J. Agric. Sci. Mansoura Univ., 33 (7): 4993 - 5003, 2008

COMBINING ABILITY AND TYPE OF GENE ACTION FOR GRAIN YIELD AND SOME OTHER TRAITS USING LINE X TESTER ANALYSIS IN NEWLY YELLOW MAIZE INBRED LINES (*Zea mays* L.).

Aly, R. S. H. and E. A. Amer
Maize Research Program, FCRI, ARC, Egypt

ABSTRACT

Fourteen newly yellow inbred lines of maize were topcrossed with the two inbred line testers; Giza-638 and Giza-649 at Sids Agricultural Research Station in 2005growing season. The 28 topcrosses in addition to two yellow single crosses; SC 155 and SC 3084 as check varieties were evaluated in 2006 season at two locations; Sakha and Sids Agric. Res. Stns. The studied traits were number of days from planting to date of 50% silking, plant height, ear height, infection of late wilt% disease, number of ears/100 plants and grain yield in (ard/fed). Highly significant differences were found between the two locations for the studied traits, these finding indicated that the traits differed from one location to another. Significant and highly significant mean squares for crosses, lines and testers were observed for all studied traits. Mean squares of lines x testers interaction were highly significant for silking date, no. of ears/100 plant and grain yield. Interactions between crosses, lines, testers and line x testers with locations were not significant. The parental inbred lines that exhibited desirable general combining ability (GCA) effects were L_4, L_5, L_7, L_{12}, for plant height toward shorter plants and ear height toward lower ear placement. Line-$_4$ had negative and significant GCA effects for 50% silking toward earliness, L_5 for grain yield, L_9 for no. of ears/100 plants, L_{10} for no. of ears/100 plants and grain yield, L_{14} toward earliness and grain yield and L_2 for grain yield. Generally, these inbred lines could be recommended for advanced stage of evaluation by maize program. Giza-638 (T_1) tester was good general combiner for days to 50% silking toward earliness and ear height toward lower ear placement. While, Giza-649 (T_2) tester was good general combiner for no. of ears/100 plants and grain yield. The highest SCA effects were observed in the topcrosses L_8 x T_2, L_{13} x T_1 and L_{14} x T_1 for grain yield, L_8 x T_2 and L_9 x T_2 for no. of ears/100 plants, L_7 x T_1 for infection of late wilt% and L_{12} x T_2 for earliness. Estimation of general combining ability variance components (σ^2GCA) was larger than that of specific combining ability variance components (σ^2SCA) for silking date, plant height and ear height, indicating that additive was found to be more important than non-additive gene action for these traits. While, the σ^2SCA was larger than σ^2GCA for infection of late wilt%, no. of ears/100 plant and grain yield, indicating that the non-additive genetic variance played the major role than additive genetic variance in the inheritance of these traits. Topcrosses were significantly superior to the check SC 3084 (26.66 ard/fed) for grain yield, silking date (toward earliness), plant height (toward shorter plants) and ear height (toward lower ear placement). Generally, eight topcrosses; L_8 x T_2 (37.44 ard/fed), L_{14} x T_1 (37.40 ard/fed), L_2 x T_2 (36.05 ard/fed), L_{10} x T_1 (35.96 ard/fed), L_9 x T_2 (35.32 ard/fed), L_5 x T_1 (35.24 ard/fed), L_{13} x T_1 (34.89 ard/fed) and L_{11} x T_2 (34.76 ard/fed) were superior to the check SC 155 (34.08 ard/fed) for grain yield. Also, the three topcrosses; L_2 x T_1 (34.27 ard/fed), L_6 x T_1 (34.24 ard/fed) and L_{10} x T_2 (34.53 ard/fed) were highly mean of grain yield, but they were not significant different from than the highly check SC 155.

Keywords: Maize, *Zea mays* L., Topcrosses, Line x tester, Combining ability, Gene action.

INTRODUCTION

Successful development for improving high yielding maize hybrid and related traits such as earliness, shorter plants, lower ear placement and high resistance of late wilt disease caused by *Cephalosprium maydis* is based mainly on accurate evaluation of inbred lines under selection and that is a major aim in the national maize research program. In fact plant breeding uses selection from the available genetic variability for crop improvement (Asins, 2002). Topcrosses procedure was suggested by Davis (1927) to test the superior inbred lines for hybrid development programs. Jenkis (1978) stated that the topcross have been used fairly widely for the preliminary evaluation of combining ability of new inbred lines, but there no general agreement as to the best type and number of testers for this purpose. Rawlings and Thampson (1962), Ameha (1977), Liakat and Tepora (1986), Al-Naggar *et al.* (1997) and Mosa *et al.* (2004), indicated the importance of using maize homozygous inbred line testers in the evaluation process. Numerous researchers reported that the variance components of SCA for grain yield and other traits were larger than these due to GCA, indicating that the importance of non-additive gene action in the inheritance of these traits; Mostafa *et al.* (1995), El-Shenawy *et al.* (2003) and Aly (2004) for grain yield. On contrary, Amer (2002), Amer *et al.* (2003) and Aly and Mousa (2008), reported that the additive genetic variance played an important role in the inheritance of silking date, plant height and ear height. The magnitude of σ^2SCA x location interactions was higher than those σ^2GCA x location interactions for plant height, no. of ears/100 plant and grain yield, indicating that the non-additive gene action was affected more by environmental conditions than additive types for these traits; Soliman *et al.* (2001), Amer *et al.* (2002), El-Morshidy *et al.* (2003) and Aly (2004) for plant height, no. of ears/100 plant and grain yield. On the other hand, (Aly, 2004 and Aly and Mousa, 2008) reported that σ^2GCA x location interactions was higher than σ^2SCA x location interactions for silking date.

