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COMBINING ABILITY IN MAIZE TOP-CROSSES FOR GRAIN YIELD AND OTHER TRAITS

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ABSTRACT

Twelve yellow maize inbred lines derived from a wide genetic base population (Gemmeiza Yellow Population, GYP) were top crossed to each of two elite inbred tester lines, Gm-1002 and Gm-1021 in 2005 season. Top crosses were evaluated in field trails at Gemmeiza and Mallawy Agric. Res. Stations during 2006 season. Data for grain yield, no. of ears/100 plants, plant and ear height and silking date were recorded to estimate combining ability, type of gene action and select superior promising line (s) and single cross (es).

Results indicated significant mean squares due to crosses, lines (L), testers (T) and L x T for all studied traits at Gemmiza and Mallawy locations, except testers for plant height at Gemmiza and crosses, lines, testers, L x T for no. of ears/100plants, and tester, L x T for plant height at Mallawy. Combined analysis of variance revealed significant mean squares differences among crosses, lines, testers, L x T for all studied traits. Environmental components were significant for all studied traits but tester x loc. was non-significant for plant and ear height and no. of ears/100 plants and L x T x Loc for plant height. Fifteen crosses i.e. Gm-1,4, 7, 14, 57, 72 x Gm-1002 and Gm-1, 7, 14, 17, 19, 43, 44, 50 and Gm-72 x Gm-1021, significantly exceeded the high check SC-155 over locations for grain yield (ard/fad.).

Inbred lines Gm-1, Gm-7, Gm-14, Gm-50 at Gemmeiza, Gm-14 at Mallawy and Gm-1, Gm-7, Gm-14 and Gm-50 over locations had positive and exhibited good

general combiners for grain yield. The crosses Gm-4×Gm1002, Gm-17 x Gm-1021, Gm-44 x Gm-1021, Gm-57 x Gm-1002, and Gm-66 x Gm-1002 were positive and significant SCA effects and suitable combinations for grain yield over locations.

Results indicated that additive genetic variance is considered to be the major source of the total genetic variance responsible for the inheritance of silking date, plant and ear height and no. of ears/100plants. Whereas, dominance genetic variance is considered to be the major source of the total genetic variance responsible for the inheritance of grain yield.

INTRODUCTION

Top cross (test cross) method using broad and /or narrow testers is used to evaluate new improved lines for combining ability in maize hybrid breeding programmes. The choice of suitable tester has been given much attention among the breeders. In this respect, *Lonnquist and Lindsey (1964)* reported that the use of common tester parent reduced the range of traits expression among the progenies being evaluated. *Russell et al (1973) and Walejko and Russell (1977)* stated that the inbred testers are effective for determining general and specific combining ability effects. Procedures for developing and improving inbred lines of maize were reported by *Bauman (1981)* and *Hallauer and Miranda (1981)* who concluded that improved inbred lines increased grain yield and maturity.

Top cross procedure was first suggested by *Davis (1927)* as an early testing to determine the usefulness of the lines for hybrid development programmes. The concept of general (GCA) and specific (SCA) combining ability was firstly defined by *Sprague and Tatum (1942)*. They and other investigators *(Hassaballa et al 1980,El-Morshidy and Hassaballa 1982, Mahmoud 1996, Konak et al 1999 and Zelleke 2000)* reported that the variance components due to SCA for grain yield and other agronomic traits was larger than that due to GCA, indicating the importance of non-additive type of gene action in the inheritance of these traits. *Mathur et al (1998)* found that general combining ability analysis revealed significant GCA variances for days to 50% silking, ear length, no. of rows/ear and no. of kernels/row. Significant GCA x environments interactions for grain yield was found for both lines and testers *(Hede et al 1999,Nass et al 2000, El-Zeir et al 2000, El-Morshidy et al 2003 and Abd El-Moula et al 2004)*. *Abd El-Moula and Ahmed (2006)* found that the variances due to testers and tester x locations were higher than those of lines and line x location for grain yield, plant and ear height in two sets in topcrosses, indicating that the testers contributed much more to the total variation and affected by locations than the lines. *Soliman et al (2007)* found that the variance due to testers contributed much more than the variance due to lines for grain yield.

The main objectives of this investigation were (i) to estimate GCA effects for lines as well for testers and SCA effects of crosses for grain yield and other traits, (ii) to estimate the variances for lines, testers and top crosses and their interaction with location, and (iii) identify the most superior line(s) and single crosses to be utilize in maize breeding program.

