58**	27.09**
P2 (172)		0.07	-0.10	0.83**	32.56**	-3.57**	-25.71**
P3 (176)		-0.74**	0.64**	-0.13	3.76	0.92**	-12.12**
P4 (206)		0.35**	1.59**	-0.40**	-5.48	0.58	7.18**
P5 (207)		-0.55**	0.39	0.24**	-8.32	0.92**	4.58
P6 (212)		0.66**	0.50	-0.21	1.50	1.03**	-9.88**
P7 (232)		-0.23	-1.62**	-0.28**	-20.11**	-1.46**	9.77**
LSD at	0.05	0.22	0.59	0.24	10.9	0.62	6.5
	0.01	0.34	0.91	0.37	16.7	0.94	9.9

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

Table 5. Specific combining ability effects (SCA) of 21 F_1 crosses for ear length, number of kernels/row and number of rows/ear during 2011 and 2012 growing seasons

Genotypes	Ear length		No. of kernels/row		No. of rows/ear	
	2011	2012	2011	2012	2011	2012
L155×L172	2.26**	0.02	3.88**	4.48**	1.30**	0.96**
L155×L176	2.65**	1.37**	2.67**	3.27**	0.70*	1.11**
L155×L206	2.30**	1.85**	5.03**	3.93**	0.64	0.65*
L155×L207	3.30**	2.54**	5.63**	5.12**	0.90*	0.95**
L155×L212	1.31*	-0.05	5.15**	4.68**	1.11**	1.20**
L155×L232	1.22*	-0.13	4.46**	4.43**	0.74*	1.19**
L172×L176	-0.12	1.44**	1.70*	1.11	0.30	0.30
L172×L206	0.75	0.69*	5.52**	5.90**	-0.13	0.21
L172×L207	1.37*	1.01**	2.99**	3.63**	-0.37	0.47
L172×L212	2.36**	1.88**	5.17**	4.85**	0.57	1.19**
L172×L232	2.53**	1.67**	6.52**	5.64**	0.54	0.58
L176×L206	0.48	0.90**	2.44**	2.82**	-0.50	-0.47
L176×L207	0.83	0.52	2.01*	1.32	0.33	0.46
L176×L212	1.95**	1.05**	3.83**	3.84**	0.31	1.01**
L176×L232	1.12*	0.45	5.17**	5.29**	0.41	0.27
L206×L207	1.65**	0.97**	2.74**	3.01**	-0.89*	-0.97**
L206×L212	0.90	-0.16	-1.14	-2.51**	0.05	-0.38
L206×L232	1.67**	0.49	1.40	2.82**	0.35	0.81*
L207×L212	0.86	3.0**	4.06**	4.96**	0.91*	1.11**
L207×L232	1.50**	0.525	5.60**	5.28**	0.58	0.47
L212×L232	1.55**	-0.51	8.05**	7.43**	0.82*	1.02**
LSD at 0.5 for Sij	**1.0**	**0.6**	**1.75**	**1.47**	**0.69**	**0.59**
LSD at 0.01 for Sij	**1.4**	**0.8**	**2.51**	**2.10**	**0.98**	**0.85**

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

Table 6. Specific combining ability effects (SCA) of 21 F_1 crosses for number of kernels/ear, 100-kernel weight and grain weight/plant during 2011 and 2012 growing seasons

Genotypes	No. of kernels/ear		100-kernel weight		Grain weight/plant	
	2011	2012	2011	2012	2011	2012
L155×L172	104.01**	106.59**	-1.82*	-1.86*	22.51**	-8.57
L155×L176	60.64**	33.84*	7.69**	7.65**	59.01**	108.85**
L155×L206	86.70**	60.31**	2.87**	0.99	25.58**	30.77**
L155×L207	109.39**	78.32**	4.62**	4.32**	34.74**	37.46**
L155×L212	98.55**	53.95**	-0.49	-0.12	14.87*	23.62**
L155×L232	71.53**	97.04**	0.62	1.69*	-5.35	36.49**
L172×L176	34.28	46.24**	-0.37	-0.86	-6.66	15.36
L172×L206	72.39**	85.54**	3.80**	3.13**	-9.60	-2.23
L172×L207	23.76	23.69	-2.45*	-4.86**	35.80**	-11.57
L172×L212	93.96**	62.29**	1.76	0.36	37.25**	72.61**
L172×L232	105.11**	122.90**	2.87**	2.84**	-4.18	51.27**
L176×L206	11.26	11.37	-1.67	1.32	15.61*	-38.30*8
L176×L207	41.26*	52.34**	4.39**	3.99**	-23.22**	60.65**
L176×L212	59.38**	50.81**	0.62	1.21	31.47**	-43.33**
L176×L232	78.88**	82.17**	1.73	-1.30	33.01**	48.32**
L206×L207	-3.37	4.32	3.58**	4.32**	21.06**	8.57
L206×L212	-18.05	1.52	6.47**	5.21**	-6.36	44.78**
L206×L232	27.96	20.05	0.58	1.02	6.45	22.75*
L207×L212	92.98**	153.84**	-2.78**	-1.45	3.57	8.28
L207×L232	91.14**	118.18**	0.65	2.36**	54.15**	1.73
L212×L232	127.34**	97.29**	6.21**	5.91**	53.60**	66.8**
LSD at 0.5 for Sij	34.4	27.1	1.8	1.5	14.6	16
LSD at 0.01 for Sij	49.2	38.7	2.6	2.2	20.8	22.9

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

A critical evaluation of the results with respect to specific combining ability effects showed that none of the cross combinations exhibited desirable significant SCA effects for yield and yield components traits. Results indicated that crosses having significantly higher SCA effects generally involved high and low overall general combiners, similar finding was recorded by Kambe *et al.* (2013).