Therefore, the present study was carried out to, 1- Estimate of the combining ability for some newly yellow inbred lines of maize. 2. Determine the most important mode of gene action that control traits under study, i.e. silking date, plant height, ear height, infection of late wilt%, no. of ears/100 plant and grain yield. 3. Define the superior topcrosses to be used for improving and developing superior hybrids yielding ability in maize breeding programs.

MATERIALS AND METHODS

Fourteen yellow maize inbred lines derived through selection from segregating generations of bank-354 (the origin of Puerto Rico Crupo5 #218, Indian) were chosen for this study. These lines were topcrossed to two testers i.e., Giza-638 and Giza-649 at Sids Agricultural Research Station during 2005 growing season. In the growing season 2006, the 28 crosses and two checks; SC 155 and SC 3084 were evaluated at two locations;

Sakha and Sids Agricultural Research Stations. Each experiment was arranged in a randomized complete blocks design with four replications. Plot size was one row, 6 m. long and 80 cm. apart. Seeds was planted in hills evenly spaced at 25 cm. a long the row at the rate of three kernels per hill. Seedling was thinned to one plant per hill after 21 days from planting. All agronomic field practices were applied as recommended. Data were recorded number of days from planting to date of 50% silking emergence, plant height (cm), ear height (cm), infection of the late wilt disease%, number of ears/100 plants and grain yield (ard/fed) adjusted to 15.5% moisture content (one ardab = 140 kg and one feddan = 4200 m^2). Statistical analyses were performed for each location then combined over locations according to Steel and Torrie (1980). The combining ability analysis was estimated using the line x tester procedure suggested by Kempthorne (1957). Combined analysis among the two locations was done on the based of homogeneity test.

RESULTS AND DISCUSSION

Analysis of variances for all the studied traits, i.e., number of days to 50% silking, plant height (cm), ear height (cm), infection of late wilt%, no. of ears/100 plant and grain yield (ard/fed) combined over both locations are presented in Table 1.

Table 1. The results of the analysis of variances for all the studied traits over both locations.

S.O.V.	D.F.	Silking date (days)	Plant height (cm)	Ear height (cm)	Infection of late wilt%	No. of ears/100 plants	Grain yield (ard/fed)
Locations (Loc.)	1	198.754**	8489.469**	3402.362**	128.532**	264.698**	768.165**
Reps/Loc.	6	5.957	515.79	417.975	6.71	31.302	48.91
Crosses (C)	27	15.543**	1675.977**	941.534**	12.22**	780.11**	47.959**
Lines (L)	13	28.046**	3369.553**	1789.74**	14.594**	833.703**	54.009**
Testers (T)	1	27.862**	367.719*	1425.112**	27.904*	4140.9**	132.586**
Lines x Testers	13	2.092**	83.036	56.131	8.64	467.994**	43.092**
C x Loc.	27	0.792	94.154	61.575	10.233**	198.149**	25.205**
Lines x Loc.	13	0.62	156.075*	74.842	9.096	274.884**	33.841**
Testers x Loc.	1	1.969	16.612	11.612	34.571*	580.18*	1.153
L x T x Loc	13	0.873	38.198	52.15	9.498	92.026	18.426*
Pooled error	162	0.861	84.343	57.715	5.478	98.302	9.48

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

Results revealed that locations mean squares were highly significant for all the studied traits, indicating that environmental conditions were different at both locations since weather for these traits tend to be higher at Sids but more humid Sakha. These results are in agreement with those of El-Zeir *et al.* (2000), Mosa (2004) and Aly and Mousa (2008). Mean squares due to crosses (C) and their partitions; line (L), tester (T) and L x T interactions were significant and highly significant for all the studied traits, except L x T for plant height, ear height and late wilt%, which were not significant. These results indicated that both inbred lines and testers were significantly different from one each to another in topcrosses. Significant line x tester interaction suggests that inbred lines may have different combining ability patterns and performed differently in crosses depending on type of tester used. Similar results were reported by El-Itriby *et al.* (1990), Amer *et al.* (2003), El-Shenawy *et al.* (2003), Aly (2004), Parvez *et al.* (2007) and Aly and Mousa (2008). On the other hand, the interactions between (C x Loc) were highly significant for infection of late wilt%, no. of ears/100 plants and grain yield. In addition, the line x Loc interaction significant and highly significant for plant height, no. of ears/100 plants and grain yield. While, the Tester x Loc interaction was significant for infection of late wilt% and no. of ears/100 plants. Line x Tester x Loc interaction was not significant for all the studied traits, except for grain yield. Similar results were recorded by Mahmoud (1996), El-Shenawy *et al.* (2003) and Aly and Mousa (2008).