MATERIALS AND METHODS

Twelve yellow maize inbred lines were developed from a wide genetic base population (Gemmeiza Yellow Population, GYP) at Gemmiza Agric. Res. Station. The 12 lines were crossed with two testers; Gm-1002 and Gm-1021 developed by National Maize Research Program at Gemmiza Agric. Res. station and were being used in seed production of the commercial hybrids. The 24 yellow top crosses were made during the 2005 season at Gemmiza Agric. Res. Station. In 2006 season, 24 top crosses with two commercial check hybrids; SC-155 and SC-3084 were evaluated at two locations i.e. Gemmiza (Gm) and Mallawy (Ml) Agric. Res. stations using RCBD with 4 replications for each trail. The experimental plot was one row, 6 meters long with 80 cm between rows. Planting was in hills spaced 25 cm apart. Data were recorded on silking date, plant and ear height, no. of ears /100 plant and grain yield ardab/fed. Separate as well as combined analysis over location, after testing homogeneity of error mean squares, according to *Gomez and Gomez (1984)*. Least significant difference (LSD) were estimated after analysis of the 24 topcrosses with the two check hybrid SC-155 and SC-3084.

Combining ability analysis was carried out according to *Kempthorne (1957)* and *Singh and Shaudhary (1979).*

From the expectation of the mean squares, hals-sib and full-sib covariance were calculated, and hence the variance due to general (GCA) and (SCA) combining ability were estimated according to *Singh and Shaudhary (1979).*

RESULTS

Analysis of variance

Mean squares due to 12 yellow maize inbred lines, two testers and their 24 top crosses at Gemmeiza, Mallawy and combined over locations for all the studied traits are presented in Table 1.

Analysis of variance revealed significant mean squares due to crosses, lines (L), testers (T) and L x T for all studied traits at Gemmiza and Mallawy locations, except testers for plant height at Gemmiza and crosses, lines, testers, L x T for no. of ears/100plants, and tester and L x T for plant height at Mallawy. Combined analysis of variance revealed significant mean squares differences among crosses, lines, testers and L x T for all the studied traits. These results indicated that a great diversity existed among parental lines and among testers over locations, which contributed to the variability among their top crosses. Environmental components were significant for all studied traits but tester x loc. was non-significant for plant and ear height and no. of ears/100 plants and L x T x Loc for plant height. These results indicated that it is worthwhile to evaluate top crosses under different environment (location) especially for grain yield. This would help in deciding which hybrids can be recommended for certain environments. The obtained results are in the same line with those obtained by *El-Itriby et al (1990), Salama et al (1995) and Soliman et al (2001)*

The magnitude of the variances due to lines for all studied traits was higher than of testers. Also, the variances due to lines x locations for all studied traits was higher than of tester x location, except for grain yield. These results indicated that the lines contributed much more to the total variation and more affected by the environmental conditions than the testers. Similar results were obtained by *Gado et al*

(2000), El-Morshidy et al (2003), Abd El-Moula et al (2004), Abd El-Moula (2005) and Soliman et al (2007).

Table 1: Mean squares (MS) for grain yield and other traits of 12 inbred lines topcrossed with two testers at each and over locations.

SOV	d.f	Mean squares (MS)				
		Silking date	Plant height	Ear height	Ears /100 plant	Grain yield
Gemmeiza						
Replications	3	1.153	171.649	123.522	726.303	30.531
Crosses	23	6.020**	585.520**	434.953**	916.005**	124.699**
Lines (L)	11	9.451**	920.805**	569.957**	1302.25**	83.431**
Testers (T)	1	7.042**	15.844	372.094**	557.089*	335.585**
L x T	11	2.495*	302.253*	305.585**	562.390**	146.795**
Error	69	1.001	130.052	30.507	103.692	2.753
CV%		1.83	4.04	3.46	3.96	4.68
Mallawy						
Replications	3	50.733	1592.806	508.250	860.107	58.850.64
Crosses	23	8.205**	283.993*	142.145**	66.651	38.504**
Lines (L)	11	11.592**	395.758**	188.371**	65.910	37.927**
Testers (T)	1	4.594**	216.000	170.667**	51.109	20.502
L x T	11	5.048**	178.409	92.326	68.804	40.925**
Error	69	1.899	144.537	53.929	93.943	4.894
CV%		2.36	5.01	6.21	6.18	11.39
Combined						
Locations(L)	1	678.755**	85134.630**	49761.88**	4718.180**	2954.019**
Rep/L	6	25.943	932.227	315.935	793.205	31.195
Crosses(C)	23	11.090**	552.014**	452.825**	560.598**	109.045**
Lin(L)	11	17.524**	988.819**	597.073**	785.332**	98.381**
Testers(T)	1	11.505**	57.422**	523.380**	472.835*	260.993**
L x T	11	4.619**	369.263**	302.164**	343.840**	105.898**
C x Loc	23	3.136**	217.508*	124.282**	422.058**	54.257**
L x Loc	11	3.618*	327.744**	161.255**	582.828**	22.979
T x Loc	1	0.130**	174.422	19.380	135.362	95.091**
L x T x Loc	11	2.926*	111.399	96.846*	287.352**	81.824**
Pooled Error	138	1.449	137.299	46.863	98.817	3.823
CV%		2.13	4.49	4.76	7.52	7.97

