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GENETIC PARAMETERS FOR SOME YELLOW MAIZE INBRED LINES FOR GRAIN YIELD AND SOME OTHER TRAITS USING LINE X TESTER ANALYSIS UNDER SANDY SOIL CONDITIONS

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ABSTRACT: *Eighteen yellow maize inbred lines derived from Composite-21 at Gemmeiza Agricultural Research Station were topcrossed with two testers; i.e. Gm-1002 and Gm-1021 during 2004 summer season. In the two growing seasons 2005 and 2006, the 36 topcrosses in addition to two commercial hybrid checks; SC-155 and SC-3084 were evaluated at Ismailia Agricultural Research Station under sprinkler irrigation system and sandy soil conditions. Differences significantly were detected among years for all traits except no. of kernels/row. Mean squares due to crosses (C) and their partitioning; Lines (L), Testers (T) and Line x Tester (L x T) were found to be significant and highly significant for all traits except (L) for grain yield and no. of kernels/row, (T) for ear diameter, no. of rows/ear and 100 kernels weight and (L x T) for grain yield and 100 kernels weight. While, the interaction between crosses and their partitioning with years were non-significant for almost traits studied. The rank of the inbred lines which had the best GCA effects were Line-2 for grain yield, ear diameter, no. of rows/ear, ear height and silking date; Line-7, Line-8 , Line-9 and Line-13 for plant height, ear height and silking date and lines 11 and 14 for ear length, ear diameter and 100 kernels weight. Moreover, the GCA effects were observed when the lines T_2 was involved for grain yield and its components. While, the T_1 was the best general combiner for shorter plant, lower ear placement and earliness. The components of variances revealed that the σ^2SCA were higher than σ^2GCA for grain yield, ear length, ear diameter, no. of rows/ear, no. of kernels/row, and 100 kernels weight, indicating that the non-additive gene action played the important role in the inheritance of these traits. While, the σ^2GCA were higher than σ^2SCA for plant height, ear height and silking date. The magnitude of the SCA x environmental interaction was higher than GCA x environmental interaction for all traits except for grain yield, ear length, no. of kernels/row, and 100 kernels weight, indicating that the non-additive gene action was more influenced and interacted with environments than additive gene action. Both of phenotypic (σ^2_p) and phenotypic coefficient of variability (PCV) were higher than the genotypic variance (σ^2_g) and genotypic coefficient of variability (GCV). The genotypic and phenotypic correlation coefficients (r_g and r_p) between all traits and grain yield were found to be highly significant. The results indicated that the three topcrosses i.e., L_2 x T_2 (32.99), L_5 x T_2 (31.50), L_8 x T_2 (30.98 ard/fed) were*

significantly superior to the best commercial hybrid check SC-155 (26.99 ard/fed). In addition that, six topcrosses; L_1 x T_2 (29.77), L_4 x T_1 (29.76), L_6 x T_1 (29.90), L_9 x T_2 (29.50), L_{11} x T_2 (29.88) and L_{14} x T_2 (29.67 ard/fed) were highly significant than another check SC-3084 (25.57 ard/fed) in the same time not differ significantly from the best check SC-155 (26.99 ard/fed). These crosses can be used in maize breeding program.

Key Words: ***maize, topcrosses, line x tester, variance components, GCA, SCA.***

INTRODUCTION

The line x tester analysi methods is used to breed both self and cross-pollinated plants and to estimate favorable parent and crosses, and their general and specific combining abilities (Kempthorne, 1957). Hallauer and Miranda (1981) stated that both general and specific combining abilities (GCA and SCA) effects should be taken in consideration when planning the maize breeding programs to produce and release new inbred lines and crosses. Also, general and specific combining abilities which identify the hybrids with high yield are the most important criteria in breeding programs. Variance components due to GCA for grain yield were larger than those due to SCA (El-Morshidy *et al.* 2003, Aly and Amer 2008 and Aly and Mousa 2008). El-Shenawy *et al.* (2003) and Aly and Mousa (2008) showed that the GCA play major role in the inheritance of plant height, ear height and silking date. Numerous investigators reported that the SCA effects were more important than GCA effects for grain yield and other traits; Amer *et al.* (1998) and Mosa (2001) for grain yield; El-Kielany (1999) for ear length and no. of kernels/row, Abd-Alla (1995) and Mosa (2004) for 100 kernels weight. While, Nawar and El-Hosary (1984) and Amer *et al.* (2003) founded that the additive gene action (GCA) was more than non-additive gene action (SCA) for ear diameter. Data of general combining ability x environmental interactions for grain yield, ear length, no. of kernels/row and 100 kernels weight, indicating that the GCA was more affected by environment than SCA. El-Morshidy *et al.* (2003), El-Moula *et al.* (2004), Parvez and Rather (2006) and Aly and Mousa (2008) for grain yield; Amer *et al.* (2002) for grain yield, ear length and no. of kernels/row; El-Shenawy *et al.* (2003) for grain yield and ear diameter. On the other hand, many researchers reported that the non-additive gene action is more affected by environment conditions than additive gene action; Amer *et al.* (2003) for ear diameter; Soliman *et al.* (2001); Aly (2004) and Aly and Amer (2008) for plant height. The critical evaluation of breeding material through existing genetic variability, correlation coefficient and interrelation-ship among grain yield and some other traits such as ear length, ear diameter, no. of rows/ear, no. of kernels/row, 100 kernels weight, plant height, ear height and silking date is pre-requisite for a consolidated breeding program. Akbar *et al.* (2008) founded that both phenotypic variance (σ^2p) and phenotypic coefficient of variability (PCV) was more than genotypic variance (σ^2g) and