Genotypic Correlation

The genotypic correlation coefficients of grain weight/plant with other quantitative traits during 2011 and 2012 seasons are presented in Table 7. Grain weight/plant showed a highly significant positive association with other studied traits during both seasons. The genetic correlation between all studied traits displayed significant or highly significant positive correlation in the two seasons, except 100-kernel weight which had insignificant association with number of rows/ear during both seasons, these results indicate that, the genetic correlations among grain weight/plant and other studied traits emphasized the possibility of improving yield in corn, through selecting the other studied traits.

Grain weight/plant showed significant genotypic correlation with number of rows/ear, number of kernels/row, number of kernels/ear and 100-kernel weight (Yousuf and Saleem, 2001). Bocanski *et al.* (2009) stated that, strong genetic correlations were found between grain yield and each of ear length, number of kernels/row and 100-kernel weight. Based upon the correlations, ear length was also found a suitable marker for selecting a maize hybrid for higher grain yield along with other yield attributes *i.e.* ear length, number of kernels/ear and 100-kernel weight traits (Inamullah *et al.*, 2011). Number of rows/ear, number of kernels/row and 100-kerenl weight correlated positively and significantly with grain yield (Khalili *et al.*, 2013).

Table 7. Genetic correlation coefficients between yield traits during 2011 and 2012 growing seasons

Traits	Ear length	No. of kernels/rows	No. of rows/ear	No. of kernels/ear	100-kernel weight
			2011 season		
No. of kernels/rows	0.91**				
No. of rows/ear	0.69**	0.70**			
No. of kernels/ear	0.91**	0.97**	0.85**		
100-kernel weight	0.65**	0.66**	0.31	0.59**	
Grain yield /plant	0.80**	0.78**	0.46**	0.73**	0.72**
			2012 season		
No. of kernels/rows	0.80**				
No. of rows/ear	0.62**	0.77**			
No. of kernels/ear	0.79**	0.94**	0.86**		
100-kernel weight	0.46*	0.57**	0.26	0.46**	
Grain weight/plant	0.59**	0.69**	0.59**	0.68**	0.76**

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

REFERENCES

Aliu, S., Sh. Fetahu and A. Salillari (2008). Estimation of heterosis and combining ability in maize (*Zea mays* L.) for ear weight using the diallel crossing method. Agronomijas vēstis (Latvian J. Agron.), 11: 7 – 12.

Bocanski, J., Z. Sreckov and A. Nastic (2009). Genetic and phenotypic relationship between grain yield and components of grain yield of maize (*Zea mays* L.). Genetika, 41(2):145–154.

Cochran, W.C. and G.M. Cox (1957). Experimental Design. 2nd Ed., Jon Willey and Sons. New York, USA.

Dhillion, B.S. (1975). Application of partial diallel crosses in plant breeding. A review. Crop Improv., 2: 1–7.

Gautam, S.R., B.R. Ojha, S.K. Ghimire and D.B. Gurung (2013). Heterosis and combining ability of Nepalese yellow maize (*Zea mays* L.). Agron. J. Nepal, 3: 172 – 180.

Griffing, B. (1956). Concepts of general and specific combining ability in relation to diallel crossing systems. Aust. J. Bio. Sci., 9: 463 – 493.

Hallauer, A.R. (1990). Methods used in developing maize inbreds. Maydica, 35: 1–16.

Inamullah, N.R., N.H. Shah, M. Arif, M. Siddiq and I.A. Mian (2011). Correlations among grain yield and yield attributes in maize hybrids at various nitrogen levels. Sarhad J. Agric., 27 (4): 531 – 538.

Ivy, N.A. and M.S. Hawlader (2000). Combining ability in maize. Bangladesh J. Agril. Res., 25 (3): 385–392.

Izhar, T. and M. Chakraborty (2013). Combining ability and heterosis for grain yield and its components in maize inbreds over environments (*Zea mays* L.). Afr. J. Agric. Res., 8 (25): 3276 – 3280.

Jagtap, D.R. (1986). Combining ability in upland cotton. Indian J. Agric. Sci., 56:833- 840.

Kambe, G.R., U. Kage, H.C. Lohithaswa, B.G. Shekara and D. Shobha (2013). Combining ability studies in maize (*Zea Mays* L.). Molecular Plant Breed., 4 (14): 116–127.