*,** Significant at 0.01 and 0.05 level of probability

Mean performance:

Mean performance of top-crosses at all and across locations for the studied traits are shown in Table 2. Results revealed that, average grain yield ranged from 24.85 for cross (Gm-44 x Gm-1002) to 43.36 for cross (Gm-19 x Gm-1021) at Gemmeiza, from 19.35 for cross (Gm-66 x Gm-1002) to 33.66 for cross (Gm-14 x Gm-1002) at Mallawy and from 25.32 for cross (Gm-66 x Gm-1021) to 36.40 ard/fad for cross (Gm-44 x Gm-1021) over locations. The cross (Gm-14 x Gm-1002) had the best cross at all and across locations. Twenty one, 10 and 19 yellow top-crosses exceeded the check SC-155. Out of these crosses 17 at Gemmeiza, 3 at Mallawy and 16 crosses i.e. Gm-1,4, 7, 14, 50, 57, 72 x Gm-1002 and Gm-1, 7, 14, 17, 19, 43, 44, 50 and Gm-72 x Gm-1021, exceeded significantly the high check SC-155 over locations for grain yield (ard/fad.), suggesting the superiorities of these crosses and would be beneficial in maize breeding program for yielding ability. Seven, four and nine crosses were significantly earlier than the check SC-155. Fourteen, five and eleven top-crosses had significantly short plants when compared with the short check SC-155. Eight, one and one crosses had low ear placement than the check SC-3084 at Gemmeiza, Mallawy and over locations, respectively. Tow yellow top-crosses at all and across locations significantly had high no.of ears/100 plants than the check SC-155.

General (g_i) and specific (s_{ij}) combining ability effects.

General combining ability effects of inbred lines for the studied traits are shown in Table 3. Desirable and significant values of GCA effects were obtained by inbred lines Gm-7, 14 at Gemmeiza, Gm-4,7,50 at Mallawy and Gm-4,7,19 and Gm-50 across locations for days to 50%silking, Gm-19,66,72 at Gemmeiza, Gm-50,72 at Mallawy and Gm-50,66 and Gm-72 over locations for plant height, Gm-17,19,50,57,66,72, at Gemmeiza Gm-50,72 at Mallawy and Gm-17,19,50,57 and Gm-72 over locations for ear height, Gm-1 and Gm-7 at Gemmeiza and over locations for no. of ears/100plants. Inbred lines Gm-1, Gm-7, Gm-14, Gm-50 at Gemmeiza, Gm-14 at Mallawy and Gm-1, Gm-7, Gm-14 and Gm-50 over locations had positive and exhibited good general combiners for grain yield. These lines could be used as good combiners to produce new high yielding crosses in maize breeding program.

Table 2: Mean performance for all studied traits at all and across locations.