genotypic coefficient of variability (GCV) for all studied traits. Plant height, 50% silking date and 100 kernels weight was positively and significant correlated with grain yield and influenced yield directly (Ibrahim 2004) or directly and indirectly (Khakim *et al.* 1998, Devi *et al.* 2001, Mohan *et al.* 2002 and Akbar *et al.* 2008) through several yield components. Plant height had positive and significant correlation with grain yield (Mohan *et al.* 2002 and Akbar *et al.* 2008). Positive and significant correlation between grain yield and 100 kernels weight, indicating that the 100 kernels weight was important components determine grain yield (Khatun *et al.* 1999).

The main objectives of this study were: 1- Evaluating of combining ability effects of new yellow maize inbred lines. 2- Determining the mode type of gene action controlling grain yield and some other traits. 3- Identifying superior lines and topcrosses to be recommended for future investigation in maize breeding programs through genetic variability and the correlation coefficient of various traits under this investigation.

MATERIALS AND METHODS

The materials used were eighteen yellow maize inbred lines derived from Composite-21 at Gemmeiza Agricultural Research Station (Table -1). These inbred lines were crosses to each of two testers i.e., Gemmeiza-1002 and Gemmeiza-1021 during the growing season 2004. In the 2005 and 2006 growing seasons, the 36 topcrosses in addition to two checks commercial crosses; SC-155 and SC-3084 were evaluated at Ismailia Agricultural Research Station under sprinkler irrigation system and sandy soil conditions. The 38 genotypes (36 topcrosses and two checks) were arranged in a randomized complete block design with four replicates. Plot size was one row, 6 m long, 80 cm a part. 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 usually recommended for maize cultivation. Data were recorded on grain yield (GY ard/fed), adjusted to 15.5% moisture content, ear length (EL cm), ear diameter (ED cm), no. of rows/ear (R/E), no. of kernels/row (K/R), 100 kernels weight (100 KW g), plant height (PHT cm), ear height (EHT cm) and number of days from planting date to date of 50% silking emergence (SD day).

Statistical analysis of the combined data over the two years was performed according to Steel and Torrie (1980). The combining ability analysis was estimated using the line x tester procedure suggested by Kempthorne (1957). Combined analysis of the two years was done on the basis of homogeneity test. The phenotypic (rp) and genotypic (rg) correlations were calculated between each pair of studied traits according to Snedecor and Cochran (1989) as follows:

$$rp = \frac{COVPij}{\sqrt{\sigma^2 pi \cdot \sigma^2 pj}} \quad , \quad rg = \frac{COVgij}{\sqrt{\sigma^2 gi \cdot \sigma^2 gj}}$$

Where: cov_{pij} and cov_{gij} = the phenotypic and genotypic covariance of the two traits i and j.
$\sigma^2 pi$ and $\sigma^2 pj$ = the phenotypic variance of the two traits i and j, respectively.
$\sigma^2 gi$ and $\sigma^2 gj$ = the genotypic variance of the two traits i and j, respectively.
The expected genetic advance from direct selection for the studied traits was calculated according to Singh and Narayanan (2000).

Table (1): The pedigree of lines and testers yellow maize under this investigation.