The calculated means and ranges for all studied traits over both locations are given in Table 2. The results showed that means and ranges of all studied traits for the two testers; Giza-638 and Giza-649 were not different. Generally, the results revealed that Giza-638 as a common tester, showed the desirable means for silking date (toward earliness), plant height (toward shorter plants), ear height (toward lower ear placement) and infection of late wilt% (toward resistance to late wilt). On the other hand, the topcrosses that involved Giza-649 as a common tester showed the highest means for number of ears/100 plant and grain yield. These results are in harmony with those of Moentono (1989) and Mosa (2004) who stated that an efficient tester is the tester that is capable of showing greater ranges of variability of the performances of the topcross hybrids.

Table 2. The calculated means and ranges for all studied traits over both locations.

Tester	Estimate	Silking date (days)	Plant height (cm)	Ear height (cm)	Infection of late wilt%	No. of ears/100 plants	Grain yield (ard/fed)
Giza - 638	Mean of Topcrosses	64.05	240.16	129.07	0.690	101.43	32.61
	Range	3.50	51.25	30.63	3.30	14.96	8.43
	Best Topcross	62.38	222.00	115.75	0.00	108.81	37.40
Giza - 649	Mean of Topcrosses	64.76	242.72	134.12	1.36	110.00	33.41
	Range	4.62	33.62	38.75	5.00	40.04	7.59
	Best Topcross	62.38	223.13	117.50	0.00	140.04	37.44

Mean performances of the topcrosses and the two checks for all the studied traits combined over the two locations are presented in Table 3. The results showed that all topcrosses were significantly superior to the check SC 3084 (26.66 ard/fed) for grain yield, but eight topcrosses; L_2 x T_2 (36.05 ard/fed), L_5 x T_1 (35.24), L_8 x T_2 (37.44 ard/fed), L_9 x T_2 (35.32 ard/fed), L_{10} x T_1 (35.96 ard/fed), L_{11} x T_2 (34.76 ard/fed), L_{13} x T_1 (34.89 ard/fed) and L_{14} x T_1 (37.40 ard/fed) were significantly superior to the check SC 155 (34.08 ard/fed) for grain yield. Moreover, results revealed that the three topcrosses; L_2 x T_1 (34.27 ard/fed), L_6 x T_1 (34.24 ard/fed) and L_{10} x T_2 (34.53 ard/fed) had higher means of grain yield, but they were not significantly different from the high yielding check SC 155. Results indicated that all topcrosses for silking date (toward earliness) and most of topcrosses for plant height (toward shorter plants) and ear height (toward lower ear placement) were significantly superior to the check SC 3084. Furthermore, four testcrosses; L_4 x T_1, L_{12} x T_2, L_{13} x T_1 and L_{14} x T_1 were earlier, had shorter plats and lower ear placement than the check SC 155. Also, most of the topcrosses appeared superior to the two checks for infection of the resistance to the late wilt disease.

Table 3: Mean performances of the topcrosses and the two checks for number of days to 50% silking, plant height (cm), ear height (cm), infection of late wilt%, no. of ears/100 plant and grain yield (ard/fed) combined over the two locations.

Lines	Silking date (days)		Plant height (cm)		Ear height (cm)		Infection of late wilt%		No. of ears/100 plants		Grain yield (ard/fed)	
	T_1	T_2	T_1	T_2	T_1	T_2	T_1	T_2	T_1	T_2	T_1	T_2
line - 1	63.13	64.88	246.63	253.13	136.75	143.88	3.30	2.67	101.50	109.60	28.97	31.25
line - 2	65.88	66.00	273.25	274.38	146.38	156.25	0.00	0.00	99.06	104.04	34.27	36.05
line - 3	64.00	64.50	236.00	239.63	125.88	133.75	0.00	0.00	100.13	105.60	28.65	31.67
line - 4	62.38	63.50	222.00	232.25	124.63	130.00	0.54	0.00	96.80	104.18	30.47	32.70
line - 5	64.13	64.75	230.38	228.50	125.25	125.63	0.00	0.00	104.81	103.13	35.24	33.93
line - 6	65.25	67.00	247.25	245.25	136.63	140.88	1.02	2.61	99.53	104.69	34.24	32.73
line - 7	64.75	64.50	228.50	223.13	116.25	119.13	0.00	5.00	102.75	104.66	31.23	29.85
line - 8	65.13	65.88	250.38	255.38	137.88	142.38	1.00	1.59	102.09	140.04	30.25	37.44
line - 9	65.63	66.75	252.88	254.00	134.25	142.38	0.00	2.04	106.85	133.30	32.77	35.32
line-10	65.00	65.63	255.25	256.75	139.50	143.38	0.00	0.52	108.81	117.91	35.96	34.53
line-11	64.38	64.75	238.00	245.38	129.63	138.88	0.54	0.50	98.08	106.66	30.54	34.76
line-12	63.25	62.38	228.63	226.63	119.75	117.50	1.09	2.50	93.85	100.00	31.74	33.92
line-13	62.13	63.25	227.50	236.00	115.75	124.75	0.54	0.52	101.46	101.65	34.89	31.28
line-14	61.75	62.88	225.63	227.75	118.50	118.88	1.64	1.04	104.35	104.51	37.40	32.31
SC-155	64.00		261.75		145.37		0.62		118.23		34.08	
SC-3084	68.00		265.50		148.37		0.00		98.78		26.66	
LSD 0.05	0.172		1.701		1.407		0.433		1.836		0.570	
0.01	0.443		4.381		3.624		1.117		4.730		1.469	