Crosses	Silking date, days			Plant height, cm			Ear height, cm		
	Gm	Ml	Com	Gm	Ml	Com	Gm	Ml	Com
Gm-1xGm-1002	55.00	57.75	56.37	288.50	237.25	262.87	160.50	128.25	144.37
Gm-1x Gm-1021	55.50	58.75	57.12	309.75	250.50	280.12	189.00	132.00	160.50
Gm-4xGm-1002	53.00	55.25	54.12	283.75	242.75	263.25	162.75	132.50	147.62
Gm-4x Gm-1021	55.75	56.50	56.12	288.75	249.50	269.12	166.50	136.00	151.25
Gm-7xGm-1002	52.50	56.25	54.37	307.25	248.25	277.75	162.25	132.50	147.37
Gm-7x Gm-1021	52.00	58.25	55.12	291.25	248.00	269.62	173.00	134.75	153.87
Gm-14xGm-1002	56.25	59.00	57.62	285.50	246.00	265.75	169.75	134.50	152.12
Gm-14x Gm-1021	55.25	59.25	57.25	289.75	244.25	267.00	178.25	133.00	155.62
Gm-17xGm-1002	54.25	57.50	55.87	278.75	242.00	260.37	149.50	128.25	138.87
Gm-17x Gm-1021	55.50	60.25	57.87	274.00	253.75	263.87	152.00	130.00	141.00
Gm-19xGm-1002	53.00	58.75	55.87	280.25	245.00	262.62	160.25	129.50	144.87
Gm-19x Gm-1021	53.25	56.75	55.00	262.75	234.00	248.37	147.00	123.00	135.00
Gm-43xGm-1002	55.50	59.75	57.62	286.00	250.25	268.12	165.00	134.75	149.87
Gm-43x Gm-1021	55.75	59.5	57.62	267.50	235.00	251.25	149.00	125.50	137.25
Gm-44xGm-1002	55.75	61.25	58.50	294.00	226.75	260.37	154.75	115.25	135.00
Gm-44x Gm-1021	55.00	58.75	56.87	287.00	244.50	265.75	169.50	133.00	151.25
Gm-50xGm-1002	53.00	57.75	55.37	271.00	224.00	247.50	150.00	117.75	133.87
Gm-50x Gm-1021	55.25	57.25	56.25	277.75	228.25	253.00	155.50	121.00	138.25
Gm-57xGm-1002	55.50	58.00	56.75	277.50	235.50	256.50	152.25	122.75	137.50
Gm-57x Gm-1021	55.75	59.75	57.75	288.50	238.00	263.25	157.75	127.25	142.50
Gm-66xGm-1002	55.00	59.00	57.00	270.50	233.25	251.87	152.00	122.50	137.25
Gm-66x Gm-1021	55.50	60.500	58.00	270.50	238.25	254.37	158.50	131.00	144.75
Gm-72xGm-1002	54.75	59.00	56.87	265.25	229.00	247.12	157.75	119.50	138.62
Gm-72x Gm-1021	55.50	59.00	57.25	271.00	232.00	251.50	148.00	123.50	135.75
Check SC-155	56.00	59.00	57.50	291.00	250.25	270.62	168.00	138.00	153.00
SC-3084	56.25	61.00	58.67	307.50	244.00	275.75	162.00	129.25	140.62
LSD 0.05	1.38	1.87	1.18	15.50	18.55	9.95	7.78	13.25	6.74

Table 2: Cont.

Crosses	No.of ears/100plants			Grain yield (ard/fad)		
	Gm	Ml	Com	Gm	Ml	Com
Gm-1xGm-1002	121.87	116.77	119.32	37.72	26.99	32.36
Gm-1x Gm-1021	174.86	124.01	149.44	40.14	32.15	36.15
Gm-4xGm-1002	119.86	112.42	116.14	36.92	31.87	34.39
Gm-4x Gm-1021	125.33	114.23	119.78	30.43	27.54	28.98
Gm-7xG m-1002	136.59	113.25	124.92	36.97	24.56	30.77
Gm-7x Gm-1021	134.53	123.87	129.20	41.65	30.90	36.28
Gm-14xGm-1002	120.99	117.38	119.18	38.92	33.66	36.29
Gm-14x Gm-1021	128.31	119.19	123.75	38.41	29.63	34.02
Gm-17xGm-1002	124.37	115.11	119.74	27.11	25.43	26.27
Gm-17x Gm-1021	115.52	114.79	115.16	40.42	26.44	33.43
Gm-19xGm-1002	117.11	115.08	116.10	29.89	27.47	28.68
Gm-19x Gm-1021	110.74	117.22	113.98	43.36	25.06	34.21
Gm-43xGm-1002	103.52	113.78	108.65	31.79	26.42	29.11
Gm-43x Gm-1021	105.00	113.03	109.02	38.03	29.41	33.72
Gm-44xGm-1002	105.69	116.93	111.31	24.85	26.84	25.85
Gm-44x Gm-1021	111.63	111.69	111.66	42.74	30.06	36.40
Gm-50xGm-1002	113.00	114.70	113.85	34.67	26.01	30.34
Gm-50x Gm-1021	110.86	117.97	114.42	41.77	29.74	35.75
Gm-57xGm-1002	108.00	112.76	110.38	36.38	28.53	32.46
Gm-57x Gm-1021	107.81	112.47	110.14	29.62	23.84	26.73
Gm-66xGm-1002	113.00	109.78	111.39	32.79	19.35	26.07
Gm-66x Gm-1021	113.34	113.22	113.28	23.62	27.01	25.32
Gm-72xGm-1002	104.50	108.50	106.50	35.00	28.66	31.83
Gm-72x Gm-1021	116.37	109.91	113.14	37.71	25.08	31.40
Check SC-155	120.86	109.42	115.14	28.08	28.21	28.15
SC-3084	101.38	97.67	99.53	24.43	30.07	27.25
LSD0.05	13.94	9.80	9.74	2.72	2.93	1.89

Values of GCA effects of inbred testers Gm1002 and Gm-1021 for all traits are presented in Table 3.The results showed that tester Gm1002 was a good general combiner for days to 50%silking and ear height, while, tester Gm-1021 line had favorable alleles for grain yield.