Lines	pedigree
L_1	Composite # 21-2004 (1-190) 4
L_2	Composite # 21-2004 (1-190) 6
L_3	Composite # 21-2004 (1-190) 14
L_4	Composite # 21-2004 (1-190) 39
L_5	Composite # 21-2004 (1-190) 41
L_6	Composite # 21-2004 (1-190) 50
L_7	Composite # 21-2004 (1-190) 54
L_8	Composite # 21-2004 (1-190) 61
L_9	Composite # 21-2004 (1-190) 65
L_{10}	Composite # 21-2004 (1-190) 89
L_{11}	Composite # 21-2004 (1-190) 90
L_{12}	Composite # 21-2004 (1-190) 91
L_{13}	Composite # 21-2004 (1-190) 93
L_{14}	Composite # 21-2004 (1-190) 101
L_{15}	Composite # 21-2004 (1-190) 106
L_{16}	Composite # 21-2004 (1-190) 109
L_{17}	Composite # 21-2004 (1-190) 116
L_{18}	Composite # 21-2004 (1-190) 131
	Testers
T_1 = Inbred lines Gemmeiza-1002	
T_2 = Inbred lines Gemmeiza-1021	

RESULTS AND DISCUSSION

Combining analysis of variances for all studied traits i.e., grain yield, ear length, ear diameter, no. of rows/ear, no. of kernels/row, 100 kernels weight, plant height, ear height and silking date over the two growing seasons 2005 and 2006 are presented in Table-2. Mean squares due to years were found to be highly significant for all traits except no. of kernels/row. These results are in agreement with reports obtained by Mosa (2004), Aly and Amer (2008) and Aly and Mousa (2008). Crosses mean squares (C) and their partitioning into line (L), tester (T) and line x tester (L x T) were significant for all studied traits except (L) for grain yield, and no. of kernels/row, (T) for ear diameter, no. of rows/ear and 100 kernels weight and line x tester for grain yield, 100 kernels weight and ear height. Similar results were obtained by Amer *et al.* (2003), Parvez *et al.* (2007) and Aly and Amer (2008). The results revealed that the mean squares of C x Y interaction were significant for almost traits. While, (L x Y), (T x Y) and (L x T x Y) mean squares were not significant except (L x Y) for grain yield, plant height and silking date, and (T x Y) for grain yield, ear length, ear diameter and 100 kernels weight. These data was in agreement with Mahmoud *et al.* (2001) and Aly and Mousa (2008), that they reported that the mean squares of (L x Loc) and (T x Loc) were significant for grain yield and non significant for plant height, ear height and silking date.

Table (2): Analysis of variances and mean squares of combined data over the two growing seasons 2005 and 2006 for all studied traits for 36 topcrosses (18 inbred lines and two testers) of maize.

S.O.V.	D.F.	Grain Yield (ard/fed)	Ear length (cm)	Ear diameter (cm)	No. of rows/ear	No. of kernels/row	100 kernels weight (gram)	Plant height (cm)	Ear height (cm)	Silking date (day)
Year (Y)	1	906.72**	273.39**	7.09**	68.64**	8.41	1449.46**	43660.13**	27747.56**	715.68**
Rep/Y.	6	14.62	0.85	0.19	2.34	44.02	25.02	1370.42	815.56	2.12
Crosses (C)	35	43.64**	15.75**	0.14**	3.71**	72.13**	49.07**	1413.54**	1417.14**	18.11**
Lines (L)	17	38.70	14.25*	0.21*	5.76*	59.18	82.87**	1481.06**	1471.39**	29.54**
Testers (T)	1	483.66**	203.49**	0.02	1.34	910.27**	0.46	18355.18**	20790.96**	62.18**
L x T	17	22.70	6.20**	0.08**	1.80**	35.78**	18.12	349.45*	223.26	4.09*
C x Y	35	29.34**	2.44**	0.06**	0.90*	8.04	21.22*	252.93	143.78	3.18*
L x Y	17	37.17*	1.88	0.06	1.09	7.41	23.44	355.14*	160.57	4.51*
T x Y	1	115.12*	30.88**	0.36**	0.06	30.06	126.33**	2.97	2.32	6.04
L x T x Y	17	16.47	1.33	0.05	0.76	7.38	12.81	165.42	145.32	1.69
Error	222+	15.57	1.16	0.03	0.85	6.93	12.99	191.19	155.46	2.10

