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ADDITIVE AND NON-ADDITIVE GENETIC VARIANCES OF IMPORTANT QUANTITATIVE TRAITS IN NEW MAIZE INBRED LINES VIA LINE × TESTER ANALYSIS

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ABSTRACT

Forty-one diverse inbred lines of white maize were top-crossed with two inbreds as Sd-7 and Sd-63 testers during the summer of 2004 at Sakha Agricultural Research Station. The resultant top-crosses (82 F_1's) were divided into three groups, i.e. group 1 included the first 28 F_1's, followed by the second 28 F_1's for group 2 and finally the third group contained the remaining 26 F_1's of the total number of the 82 crosses. Each group was tested in a separate experiment, designated as Exp.1, Exp.2 and Exp.3 with the two commercial hybrids S.C. Giza 10 and S.C. Giza 129 as checks in these groups. Experiments 1 and 2 were evaluated at Sakha and Mallawy Stations while experiment 3 was evaluated at Sakha and Sids Stations, all in 2005 growing season. The aims of this investigation were to determine the types of genetic variances controlling grain yield ard/fed. (GY), days to 50% silking (SD), plant height (PH) and ear position% (EP%) and to identify superior top-crosses (Single Crosses) and desirable inbred lines in the studied traits.

Non-additive genetic effect was found to be more important than additive genetic effect in the inheritance of all studied traits at all experiments except GY in Exp.2, SD in Exp.3 and PH in the three experiments. Additive genetic variances showed significant interaction by locations than non-additive variances in the behavior of PH and EP% in the three experiments except in Exp.1. While, non-additive gene action represented the major role in the interaction by locations for GY and SD except GY in Exp.1 and SD in Exp.2. Desirable and significant g_i effects obtained by 12, 10, 12, and 10 inbred lines toward increasing favorable alleles for SD, PH, EP% and GY out of 41 studied inbreds, respectively. Moreover, inbreds Sk-5140/40 in Exp.1, Sk-5142/42 in Exp.2 and Sk-6001/83 in Exp.3 had good general combiners for yielding ability and earliness simultaneously, indicating that they can be used as new inbreds in future maize breeding program for improving these traits. Four top- crosses (Sd-7 × Sk-5078/26 and Sd-63 × Sk-5126/36 in Exp.1 and Sd-7 × Sk-6001/83 and Sd-7 × Sk-6030/90 in Exp.3) increased significantly in GY (ard/fed) relative to the best check hybrid (S.C. Giza 10). And they were not significant differences compared to S.C. Giza 10 in the other studied traits. Beside that, seven top-crosses significant out yielding from other check (S.C. Giza 129), suggesting these promising hybrids (11 top-crosses) will be beneficial and effective in improving maize production.
Keywords: Maize, Line x Tester, Additive and non-additive genetic variance.

INTRODUCTION

Top-cross test has been used widely as a means of estimating the combining ability of new inbred lines of maize. Inbred line as narrowest genetic base could be considered as one of the suitable tester for distinguishing the new inbreds for their combining abilities (Ali and Tepora 1986 and Al-Naggar *et al.* 1997).

Additive genetic variance played an important role in the inheritance of grain yield (Shehata 1992; Kadlubiec *et al.* 2000; Soengas *et al.* 2003; Mosa *et al.* 2004 and El-Shenawy *et al.* 2005), days to 50% silking (Konak *et al.* 2000, Amer 2004 and Motawei *et al.* 2005) and plant height (Gul *et al.* 2000, Amer *et al.* 2002 and Ibrahim and Motawei 2005). However, other investigators found that non-additive genetic variance was responsible for the inheritance of grain yield (Sedhom 1992, Kara 2001, Ashish and Singh 2002, Dodiya and Joshi 2003 and Motawei *et al.* 2005), days to 50% silking (Singh and Singh 1998, Gul *et al.* 2000, Dubey *et al.* 2001 and El-Shenawy 2005) and ear position% (Amer 2004).

The behavior of the additive type of gene action was found to be more affected by environmental conditions than non-additive type of gene action in the expression of grain yield (Hede *et al.* 1999 and El-Shenawy *et al.* 2003), plant height (Amer *et al.* 2002 and Motawei *et al.* 2005) and days to 50% silking (Nirala and Jha 2001). On contrary, numerous investigators reported that non-additive genetic variance was more sensitive to environmental effects than the additive gene action for grain yield (Nawar and El-Hosary 1984, Gul *et al.* 2000 Kadlubiec *et al.* 2003 and Motawei *et al.* 2005), plant height (El-Shenawy *et al.* 2003 and Amer 2004), ear position% (Amer *et al.* 2002) and days to 50% silking (Ibrahim and Motawei 2005).

Superiority of top-crosses relative to commercial check hybrids for grain yield were measured by several researchers among of them (Venkatesh and Sarma 1999; Turgut 2001; Venugopal *et al.* 2002;El-Shenawy *et al.* 2005 and Motawei and Ibrahim 2005).

The main objectives of this investigation were: to study the nature of genetic variance, to distinguish new inbred lines for their combining abilities and to identify superior top-crosses for further use in the maize breeding program.

