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ESTIMATION OF COMBINING ABILITY AND TYPE OF GENE ACTION FOR GRAIN YIELD AND OTHER ATTRIBUTES BETWEEN NEW LINES OF WHITE MAIZE (*Zea mays L.*)

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ABSTRACT

Eleven white maize inbred lines were top crossed during 2004 to each of the four different testers viz. Sd-7, Gm-2, Gm-4 and Gm-21 at Gemmeiza Agric. Res. Station. In 2005 season, the obtained forty four top crosses were evaluated along with the 2 checks, S.C.10 and S.C.129 at Gemmeiza and Sids Agric. Res. Stations for days to 50% Silking, plant and ear heights, no of ears/100 plant and grain yield ard/Fed.

Mean squares for crosses (C) line (L), testers (T) and L x T were significant for all studied traits at both locations and the combined over them. The interaction of crosses x locations was significant for all studied traits. Lines x location and T x L interactions were significant for all studied traits except, plant height for L x T and ear height for T x Location. While the interaction of L x T x Location mean squares was significant for all studied traits except, no. of ears/100 plants. The best GCA effects for grain yield were obtained for lines Gm- 8 and Gm- 14 these liens should be directly utilized in breeding programs to develop height yielding hybrids. Results in addition 9 crosses gave positive and significant SCA effects for grain yield and other characters. were than checks, respectively. The magnitude of δ^2 GCA was larger for days 50% silking, plant and ear heights, while δ^2 SCA was larger for no. of ears/100 plants and grain yield. The interaction δ^2 SCA x L was higher than that of δ^2 GCA x L for all studied traits, indicating that the non-additive type of gene action is more affected by environmental conditions than the additive type.

Key words: Maize, combining ability, top crosses, type of gene action.

INTRODUCTION

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 methods of top cross using broad and narrow testers is used to evaluate new improved lines for combining ability in maize hybrid breeding programmes.

Kempthorne (1957) suggested a method of statistical of the line x tester for testing general and specific combining ability of inbred lines. Nawar and EL-Hosary (1984), found that broad genetic base testers were efficient than the narrow genetic base tester for evaluation of general combining ability in inbred lines of maize.

The 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 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 were fount for both lines and testers (Soliman and Sadek 1999, Nass *et al.*, 2002 and EL-Morshidy *et al.*, 2003)

The main objectives of this investigation were to (i) evaluate 44 top crosses (ii) estimate of GCA and SCA effects of for lines, testers and crosses for grain yield and other traits, (iii) and estimate the variances of lines and testers δ^2 GCA for lines δ testers and δ^2 SCA for top crosses and their interaction with location.

MATERIALS AND METHODS

Eleven S^4 white maize inbred lines *(zea maize, L.)* i.e. Gm. 1, Gm. 4, Gm. 6, Gm. 8, Gm. 12, Gm. 14, Gm. 18, Gm. 25, Gm. 26, Gm. 30 and Gm, 32 were derived form the wide genetic base Gemmeiza white maize population through selection from segregating generation at Gemmmeiza Agricultural Research Station. In 2004 these lines were top crossed to each of the four narrow base inbred testers.; Sd. 7, Gm. 2, Gm. 4, and Gm. 21 at Gemmmeiza Agricultural Research Station. In 2005 season, 44 top crosses were evaluated with two commercial check hybrids, S.C. 10 and S.C. 129, in replicated yield trials conducted at Gemmeiza and Sids Agricultural Research Station., representing Delta and Middle Egypt regions, respectively .

A randomized complete block design with four replications was used in each location. The experimental plot was one row, 6 meter long with 80 cm between rows. Planting was in hills spaced 25 cm apart. Data were recorded for number of days to 50% silking, plant and ear height, no. of ears/100 plant and grain yield ardab / Fed.

Analysis of variance were carried out separately for each location and the combined over locations according to Steel and Torrei (1980). Combining ability analysis was carried out for each location according to Kempthorne (1957).

RESULTS AND DISCUSSION

Analysis of variance

Data presented in Table (1) show mean squares and degrees of freedom at Gemmeiza, Sids and the combined over locations for grain yield and other agronomic traits. Highly significant differences were detected between locations for all studied traits, indicating that the two locations differed in their environmental condition.

Mean squares due to crosses, lines, testers and lines x testers were significant for all studied traits at both locations and over locations. These results indicate wide diversity among each of lines and testers in their contribution to the performance of top crosses. In addition, the interactions of crosses, lines, testers and lines x testers with location were significant for all studied traits, except plant height for lines x locations, ear height for testers x locations and ears / 100 plants for L x T x locations interaction. These interactions with location are mainly attributed to the different ranking of genotypes from location to another. (1990), Salama *et al.*, (1995), Soliman *et al.*, (1995), Mahgoub *et al.*, (1996), Shehata *et al.*, (1997), Soliman and Sadek (1999), Gado *et al.*, (2000), Soliman (2000), Mahmoud *et al.*, (2001), Barakat (2001) and Abd El-Moula *et al.*, (2004).

The magnitude of the variances due to testers for all studied traits was higher than of lines at Gemmeiza, Sids and over locations. Also, the variances due to testers x locations was ligher lines x locations for plant height, no of ears/100 plants and grain yield (ard/Fed.) . This indicates that the testers contributed much more to the total variation and more affected by the environmental conditions than the lines. Simlar results were obtained by Gado *et al.*, (2000), Soliman (2000), Barakat (2001), EL-Morshidy *et al.*, (2003) and Abd EL-Moula *et al.*, (2004).