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

Mean performances of combined data over the two growing seasons 2005 and 2006 for all studied traits for genotypes (36 topcrosses and two checks) are given in Table-3. Results showed that three topcrosses i.e., L_2 x T_2 (32.99 ard/fed), L_5 x T_2 (31.50 ard/fed) and L_8 x T_2 (30.98 ard/fed) were significantly superior to the best check SC-155 (26.99 ard/fed). In addition that, six topcrosses i.e., L_1 x T_2 (29.77 ard/fed), L_4 x T_1 (29.76 ard/fed), L_6 x T_1 (29.90 ard/fed), L_9 x T_2 (29.50 ard/fed), L_{11} x T_2 (29.88 ard/fed) and L_{14} x T_2 (29.67 ard/fed) were found to be highly significant than the check SC-3084 (25.57 ard/fed) and not differ significantly from the best check SC-155. Results showed that the best topcrosses for studied traits were; L_1 x T_2, L_2 x T_2, L_5 x T_2, L_8 x T_2, L_{11} x T_2 and L_{14} x T_2 for ear length; L_1 x T_2, L_2 x T_2, L_4 x T_1, L_4 x T_2, L_5 x T_2 and L_{17} x T_1 for no. of rows/ear; L_1 x T_2, L_3 x T_2, L_6 x T_2, L_8 x T_2 and L_{16} x T_2 for no. of kernels/row; L_8 x T_2, L_9 x T_2, L_{11} x T_1 and L_{13} x T_2 for 100 kernels weight; L_{12} x T_1 for plant height toward shorter plant; L_{13} x T_1 for ear height toward lower ear placement and topcross L9 x T1 for silking date toward earliness.

Table (3): Mean performances of combined data over the two growing seasons 2005 and 2006 for all studied traits for genotypes (36 topcrosses and two checks) of maize.

Genotypes	Grain Yield (ard/fed)	Ear length (cm)	Ear diameter (cm)	No. of rows/ear	No. of kernels/ row	100 kernels weight (g)	Plant height (cm)	Ear height (cm)	Silking Date (day)
L_1 X T_1	27.26	15.20	4.71	14.05	33.20	33.26	276.50	132.50	58.63
L_1 X T_2	29.77	17.08	4.66	15.05	37.45	29.20	284.13	136.75	59.38
L_2 X T_1	26.43	14.80	5.04	15.95	32.63	29.44	268.88	122.00	57.00
L_2 X T_2	32.99	17.93	4.79	15.50	38.75	29.74	284.75	141.38	57.38
L_3 X T_1	25.6	16.30	4.71	13.95	36.61	35.21	274.25	133.75	58.63
L_3 X T_2	29.25	18.78	4.80	14.00	39.34	33.56	281.25	142.75	60.13
L_4 XT_1	29.76	16.33	4.72	15.13	37.00	31.60	273.17	134.50	58.17
L_4 X T_2	28.94	17.34	4.74	15.24	36.99	30.57	281.40	153.80	59.40
L_5 X T_1	25.65	15.68	4.61	14.98	36.88	32.53	263.63	139.13	56.25
L_5 X T_2	31.5	16.38	4.73	15.55	35.10	35.24	280.25	156.00	57.63
L_6 XT_1	29.9	17.23	4.59	14.10	37.25	34.10	259.25	125.38	58.00
L_6 X T_2	27.29	17.05	4.54	13.25	37.46	33.33	278.50	145.25	58.88
L_7 X T_1	25.99	14.58	4.84	14.60	33.10	33.66	257.50	121.38	55.88
L_7 X T_2	28.01	16.65	4.88	14.45	36.85	33.54	271.13	135.00	57.63
L_8 X T_1	24.05	13.65	4.63	14.85	30.00	33.61	250.88	118.75	57.13
L_8 X T_2	30.98	17.08	4.71	14.4	37.53	36.01	273.38	135.88	56.50
L_9 X T_1	25.51	13.85	4.83	14.35	29.68	32.98	251.13	116.25	55.63
L_9 X T_2	29.5	16.00	4.88	14.10	34.00	37.56	266.50	133.75	56.75
L_{10} X T_1	22.18	11.90	4.38	14.10	26.30	31.45	254.25	133.63	61.00
L_{10} X T_2	25.39	16.03	4.65	14.70	35.85	34.26	288.25	156.63	59.88
L_{11} X T_1	26.24	16.80	4.88	14.45	35.65	37.05	267.50	128.75	59.00
L_{11} X T_2	29.88	17.15	4.81	14.65	35.98	36.30	282.63	143.13	58.25
L_{12} X T_1	24.71	14.28	4.68	12.9	30.05	33.95	244.38	120.38	57.50
L_{12} X T_2	25.67	17.60	4.79	14.4	35.78	36.51	271.50	141.50	59.88
L_{13} X T_1	26.42	15.10	4.76	14.15	32.78	36.90	259.25	110.39	56.13
L_{13} X T_2	27.6	17.90	4.59	13.55	35.93	39.14	273.50	138.13	58.75
L_{14} X T_1	27.74	16.13	4.83	14.75	31.20	35.59	264.88	129.38	58.25
L_{14} X T_2	29.67	18.08	4.8	14.60	38.70	36.31	301.50	164.00	59.88
L_{15} X T_1	27.4	14.20	4.88	14.90	30.70	33.76	286.00	144.75	59.38
L_{15} X T_2	27.26	15.45	4.78	14.70	33.30	33.33	287.38	152.88	60.25
L_{16} X T_1	24.86	16.08	4.71	14.90	32.73	35.53	285.50	144.63	59.25
L_{16} X T_2	28.02	17.65	4.61	14.15	38.05	32.74	286.00	168.13	60.88
L_{17} X T_1	27.09	15.80	4.71	15.55	34.10	31.18	270.88	145.50	60.50
L_{17} X T_2	29.06	15.60	4.75	15.00	34.95	30.69	280.25	151.88	60.63
L_{18} X T_1	23.76	15.70	4.68	14.10	32.61	33.01	267.13	129.75	59.13
L_{18} X T_2	25.84	16.03	4.38	12.75	33.70	35.45	271.00	136.75	60.00
SC-155	26.99	16.05	4.81	14.15	34.88	37.36	292.13	152.63	58.38
SC- 3084	25.57	16.23	5.16	14.30	41.25	36.61	291.00	139.72	61.25
LSD at 0.05	3.87	1.06	0.18	0.90	2.58	3.53	10.57	12.22	1.42
0.01	5.08	1.39	0.23	1.19	3.39	4.64	13.62	16.58	1.87