MATERIALS AND METHODS

The materials were used in this study included 41 inbred lines of white maize derived from 25 different genetic source. They were top-crossed with the two inbreds Sd-7 and Sd-63 which were used as narrow genetic base testers during 2004 growing season at Sakha Agriculture Research Station. The resultant top-crosses (82 F_1's) were divided into three groups; each has different types of genotypes (top-crosses), i.e. group 1 included the first 28 F_1's, followed by the second 28 F_1's for group 2 and finally the third group contained the remaining 26 F_1's of the total number of the 82 crosses. Each group was tested in a separate experiment, designated as Exp.1, Exp.2 and Exp.3 with the two commercial hybrids S.C. Giza 10 and S.C. Giza 129 as checks in these groups. Experiments 1 and 2 were evaluated at Sakha and Mallawy Stations while experiment 3 was evaluated at Sakha and Sids Stations, all in 2005 growing season. A Randomized Complete Block Design with four replications was used in all experiments over locations. Plot size was one row, 6 m long, 0.80 m width, 0.25 m between hills and one plant was left per each hill after thinning. All culture practices were applied as recommended. The data were recorded for days to 50% silking (SD), plant height (PH) in cm, ear position% (EP%) and grain yield (GY) ard/fed (adjusted based on 15.5% grain moisture content).

Combined analysis of variance over locations for each trait was done in each experiment after testing homogeneity of error mean squares as out lined by Snedecor and Cochran (1967). When differences among top-crosses were significantly found, line × tester analysis according to Kempthorne (1957) was applied for each location and combined.

RESULTS AND DISCUSSION

Combined mean squares of each of the four traits over the two locations for each experiment (1, 2 and 3) are shown in Table 1. Highly significant differences among each two locations were detected for all traits except for PH in both Exp.1 and Exp.2 and GY in Exp.2 and 3. These results revealed the presence of markedly variations among two locations in climatic and soil conditions. Mean squares due to entries (E) and their partitions, crosses (C), checks (Ch) and C vs. Ch exhibited significant or highly significant variations for all studied traits in the all experiments except of (Ch) for PH in Exp.1, GY in Exp.2 and EP% in the three experiments; and C vs. Ch for PH and EP% in Exp.1 and 2 and GY in Exp.3. Meanwhile, E × Loc. and C × Loc. were detected highly significant differences for all the studied traits in the three experiments except of PH in Exp.1 and EP% in Exp.1, 2 and 3. On the other side, mean squares due to Ch × Loc. and C vs. Ch × Loc. were not significant for all traits in the all experiments except of Ch × Loc. for SD in Exp.1, EP% in Exp.2 and GY in Exp.3, and C vs. Ch × Loc. for GY in Exp.2.

Analysis of variance of line × tester over the two locations for each experiment (1, 2 and 3) are found in Table 2. Mean squares due to line (L) tester (T) and L × T interaction were significant or highly significant variations for all studied traits in all experiments except of T for PH, EP% and GY in Exp.1, SD and EP% in Exp.2 and EP% and GY in Exp.2. On the other hand, (L × Loc.) interactions were found to be significant for SD in Exp.1 and Exp.2, PH in Exp.2 and Exp.3 and GY in Exp.1 and Exp.3. Furthermore, (T × Loc.) was detected significant for SD in the three experiments, PH in Exp.3, EP% in Exp.2 and 3, and GY in Exp.2. While, (L x T x Loc.) interactions were not significant for all traits of all experiments except of SD in Exp.1 and Exp.3. Many investigators found significant differences among top-crosses, (L × T) and their interactions by locations for grain yield and other related traits among of them (Hede *et al.* 1999; Gul *et al.* 2000; Dubey *et al.* 2001, Amer *et al.* 2002, El-Shenawy *et al.*2003; Mosa *et al.* 2004 and Motawei *et al.* 2005).

Mean performance of 82 top-crosses over two locations for all the studied traits in the three experiments are presented in Table 3. In Exp.1, the SC Sd-7 × Sk-5078/26 (41.03 ard/fed) and Sd-63 × Sk-5126/36 (40.84 ard/fed) increased significantly than the best checks (SC G-10) for GY and not significant differences from it with the other studied traits. While, in Exp.2, SC Sd-7 × Sk-5142/46 (36.66 ard/fed) had the highest mean of GY and there were no significant differences between it and the best checks for all the studied traits. Moreover, two top-crosses Sd-7 × Sk-6001/83 (39.46 ard/fed) and Sd-7 × Sk-6030/90 (36.46 ard/fed) significantly out-yielded the highest checks and not significant from it for the most studied traits in Exp.3. These new single crosses will be beneficial and fruitful to improve maize production with desirable traits.

Table 1: Combined mean squares of each of the four traits over the two locations for each experiment (1,2 and 3), season of 2005.