Mean Performance

The highly significant variances among crosses are clearly shown in the average performance of the crosses (Table 2). The average performance of crosses showed that the earliest cross (Gm- 8 x Gm- 2) flowered at 49.833 days while the latest cross (Gm- 32 x Gm- 2) flowered at 59.283 days. Out of 44 crosses there were 11 crosses significantly earlier than the two checks SC-10 and SC-129. Plant height ranged from 175.233 for cross (Gm.18 x Gm. 4) to 246.708 cm for cross (Gm- 18 x Sd- 7). There were 22 crosses significantly shorter than the two checks. For ear height, the shortest cross was (Gm-26 x Gm-2) 108.783 cm, while the tallest placement (Gm-14 x Sd-7) 147.258 cm. There were 16 crosses and showed significantly lowest ear placement than the two checks. Regarding no. of ears /100 plants, the highest value was obtained by the cross (Gm-32 x Sd-7) 113.643 ears, while the lowest value was detected by cross (Gm-12 x Gm- 4) 83.997 ears. There were 5 crosses expressed significantly higher no. of ears/100 plants than the two checks. Grain yield ranged from 8.964 for cross (Gm- 32 x Gm-2) to 31.653 ard/Fed. For cross (Gm- 32 x Sd- 7). The best crosses (Gm- 4 x Sd- 7), (Gm- 8 x Sd-7), (Gm-14 x Sd- 7), (Gm-18 x Gm-21) and (Gm-32 x Sd-7) at Gemmeiza and (Gm-14 x Sd-7) and (Gm-32 x Sd-7) at Sids and

(Gm- 4 x Sd- 7), (Gm- 8 x Sd-7), (Gm-14 x Sd-7) and (Gm- 32 x Sd-7) over locations and out yielded the best check SC- 10 by 22.62, 21.54, 24.40, 12.26 and 30.14% at Gemmeiza and by 18.38, 16.83% at Sids and by 7.74, 11.59, 21.21 and 23.10% over locations, respectively.

Table (1): Mean squares (MS) of grain yield and other agronomic traits at Gemmiza and Sids and over locations in 2005 season.

sov	d.f	M.S				
		Silking date	Plant height	Ear height	Ears/100 Plant	Grain yield
Gemmiza						
Replications	3	6.813	2093.004	2999.547	48.600	1.899
Crosses	43	26.631	1277.028	533.943	267.066	89.631
Lines (L)	10	42.822	627.219	429.399	425.286	55.575
Testers (T)	3	100.125	12403.188	3518.90	769.599	606.501
LxT	30	14.346	381.015	270.297	164.070	49.293
Error	129	0.701	94.464	89.199	96.732	3.348
Sids						
Replications	3	27.729	528.462	80.883	213.813	105.876
Crosses	43	20.862	1552.374	461.916	217.413	106.857
Lines (L)	10	10.926	953.280	736.335	321.858	98.928
Testers (T)	3	191.160	13433.085	2562.030	246.807	539.370
LxT	30	7.137	564.003	160.434	179.658	66.249
Error	129	2.790	123.039	78.831	64.656	13.671
Combined						
Locations (L)	1	1681.380	110701.026	16552.890	5626.971	138.330
Rep/L	6	17.262	1310.733	1540.215	131.301	53.883
Crosses(C)	43	42.255	2656.836	872.730	360.594	173.817
Lin(L)	10	45.414	1522.701	1028.817	609.507	140.535
Testers (T)	3	283.419	25153.821	5967.459	699.831	1091.934
LxT	30	17.082	785.187	311.229	243.693	93.096
CxLoc	43	5.247	172.566	123.138	123.885	22.662
Lx Loc	10	8.334	57.798	136.917	137.628	13.968
T x Loc	3	7.866	682.452	113.490	316.575	53.928
L x T x Loc	30	3.951	159.831	119.502	100.035	22.437
Pooled Error	258	1.746	108.747	84.015	80.694	8.514

*, ** Significant and highly significant at 0.05 and 0.01 level of probability, respectively.

General and Specific combining ability effects

For general combining ability (GCA) effects (Table 3), the inbred lines., Gm. 1, Gm. 8, Gm. 12, Gm. 18, Gm.26 and Gm. 30 manifested negative and significant GCA effects for silking at Gemmeiza and over locations. Lines Gm- 1, Gm. 18 at Gemmeiza, Gm. 1, Gm. 6 and Gm. 18 at Sids and Gm1, Gm. 4, Gm. 6 and Gm. 18 over the locations had negative and significant GCA effects for plant height, lines Gm. 6 at Gemmeiza, Gm. 6, Gm. 18 at Sids and Gm. 1, Gm. 6 and Gm. 18 over locations had negative and significant GCA effects for ear height. Lines Gm. 25, Gm. 26, Gm-32 at Gemmeiza, Gm.14, Gm. 32 at Sids and Gm. 14, Gm. 25 and Gm.32 over locations manifested positive and significant GCA effects were detected for no. of ears/100 plants. Lines Gm. 12 Gm. 14 at Gemmeiza, Gm. 8, Gm. 14 at Sids and Gm. 8 and Gm. 60 over locations exhibited significal positive GCA effects for grain yield/fed.