From these results, the topcrosses L_1 x T_2, L_2 x T_2, L_5 x T_2, L_8 x T_2, L_{11} x T_2 and L_{14} x T_2 were highly significant for grain yield and almost studied traits.

Table-4 showed that the general combining ability (GCA) effects for eighteen inbred lines and the two testers as combined over 2005 and 2006 growing seasons. The results exhibited that the inbred lines L_2 and L_4 had positive and significant GCA effects for grain yield; Lines L_3, L_4, L_6, L_{11}, L_{14} and L_{16} gave highly positive values GCA effects for ear length; L_2, L_7, L_9, L_{11}, L_{14} and L_{15} had positive and significant GCA effects for ear diameter; L_2, L_4 and L_{17} exhibited highly significant and positive GCA effects for no. of rows/ear. The inbred lines L_3, L_4, L_5 and L_6 exhibited positive and significant GCA effects for no. of kernels/row; lines L_{11}, L_{13} and L_{14} for 100 kernels weight. On the other hand, results revealed that the inbred lines L_7, L_8, L_9, L_{12} and L_{13} had a negative and significant GCA effects for plant height and ear height toward shorter plant and lower ear placement. Also, the lines L_2, L_5, L_7, L_8, L_9 and L_{13} had a negative and significant GCA effects for silking date toward earliness. The obtained results in Table-4 showed that the T_1 as tester was the best general combiner for silking date, plant height and ear height. While, the T_2 as a tester was the best combiner for grain yield and some its components. The same Table-4 showed the rank and arrangement of the inbred lines according to the grain yield and other traits such as, ear length, ear diameter, no. of rows/ear, no. of kernels/row, 100 kernels weight, plant height, ear height and silking date. The results reported that the line-2, line-4, line-11and line-14 had positive and significant GCA effects (favorable) for grain yield and its components. While, the inbred line-2, line-7, line-8 and line-9 had a high frequency of favorable alleles which contributed to the other traits such as plant height toward shorter plant, ear height toward lower ear placement and silking date toward earliness. These lines had negative and significant (favorable) GCA effect which favorable in these traits, then these inbred can be used in future in maize breeding program.

Specific combining ability (SCA) effects of topcrosses for traits combined data over the two growing seasons 2005 and 2006 are presented in Table-5. The results showed that the best SCA effects were observed in the topcrosses; L_2 x T_2, L_6 x T_1 and L_8 x T_2 for grain yield; L_6 x T_1, L_8 x T_2, L_{10} x T_2, L_{11} x T_1, L_{12} x T_2 and L_{17} x T_1 for ear length; L_{10} x T_2 and L_{18} x T_1 for ear diameter; L_1 x T_2, L_{12} x T_2 and L_{18} x T_1 for no. of rows/ear; L_5 x T_1, L_8 x T_2, L_{10} x T_2 and L_{14} x T_2 for no. of kernels/row; L_{14} x T_1 for shorter plant height and lower ear placement and topcross L_{10} x T_2 for earliness. This result demonstrated that the inbred line T_2 was the most favorable and the best tester for evaluating combining ability of the inbred lines for grain yield more than line T_1.