Specific combining ability effects for the studied traits of top-crosses (Table 4) pointed out that the crosses Gm-4×Gm1002, Gm-17 x Gm-1021, Gm-19 x Gm-1021, Gm-44 x Gm-1021, Gm-57 x Gm-1002, and Gm-66 x Gm-1002 at Gemmeiza, Gm-66 x Gm- 1002 at

Table 3: General combining ability effects for all studied traits at all and across locations.

Lines	Siliking date, days			Plant height, cm			Ear height, cm			No.of ears/100plants			Grain yield (ard\fad.)		
	Gm	Ml	Com	Gm	Ml	Com	Gm	Ml	Com	Gm	Ml	Com	Gm	Ml	Com
Gm-1	0.521	-0.239	0.141	17.177**	4.042	10.609**	14.719**	2.292	8.506**	30.249**	1.811	16.030**	3.478**	1.957*	2.717**
Gm-4	-0.354	-2.615**	-1.485**	4.302	6.292	5.297	4.594*	6.417*	5.506**	0.477	-4.330	-1.926	-1.782*	2.091**	0.154
Gm-7	-2.479**	-1.239*	-1.859**	17.302**	8.292*	12.797**	7.594**	5.792*	6.693**	17.443**	-0.161	8.641**	3.857**	0.123	1.990**
Gm-14	1.021**	0.635	0.828*	5.677	5.252	5.464	13.968**	5.917*	9.942**	6.553	5.546	6.049*	3.209**	4.033**	3.621**
Gm-17	0.146	0.385	0.266	-5.573	8.042*	1.234	-9.281**	1.292	-3.943*	1.830	1.387	1.608	-1.692**	-1.673*	-1.683**
Gm-19	-1.604**	-0.739	-1.172**	-10.448**	-0.333	-5.390	-6.406**	-1.583	-3.995*	-4.188	0.785	-1.701	1.169	-1.348	-0.089
Gm-43	0.896*	1.135**	1.016**	-5.198	2.792	-1.203	-3.031	2.292	-0.369	-13.859**	-0.295	-7.077**	-0.544	0.309	-0.117
Gm-44	0.646*	1.510**	1.078**	8.552*	-4.208	2.172	2.094	-3.708	-0.807	-9.455*	-0.779	-5.117*	-1.658*	0.838	-0.410
Gm-50	-0.604*	-0.989*	-0.797*	-7.573	-13.708**	-10.640**	-7.281**	-8.458**	-7.869**	-6.187	2.509	-1.839	2.764**	0.263	1.514**
Gm-57	0.896*	0.385	0.641*	1.052	-3.083	-1.016	-5.031*	-2.833	-3.932*	-10.212**	-2.508	-6.360*	-2.455**	-1.424	-1.939**
Gm-66	0.521	1.260**	0.890*	-11.448**	-4.083	-7.766*	-4.781*	-1.083	-2.932	-4.950	0.674	-2.138	-7.247**	-4.428**	-5.837**
Gm-72	0.396	0.510	0.453	-13.823**	-9.333*	-11.578**	-7.156**	-6.333**	-6.744**	-7.680*	-4.639	-6.159*	0.901	-0.739	0.081
SE_{g_i}	0.296	0.387	0.301	4.031	3.873	2.929	1.952	2.289	1.714	3.600	3.239	2.485	0.586	0.782	0.483
$SE_{g_i-g_j}$	0.418	0.547	0.425	5.702	5.478	4.142	2.761	3.237	2.420	5.0991	4.581	3.514	0.829	1.106	0.691
Gm-1002	-0.271*	-0.218	-0.244*	0.406	1.500	0.953	-1.969**	-1.333	-1.651*	-2.409	-0.729	-1.569	-1.869**	-0.462	-1.166**
Gm-1021	0.271*	0.218	0.244*	-0.406	-1.500	-0.953	1.969**	1.333	1.651*	2.409	0.729	1.569	1.869**	0.462	1.166**
SE_{g_i}	0.120	0.158	0.122	1.581	1.581	1.195	0.797	0.934	0.698	1.3.97	1.322	1.014	0.239	0.319	0.179
$SE_{g_i-g_j}$	0.170	0.223	0.173	2.236	2.236	1.691	1.127	1.321	0.988	1.975	1.870	1.434	0.338	0.451	0.282