S.O.V.	d.f.	Exp. 1				Exp. 2				d.f.	Exp. 3			
		Days to 50% silking	Plant height (cm)	Ear position %	Grain yield ard/fed	Days to 50% silking	Plant height (cm)	Ear position %	Grain yield ard/fed		Days to 50% silking	Plant height (cm)	Ear position %	Grain yield ard/fed
Locations (Loc.)	1	2294.0**	650.1	754.9**	1608.0**	788.4**	666.6	333.7**	219.9	1	274.5**	15428.0**	88.558*	9.93
Rep/Loc.	6	7.728	369.549	6.36	16.622	12.31	1128.031	30.909	63.17	6	13.58	821.4	19.44	10.52
Entries (E)	29	11.279**	294.116**	30.048**	171.267**	6.92**	802.7**	41.57**	53.38**	27	29.91**	1505.93**	15.92**	81.77**
Crosses (C)	27	8.81**	293.47**	31.40**	179.09**	4.65**	830.2**	44.60**	56.58**	25	26.68**	1543.41**	14.75**	84.90**
Checks (Ch)	1	27.56**	517.56	19.44	69.79*	27.56**	729.0**	1.366	7.325	1	6.250*	870.25*	7.403	50.578**
C vs. Ch	1	61.66**	88.114	4.152	61.521*	47.57**	133.59	0.03 6	13.035	1	134.32**	1204.61**	53.687**	34.712*
E × Loc.	29	3.724**	169.63	6.949	30.429**	3.05**	166.2**	8. 43	20.81*	27	3.044**	259.1**	5.89	13.99**
C × Loc.	27	3.76**	178.69	7.43	29.97**	3.25**	173. 47 **	7. 8 4	21.02*	25	3.26**	266.69**	5.84	13.65**
Ch × Loc.	1	5.063*	60.063	0.093	2.452	0.563	16.00	31.516*	0.065	1	0.25	256.00	2.574	36.457*
C vs. Ch × Loc.	1	1.413	34.58	0.818	70. 798*	0.137	121.879	1.274	35.885	1	0.438	72.45	10.456	0.023
Error	174	1.231	138.738	6.862	12.95	0.853	86.309	7.44	13.52	162	1.485	134.51	5.58	5.88
Mean		67.2	292.04	58 .56	32.53	67.85	288.95	56.8	31.76	Mean	70.79	277.76	55.96	31.36
C.V.%		1.65	4.03	4.47	11.06	1.36	3.32	4.8	11.58	C.V.%	1.72	4.18	4.22	7.74

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

Table 2: Combined mean squares of line × tester for the four traits over the two locations for each experiment (1, 2 and 3).

S.O.V.	d.f.	Exp. 1				Exp. 2				d.f.	Exp. 3			
		Days to 50% silking	Plant height (cm)	Ear position%	Grain yield ard/fed	Days to 50% silking	Plant height (cm)	Ear position%	Grain yield ard/fed		Days to 50% silking	Plant height (cm)	Ear position%	Grain yield ard/fed
Lines (L)	13	8.86**	418.77**	48.48**	321.17**	6.68**	1044.40**	83.68**	95.69**	12	43.92**	2197.44**	18.82**	71.68**
Tester (T)	1	38.61**	168.01	0.894	42.71	0.018	5480.64**	7.17	75.16*	1	62.48**	9248.88**	7.68	944.12**
L ×T	13	6.46**	177.61	16.67**	47.38**	2.97**	258.37**	8.40	16.03	12	6.46**	247.26*	11.26*	26.52**
L × Loc.	13	2.43*	150.94	6.79	46.80**	2.08**	274.82**	9.22	22.69	12	2.42	402.59**	6.07	21.31**
T × Loc.	1	29.26**	396.44	1.96	10.55	50.16**	0.44	38.44*	55.81*	1	11.08**	1376.08**	22.39*	1.022
L×T x Loc.	13	3.12**	189.69	8.50	14.64	0.815	85.42	4.11	16.68	12	3.45**	38.35	4.24	7.034
Error	174	1.231	138.738	6.862	12.95	0.853	86.309	7.44	13.52	162	1.485	134.51	5.58	5.88

*,** significant differences at 0.05 and 0.01 levels of probability

Table 3: Mean performance of top crosses for all studied traits in the three experiments over two locations.