Table (2): Average performance of 44 top crosses for grain yield and its attributes at Gemmiza, Sids and combined in 2005 season

Crosses	Days to 50% silking			Plant height			Ear height		
	Gemm	Sids	Com.	Gemm	Sids	Com	Gemm	Sids	Com.
Gm-1 x sd-7	52.875	58.275	55.575	235.350	197.550	216.450	136.125	109.800	122.958
Gm-1 x Gm-2	48.150	52.425	50.283	210.150	191.925	201.033	126.225	103.275	114.750
Gm-1 x Gm-4	51.300	54.000	52.650	214.425	174.150	194.283	128.925	103.725	116.325
Gm-1 x Gm-21	52.200	56.700	54.450	231.975	194.400	213.183	138.375	112.275	125.325
Gm-4 x sd-7	53.100	59.175	56.133	246.150	209.250	227.700	139.500	123.075	131.283
Gm-4 x Gm-2	47.250	53.100	50.175	216.225	184.950	200.583	132.075	99.675	115.875
Gm-4 x Gm-4	51.750	56.025	53.883	218.925	174.600	196.758	130.500	99.675	115.083
Gm-4 x Gm-21	53.325	58.275	55.800	228.375	195.075	211.725	131.850	105.075	118.458
Gm-6 x sd-7	52.650	55.575	54.108	249.300	198.675	223.983	151.650	107.100	129.375
Gm-6 x Gm-2	50.175	52.875	51.525	207.900	186.750	197.325	120.825	99.000	109.908
Gm-6 x Gm-4	51.750	55.125	53.433	222.750	176.400	199.575	127.575	105.750	116.658
Gm-6 x Gm-21	52.425	58.050	55.233	224.100	192.375	208.233	128.025	102.375	115.200
Gm-8 x sd-7	52.875	58.725	55.800	263.250	219.150	241.200	157.275	113.625	135.450
Gm-8 x Gm-2	47.700	51.975	49.833	220.050	185.175	202.608	130.275	103.050	116.658
Gm-8 x Gm-4	51.975	56.700	54.333	219.150	193.500	206.325	131.400	113.400	122.400
Gm-8 x Gm-21	51.750	54.000	52.875	220.950	174.150	197.550	124.425	100.800	112.608
Gm-12 x sd-7	53.325	58.275	55.800	245.700	228.825	237.258	141.750	127.350	134.550
Gm-12 x Gm-2	47.700	52.650	50.175	220.275	187.650	203.958	126.000	108.225	117.108
Gm-12 x Gm-4	48.150	53.325	50.733	223.425	179.550	201.483	133.650	101.250	117.450
Gm-12 x Gm-21	52.200	56.475	54.333	231.750	196.875	214.308	137.700	108.450	123.075
Gm-14 x sd-7	52.425	57.150	54.783	259.200	219.375	239.283	164.475	130.050	147.258
Gm-14 x Gm-2	51.075	53.775	5242.500	228.825	204.300	216.558	138.600	123.975	131.283
Gm-14 x Gm-4	51.975	54.900	53.433	235.800	204.075	219.933	144.000	118.575	131.283
Gm-14 x Gm-21	53.100	58.500	55.800	257.400	228.375	242.883	147.825	131.850	139.833
Gm-18 x sd-7	53.325	57.825	55.575	264.375	229.050	246.708	152.775	120.375	136.575
Gm-18 x Gm-2	48.600	52.200	50.400	203.850	180.225	192.033	124.650	94.725	109.683
Gm-18 x Gm-4	51.075	55.125	53.100	197.325	154.350	175.833	127.125	94.725	110.925
Gm-18 x Gm-21	51.975	56.475	54.225	228.600	197.100	212.850	135.675	103.275	119.475
Gm-25 x sd-7	52.425	56.025	54.225	232.650	208.125	220.383	131.850	111.375	121.608
Gm-25 x Gm-2	51.750	55.350	53.550	214.875	182.475	198.675	132.525	105.075	118.800
Gm-25 x Gm-4	51.750	55.800	53.775	228.375	185.175	206.775	142.425	106.875	124.650
Gm-25 x Gm-21	52.425	58.275	55.350	242.775	213.750	228.258	152.100	118.125	135.108
Gm-26 x sd-7	53.775	58.500	56.133	260.775	232.425	246.600	162.675	125.775	144.225
Gm-26 x Gm-2	47.700	53.325	50.508	210.825	184.950	197.883	124.875	92.700	108.783
Gm-26 x Gm-4	49.050	54.225	51.633	214.200	174.825	194.508	134.100	98.100	116.100
Gm-26 x Gm-21	52.425	57.375	54.900	234.900	197.325	216.108	138.825	107.550	123.183
Gm-30 x sd-7	53.100	56.925	55.008	246.150	227.925	237.033	139.950	115.650	127.800
Gm-30 x Gm-2	48.150	52.650	50.400	212.625	186.525	199.575	125.550	101.925	113.733
Gm-30 x Gm-4	51.750	54.450	53.100	220.725	174.150	197.433	128.025	102.375	115.200
Gm-30 x Gm-21	51.750	57.600	54.675	237.375	195.525	216.450	135.900	112.500	124.200
Gm-32 x sd-7	54.675	59.175	56.925	253.575	229.500	241.533	146.925	128.025	137.475
Gm-32 x Gm-2	60.750	57.825	59.283	209.250	174.825	192.033	118.125	99.900	109.008
Gm-32 x Gm-4	54.450	56.700	55.575	239.850	198.450	219.150	150.750	116.325	133.533
Gm-32 x Gm-21	54.675	57.375	56.025	225.225	205.425	215.325	130.950	116.100	123.525
Check SC-10	53.550	58.275	55.908	254.025	225.900	239.958	148.050	128.025	138.033
SC-129	51.975	56.700	54.333	238.950	212.175	225.558	136.800	30.825	128.808
LSD 0.05	1.125	2.196	0.837	4.725	14.841	13.707	12.780	2.745	3.051

Table (2): Cont.