*,** Significant at 0.01 and 0.05 level of probability

Mallawy and Gm-4×Gm1002, Gm-17 x Gm-1021, Gm-44 x Gm-1021, Gm-57 x Gm-1002, and Gm-66 x Gm-1002 over location were suitable combinations for grain yield. Also, the results revealed that the crosses Gm-4 x Gm-1002 at Gemmeiza and Gm-44 x Gm-1021 at Mallawy and over locations for silking date; Gm-1 x Gm-1002 at Gemmeiza, Gm-1 x Gm-1002 and Gm-43 x Gm-1021 over locations for plant height; Gm-1 x Gm-1002, Gm-19 x Gm-1021, Gm-43 x Gm-1021, Gm-44 x Gm-1002, Gm-72 x Gm-1021 at Gemmeiza, Gm-44 x Gm-1002 at Mallawy and Gm-1 x Gm-1002, Gm-19 x Gm-1021, Gm-43 x Gm-1021 and Gm-44 x Gm-1002 over locations for ear height and cross Gm-1 x Gm-1021 for no. of ears/100 plants they exhibited desirable and significant SCA effects suggesting that these crosses are suitable and good combinations requiring in maize breeding program.

Genetic variances:

Robinson et al (1955) pointed out that any negative estimates of additive or dominance is considered to be equal zero. These negative estimates could be due to sampling error and / or assortment mating, which resulted from the difference in flowering time when developing the top crosses.

Estimates of additive (δ^2A) genetic variances for inbred lines were higher values than dominance (δ^2D) genetic variance for all studied traits except grain yield the dominance variance were higher than additive variance at two locations. These results indicated that additive genetic variance is considered to be the major source of the total genetic variance responsible for the inheritance of silking date, plant and ear height and no. of ears/100plants. The dominance genetic variance is considered to be the major source of the total genetic variance responsible for the inheritance of grain yield.

These results are in accordance with those of *El-Itriby et al (1990), Salama et al (1995), Soliman and Sadek (1999), Saliman et al (2001), Amer et al (2003) and Mahmoud and Abd El-Azeem (2004).* They reported that δ^2 GCA (additive genetic variance) exceeded that of δ^2 SCA (non-additive genetic variance) for grain yield. On the other hand, *El-Zeir et al (2000), Sadek et al (2002),Soliman et al (2001), El-Shenawy et al (2003), Gaber (2003), Abd El-Moula et al (2004),and Abd El-Moula (2005)* indicated that non-additive gene action was involved and comprised most of genetic the variance in the inheritance of grain yield and other traits.

Table 4: SCA effects for all studied traits at all and across locations.

Crosses	Silking date, days			Plant height, cm			Ear height, cm		
	Gm	Ml	Com	Gm	Ml	Com	Gm	Ml	Com
Gm-1xGm-1002	0.021	-0.281	-0.130	-11.031*	-5.125	-8.078*	12.281**	-0.542	-6.412**
Gm-1x Gm-1021	-0.021	0.281	0.130	11.031*	5.125	8.078*	12.281**	0.542	6.412**
Gm-4xGm-1002	-1.104*	-0.406	-0.755	-2.906	-1.875	-2.390	0.094	-0.417	-0.162
Gm-4x Gm-1021	1.104*	0.406	0.755	2.906	1.875	2.390	-0.094	0.417	0.162
Gm-7xGm-1002	0.521	-0.781	-0.130	7.594	1.625	4.609	-3.406	0.208	-1.599
Gm-7x Gm-1021	-0.521	0.781	0.130	-7.594	-1.625	-4.609	3.406	-0.208	1.599
Gm-14xGm-1002	0.771	0.094	0.433	-2.531	2.375	-0.078	-2.281	2.083	-0.099
Gm-14x Gm-1021	-0.771	-0.094	-0.433	2.531	-2.375	0.078	2.281	-2.083	0.099
Gm-17xGm-1002	-0.354	-1.156	-0.755	1.969	-4.375	-1.203	0.719	0.458	0.588
Gm-17x Gm-1021	0.354	1.156	0.755	-1.969	4.375	1.203	-0.719	-0.458	-0.588
Gm-19xGm-1002	0.146	1.219	0.683	8.344	7.000	7.672	8.594**	4.583	6.588**
Gm-19x Gm-1021	-0.146	-1.219	-0.683	-8.344	-7.000	-7.672	-8.594**	-4.583	-6.588**
Gm-43xGm-1002	0.146	0.344	0.245	8.844	9.125	8.984**	9.969**	5.958	7.963**
Gm-43x Gm-1021	-0.146	-0.344	-0.245	-8.844	-9.125	-8.984**	-9.969**	-5.958	-7.963**
Gm-44xGm-1002	0.646	1.469*	1.057**	3.094	-7.375	-2.140	-5.426*	-7.542*	-6.484**
Gm-44x Gm-1021	-0.646	-1.469*	-1.057**	-3.094	7.375	2.140	5.426*	7.542*	6.484**
Gm-50xGm-1002	-0.854	0.469	-0.193	-3.781	-0.625	-2.203	-0.781	-0.292	-0.536
Gm-50x Gm-1021	0.854	-0.469	0.193	3.781	0.625	2.203	0.781	0.292	0.536
Gm-57xGm-1002	0.146	-0.656	-0.255	-5.906	0.250	2.828	-0.781	-0.917	-0.849
Gm-57x Gm-1021	-0.146	0.656	0.255	5.906	-0.250	-2.828	0.781	0.917	0.849
Gm-66xGm-1002	0.021	-0.531	-0.255	-0.406	-1.000	-0.703	-1.281	-2.917	-2.099
Gm-66x Gm-1021	-0.021	0.531	0.255	0.406	1.000	0.703	1.281	2.917	2.099
Gm-72xGm-1002	-0.104	0.219	0.057	-3.281	0.000	-1.640	6.844*	-0.667	3.088
Gm-72x Gm-1021	0.104	-0.219	-0.057	3.281	0.000	1.640	-6.844*	0.667	-3.088
SEsij	0.500	0.689	0.425	5.478	6.011	4.142	2.761	3.671	2.420
SEsij-sik	0.707	0.974	0.601	7.747	8.501	5.858	3.905	5.192	3.422