Table (4): General combining ability (GCA) effects for eighteen inbred lines and two testers combined data over the two growing seasons 2005 and 2006 of maize.

Lines and Testers	Grain Yield (ard/fed)	Ear length (cm)	Ear diameter (cm)	No. of rows/ear	No. of kernels/ row	100 kernels weight (g)	Plant height (cm)	Ear height (cm)	Silking date (day)
L1	1.106	-0.467	-0.034	0.036	0.466	-2.332**	7.113*	-3.273	0.460
L2	2.303*	-0.167	0.190**	1.261**	1.028	-3.976**	3.613	-6.210*	-1.352**
L3	0.016	1.509**	0.033	-0.489*	3.316**	0.824	4.55	0.352	0.835*
L4	1.938*	0.808**	0.006	0.723**	2.336**	-2.478**	4.084	6.252*	0.243
L5	1.165	-0.003	-0.054	0.299	1.328*	-3.181**	-1.262	9.665**	-1.602**
L6	1.183	1.109**	-0.160**	-0.789**	2.691**	0.149	-4.325	-2.584	-0.102
L7	-0.410	-0.416	0.133**	0.061	0.316	0.037	-8.887*	-9.710**	-1.790*
L8	0.106	-0.666*	-0.054	0.161	-0.897	-0.251	-11.075**	-10.585**	-1.727**
L9	0.097	-1.103**	0.127**	-0.239	-2.822**	1.706	-14.387**	-12.898**	-2.353**
L10	-3.624**	-2.066**	-0.210**	-0.064	-3.584**	-0.706	-1.950	7.227*	1.897**
L11	0.447	0.872**	0.121**	0.086	1.153	3.112**	1.863	-1.960	0.085
L12	-2.22*	-0.091	0.008	-0.813**	-1.747**	1.668	-15.262**	-6.960*	0.147
L13	-0.400	0.472	-0.048	-0.613**	-0.309	4.456**	-6.825*	-13.641**	-1.102**
L14	1.290	1.072**	0.090*	0.211	0.291	2.387**	9.987**	8.790**	0.522
L15	-0.081	-1.203**	0.102*	0.336	-2.658**	-0.019	13.487**	10.915**	1.272**
L16	-0.969	0.834**	-0.060	0.061	0.728	0.568	21.05**	18.477**	1.522**
L17	0.663	-0.328	0.008	0.811**	-0.134	-2.632**	2.363	10.790**	2.023**
L18	-2.610**	-0.166	-0.198**	-1.039**	-1.502*	0.668	-4.137	-4.647	1.022**
LSD 0.05	1.934	0.528	0.088	0.451	1.290	1.766	6.775	6.109	0.710
LSD 0.01	2.541	0.694	0.116	0.593	1.696	2.321	8.905	8.030	0.934
T1	-1.269**	-0.829**	0.008	0.078	-1.745**	-0.074	-7.927**	-8.411**	-0.461**
T2	1.269**	0.829**	-0.008	-0.078	1.745**	0.074	7.927**	8.411**	0.461**
LSD 0.05	0.645	0.176	0.029	0.150	0.430	0.589	2.258	2.036	0.237
LSD 0.01	0.847	0.231	0.039	0.198	0.565	0.774	2.968	2.677	0.311

Rank and arrangement of the inbred lines which contributed to grain yield and some other traits.

Lines	Pedigree	Grain Yield (ard/fed)	Ear length (cm)	Ear diameter (cm)	No. of rows/ear	No. of kernels/ row	100 kernels weight (g)
Line-2	Composite # 21-2004 (1-190) 6	+ *	-	+ **	+ **	-	-
Line-4	Composite # 21-2004 (1-190) 39	+ *	+ **	-	+ **	+ **	-
Line-11	Composite # 21-2004 (1-190) 90	-	+ **	+ **	-	-	+ **
Line-14	Composite # 21-2004 (1-190) 101	-	+ **	+ *	-	-	+ **
Other traits		Plant height	Ear height	Silking date			
Line-2	Composite # 21-2004 (1-190) 6	-	- *	- **			
Line-7	Composite # 21-2004 (1-190) 54	- *	- **	- **			
Line-8	Composite # 21-2004 (1-190) 61	- **	- **	- **			
Line-9	Composite # 21-2004 (1-190) 65	- **	- **	- **			
Lines-13	Composite # 21-2004 (1-190) 93	-*	-**	-**			

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

Table(5): Specific combining ability (SCA) effects of topcrosses for all studied traits combined data over the two growing seasons 2005 and 2006 of maize.