T_1 = tester-1=Giza-638
T_2 = tester-2=Giza-649

General combining ability (GCA) effects for the parental inbred lines and the two testers for six traits combined over both locations are presented in Table 4. Results indicated that the inbred lines L_4, L_5, L_7, L_{12}, L_{13} and L_{14} exhibited desirable GCA effects for plant height toward shorter plants and ear height toward lower ear placement. On the other hand, line L_4 had negative and significant GCA effect for number of silking date toward earliness, line L_5 showed positive and significant GCA effect for grain yield, line L_9 had positive and significant GCA effect for no. of ears/100 plants, line L_{10} had the highest positive and significant GCA effect for no. of ears/100 plants and grain yield, line L_{14} exhibited desirable GCA effect toward earliness and higher grain yield and line L_2 had highly positive and significant GCA effect for grain yield. Generally, these inbred lines could be recommended for advanced stage of evaluation through the breeding program. Results showed that the favorable GCA effects were recorded when T_1 was used for days to 50% silking toward earliness and ear height tower lower ear placement, while T_2 for no. of ears/100 plants and grain yield. These results are in agreement with those by Liakat and Tepora (1986), Soliman and Sadek (1999), El-Shenawy *et al.* (2003) and Aly and Mousa (2008). They found that the superior inbred lines should be used as testers to evaluate and select the best lines with highest GCA effects.

Table 4. General combining ability (GCA) effects for the fourteen inbred lines and the two testers for number of days to 50% silking, plant height (cm), ear height (cm), infection of late wilt%, no. of ears/100 plant and grain yield (ard/fed) combined over both locations.

	Silking date (days)	Plant height (cm)	Ear height (cm)	Infection of late wilt%	No. of ears/ 100 plants	Grain yield (ard/fed)
Line -1	-0.406	8.433**	8.719**	1.939**	-0.142	-3.139**
Line-2	1.532**	32.371**	19.719**	-1.043	-4.142	2.166**
Line-3	-0.156	-3.629	-1.781	-1.043	-2.829	-2.838**
Line-4	-1.469**	-14.317**	-4.281*	-0.510	-5.204*	-1.411
Line-5	0.032	-12.005**	-6.156**	-1.043	-1.723	1.588*
Line-6	1.719**	4.808*	7.157**	0.772	-3.585	0.506
Line-7	0.219	-15.630**	-13.906**	1.458*	-1.985	-2.457**
Line-8	1.094**	11.433**	8.532**	0.253	15.371**	0.849
Line-9	1.782**	11.996**	6.719**	-0.021	14.252**	1.052
Line-10	0.907**	14.558**	9.844**	-0.782	7.671**	2.246**
Line-11	0.157	0.246	2.657	-0.521	-3.323	-0.350
Line-12	-1.594	-13.817**	-12.969**	0.753	-8.767**	-0.168
Line-13	-1.719	-9.692**	-11.344**	-0.510	-4.133	0.092
Line-14	-2.094**	-14.755**	-12.906**	0.297	-1.460	1.860*
Tester-1	-0.353**	-1.282	-2.523**	-0.353	-4.300**	-0.582*
Tester-2	0.353**	1.282	2.523**	0.353	4.300**	0.582*
LSD gi (L) 0.05	0.455	4.500	3.722	1.147	4.859	1.509
0.01	0.598	5.914	4.892	1.507	6.386	1.983
LSD gi (T) 0.05	0.172	1.701	1.407	0.443	1.836	0.570
0.01	0.227	2.236	1.849	0.569	2.414	0.750

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

Estimates of specific combining ability effects (SCA) for 28 topcrosses for silking date, plant height, ear height, infection of late wilt%, no. of ears/100 plants and grain yield as a combined over all the two locations are shown in Table (5). The results showed that the best SCA effects were obtained in the topcrosses L_8 x T_2, L_{13} x T_1 and L_{14} x T_1 for grain yield, L_8 x T_2 and L_9 x T_2 for no. of ears/100 plants. While, the topcross L_7 x T_1 exhibited desirable SCA effects for infection of late wilt%. Meanwhile, the topcross L_{12} x T_2 possesses SCA effects for earliness trait.