Crosses	No of ears/100 plants			Grain yield (ard /fed)		
	Gemm	Sids	Com.	Gemm	Sids	Com.
Gm-1 x sd-7	91.179	89.703	90.441	22.698	22.680	22.689
Gm-1 x Gm-2	92.979	83.745	88.362	21.060	20.988	2103.300
Gm-1 x Gm-4	90.171	174.348	87.255	18.216	16.470	17.352
Gm-1 x Gm-21	98.001	90.018	94.005	23.652	19.953	21.807
Gm-4 x sd-7	92.772	87.678	90.234	29.619	25.830	27.729
Gm-4 x Gm-2	86.949	85.833	86.391	18.486	19.215	18.855
Gm-4 x Gm-4	91.071	90.900	90.990	19.125	18.000	18.558
Gm-4 x Gm-21	95.859	77.130	86.490	18.702	14.850	16.785
Gm-6 x sd-7	100.422	81.720	91.071	25.857	22.203	22.680
Gm-6 x Gm-2	91.188	80.478	85.833	16.848	16.398	16.632
Gm-6 x Gm-4	96.831	85.653	91.242	16.308	16.560	16.425
Gm-6 x Gm-21	94.311	81.585	87.957	16.254	13.338	14.787
Gm-8 x sd-7	88.884	88.920	88.911	29.358	28.035	28.692
Gm-8 x Gm-2	89.136	88.083	88.614	19.422	20.493	19.962
Gm-8 x Gm-4	91.179	96.300	93.735	19.476	23.553	21.519
Gm-8 x Gm-21	94.653	89.955	92.304	14.067	18.225	16.128
Gm-12 x sd-7	94.185	88.668	91.440	25.470	24.570	25.029
Gm-12 x Gm-2	90.090	86.850	88.470	22.788	24.255	23.526
Gm-12 x Gm-4	94.050	73.953	83.997	19.935	16.380	18.153
Gm-12 x Gm-21	89.352	83.718	86.535	20.925	17.478	19.197
Gm-14 x sd-7	100.791	102.600	101.691	30.051	32.283	31.167
Gm-14 x Gm-2	91.251	87.075	89.154	19.746	22.185	20.961
Gm-14 x Gm-4	102.861	89.280	96.075	23.094	18.468	20.790
Gm-14 x Gm-21	104.823	100.800	102.816	26.091	24.183	25.146
Gm-18 x sd-7	90.639	87.750	89.190	24.264	24.048	24.156
Gm-18 x Gm-2	96.768	89.775	93.276	18.729	23.400	21.069
Gm-18 x Gm-4	90.234	87.813	89.010	17.892	16.920	17.397
Gm-18 x Gm-21	95.130	84.825	89.964	27.117	19.800	23.490
Gm-25 x sd-7	91.125	85.725	88.425	20.961	20.565	20.790
Gm-25 x Gm-2	94.275	85.860	90.090	19.728	20.178	19.953
Gm-25 x Gm-4	100.764	88.020	94.392	19.539	18.693	19.125
Gm-25 x Gm-21	117.153	106.938	112.050	20.952	20.223	20.583
Gm-26 x sd-7	94.338	90.000	92.169	26.190	21.618	23.913
Gm-26 x Gm-2	92.205	89.505	90.864	18.891	22.410	20.655
Gm-26 x Gm-4	109.449	89.028	99.234	17.937	16.398	17.190
Gm-26 x Gm-21	110.673	83.898	97.290	22.590	17.478	20.025
Gm-30 x sd-7	97.542	90.900	94.221	22.050	21.195	21.627
Gm-30 x Gm-2	96.552	88.020	92.286	20.979	23.760	22.365
Gm-30 x Gm-4	90.000	86.670	88.335	19.377	16.515	17.937
Gm-30 x Gm-21	95.670	93.150	94.410	25.227	18.558	21.897
Gm-32 x sd-7	112.986	114.300	113.643	31.437	31.860	31.653
Gm-32 x Gm-2	88.038	86.733	87.390	13.851	4.068	8.964
Gm-32 x Gm-4	100.890	90.000	95.427	10.890	13.158	12.042
Gm-32 x Gm-21	120.276	90.000	105.138	16.389	14.913	15.651
Check SC-10	92.493	85.032	88.767	24.156	27.270	25.713
SC-129	94.959	82.386	88.677	21.177	20.295	20.745
LSD 0.05	12.915	10.557	11.808	2.394	5.067	3.834

Table (3): Estimates of general combining effects for grain yield and other traits at Gemmiza, Sids and combined in 2005 season.