Crosses	Exp. 1				Crosses	Exp. 2				Crosses	Exp.3			
	Days to 50% silking	Plant height (cm)	Ear posit-ion%	Grain yield ard/fed		Days to 50% silking	Plant height (cm)	Ear position %	Grain yield ard/fed		Days to 50% silking	Plant height (cm)	Ear posit-ion%	Grain yield ard/fed
Sd-7 × Sk-5078/26	66.5	300.0	60.6	41.03	Sd-7× Sk-5141/41	66.8	313.6	59.7	35.14	Sd-7× Sk-6001/83	68.3	311.0	52.7	39.41
Sd-7 × Sk-086/27	66.0	286.2	58.6	29.61	Sd-7× Sk-5142/42	68.0	291.5	56.7	33.33	Sd-7× Sk-6001/84	70.1	270.7	54.7	30.00
Sd-7 × Sk-5086/28	66.3	282.6	56.1	29.39	Sd-7× Sk-5142/43	67.8	288.5	55.3	31.70	Sd-7× Sk-6003/85	73.1	307.1	57.6	32.46
Sd-7 × Sk-5086/29	67.2	293.3	59.3	30.48	Sd-7× Sk-5142/44	68.1	294.6	53.8	32.47	Sd-7× Sk-6004/86	68.6	287.7	55.0	34.90
Sd-7 × Sk-5092/31	68.5	290.2	60.7	30.89	Sd-7× Sk-5142/45	68.8	298.7	57.8	33.42	Sd-7× Sk-6026/87	71.0	282.8	55.5	30.90
Sd-7 × Sk-5094/32	66.3	296.1	57.0	33.84	Sd-7× Sk-5142/46	67.8	297.0	56.9	36.66	Sd-7× Sk-6026/88	71.3	280.5	57.6	33.99
Sd-7 × Sk-5094/33	64.6	292.2	56.7	33.87	Sd-7× Sk-5157/47	67.2	299.3	60.1	34.33	Sd-7× Sk-6028/89	71.0	264.3	55.3	29.81
Sd-7 × Sk-5096/34	68.2	284.1	56.3	22.47	Sd-7× Sk-5157/48	68.2	291.7	58.6	30.73	Sd-7× Sk-6030/90	71.8	298.6	55.2	36.46
Sd-7 × Sk-5096/35	67.6	301.1	59.7	32.07	Sd-7× Sk-5163/49	69.0	302.2	60.8	33.43	Sd-7× Sk-6030/91	70.5	278.1	57.0	32.33
Sd-7 × Sk-5126/36	67.8	288.6	58.3	34.07	Sd-7× Sk-5172/50	68.1	289.3	51.4	27.92	Sd-7× Sk-6032/92	71.6	272.1	57.0	35.08
Sd-7 × Sk-5126/37	67.0	286.5	57.6	33.06	Sd-7× Sk-5172/51	67.7	296.6	54.8	30.17	Sd-7× Sk-6033/93	71.3	270.1	56.8	32.88
Sd-7 × Sk-5126/38	66.5	299.3	60.0	36.23	Sd-7 × Sk-5172/52	67.8	279.7	56.7	29.83	Sd-7× Sk-6036/94	69.3	289.1	56.4	34.21
Sd-7 × Sk-5132/39	67.7	303.0	59.5	35.02	Sd-7 × Sk-5196/53	68.3	283.3	55.7	30.40	Sd-7× Sk-6233/95	67.6	276.7	56.1	31.44
Sd-7 × Sk-5140/40	66.3	294.8	58.7	37.52	Sd-7 × Sk-5201/54	67.5	285.3	53.9	32.31	Sd-63 × Sk-6001/83	67.6	287.6	56.8	32.73
Sd-63×Sk-5078/26	67.7	302.9	58.3	35.20	Sd-63 × Sk-5141/41	67.7	288.2	57.9	29.87	Sd-63 × Sk-6001/ 84	68.8	265.3	53.1	28.69
Sd-63×Sk-5086/27	66.7	286.6	60.8	31.82	Sd-63 × Sk-5142/42	66.7	289.2	58.4	34.25	Sd-63 × Sk-6003/85	72.3	281.2	56.6	29.97
Sd-63×Sk-5086/28	67.0	284.6	57.5	25.69	Sd-63 × Sk-5142/43	67.6	282.5	54.7	27.89	Sd-63 × Sk-6004/86	70.2	265.2	56.6	24.78
Sd-63×Sk-5086/29	68.8	292.0	61.5	29.40	Sd-63 × Sk-5142/44	68.6	283.6	55.0	33.15	Sd-63 × Sk-6026/87	72.7	266.5	55.2	28.69
Sd-63×Sk-5092/31	67.0	289.6	61.3	30.69	Sd-63 × Sk-5142/45	68.7	297.1	57.3	31.95	Sd-63 × Sk-6026/88	71.5	263.7	57.8	28.85
Sd-63×Sk-5094/32	68.2	295.5	56.2	33.04	Sd-63 × Sk-5142/46	68.0	289.1	58.2	35.37	Sd-63 × Sk-6028/89	73.3	260.5	56.6	26.91
Sd-63×Sk-5094/33	68.5	294.5	57.8	34.17	Sd-63 × Sk-5157/47	67.8	289.7	59.7	32.36	Sd-63 × Sk-6030/90	73.8	280.0	57.2	32.41
Sd-63×Sk-5096/34	69.5	282.6	55.8	19.33	Sd-63 × Sk-5157/48	67.2	284.1	57.2	31.76	Sd-63 × Sk-6030/91	72.6	276.5	57.1	31.82
Sd-63×Sk-5096/35	67.5	291.1	57.9	35.83	Sd-63 × Sk-5163/49	69.7	300.5	60.5	33.92	Sd-63 × Sk-6032/92	73.5	261.7	53.7	28.30
Sd-63×Sk-5126/36	67.3	296.5	60.5	40.84	Sd-63 × Sk-5172/50	68.5	267.1	53.7	26.13	Sd-63 × Sk-6033/93	72.7	256.7	56.8	28.16
Sd-63×Sk-5126/37	66.8	294.3	54.1	28.46	Sd-63 × Sk-5172/51	67.6	273.7	53.5	26.96	Sd-63 × Sk-6036/94	71.2	281.7	56.5	29.48
Sd-63×Sk-5126/38	67.6	288.8	59.9	32.55	Sd-63 × Sk-5172/52	69.3	277.1	57.4	27.89	Sd-63 × Sk-6233/95	69.5	268.5	57.3	27.76
Sd-63×Sk-5132/39	69.0	290.8	58.8	35.15	Sd-63 × Sk-5196/53	67.0	273.0	57.4	31.20	....	.....	....	....	....
Sd-63×Sk-5140/40	66.6	284.1	58.4	35.16	Sd-63 × Sk-5201/54	66.6	278.1	56.5	32.92	....	.....	....	....	....
SC G-10	66.6	300.0	59.2	36.54	SC G-10	67.5	298.5	57.0	33.32	SC G-10	68.6	293.5	54.8	34.11
SC G-129	64.0	288.6	56.9	32.37	SC G-129	64.8	275.0	56.4	31.96	SC G-129	67.3	278.7	53.5	31.00
L.S.D 0.05	1.09	11.54	2.57	3.53	L.S.D at 0.05	0.91	9.10	2.67	3.60	L.S.D at 0.05	1.19	11.37	2.31	2.38
0.01	1.43	15.19	3.38	4.64	0.01	1.19	11.98	3.52	4.74	0.01	1.57	14.96	3.05	3.17