Karayaa, H., K. Njorogeb, S. Mugoa and H. Nderitub (2009). Combining ability among twenty insect resistant maize inbred lines resistant to *Chilo partellus* and *Busseola fusca* stem borers. Int. J. Plant Prod., 3 (1): 115-126.

Khalil, I.A., H. Rahman, N. Saeed and N.U. Khan (2010). Combining ability in maize single cross hybrids for grain yield: a graphical analysis. Sarhad J. Agric., 26 (3): 375 – 379.

Khalili, M., M.R. Naghavi, A.P. Aboughadareh and H.N. Rad (2013). Evaluation of relationships among grain yield and related traits in Maize (*Zea mays* L.) cultivars under drought stress. Int. J. Agron. Plant Prod., 4 (6): 1251–1255.

Khan, S.U., H. Rahman, M. Iqbal and G. Ullah (2014). Combining ability studies in maize (*Zea mays* L.) using populations diallel. Int. J. Basic and Appl. Sci., 14 (1): 17 – 23.

Kiani, G., G.A. Nematzadeh, S.K. Kazemitabar and O. Alishah (2007). Combining ability in cotton cultivars for agronomic traits. Int. J. Agric. Biol., 9: 521 – 2.

Malik, I (2004). General and specific combining ability studies in maize diallel crosses, Int. J. Agric. and Biol., NARC, Pakistan.

Paul, S.K. and R.K. Duara (1991). Combining ability studies in maize (*Zea mays* L.). Int. J. Tropics. Agric., 9 (4): 250–254.

Roy, N.C., S.U. Ahmed, A.S. Hussain and M.M. Hoque (1998). Heterosis and combining ability analysis in maize (*Zea mays* L.). Bangladesh J. Pl. Breed Genet., 11(172): 35-41.

Singh, R.K. and B.D. Chaudhary (1979). Biometrical Method in Quantitative Genetic Analysis. 2nd Ed., Kalyani. Publishers. Daryangai., New York, USA.

Sprague, G.F. and L.A. Tatum (1942). General and specific combining ability in single crosses in corn. J. American Soc. for Agron., 34: 923 – 932.

Yousuf, M. and M. Saleem (2001). Correlation analysis of maize for grain yield and its components. Int. J. Agri. Biol., 3(4):387- 388.

تأثيرات القدرة العامة والخاصة على التآلف للمحصول ومكوناته فى هجن الذرة الشامية التبادلية

محمد أحمد هاجر - عصام فتحي الحشاش - محمد علي محمد علي

قسم المحاصيل – كلية الزراعة – جامعة الأزهر– القاهرة – مصر

تم دراسة التحليل نصف التبادلى (دائرى) لسبعة أباء من الذرة الشامية لسبع صفات لتحديد القدرة على التالف فى عشائر الآباء والهجن. وقد ركزت هذه الدراسة على الاهتمام بالجوانب الإجرائية لتحسين القدرة على التالف لأداء الهجين المتوقع للتعرف على أفضل الهجن الفردية التى يمكن الاستفادة منها فى الشروع فى الانتخاب للقدرة على التالف، وكانت أهم النتائج المتحصل عليها كالتالى: أظهرت النتائج معنوية التباينات الراجعة إلى التراكيب الوراثية لجميع الصفات المدروسة خلال موسمى التجربة ٢٠١١ و ٢٠١٢، أشارت البيانات أن قيم متوسط الأداء لمعظم الهجن الفردية كانت أعلى من الأباء في كل الصفات محل الدراسة خلال موسمى الدراسة، وأعطى الهجين الفردى L 155 x L 207 أفضل متوسط أداء في معظم الصفات تحت الدراسة، وحددت نتائج تأثيرات القدرة العامة على التآلف أن الآباء L 155 و L 206 أعطا أفضل قدرة عامة على التآلف لمعظم صفات المحصول ومكوناته خلال موسمي الدراسة، ويمكن استخدام هذه الآباء فى التربية للحصول على الصفات المطلوبة، أوضحت النتائج أن الهجن الفردية L 155 x L 207 لصفة طول الكوز، L 212 x L232 لصفة عدد الحبوب/صف، L 155 x L 172 لصفة عدد الصفوف/ كوز، L 207 x L 212 لصفة عدد الحبوب/كوز وL 155 x L 176 لصفتى وزن الـ ١٠٠ حبة وزن الحبوب/نبات كانت هى أفضل قدرة خاصة على التآلف، أظهرت النتائج وجود ارتباط وراثى موجب وعالى المعنوية بين محصول حبوب النبات وباقى الصفات تحت الدراسة خلال موسمى التجربة، فى إشارة إلى إمكانية تحسين محصول حبوب الذرة الشامية من خلال الإنتخاب لصفات طول الكوز، عدد الحبوب/الصف، عدد الصفوف/ الكوز، عدد الحبوب/ الكوز، وزن ١٠٠ حبة.

المحكمـــــون:

١ـ أ.د. **سمير السيد بيومي مراد** أستاذ المحاصيل – كلية الزراعة – جامعة الأزهر.

٢ـ أ.د. **حســـن عـــوده عـــواد** أستاذ المحاصيل – كلية الزراعة – جامعة الزقازيق.