Lines	Days to 50% silking			Plant height			Ear height			No of ears/100 plants			Grain yield(ard/fed)		
Testers	Gm.	Sids	Com	Gm.	Sids	Com	Gm.	Sids	Com	Gm.	Sids	Com	Gm.	Mal.	Com
L - 1	-0.614	-0.542	-0.578	-6.791	-6.612	-6.719	-4.060	-2.342	-3.201	-3.225	-1.769	-2.497	0.230	0.031	0.131
L - 4	-0.389	0.752	0.182	-2.347	-5.149	-3.749	-2.992	-2.735	-2.864	-4.648	-3.339	-3.993	0.310	-0.520	-1.005
L - 6	0.005	-0.485	-0.240	-3.753	-7.568	-5.660	-4.454	-6.054	-5.254	-0.615	-6.366	-3.490	-2.373	-3.542	-2.957
L - 8	-0.670	-0.542	-0.606	1.085	-3.124	-1.020	-0.629	-1.892	-1.260	-5.351	2.089	-1.631	-0.618	2.058	0.983
L - 12	-1.401	-0.710	-1.056	0.521	2.107	1.314	-1.697	1.708	0.005	-4.383	-5.426	-4.904	1.092	0.677	0.884
L - 14	0.399	0.189	0.294	15.540	17.913	16.727	12.253	16.502	14.377	3.615	6.212	4.913	3.550	4.289	3.919
L - 18	-0.501	-0.485	-0.493	-6.228	-5.936	-6.082	-1.417	-6.335	-3.876	3.123	1.184	2.154	0.810	1.049	0.930
L - 25	0.343	0.471	0.407	-0.097	1.263	0.583	3.253	0.752	2.002	4.515	2.910	3.713	-0.888	-0.077	-0.482
L - 26	-1.007	-0.351	-0.521	0.410	1.263	0.836	3.646	-3.579	0.033	5.359	-0.617	2.372	0.220	-0.515	-0.148
L - 30	-0.557	-0.485	-0.521	-0.547	-0.087	-0.317	-4.117	-1.499	-2.807	-1.374	0.959	-0.208	0.720	0.014	0.366
L - 32	4.392	1.877	3.135	2.210	5.932	4.071	0.215	5.477	2.845	9.229	6.532	7.880	-3.048	-3.992	-3.520
Sd. 7	1.396	1.892	1.644	20.822	22.050	21.436	11.250	9.680	10.465	0.416	2.908	1.246	4.994	4.751	4.873
Gm.2	-1.835	-2.424	-2.129	-15.689	-9.761	-12.733	9.225	-6.745	-7.985	-4.541	-2.183	-3.362	-2.047	-0.233	-1.139
Gm.4	-0.383	-0.767	-0.575	-8.407	15.279	-11.843	-2.066	-4.085	-3.076	-0.180	-1.273	-0.726	-2.842	-2.618	-2.730
Gm.21	0.824	1.299	1.061	3.272	3.007	3.139	0.041	1.150	0.596	5.137	0.549	2.843	-0.105	-1.900	-1.003
SE.g lines	0.198	0.396	0.221	2.305	2.631	1.749	2.239	2.105	1.536	2.332	1.906	1.506	0.434	0.877	0.489
Testers	0.085	1.068	1.033	0.983	1.121	1.054	0.955	0.897	0.926	0.995	0.813	0.908	0.185	0.374	0.294
S.E(gi-gi)L	0.281	0.560	0.158	3.260	3.720	2.473	3.167	2.977	2.174	3.299	2.696	2.130	0.613	1.239	0.691
T	0.120	0.239	0.188	1.390	1.586	1.491	1.351	1.269	1.310	1.406	1.149	1.284	0.261	0.528	0.417

Significant and highly significant at 0.05 and 0.01 level of probability, respectively

Results in Table (3), revealed that the two tester Gm. 2 and Gm. 4 were good general combiner for earliness, plant and ear heights at both and over locations. The tester line Gm. 21 was the best combiner for ears/100 plants and Sd- 7 was the best combiner for grain yield in both location, as wall as the combined over them.

Estimates of SCA effects for the studied traits are presented in Table (4), revealed that there were 14.4 and 10 crosses for days to 50% silking; 4.6 and 6 crosses for plant hight; 3.2 and 5 crosses for ear height had negative and significant SCA effects at Gemmeiza, Sids and the combined analysis respectively. Positive and significant SCA effects were detected by crosses (Gm. 25 x Gm. 21), (Gm. 32 x Gm-21) at Gemmeiza (Gm. 25 x Gm-21), (Gm. 32 x Sd-7) at Sids and crosses (Gm- 25 x Gm-21),(Gm-32 x Sd-7) over both locations for no. of ears/100 plants.

Four and nine showed positive and significant SCA effects for grain yield/fed. at Gemmeiza, Sids and the combined analysis, respectively.

In this connection, Sprague and Tatum (1942) emphasized the importance of single and 3-way cross trials for determining the most productive specific combination. Mahgoub *et el.* (1996), Shehata *et al.*, (1997) and El-Zeir (1999), reported that the inbred tester method was effective to select lines that combined well with unrelated tester. Moreover, they emphasized that inbred testers were more effective in detecting small differences in combining ability more than the wide genetic base testers.

Variance components

The estimates of combining ability variances δ^2 GCA for lines and testers and δ^2 SCA for each locations and their interaction with locations are presented in (Table 5).

Results revealed that values of δ^2 GCA for tester was higher than that δ^2 SCA for lines for all studied traits except, for no. of ears/100 plants at separation of the combined over them. These results indicate that most of the total genetic variance was due to GCA of the testers. The variances interaction of δ^2 SCA x T were larger than δ^2 SCA x L for plant height, no. of ears/100 plants and grain yield indicating that δ^2 GCA for testers was more affected by environment (L) condition than that for lines. The variances among half-sibs δ^2 SCA were larger than those of δ^2 SCA for days to 50% silking, plant and ear height indicating that the additive gene effects were more important in the inheritance of these traits. While the δ^2 SCA variances were larger than δ^2 SCA variances for no. of ears/100 plant and grain yield, indicating that the non-additive gene effects were important in the inheritance of these traits.