Genotypes	Grain Yield (ard/fed)	Ear length (cm)	Ear diameter (cm)	No. of rows/ear	No. of kernels/ row	100 kernels weight (gram)	Plant height (cm)	Ear height (cm)	Silking date (day)
L_1 X T_1	0.012	0.467	0.017	-0.688*	-0.180	2.105	4.114	6.286	0.086
L_1 X T_2	-0.012	-0.467	-0.017	0.688*	.0.180	-2.105	-4.114	-6.286	-0.086
L_2 X T_1	-2.741*	-0.233	0.117	0.147	-1.317	-0.076	-0.011	-1.277	0.274
L_2 X T_2	2.741*	0.233	-0.117	-0.147	1.317	0.076	0.011	1.277	-0.274
L_3 X T_1	-0.557	-0.408	-0.052	-0.103	0.383	0.899	4.427	3.911	-0.289
L_3 X T_2	0.557	0.408	0.052	0.103	-0.383	-0.899	-4.427	-3.911	0.289
L_4 XT_1	1.677	0.326	-0.02	-0.132	1.750	0.589	3.81	-1.239	-0.155
L_4 X T_2	-1.677	-0.326	0.02	0.132	-1.750	-0.589	-3.81	1.239	0.155
L_5 X T_1	-1.657	0.479	-0.064	0.134	2.633**	0.218	-0.386	-0.027	-0.226
L_5 X T_2	1.657	-0.479	0.064	-0.134	-2.633**	-0.218	0.386	0.027	0.226
L_6 XT_1	2.770*	0.917*	0.017	0.347	1.645	0.462	-1.698	-1.527	0.024
L_6 X T_2	-2.770*	-0.917*	-0.017	-0.347	-1.645	-0.462	1.698	1.527	-0.024
L_7 X T_1	0.261	-0.208	-0.027	-0.003	-0.130	0.137	1.114	1.598	-0.414
L_7 X T_2	-0.261	0.208	0.027	0.003	0.130	-0.137	-1.114	-1.598	0.414
L_8 X T_1	-2.895*	-0.883*	-0.052	0.147	-2.017**	0.374	-3.323	-0.152	0.774
L_8 X T_2	2.895*	0.883*	0.052	-0.147	2.017**	-0.374	3.323	0.152	-0.774
L_9 X T_1	-0.725	-0.246	-0.033	0.047	-0.417	-2.22	0.239	-0.339	-0.101
L_9 X T_2	0.725	0.246	0.033	-0.047	0.417	2.22	-0.239	0.339	0.101
L_{10} X T_1	-0.336	-1.233**	-0.146*	-0.378	-3.030**	-1.332	-9.073	-3.089	1.024*
L_{10} X T_2	0.336	1.233**	0.146*	0.378	3.030**	1.332	9.073	3.089	-1.024*
L_{11} X T_1	-0.351	0.749*	0.023	-0.178	1.583	0.449	0.364	1.223	0.836
L_{11} X T_2	0.351	-0.749*	-0.023	0.178	-1.583	-0.449	-0.364	-1.223	-0.836
L_{12} X T_1	0.790	-0.833*	-0.064	-0.828**	-1.117	-1.207	-5.636	-2.152	-0.726
L_{12} X T_2	-0.790	0.833*	0.064	0.828**	1.117	1.207	5.636	2.152	0.726
L_{13} X T_1	0.676	-0.571	0.079	0.222	0.170	-1.045	0.802	-5.457	-0.851
L_{13} X T_2	-0.676	0.571	-0.079	-0.222	-0.170	1.045	-0.802	5.457	0.851
L_{14} X T_1	0.303	-0.146	0.004	-0.003	-2.005*	-0.288	-10.386*	-8.902*	-0.351
L_{14} X T_2	-0.303	0.146	-0.004	0.003	2.005*	0.288	10.386*	8.902*	0.351
L_{15} X T_1	1.342	0.204	0.042	0.022	0.445	0.293	7.239	4.348	0.024
L_{15} X T_2	-1.342	-0.204	-0.042	-0.022	-0.445	-0.293	-7.239	-4.348	-0.024
L_{16} X T_1	-0.311	0.042	0.042	0.297	-0.917	1.468	-0.823	-3.339	-0.351
L_{16} X T_2	0.311	-0.042	-0.042	-0.297	0.917	-1.468	0.823	3.339	0.351
L_{17} X T_1	0.280	0.929*	-0.027	0.197	1.320	0.318	3.239	5.223	0.399
L_{17} X T_2	-0.280	-0.929*	0.027	-0.197	-1.320	-0.318	-3.239	-5.223	-0.399
L_{18} X T_1	0.233	0.667	0.142*	0.697*	1.201	-1.145	5.989	4.911	0.024
L_{18} X T_2	-0.233	-0.667	-0.142*	-0.697*	-1.201	1.145	-5.989	-4.911	-0.024
LSD L x T 0.05	2.734	0.746	0.126	0.638	1.825	2.497	9.582	8.640	1.004
0.01	3.594	0981	0.165	0.839	2.398	3.282	12.593	11.350	1.320