Superiority of top-crosses relative to the commercial hybrids (S.C. Giza 10 and Giza 129) for grain yield in three experiments over two locations are shown in Table 4. Two single crosses Sd-7 × Sk-5078/26 and Sd-63 × Sk-5126/36 exhibited positive and significant percentage over the two checks however, SC Sd-7 × Sk-5126/38 and SC Sd-7 × Sk-5140/40 were significantly increased relative S.C. Giza 129 only in Exp.1. Also, one top-cross (Sd-7 × Sk-5142/46 in Exp.2 exceeded significantly than S.C. Giza 129. Meanwhile, in Exp.3, two SC Sd-7 × Sk-6001/83 and Sd-7 × Sk-6030/90 significantly out-yielding than S.C. Giza 10 and S.C. Giza 129. Furthermore, SC Sd-7 × Sk-6004/86, Sd-7 × Sk-6026/88, Sd-7 × Sk-6032/92 and Sd-7 × Sk-6036/94 were significantly increased than S.C. Giza 129. These results pointed out that these 11 promising single crosses which showed superiority over the checks could be used in future program for hybrid maize production. Venkatesh and Sarma 1999; Turgut 2001; Venugopal *et al.* 2002; El-Shenawy *et al.* 2005 and Motawei and Ibrahim 2005 estimated the superiority relative to commercial check hybrids for grain yield .

Estimates of general combining ability effects of 41 inbred lines and two testers are presented in Table 5. Desirable and significant g_i effects achieved by 12, 10, 12, and 10 inbred lines toward increasing favorable alleles for SD, PH, EP% and GY out of the 41 studied inbreds, respectively. The highest and desirable values of g_i effects were obtained with inbred lines: Sk-5086/27 for SD, Sk-5096/34 for PH, Sk-5126/36 for EP% and Sk-5078/26 for GY in the Exp.1; Sk-5201/54, Sk-5196/53, Sk-5172/50 and Sk-5142/46 for SD, PH, EP% and GY, respectively in the Exp.2. And Sk-6001/83 for SD and GY, Sk-6028/89 for PH and Sk-6001/84 for EP% in the Exp.3. In view of g_i effects it could be noticed that, inbreds Sk-5140/40 in Exp.1, Sk-5142/42 in Exp.2 and Sk-6001/83 in Exp.3 had good general combiners for yielding ability and earliness together. In addition, three inbred lines i.e., Sk-5086/28, Sk-5201/54 and Sk-6001/84 exhibited desirable g_i effects toward earliness, short plants and best ear position simultaneously in Exp.1, Exp.2 and Exp.3, respectively. This result indicate that these new inbreds could be used in future maize breeding program for improving these traits.

Tester Sd-7 was the best combiner for days to 50% silking in Exp.1 and Exp.3 and toward inducing grain yield in Exp.3. On the other hand, the second tester (Sd-63) had desirable and high significant estimates for g_i effects toward short plants in Exp.2 and Exp.3. Ali and Tepora 1986 and Al-Naggar *et al.* 1997 found that narrow genetic base considered as the suitable tester for distinguishing the new inbreds for combining abilities.

Genotypic variance and their interaction by locations of the four studied traits at the three experiments are shown in Table 6. Non-additive genetic variance played an important role in the inheritance of SD, EP% and GY for the three experiments except of SD in Exp.3 and GY in Exp.2 whereas, the additive effect represented the most contribution. While, the additive gene action was predominant than the non-additive effect in the inheritance of plant height in all experiments.

Table 4: Superiority of top-crosses relative to two commercial checks for grain yield in the three experiments over two locations, season 2005.