Furthermore, the magnitude of δ^2 SCA x L interaction was higher than that of δ^2 GCA x L interaction for all studied traits. These findings indicated that the non-additive type of gene action is more affected by environmental conditions than the additive type. Soliman and Sadek (1999) Sadek *et al.*, (2000), Abd El-Moula (2001), Mahmoud *et al.*, (2001) Singh and Singh (1998), Soliman *et al.* (2001), El-Morshidy *et al.*, (2003) and Abd El-Moula *et al.*, (2004)

Table (4): Estimates of specific combining ability for grain yield and other traits at Gemmiza, Sids and the combined analysis in 2005 season.

Crosses	Days to 50% silking			Plant height			Ear height		
	Gemm	Sids	Com.	Gemm	Sids	Com	Gemm	Sids	Com,
Gm-1 x sd-7	0.347	1.033	0.690	-8.447	-14.007*	-11.227**	-7.538	-7.149	-7.343*
Gm-1 x Gm-2	-1.146**	-0.501	-0.823	2.863	12.196*	7.529*	3.038	2.750	2.894
Gm-1 x Gm-4	0.553	-0.583	-0.015	-0.143	-0.077	-0.110	-1.421	0.542	-0.440
Gm-1 x Gm-21	0.246	0.051	0.149	5.728	1.886	3.807	5.921	3.856	4.889
Gm-4 x sd-7	0.347	0.639	0.493	-2.092	-3.769	-2.930	-5.231	6.520	0.644
Gm-4 x Gm-2	-2.271**	-1.120	-1.695**	4.495	3.758	4.127	7.818	-0.455	3.682
Gm-4 x Gm-4	0.778	0.149	0.463	-0.086	-1.089	-0.588	-0.915	-3.114	-2.015
Gm-4 x Gm-21	1.146**	0.332	0.739	-2.317	1.100	-0.608	-1.672	-2.950	-2.311
Gm-6 x sd-7	-0.496	-1.724*	-1.110*	2.465	-11.925	-4.730	8.381	-6.136	1.122
Gm-6 x Gm-2	0.260	-0.107	0.077	-2.424	7.978	2.777	-1.968	2.188	0.110
Gm-6 x Gm-4	0.383	0.485	0.435	5.144	3.129	4.136	-2.378	6.279	1.951
Gm-6 x Gm-21	-0.149	1.345	0.599	-5.185	0.819	-2.183	-4.035	-2.332	-3.183
Gm-8 x sd-7	0.404	1.481	0.943*	11.578*	4.107	7.842*	10.181*	-3.774	3.203
Gm-8 x Gm-2	-1.539**	-0.951	-1.246**	4.889	1.958	3.424	3.656	2.076	2.867
Gm-8 x Gm-4	1.283**	2.117**	1.700**	-3.293**	15.785	6.246	-2.378	9.767*	3.695
Gm-8 x Gm-21	-0.149	-2.649**	-1.399**	-13.172**	-21.850**	-17.511**	-11.460*	-8.069	-9.764**
Gm-12 x sd-7	1.585**	1.202	1.393**	-5.410	8.550	1.570	-4.275	6.351	1.038
Gm-12 x Gm-2	-0.808*	-0.107	-0.458	5.676	-0.797	2.439	0.450	3.651	2.050
Gm-12 x Gm-4	-1.810**	-1.089	-1.450**	1.544	-3.396	-0.925	0.941	-5.983	-2.521
Gm-12 x Gm-21	1.033*	-0.005	0.514	-1.810	-4.357	-3.083	2.884	-4.019	-0.568
Gm-14 x sd-7	-1.115**	-0.824	-0.969*	-6.929	-16.707	-11.818**	4.500	-5.743	-0.621
Gm-14 x Gm-2	0.767	0.118	0.442	-0.793	0.046	-0.373	-0.900	4.607	1.853
Gm-14 x Gm-4	0.215	-0.414	-0.100	-1.099	5.324	2.111	-2.659	-3.452	-3.055
Gm-14 x Gm-21	0.133	1.120	0.626	8.821	11.337	10.079	-0.941	4.587	1.823
Gm-18 x sd-7	0.685	0.527	0.606	20.015**	16.819**	18.417**	6.468	7.420	6.944*
Gm-18 x Gm-2	-0.808*	-0.782	-0.796	-3.999	-0.179	-2.089	-1.181	-1.805	-1.493
Gm-18 x Gm-4	0.215	0.485	0.350	-17.806**	-20.552**	-19.178**	-5.865	-4.464	-5.165
Gm-18 x Gm-21	-0.092	-0.230	-0.161	1.790	3.912	2.851	0.578	-1.150	-0.286
Gm-25 x sd-7	-1.058*	-2.229**	-1.644*	-17.842**	-11.307*	-14.574**	-19.125**	-8.668*	-13.896**
Gm-25 x Gm-2	1.499**	1.411	1.454**	0.895	-5.129	-2.117	2.025	1.457	1.742
Gm-25 x Gm-4	0.046	0.204	0.125	7.113	3.074	5.093	4.766	0.599	2.682
Gm-25 x Gm-21	-0.485	0.614	0.064	9.833*	13.361*	11.597**	12.334**	6.611	9.473**
Gm-26 x sd-7	1.642**	0.752	1.197*	9.778*	12.994*	11.385**	11.306**	10.063**	10.685**
Gm-26 x Gm-2	-1.202**	-0.107	-0.654	-3.661	-2.654	-3.157	-6.018	-6.586	-6.303*
Gm-26 x Gm-4	-1.304**	-0.864	-1.085*	-7.568	-7.277	-7.422	-3.953	-3.846	-3.899
Gm-26 x Gm-21	0.864*	0.220	0.542	1.453	-3.063	-0.806	-1.335	0.368	-0.483
Gm-30 x sd-7	0.517	-0.374	0.071	-3.892	9.843	2.976	-3.656	-2.143	-2.899
Gm-30 x Gm-2	-1.202**	-0.332	-0.767	-0.905	0.271	-0.317	2.418	0.557	1.488
Gm-30 x Gm-4	0.946*	-0.189	0.378	-0.086	-6.602	-3.344	-2.265	-1.652	-1.958
Gm-30 x Gm-21	-0.260	0.895	0.317	4.883	-3.513	0.685	3.503	3.236	3.370
Gm-32 x sd-7	-2.858**	-0.485	-1.672*	0.778	5.400	3.089	-1.013	3.257	1.122
Gm-32 x Gm-2	6.449**	2.480**	4.464**	-7.036	-17.447**	-12.242**	-9.338*	-8.443*	-8.889**
Gm-32 x Gm-4	-1.304**	-0.302	-0.803	16.282**	11.679*	13.981**	16.128**	5.324	10.726**
Gm-32 x Gm-21	-2.285**	-1.692*	-1.989**	-10.022*	0.369	-4.828	-5.778	-0.138	-2.958
SE.Sij	0.397	0.792	0.443	4.610	5.261	3.497	4.479	4211.100	2.724
(Sij-Sik)	0.562	1.120	0.626	6.520	7.440	4.946	6.335	5.955	4.348