*,** Significant at 0.01 and 0.05 level of probability

Table 4: Cont.

Crosses	No. of ears/100 plants			Grain yield (ard/fad)		
	Gm	Ml	Com	Gm	Ml	Com
Gm-1xGm-1002	-24.088**	-1.262	-12.675**	0.659	-2.119	-0.730
Gm-1x Gm-1021	24.088**	1.262	12.675**	-0.659	2.119	0.730
Gm-4xGm-1002	-4.329	-2.132	-3.231	5.114**	2.628*	3.871**
Gm-4x Gm-1021	4.329	2.132	3.231	-5.114**	-2.628*	-3.871**
Gm-7xGm-1002	3.438	-5.094	-0.828	-0.469	-2.707*	-1.588*
Gm-7x Gm-1021	-3.438	5.094	0.828	0.469	2.707*	1.588*
Gm-14xGm-1002	6.749	2.358	4.554	2.126	2.478*	2.302**
Gm-14x Gm-1021	-6.749	-2.358	-4.554	-2.126	-2.478*	-2.302**
Gm-17xGm-1002	6.836	1.749	4.293	-4.786*	-0.043	-2.415**
Gm-17x Gm-1021	-6.836	-1.749	-4.293	4.786*	0.043	2.415**
Gm-19xGm-1002	5.593	-2.753	1.420	-4.866*	1.666	-1.600*
Gm-19x Gm-1021	-5.593	2.753	-1.420	4.866*	-1.666	1.600*
Gm-43xGm-1002	1.668	4.105	2.887	-1.247	-1.032	-1.139
Gm-43x Gm-1021	-1.668	-4.105	-2.887	1.247	1.032	1.139
Gm-44xGm-1002	-0.559	3.987	1.714	-7.073**	-1.145	-4.109**
Gm-44x Gm-1021	0.559	-3.987	-1.714	7.073**	1.145	4.109**
Gm-50xGm-1002	3.478	-2.029	0.725	-1.677	-1.406	-1.542*
Gm-50x Gm-1021	-3.478	2.029	-0.725	1.677	1.406	1.542*
Gm-57xGm-1002	2.503	2.799	2.651	5.253**	2.804*	4.028**
Gm-57x Gm-1021	-2.503	-2.799	-2.651	-5.253**	-2.804*	-4.028**
Gm-66xGm-1002	2.241	-1.113	0.564	6.455**	3.370**	4.912**
Gm-66x Gm-1021	-2.241	1.113	-0.564	-6.455**	-3.370**	-4.912**
Gm-72xGm-1002	-3.528	-0.616	-2.072	0.512	2.248*	1.380*
Gm-72x Gm-1021	3.528	0.616	2.072	-0.512	-2.248*	-1.380*
SEsij	4.839	4.846	3.514	1.764	1.106	0.683
SEsij-sik	6.844	6.853	4.970	2.495	1.564	0.977

*,** Significant at 0.01 and 0.05 level of probability

Combined estimates (Table 5) revealed that the magnitude of additive variance x Loc. Interaction for parental inbred lines was higher than dominance x Loc interaction for plant height, ear height and no. of ears/100 plants or exhibited negative in case of grain yield. These results indicated that variance due to additive (δ^2 A) was more affected by environmental condition than δ^2 D. Similar results were reported by *Sadek et al (2001), El-Shenawy et al (2003) and Abd El-Azeem et al (2004)* for grain yield.