Crosses	Exp. 1		Crosses	Exp. 2		Crosses	Exp. 3	
	SC G-10	SC G-129		SC G-10	SC G-129		SC G-10	SC G-129
Sd-7 × Sk-5078/26	12.28*	26.75**	Sd-7 × Sk-5141/41	5.46	9.96	Sd-7 × Sk-6001/83	15.53**	27.12**
Sd-7 × Sk-086/27	-18.96**	-8.52	Sd-7 × Sk-5142/42	0.03	4.28	Sd-7 × Sk-6001/84	-11.79**	-2.96
Sd-7 × Sk-5086/28	-19.56**	-9.20	Sd-7 × Sk-5142/43	-4.86	-0.81	Sd-7 × Sk-6003/85	-4.83	4.70
Sd-7 × Sk-5086/29	-16.58**	-5.83	Sd-7 × Sk-5142/44	-2.55	1.59	Sd-7 × Sk-6004/86	2.31	12.50**
Sd-7 × Sk-5092/31	-15.60**	-4.57	Sd-7 × Sk-5142/45	0.30	4.56	Sd-7 × Sk-6026/87	-9.4**	-0.32
Sd-7 × Sk-5094/32	-7.38	4.54	Sd-7 × Sk-5142/46	10.02	14.70*	Sd-7 × Sk-6026/88	-0.35	9.64*
Sd-7 × Sk-5094/33	-7.42	4.63	Sd-7 × Sk-5157/47	3.33	7.4	Sd-7 × Sk-6028/89	-12.60**	-3.83
Sd-7 × Sk-5096/34	-38.50**	-30.58**	Sd-7 × Sk-5157/48	-7.77	-3.84	Sd-7 × Sk-6030/90	6..88*	17.61**
Sd-7 × Sk-5096/35	-12.23*	-0.92	Sd-7 × Sk-5163/49	0.33	4.60	Sd-7 × Sk-6030/91	-5.21	4.29
Sd-7 × Sk-5126/36	-6.75	5.25	Sd-7 × Sk-5172/50	-16.20**	-12.64*	Sd-7 × Sk-6032/92	2.83	13.16**
Sd-7 × Sk-5126/37	-9.52	2.13	Sd-7 × Sk-5172/51	-9.45	-5.60	Sd-7 × Sk-6033/93	-3.6	3.22
Sd-7 × Sk-5126/38	-0.80	11.92*	Sd-7 × Sk-5172/52	-10.47	-6.66	Sd-7 × Sk-6036/94	0.29	10.35**
Sd-7 × Sk-5132/39	-4.15	8.18	Sd-7 × Sk-5196/53	-8.76	-4.88	Sd-7 × Sk-6233/95	-7.80*	1.41
Sd-7 × Sk-5140/40	2.68	15.94**	Sd-7 × Sk-5201/54	-3.03	1.10	Sd-63 × Sk-6001/83	-4.04	-5.58
Sd-63 × Sk-5078/26	-3.66	8.74	Sd-63 × Sk-5141/41	-10.35	-6.53	Sd-63 × Sk-6001/ 84	-15.88**	-7.45
Sd-63 × Sk-5086/27	-12.91**	-1.69	Sd-63 × Sk-5142/42	2.79	7.16	Sd-63 × Sk-6003/85	-12.13**	-3.32
Sd-63 × Sk-5086/28	-29.61**	-20.63**	Sd-63 × Sk-5142/43	-16.29**	-12.73*	Sd-63 × Sk-6004/86	-27.35**	-20.06**
Sd-63 × Sk-5086/29	-19.54**	-9.17	Sd-63 × Sk-5142/44	-0.51	3.72	Sd-63 × Sk-6026/87	-15.88**	-7.45
Sd-63 × Sk-5092/31	-16.00**	-5.18	Sd-63 × Sk-5142/45	-4.11	-0.03	Sd-63 × Sk-6026/88	-15.42**	-6.93
Sd-63 × Sk-5094/32	-9.57	2.06	Sd-63 × Sk-5142/46	6.15	10.66	Sd-63 × Sk-6028/89	-21.10**	-13.19**
Sd-63 × Sk-5094/33	-6.48	-5.56	Sd-63 × Sk-5157/47	-2.88	1.25	Sd-63 × Sk-6030/90	-3.78	4.54
Sd-63 × Sk-5096/34	-47.09**	-40.28**	Sd-63 × Sk-5157/48	-4.68	-0.62	Sd-63 × Sk-6030/91	-6.71	2.64
Sd-63 × Sk-5096/35	-1.94	10.68	Sd-63 × Sk-5163/49	1.80	6.13	Sd-63 × Sk-6032/92	-17.03**	-8.70*
Sd-63 × Sk-5126/36	11.76*	26.16**	Sd-63 × Sk-5172/50	-21.57**	-18.24**	Sd-63 × Sk-6033/93	-17.44**	-9.16*
Sd-63 × Sk-5126/37	-22.11**	-12.07*	Sd-63 × Sk-5172/51	-19.08**	-15.64**	Sd-63 × Sk-6036/94	-13.55**	-4.90
Sd-63 × Sk-5126/38	-10.92*	0.55	Sd-63 × Sk-5172/52	-16.29**	-14.87**	Sd-63 × Sk-6233/95	-18.61**	-10.45*
Sd-63 × Sk-5132/39	-3.80	8.58	Sd-63 × Sk-5196/53	-6.36	-2.37	....	....	....
Sd-63 × Sk-5140/40	-3.77	8.62	Sd-63 × Sk-5201/54	-1.20	3.00	....	....	....
L.S.D 0.05	9.66	10.91	L.S.D 0.05	10.80	11.26	L.S.D 0.05	6.88	7.68
0.01	12.69	14.33	0.01	14.22	14.83	0.01	9.18	10.09

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

Table 5: General combining ability effects of inbred lines and two testers over two locations for the three experiments.