*, ** Significant and highly significant at 0.05 and 0.01 level of probability, respectively.

Table(4): Cont.

Crosses	No of ears/100 plants			Grain yield(ard/fed)		
	Gemm	Sids	Com.	Gemm	Sids	Com.
Gm-1 x sd-7	-1.480	-0.157	-0.818	-3.706	-2.096	-2.901
Gm-1 x Gm-2	4.445	-1.028	1.708	1.715	1.201	1.457
Gm-1 x Gm-4	-2.728	-1.331	-2.030	-0.347	-0.937	-0.642
Gm-1 x Gm-21	-0.239	2.516	1.139	2.338	1.832	2.085
Gm-4 x sd-7	1.518	-0.613	0.453	3.122	1.605	2.363
Gm-4 x Gm-2	-0.184	2.633	1.225	-0.951	-0.025	-0.488
Gm-4 x Gm-4	-0.404	6.785	3.191	0.497	1.145	0.821
Gm-4 x Gm-21	-0.930	-8.807	-4.868	-2.668	-2.723	-2.696
Gm-6 x sd-7	5.135	-3.549	0.793	2.048	-1.697	0.176
Gm-6 x Gm-2	0.035	0.305	0.170	0.089	0.183	0.136
Gm-6 x Gm-4	1.322	4.569	2.946	0.322	2.725	1.524
Gm-6 x Gm-21	-6.493	-1.325	-3.909	-2.460	-1.211	-1.835
Gm-8 x sd-7	-1.671	-4.803	-3.236	3.803	0.705	2.255
Gm-8 x Gm-2	2.724	-0.545	1.090	0.877	-1.848	-0.485
Gm-8 x Gm-4	0.389	6.758	3.573	1.740	3.597	2.669
Gm-8 x Gm-21	-1.442	-1.409	-1.426	-6.420	-2.453	-4.436
Gm-12 x sd-7	2.671	2.464	2.568	-1.777	-0.853	-1.315
Gm-12 x Gm-2	2.724	5.732	4.229	2.542	3.816	3.179
Gm-12 x Gm-4	2.301	-8.069	-2.884	0.480	-1.673	-0.597
Gm-12 x Gm-21	-7.697	-0.127	-3.911	-1.245	-1.289	-1.267
Gm-14 x sd-7	1.288	4.754	2.930	0.332	3.253	1.793
Gm-14 x Gm-2	-4.127	-5.680	-4.903	-2.976	-1.865	-2.420
Gm-14 x Gm-4	3.100	-4.386	-0.643	1.194	-3.192	-0.999
Gm-14 x Gm-21	-0.260	5.312	2.525	1.450	1.805	1.627
Gm-18 x sd-7	-2.144	-2.699	-2.421	-2.732	-1.742	-2.237
Gm-18 x Gm-2	8.124	4.416	6.270	-1.228	2.590	0.681
Gm-18 x Gm-4	-2.784	1.549	-0.617	-1.264	-1.505	-1.384
Gm-18 x Gm-21	-3.197	-3.265	-3.232	5.225	0.657	2.940
Gm-25 x sd-7	-9.287	-8.819	-9.053	-4.319	-4.105	-4.211
Gm-25 x Gm-2	-2.012	-3.594	-2.802	1.484	0.498	0.991
Gm-25 x Gm-4	0.107	-2.344	-1.118	2.077	1.398	1.737
Gm-25 x Gm-21	11.192	14.756	12.974	0.758	2.210	1.483
Gm-26 x sd-7	-6.914	-1.018	-3.965	-0.207	-2.608	-1.408
Gm-26 x Gm-2	-4.903	3.578	-0.662	-0.456	3.164	1.354
Gm-26 x Gm-4	7.949	2.195	5.072	-0.628	-0.459	-0.544
Gm-26 x Gm-21	3.867	-4.757	-0.444	1.292	-0.096	0.598
Gm-30 x sd-7	3.014	-1.693	0.661	-4.870	-3.565	-4.217
Gm-30 x Gm-2	6.128	0.518	3.323	1.135	3.985	2.597
Gm-30 x Gm-4	-4.757	-1.742	-3.250	0.333	-0.875	-0.271
Gm-30 x Gm-21	-4.384	2.915	-0.734	3.401	0.455	1.928
Gm-32 x sd-7	7.869	16.133	12.001	8.303	11.105	9.705
Gm-32 x Gm-2	-12.957	-6.338	-9.648	-2.228	-11.697	-6.963
Gm-32 x Gm-4	-4.494	-3.985	-4.240	-4.403	-0.222	-2.312
Gm-32 x Gm-21	9.583	-5.809	1.886	-1.672	0.815	-0.428
SE.Sij	4.665	3.813	3.012	0.868	1.753	0.978
(Sij-Sik)	6.597	5.394	4.261	1.227	2.480	1.383