Estimates of genetic variance components for all studied traits over the two locations and their interaction with locations are illustrated in Table 6. Results revealed that estimates of σ^2GCA for lines were higher in magnitude than those of σ^2GCA for testers for all the studied traits, except for grain yield indicating that most of the total GCA variances were due to the inbred lines and the contribution of lines were higher than the contribution of the testers for most of the traits. General combining ability variance components (σ^2GCA) was larger than that of σ^2SCA for silking date, plant height and ear height indicating that additive was more important than non-additive gene action for these traits. While, the σ^2SCA was larger than σ^2GCA for infection of late wilt%, no. of ears/100 plant and grain yield indicating that the non-additive genetic variance played the major role than additive genetic variance in the inheritance of these traits.

Table 5. Specific combining ability effects for 28 topcrosses for silking date, plant height, ear height, infection of late wilt%, no. of ears/100 plant and grain yield as a combined over all the two locations.

	Silking date (days)		Plant height (cm)		Ear height (cm)		Infection of late wilt%		No. of ears/ 100 plants		Grain yield (ard/fed)	
	T_1	T_2	T_1	T_2	T_1	T_2	T1	T2	T1	T2	T1	T2
line - 1	-0.518	0.518	-1.969	1.969	-1.040	1.040	0.668	-0.668	0.205	-0.205	-0.511	0.511
line - 2	0.290	-0.290	0.719	-0.719	-2.415	2.415	0.353	-0.353	1.812	-1.812	-0.511	0.511
line - 3	0.103	-0.103	-0.531	0.531	-1.415	1.415	0.353	-0.353	1.562	-1.562	-1.129	1.129
line - 4	-0.210	0.210	-3.844	3.844	-0.165	0.165	0.342	-0.342	0.612	-0.612	-0.738	0.738
line - 5	0.040	-0.040	0.719	-0.719	2.335	-2.335	0.353	-0.353	5.143	-5.143	1.035	-1.035
line - 6	-0.523	0.523	2.282	-2.282	0.397	-0.397	-0.442	0.442	1.718	-1.718	1.116	-1.116
line - 7	0.478	-0.478	3.969	-3.969	1.085	-1.085	-2.147**	2.147**	3.343	-3.343	1.072	-1.072
line - 8	-0.023	0.023	-1.219	1.219	0.273	-0.273	0.058	-0.058	-14.676**	14.676**	-3.215**	3.215**
line - 9	-0.210	0.210	0.719	-0.719	-1.540	1.540	-0.669	0.669	-9.057*	9.057*	-0.894	0.894
line-10	0.040	-0.040	0.532	-0.532	0.585	-0.585	0.093	-0.093	-0.251	0.251	1.095	-1.095
line-11	0.165	-0.165	-2.406	2.406	-2.103	2.103	0.375	-0.375	0.006	-0.006	-1.729	1.729
line-12	0.790*	-0.790*	2.282	-2.282	3.648	-3.648	-0.352	0.352	1.225	-1.225	-0.711	0.711
line-13	-0.210	0.210	-2.969	2.969	-1.978	1.978	0.364	-0.364	4.206	-4.206	2.186*	-2.186*
line-14	-0.210	0.210	0.219	-0.219	2.335	-2.335	0.651	-0.651	4.106	-4.106	2.933**	-2.933**
Lsd 0.05	0.643		6.364		5.264		1.621		6.870		2.134	
0.01	0.845		8.364		6.919		2.130		9.029		2.805	

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

Table 6. Estimates of genetic variance components for all studied traits over the two locations and their interaction with locations.

Genetic parameters	Silking date (days)	Plant height (cm)	Ear height (cm)	Infection of late wilt %	No. of ears/ 100 plants	Grain yield ard/fed
σ^2 L = σ^2GCA (Lines)	1.622	205.285	108.226	0.372	32.857	0.682
σ^2T = σ^2GCA (Testers)	0.230	2.524	12.205	0.172	32.794	0.094
σ^2GCA = σ^2 GCA (aver.)	0.404	27.869	24.208	0.197	31.552	0.003
σ^2LxT= σ^2SCA (aver.)	0.154	0.087	0.052	0.395	46.212	4.202
σ^2 GCA/σ^2 SCA = σ^2GCA aver /σ^2SCAaver.	2.623	320.333	465.538	0.499	0.683	0.0007
σ^2L x Loc = σ^2GCA (L) x Loc	-0.0316	14.7346	2.8365	-0.0503	22.8573	1.9269
σ^2T x Loc = σ^2 GCA (T) x Loc	0.0195	-0.3855	-0.7239	0.4477	8.7170	-0.3084
σ^2GCA x Loc = σ^2 GCA aver. x Loc	0.013	1.505	-0.279@	0.385	0.485	-0.029@
σ^2L x T x Loc. = σ^2S CA average x Loc	0.003	11.536	-1.391 @	1.005	1.569	2.237
Contribution of Lines	86.879	96.802	91.524	57.502	51.456	54.222
Contribution of Tester	6.639	0.813	5.606	8.457	19.660	2.517
Contribution of L x T	6.480	2.493	2.870	34.043	28.884	3.328

@ Variance estimate proceeded by negative sign is considered zero (Robinson *et al.*, 1955).