Inbred lines (L)	Exp. 1				Inbred lines (L)	Exp. 2				Inbred lines (L)	Exp. 3			
	Days to 50% silking	Plant height (cm)	Ear position %	Grain yield ard/fed		Days to 50% silking	Plant height (cm)	Ear position %	Grain yield ard/ fed		Days to 50% silking	Plant height (cm)	Ear position %	Grain yield ard/ fed
Sk-5078/26	-0.21	9.55**	1.83**	5.66**	Sk-5141/41	-0.66**	12.17*	2.04**	0.77	Sk-6001/83	-3.00**	22.19**	-1.20*	4.86**
Sk-5086/27	-0.96*	-5.44	0.95	-1.71	Sk-5142/42	-0.59**	1.61	0.91	2.08*	Sk-6001/84	-1.50**	-9.05**	-2.13**	-1.82**
Sk-5086/28	-0.65*	-8.25**	-1.66*	-4.83**	Sk-5142/43	0.22	-3.25	-1.77**	-1.85*	Sk-6003/85	1.74**	17.25**	1.04	-0.01
Sk-5086/29	0.71*	0.80	1.76**	-2.40**	Sk-5142/44	0.40	0.36	-2.45**	1.02	Sk-6004/86	-1.57**	-0.62	-0.20	-1.50*
Sk-5092/31	0.40	-1.94	2.39**	-1.40	Sk-5142/45	0.83**	9.17**	0.91	0.95	Sk-6026/87	0.86**	-2.43	-0.76	-1.44*
Sk-5094/32	-0.03	3.92	-1.98**	1.03	Sk-5142/46	-0.03	4.30	0.79	4.39**	Sk-6026/88	0.42	-4.99	1.61**	0.11
Sk-5094/33	-0.78**	1.49	-1.29*	1.66	Sk-5157/47	-0.41	5.80*	2.97**	1.70	Sk-6028/89	1.17**	-14.68**	-0.01	-2.82**
Sk-5096/34	1.53**	-8.50**	-2.54**	-11.46**	Sk-5157/48	-0.22	-0.82	1.16	-0.35	Sk-6030/90	1.86**	12.19**	0.23	3.17**
Sk-5096/35	0.21	4.24	0.14	1.47	Sk-5163/49	1.40**	12.61**	3.91**	1.89*	Sk-6030/91	0.55	0.19	0.92	0.80
Sk-5126/36	0.28	0.67	0.83	5.03**	Sk-5172/50	0.33	-10.50**	-4.14**	-4.60**	Sk-6032/92	1.55**	-10.18**	-1.13	0.36
Sk-5126/37	-0.40	-1.44	-2.60**	-1.58	Sk-5172/51	-0.28	-3.57	-2.70**	-3.16**	Sk-6033/93	1.052**	-13.68**	0.69	-0.75
Sk-5126/38	-0.28	2.24	1.51*	1.97*	Sk-5172/52	0.65**	-10.32**	-0.02	-2.91**	Sk-6036/94	-0.69*	8.31**	0.48	0.61
Sk-5132/39	1.03**	5.05	0.64	2.66**	Sk-5196/53	-0.28	-10.57**	-0.14	-0.85	Sk-6233/95	-2.44**	-4.49	0.48	-1.57**
Sk-5140/40	-0.84**	-2.38	0.01	3.91**	Sk-5201/54	-0.91**	-7.00**	-1.45*	0.89	-----	----	----	----	-----
						Tester (T)								
Sd-7	-0.41**	0.86	0.044	0.41	Sd-7	0.008	4.94**	-0.20	0.57	Sd-7	-0.54**	6.66**	-0.18	2.15**
Sd-63	0.41**	-0.86	-0.044	-0.41	Sd-63	-0.008	-4.94**	0.20	-0.57	Sd-63	0.54**	-6.66**	0.18	-2.15**
L.S.D for (L) 0.05	0.54	5.77	1.28	1.76	L.S.D for (L) 0.05	0.45	4.55	1.33	1.80	L.S.D for (L) 0.05	0.60	5.68	1.16	1.19
0.01	0.72	7.60	1.68	2.31	0.01	0.58	5.99	1.75	2.37	0.01	0.79	7.28	1.52	1.56
L.S.D for (T) 0.05	0.21	2.18	0.48	0.67	L.S.D for (T) 0.05	0.17	1.73	0.48	0.68	L.S.D for (T) 0.05	0.24	2.17	0.44	0.46
0.01	0.27	2.87	0.63	0.87	0.01	0.22	2.27	0.62	0.90	0.01	0.31	2.85	0.57	0.60

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

Table 6: Genotypic variance of four traits for three experiments over two locations.

Genotypic variance	Exp. 1				Exp. 2				Exp. 3			
	Days to 50% silking	Plant height (cm)	Ear position %	Grain yield ard/fed	Days to 50% silking	Plant height (cm)	Ear position %	Grain yield ard/fed	Days to 50% silking	Plant height (cm)	Ear position%	Grain yield ard/fed
σ^2 GCA	0.071	0.49	0.189	1.88	-0.388	46.127	0.270	0.743	0.72	77.08	-0.314	7.95
σ^2 SCA	0.417	-1.51	1.021	4.09	0.269	21.61	0.53	-0.081	0.376	26.11	0.877	19.49
σ^2 GCA x Loc.	0.379	2.60	-0.127	0.43	0.79	26.2	0.616	0.70	0.109	28.36	0.302	0.137
σ^2 SCA x Loc.	0.465	11.365	0.425	0.42	-0.004	-0.425	-0.63	0.73	0.472	-22.33	-0.250	0.346

Several investigators reported that additive genetic variance was operated in the expression of grain yield (Shehata 1992; Kadlubiec *et al.* 2000; Soengas *et al.*2003 and El-Shenawy *et al.*2005), days to 50%silking (Konak *et al.*2001, Amer 2004 and Motawei *et al.*2005) and plant height (Gul *et al.*2000; Amer *et al.*2002 and Ibrahim and Motawei 2005). Meanwhile, the other investigators found that variance due to non-additive gene action played an important role in the inheritance of grain yield (Kara 2001, Dodiya and Joshi 2003 and Motawei *et al.*2005); for days to 50% silking (Singh and Singh 1998, Dubey *et al.*2001 and El-Shenawy 2005) and for ear position% (Amer 2004).