, Significant and highly significant at 0.05 and 0.01 level of probability, respectively.

Table (5): Estimates of general GCA and specific(SCA) combining ability variances at Gemmiza and Sids for grain yield and other traits.

Trait	Gemmiza				Sids			
	δ^2 GCA Lines	δ^2 GCA Testers	δ^2 GCA	δ^2 SCA	δ^2 GCA Lines	δ^2 GCA Testers	δ^2 GCA	δ^2 SCA
Days to 50% siiking	1.827	1.962	0.144	3.411	0.414	4.248	0.153	1.089
Plant height	21.294	275.373	10.152	71.640	32.022	295.290	11.196	110.241
Ear height	15.516	75.861	2.988	45.270	40.923	56.376	3.411	20.403
No of ears/ 100 plants	22.374	15.957	1.161	16.830	12.924	2.997	0.423	28.746
Grain yield	0.603	12.744	0.459	11.484	2.898	11.061	0.459	13.149

Table (6): Combined estimates of general GCA and specific(SCA) combining ability variances for grain yield and other traits.

Trait	δ^2 GCA				δ^2 GCA	δ^2 GCA x Loc	δ^2 SCA	δ^2 SCA x Loc
	Lines	Testers	L x Loc	T x Loc				
Days to 50%siiking	0.747	2.979	0.270	0.090	2.385	0.135	1.638	0.549
Plant height	26.235	270.990	-6.390	11.871	205.704	7.002	78.165	12.771
Ear height	21.879	64.341	1.089	-0.135	53.019	0.189	23.967	8.874
No of ears/ 100plants	10.260	2.727	2.349	4.923	4.734	4.239	17.955	483.300
Grain yield	1.746	10.989	-0.531	0.720	8.523	0.387	8.829	3.483

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تقدير القدرة على التآلف وطرز فعل الجين لمحصول الحبوب وبعض الصفات الأخرى بين سلالات جديدة من الذرة الشامية البيضاء

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تم تهجين ١١ سلالة من الذرة الشامية موسم ٢٠٠٤ مع ٤ كشافات مختلفة هي:- سدس ٧ ، جميزة ٢ ، جميزة ٤ ، جميزة ٢١ بمحطة بحوث الجميزة . وفي موسم ٢٠٠٥ تم تقييم الهجن القمية وعددها ٤٤ هجين قمي مع صنفي المقارنة هـ. ف ١٠ ، هـ. ف ١٢٩ في كل من محطة البحوث الزراعية بالجميزة وسدس لصفات ٥٠ % حريره – ارتفاع النبات والكوز وعدد الكيزان/١٠٠ نبات ومحصول الحبوب بالإردب للفدان. ومن نتائج تحليل البيانات وجد الآتي:-

١- وجدت اختلافات معنوية بين الموقعين (الجميزة وسدس) والتفاعل بينهما والهجن القمية لكل الصفات.

٢- وجدت اختلافات معنوية بين الهجن القمية و السلالات ، الكشافات، السلالات × الكشافات لكل الصفات تحت الدراسة.

٣- كان التفاعل بين السلالات والبيئات معنويا لجميع الصفات عدا صفة ارتفاع النبات.

٤- كان التفاعل بين الكشافات والبيئات معنويا لجميع الصفات عدا صفة ارتفاع الكوز.

٥- أيضا كان التفاعل بين السلالات × الكشافات × البيئات معنويا لجميع الصفات عدا صفة عدد الكيزان / ١٠٠ نبات.

٦- كان تباين القدرة العامة على التآلف عاليا لصفات عدد الأيام حتى ظهور ٥٠% حريره – ارتفاع النبات – ارتفاع الكوز بينما كان تباين القدرة الخاصة عاليا لصفتي عدد الكيزان/ ١٠٠ نبات ومحصول الحبوب بالإردب للفدان.

٧- كان تفاعل التباين للقدرة الخاصة على التآلف مع البيئات عاليا لجميع الصفات مما يدل على أن الفعل الجيني غير المضيف أكثر تأثراً بالبيئة عن الفعل المضيف.
٨- أظهرت السلالات جميزة ٨ ، ١٤ قدرة عامة ومرغوبة لصفة المحصول.

أظهرت ٩ هجن قمية تقديرات أفضل للقدرة الخاصة لصفة المحصول والصفات الأخرى بالنسبة للهجن التجارية المستخدمة كأصناف قياسية ، وتعتبر هذه الهجن جيدة لإمكانية استخدامها في برنامج تربية محصول الذرة الشامية