(T) Denote testers, (L) inbred lines and (Loc) locations.

While, the σ^2SCA was larger than σ^2GCA for infection of late wilt%, no. of ears/100 plant and grain yield indicating that the non-additive genetic variance played the major role than additive genetic variance in the inheritance of these traits. These results are in agreement with those by El-Zeir *et al.* (1993) and Mostafa *et al.* (1995) for silking date, plant height and grain yield; Aly and Mousa (2008) for silking date, plant height and ear height; Aly (2004) for silking date and no. of ears/100 plant; Mosa (2004) for silking date and grain yield; El-Shenawy *et al.* (2003) for silking date, plant height, ear height and grain yield, and Tabassum *et al*. (2007) for grain yield. Moreover, results indicated that variance interactions of σ^2GCA_L x Location was higher than σ^2GCA_T x location for plant height, ear height, no. of ears/100 plant and grain yield, indicating that the σ^2GCA for lines was affected more by environment than by testers for these traits. Combined data revealed that the variance of σ^2GCA x location interaction was either smaller or negligible than the variance of σ^2SCA x location interaction for infection of late wilt%, no. of ears/100 plant and grain yield. These results indicated that non-additive type of gene action was more affected by environmental conditions than additive effects. Soliman *et al.* (2001), El-Morshidy *et al.* (2003), Aly and Mousa (2008) found similar results.

All possible simple correlation coefficients among studied traits were calculated and the results are shown in Table 7. Silking date was negative and significantly correlated with the other traits; plant height, ear height, no. of ears/100 plant and grain yield. Negative correlation indicated that the silking date decreased, but the other traits tended to increase. On the other hand, positive and significant correlation coefficient appeared between ear height with no. of ears/100 plant and between no. of ears/100 plant with grain yield. Similar results were obtained by El-Zeir (2001), Amer *et al.* (2002), Mosa (2003), Saleem *et al.* (2007) and Shakoor *et al.* (2007).

Table 7: Simple correlation coefficient between grain yield and silking date, plant height, ear height and no. of ears/100 plant as a combined over all two locations.

	Silking date	Plant height	Ear height	No. of ears/100 plant	Grain yield (ard/fed)
Silking date	-	-0.734**	-0.762**	-0.493**	-0.396*
Plant height		--	0.935**	0.378*	0.312
Ear height			-	0.418*	0.269
No. of ears/100 plant				-	0.492**
Grain yield (ard/fed)					-

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

REFERENCES

Al-Naggar, A.M.; H.Y.El-Sherbieny and A.A. Mahmoud (1997). Effectiveness of inbreds, single crosses and populations as tester for combining ability in maize. Egypt. J. Plant Breed., 1: 35 – 46.

Aly, A.A. (2004). Combining ability and gene action of new inbred maize lines (*Zea mays* L.) using line x tester analysis. Egypt. J. Appl. Sci., 19(12 B): 492 – 518.

Aly, R.S.H. and S.Th.M. Mousa (2008). Estimation of combining ability for newly developed white inbred lines of maize (*Zea mays* L.) via line x tester analysis. Egypt. J. of Appli. Sci., 23(2B): 554 – 564.

Ameha, M. (1977). Comparison of S2 progeny and inbred tester methods for improving maize. Ph. D. Thesis, Fac. Agric., Iowa State Univ., USA.

Amer, E.A. (2002). Combining ability on early maturing inbred lines of maize. Egypt. J. Appl. Sci., 17(5): 162 – 181.

Amer, E.A.; A.A. El-Shenawy and A.A. Motawei (2003). Combining ability of new inbred lines via line x tester analysis. Egypt. J. Plant Breed., 7(1): 229 – 239.

Amer, E.A.; A.A. El-Shenawy and H.E. Mosa (2002). Evaluation of some new inbred lines of maize for combining ability. Annals of Agric. Sci., Moshtohar, 40(2): 2791 – 2190.

Asins, M.J. (2002). Present and future QTL analysis in plant breeding. Plant Breed, 121: 281 – 286.

Davis, R.L. (1927). Report of the plant breeding. Ann. Rep. Puerto Rico Agric. Res., 48: 14 – 45.

El-Itriby, H.A.; M.M. Ragheb, H.Y. El-Sherbiney, M.A.K. Sherieny (1990). Estimates of combining ability of maize inbred lines in topcrosses and its interaction with environment. Egypt. J. Appl. Sci., 5(8): 354 – 370.

El-Morshidy, M.A.; E.A. Hassaballa; Sh.F. Abou-Elsaad and M.A. Abd El-Moula (2003). Combining ability and type of gene action in maize under favorable and water stress environments. Egypt. J. Plant Breed., 7(1): 55 – 75.

El-Shenawy, A.A.; E.A. Amer and H.E. Mosa (2003). Estimation of combining ability of newly developed inbred lines of maize by (line x tester) analysis. J. Agric. Res. Tanta Univ., 29(1): 50 – 63.