Additive genetic effects showed high interaction by locations than the non-additive effects in the expression of GY in Exp.1, SD in Exp.2 and PH and EP% in Exp.2 and Exp.3. While, non-additive genetic variance was more sensitive to locations of PH and EP% in Exp.1, SD in Exp.1 and Exp.3, and GY in Exp.2 and Exp.3. The magnitude of the interaction due to σ^2 GCA × Loc. was markedly higher than σ^2 SCA × Loc. for PH (Amer *et al.*2002 and Motawei and Ibrahim 2005) and for SD by Nirala and Jha 2001. While, it was vice versa for GY by Nawar and El-Hosary 1984, Gul *et al.* 2000 and Kadlubiec *et al.*2003; for PH by El-Shenawy *et al.* 2003 and Amer 2004; for EP% by Amer *et al.* 2002 and for SD by Ibrahim and Motawei 2005.

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التباين الوراثى التجميعى والغير تجميعى للصفات الكمية الهامة فى سلالات جديدة من الذرة الشامية من خلال تحليل السلالة × الكشاف

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تم التهجين القمى بين ٤١ سلاله مختلفة المصادر الوراثية من الذرة الشامية البيضاء الحبوب مع اثنان من السلالات الكشافة (سلاله سدس-٧ ، سلاله سدس-٦٣) خلال صيف ٢٠٠٤ فى محطة البحوث الزراعية بسخا. تم تقسيم الـ٨٢ هجين قمى الناتجة إلى ثلاثة مجاميع كالآتى:-اشتملت المجموعة ١ على الـ ٢٨ هجين فردى الأولى ثم المجوعة ٢ على الـ ٢٨ هجين فردى التالية وأخيرا اشتملت المجموعة ٣ على الـ٢٦ هجين فردى الباقية من العدد الكلى من الـ ٨٢ هجين فردى ٠ كل مجموعة اختبرت فى تجربة مستقلة وأطلق عليهم التجربة الأولى ، التجربة الثانية والتجربة الثالثة مع هجين فردى جيزة ١٠ وهجين فردى جيزة ١٢٩ كهجن مقارنة فى هذة المجاميع وقد قيمت التجربة الأولى والثانية فى محطتى بحوث سخا وملوى بينما قيمت التجربة الثالثة فى محطتى بحوث سخا وسدس وذلك خلال موسم نمو ٢٠٠٥ . كان تحديد نوع التباين الوراثى المتحكم فى صفات محصول الحبوب بالإردب/فدان ، عدد الأيام اللازمة لظهور ٥٠% حريرة ، إرتفاع النبات وكذلك موقع الكوز بالإضافة إلى التعرف على الهجن القمية المتميزة والسلالات المرغوبة من أهم أهداف هذا البحث.

- كان تأثير التباين الوراثى الغير تجميعى أكثر أهمية عن تأثير التباين الوراثى التجميعى فى وراثة كل الصفات المدروسة باستثناء محصول الحبوب فى التجربة الثانية والتذهير فى التجربة الثالثة وإرتفاع النبات فى الثلاث تجارب حيث لعبت التأثيرات التجميعية للجين الدور الأهم.
- كانت التباينات الوراثية التجميعية الأكثر تأثرا بالمواقع عن التأثيرات الغير تجميعية فى سلوك صفات إرتفاع النبات وموقع الكوز فى الثلاث تجارب فيما عدا التجربة الأولى بينما مثل الفعل الجينى الغيرتجميعى الدور الأعظم فى التفاعل مع المواقع لصفتى المحصول والتذهيرفى كل التجارب فيما عدا نفس الصفتين فى التجربة الأولى وكذلك التذهير فى التجربة الثانية.
- أظهرت ١٢، ١٠، ١٢ و١٠ سلالات تأثيرات معنوية ومرغوبة للقدرة العامة على التآلف لزيادة الآليلات المرغوبة لصفات التذهير ، ارتفاع النبات ، موقع الكوز ومحصول الحبوب على التوالى وذلك من الـ ٤١ سلالة تحت الدراسة. كذلك إمتلكت السلالة سخا- ٤٠/٥١٤٠ فى التجربة الأولى ، السلالة سخا-٤٢/٥١٤٢ وكذلك السلاله سخا- ٨٣/٦٠٠١ فى التجربة الثالثة قدرة تآلف جيدة للزيادة المحصولية والتبكير معا ، مما يشير على إمكانية استخدام هذه السلالات الجديدة ذات قدرة التآلف العامة الجيدة فى برنامج التربية للذرة الشامية لتحسين هذه الصفات.
- زادت أربعة هجن قمية زيادة معنوية فى صفة محصول الحبوب بالإردب/فدان ولم تختلف معنويا فى باقي الصفات المدروسة بالنسبة لأفضل هجن المقارنة (هـ.ف جيزة-١٠) وهى هجين فردى سدس-٧ × سخا- ٢٦/٥٠٧٨ ، سدس- ٦٣ × سخا٣٦/٥١٢٦ فى التجربة الأولى و سدس-٧× سخا- ٨٣/٦٠٠١ ، سدس-٧ × سخا- ٩٠/٦٠٣٠ فى التجربة الثالثة. هذا بالإضافة إلى سبعة هجن قمية أخرى تفوقت معنويا فى القدرة المحصولية على هجين المقارنة جيزة ١٢٩ فقط. وتشيرهذه النتائج على أن هذه الهجن الجديدة (١١هجين قمى) سوف تكون مؤثرة ومفيدة لتحسين إنتاجية الذرة الشامية.