Table 5: Estimates of genetic variance components for grain yield and other traits at separate and over locations in a line x tester analysis

S.O.V	Silking date	Plant height,cm	Ear height,cm	Ears/100 plant	Grain yield
			Gemmeiza		
δ^2(A) lines	3.478	309.276	132.186	369.930	-31.682
δ^2 (A) testers	0.379	-23.867	5.542	-0.442	15.733
δ^2 (D) for (L x T)	0.374	43.050	68.769	114.675	36.010
			Mallawy		
δ^2 (A)line	3.272	108.675	48.023	-1.447	-1.499
δ^2 (A) tester	-0.038	3.133	6.528	-1.175	-1.702
δ^2 (D) (L x T)	0.787	8.468	9.599	-6.285	9.008
			Combined		
δ^2 (A)line	3.226	154.888	73.727	110.373	-1.879
δ^2 (A)tester	0.287	-12.993	9.217	5.375	6.462
δ^2 (D) (L x T)	0.396	28.995	31.913	30.628	12.447
δ^2 (A) line x Loc	0.346	108.173	32.204	147.738	-29.422
δ^2 (A) tester x Loc	-0.233	5.252	-6.456	-12.666	1.106
δ^2 D (L x T) x Loc	0.369	-6.475	12.496	47.134	19.500

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القدرة على التآلف في الهجن القمية لمحصول الحبوب وبعض الصفات الأخرى

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تم التهجين بين ١٢ سلالة من الذرة الشامية الصفراء تم عزلها من مجتمع عريض التركيب الوراثي - مجتمع جميزة الأصفر- مع اثنين من الكشاف هى جميزة-١٠٠٢ وجميزة- ١٠٢١ في موسم ٢٠٠٥ . تم تقييم الهجن القمية في موسم ٢٠٠٦ في محطتي البحوث الزراعية بالجميزة وملوي. وتم اخذ قراءات المحصول وعدد الكيزان لكل ١٠٠ نبات وعدد الأيام حتى ظهور ٥٠% من الحرايرو ارتفاع النبات والكوز بهدف تقدير القدرة على التآلف وطرز فعل الجين وانتخاب أحسن السلالات والهجن للاستفادة منها في برامج التربية.

أظهرت النتائج وجود فروق معنوية بين الهجن والسلالات والكشاف والتفاعل بين السلالات والكشاف لكل الصفات المدروسة بالجميزة وملوي ما عدا الكشاف لصفة ارتفاع النبات بالجميزة والهجن و السلالات والكشاف والتفاعل بين السلالات والكشاف لصفة عدد الكيزان لكل ١٠٠ نبات والكشاف والتفاعل بين السلالات والكشاف لصفة ارتفاع النبات بملوي. أظهر التحليل المشترك وجود فروق معنوية بين الهجن والسلالات والكشاف والتفاعل بين السلالات والكشاف لكل الصفات المدروسة. كان التفاعل بين المناطق ومكونات التباين معنويا لجميع الصفات ماعدا التفاعل بين الكشاف و المناطق لصفات ارتفاع النبات والكوز وعدد الكيزان لكل ١٠٠ نبات وكذلك التفاعل المشترك بين السلالات والكشاف والمناطق لصفة عدد الكيزان لكل ١٠٠ نبات.

اظهر ١٥ هجين قمى تفوقا معنويا على هجين المقارنة هـ . فـ ١٥٥ لصفة محصول الحبوب فى التحليل المشترك مما يشير إلى إمكانية استخدام هذة الهجن فى برنامج التربية للمحصول العالى.

أظهرت السلالات جميزة – ١ و ٧ و ١٤ و ٥٠ في الجميزة والتحليل المشترك وجميزة–١٤ في ملوي قدرة عامة موجبة ومرغوبة لصفة محـصول الحبـوب . كمـا اظهرت الهجن القمية

Gm -4×Gm1002, Gm-17 x Gm-1021, Gm-44 x Gm-1021, Gm-57 x Gm-1002, Gm-66 x Gm-1002

قدرة خاصة موجبة ومرغوبة لصفة محصول الحبوب

أظهرت النتائج ان الفعل الوراثى المضيف هو الفعال فى وراثة صـفات عـدد الايام حتى ظهور ٥٠% من الحراير وارتفاع النبات والكوز وعدد الكيـزان لكـل ١٠٠ نبات بينما كان الفعل الوراثي السيادي هو الفعال في وراثة صفة محصول الحبوب.