El-Zeir, F.A.; A.A. Abdel-Aziz and A.A. Galal (1993). Estimation of heterosis and combining ability effects in some new top crosses in maize. Minufiya J. Agric. Res. 4 (1): 2179 – 2190.

El-Zeir, F.A.; E.A. Amer and H.E. Mosa (2001). Combining ability for two sets of white and yellow diallel crosses for agronomy traits, resistance to disease, chlorophyll and grain yield of maize. J. Agric. Sci., Mansoura Univ., 26(2): 703 – 714.

El-Zeir, F.A.; E.A. Amer; A.A. Abdel-Aziz and A.A. Mahmoud (2000). Combining ability of new maize inbred lines and type of gene action using top crosses of maize. Egypt. J. Appl. Sci., 15(2): 116 – 128.

Jenkins, M.T. (1978). Maize breeding during the development and early years of hybrid maize. In Walden, D.B. (ed.) Maize breeding and genetics. New York, Wiley. Interscience Pupl.

Kempthorne, O. (1957). An introduction to genetic statistical. John Wiley-Sons Inc., New York U.S.A.

Liakat, M.A. and N.M. Tepora (1986). Comparative performances of four types of testers for evaluating corn lines from two populations. Philippine. J. Crop Sci., 4(5): 175 – 179

Mahmoud, A.A. (1996). Evaluation of combining ability of newly developed inbred lines of maize. Ph.D. Thesis, Fac. Agric. Cairo Univ., Egypt.

Moentono, M.D. (1989). Efficient tester for evaluation of combining ability of downy mildew resistant inbred lines in the development of hybrid corn. Indonesian J. Crop Sci., 4(1): 41 – 51.

Mosa, H.E. (2003). Heterosis and combining ability in maize (Zea mays L.). Minufiya J. Agric. Res. 28 (1): 1375 – 1386.

Mosa, H.E. (2004). Comparison between two types of testers for evaluating new white inbred lines of maize. Annals of Agric. Sci., Moshtohor, 42(2): 475 – 487.

Mosa, H.E.; A.A. Motawei and Afaf, A.I. Gabr (2004). Evaluation of new inbred lines of yellow maize via line x tester analysis over three locations. J. Agric. Sci., Mansoura Univ., 29(3): 1023 – 1033.

Mostafa, M.A.; F. A. Salama and A.A. Abdel-Aziz (1995). Combining ability of white maize population with inbred testers. J. Agric. Sci., Mansoura Univ., 20(1): 143 – 149.

Parvez A. Sofi; A.G. rather and Zahoor Dar (2007). Association of heterotic expression for grain yield and its components traits in maize (Zea mays L.). International J. of Agric. Res., 2(5): 500 – 503.

Rawlings, J.O. and D.L. Thompson (1962). Performance level as criterion for the choice of maize testers. Crop Sci., 2: 217 – 220.

Robinson, J.O.; R.E. Comstock and P.H. Harvey (1955). Genetic variance in open pollinated varieties of corn. Genetics, 40: 45 – 60.

Saleem, A.; U. Saleem and G.M. Subhani (2007). Correlation and path coefficient analysis in maize (Zea mays L.). Journal of Agric. Res. (Pakistan), 45(3): 177 – 183.

Shakoor, M.S.; M. Akber and A. Hussain (2007). Correlation and path coefficient studies of some morphological traits in maize double crosses. Pakistan J. of Agric. Sci., 44(2): 213 – 216.

Soliman, F.H. and S.E. Sadek (1999). Combining ability of new maize inbred lines and its utilization in the Egyptian hybrid program. Bull. Fac. Agric. Cairo Univ., 50: 1 – 20.

Soliman, F.H.S.; S.H.A. Shafay; A.I. El-Agamy and M.A. Mostafa (2001). Combining ability in maize topcrosses for grain yield and oil content. Egypt; J. Plant Breed. 5: 43 – 60.

Steel, R.G. and J.H. Torrie (1980). Principal and procedures of statistics. Mc Grow Hill Inc., New York U.S.A.

Tabassum, M.I.; M. Saleem, M. Akbar, G.Y. Ashraf and N. Mahmood (2007). Combining ability studies in maize under normal and water stress conditions. Journal of Agric. Res. (Pakistan), 45(4): 261 – 268.

J. Agric. Sci. Mansoura Univ., 33 (7), July, 2008

القدرة على الإئتلاف وطبيعة الفعل الجينى لصفة المحصول وبعض الصفات الأخرى بإستخدام تحليل السلالة x الكشاف لسلالات صفراء جديدة من الذرة الشامية (*Zea mays* L.)

رزق صلاح حسانين على و عصام عبد الفتاح عامر
مركز البحوث الزراعية – معهد بحوث المحاصيل الحقلية – برنامج بحوث الذرة الشامية

هجنت أربعة عشر سلالة صفراء جديدة من الذرة الشامية مع إثنين من الكشافات وهما السلالة جيزة-٦٣٨ والسلالة جيزة-٦٤٩ بمحطة البحوث الزراعية بسدس فى الموسم الزراعى ٢٠٠٥ . وفى الموسم الزراعى ٢٠٠٦ تم تقييم ٢٨ هجين القمى المتحصل عليهم بالإضافة إلى إثنين من الأصناف التجارية وهى الهجين الفردى الأصفر ١٥٥ والهجين الفردى الأصفر ٣٠٨٤ فى محطتى البحوث الزراعية فى سخا وسدس. وتم التحليل الوراثى للقدرة على التآلف بإستخدتم تصميم السلالة x الكشاف طبقاً لما إقترحه Kempthorne (1957) لصفات محصول الحبوب ، عدد الأيام حتى ظهور ٥٠% من النورات المؤنثة ، إرتفاع النبات ، إرتفاع الكوز ، الإصابة بمرض الذبول المتأخر وعدد الكيزان لكل ١٠٠ نبات. وتم تلخيص أهم النتائج المتحصل عليها فيما يلى:

- وجدت إختلافات عالية المعنوية بين موقعى الدراسة لجميع الصفات المدروسة ، وكذلك وجدت إختلافات معنوية بين الهجن القمية ومجزئاتها (السلالات والكشافات) لكل الصفات المدروسة، كما سجلت النتائج وجود إختلافات عالية المعنوية لتفاعل السلالات مع الكشافات لصفات التزهير حتى ٥٠% من النورات المؤنثة ، عدد الكيزان/١٠٠ نبات ومحصول الحبوب. بالإضافة إلى ذلك فإن التفاعل بين الهجن القمية ومجزئاتها مع المواقع كانت غير معنوية لمعظم الصفات تحت الدراسة.
- كانت أفضل السلالات والتى تمتلك قدرة عامة ومرغوبة على الإئتلاف هى L_4, L_5, L_7, L_{12} لصفات قصر النبات ومكان أفضل لموقع الكوز على النبات بينما أظهرت السلالة L_4 قدرة إئتلاف سالبة معنوية ومرغوبة تجاة التبكير ، L_5 لصفة محصول الحبوب ، L_9 لصفة عدد الكيزان/١٠٠ نبات ، L_{10} لصفات عدد الكيزان /١٠٠ نبات وصفة محصول الحبوب ، بينما أظهرت السلالة L_{14} قدرة إئتلاف مرغوبة تجاة صفات التبكير والمحصول بينما تمتلك السلالة L_2 قدرة إئتلاف عالية لصفة محصول الحبوب. وعلى الرغم من أن السلالتين المستحدمتين ككشافات ذات تركيب وراثى متجانس إلا أنه أظهرت السلالة جيزة-٦٣٨ أحسن قدرة إئتلاف مرغوبة لصفات التبكير وقصر النبات وموقع أفضل للكوز على النبات بينما أظهرت السلالة جيزة-٦٤٩ أحسن قدرة إئتلاف مرغوبة لصفات عدد الكيزان/١٠٠نبات ومحصول الحبوب .
- أشارت النتائج إلى أهمية الفعل الجينى غير المضيف فى وراثة صفات الإصابة بمرض الذبول المتأخر و عدد الكيزان /١٠٠ نبات ومحصول الحبوب بينما كان التباين الراجع للفعل الجينى المضيف يلعب الدور الأكبر والأكثر أهمية فى وراثة صفات التزهير وإرتفاع النبات وإرتفاع الكوز ومن ناحية أخرى كان الفعل الجينى غير المضيف أكثر تأثراً وتفاعلاً بالمواقع من الفعل الجينى المضيف لصفات الذبول المتأخر ، عدد الكيزان/١٠٠ نبات ومحصول الحبوب.
- أشارت النتائج إلى وجود أرتباط سالب ومعنوى بين صفة التزهير وباقى الصفات المدروسة والمتمثلة فى إرتفاع النبات ، إرتفاع الكوز ، عدد الكيزان/١٠٠ نبات ومحصول الحبوب بينما وجد إرتباط موجب ومعنوى بين كلا من إرتفاع النبات وإرتفاع الكوز ، وبين إرتفاع الكوز وعدد الكيزان/١٠٠نبات ، وبين عدد الكيزان/١٠٠نبات ومحصول الحبوب.
- أوضحت النتائج أن كل الهجن القمية كانت تتفوق على هجين المقارنة ٣٠٨٤ بالإضافة الى ان معظم الهجن القمية تفوقت عليه ايضاً فى صفات التبكير وقصر النبات وموقع أفضل للكوز على النبات . ومن ناحية أخرى أشارت النتائج إلى وجود ثمانية هجن قمية تفوقت على هجين المقارنة الأعلى فى المحصول هجين فردى ١٥٥ (٣٤,٠٨ أردب/فدان) وهى:

L_8 X T_2 (37.44 ard/fed), L_{14} X T_1 (37.40 ard/fed), L_2 X T_2 (36.05 ard/fed), L_{10} X T_1 (35.96 ard/fed), L_9 X T_2 (35.32 ard/fed), L_5 X T_1 (35.24 ard/fed), L_{13} X T_1 (34.89 ard/fed) and L_{11} X T_2 (34.76 ard/fed).