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

Table -6 showed the results of genetic variance components for all studied traits of the 36 crosses, combined data over the two growing seasons 2005 and 2006. These data revealed that the SCA variances (σ^2SCA) were higher than GCA variances (σ^2GCA) for grain yield, ear length, ear diameter, no. of rows/ear, no. of kernels/row and 100 kernels weight, indicating that the non-additive gene action played an important role in the inheritance of this traits. The same results were reported by Abdel-Aziz *et al.* (1994), Amer *et al.* (2002) and Aly and Amer (2008). They reported that the dominance gene effects were more than the additive gene effects in the inheritance of these traits. While, the GCA variances (σ^2GCA) were higher than SCA variance (σ^2SCA) for plant height, ear height, and silking date, indicating that the additive gene action played an major role in the inheritance of these traits. Several investigators were obtained the similar results; Soklov and Kostyuchanes (1978) for plant height; Abd El-Maksoud *et al.* (2004) for silking date and Aly and Amer (2008) for silking date, plant height and ear height. On the other hand, the magnitude of the SCA x environmental interaction was higher than GCA x environmental interaction for all studied traits except for grain yield, ear length, no. of kernels/row, and 100 kernels weight, indicating that the non-additive gene action was more influenced and interacted with environments than additive gene action. These results are similar with those reported by El-Kielany (1999) and Mosa (2004) for ear diameter, no. of rows/ear, no. of kernels/row and 100 kernels weight; Pravez and Rather (2006) for grain yield, and Aly and Amer (2008) for plant height.

Table (6): Estimates of genetic variance components for all the studied traits for 36 crosses of maize combined data over the two growing seasons 2005 and 2006.

Genetic estimates	Grain Yield (ard/fed)	Ear length (cm)	Ear diameter (cm)	No. of rows/ear	No. of kernels/ row	100 kernels weight (gram)	Plant height (cm)	Ear height (cm)	Silking date (day)
σ^2GCA	0.3915	0.179	0.0010	0.0357	0.6796	0.5788	19.895	22.322	0.262
σ^2SCA	0.8905	0.630	0.0063	0.1188	3.6060	0.6413	19.783	8.475	0.249
σ^2GCA / σ^2SCA	0.4400	0.284	0.1588	0.3010	0.1880	0.9030	1.006	2.634	1.052
σ^2GCA x Env.	1.4919	0.376	0.0040	-0.0046@	0.2839	1.5519	0.328	1.722	0.090
σ^2SCA x Env.	0.2234	0.042	0.0041	0.0211	0.1113	-0.0432@	0.743	2.534	0.406
σ^2GCA x Env/ σ^2SCA x Env	6.678	8.952	0.9760	0.2180	2.5510	-35.924@	0.442	0.680	0.221

@ Any negative value of variances is considerable to be zero (Robinson *et al.*, 1955).

Estimates of phenotypic (σ^2_p), genotypic (σ^2_g) variances, phenotypic, genotypic coefficient of variabilites (PCV and GCV) and genetic advance (Gs %) for all studied traits for 36 crosses of maize combined data over the two growing seasons 2005 and 2006 are shown in Table-7. The results showed that the σ^2_p and the PCV were higher than the σ^2_g and the GCV for all studied traits. Silking date and ear diameter had lower value of GCV, indicating that these traits are more influenced by environment. Similar results were reported by Akbar *et al.* (2008). A perusal of data revealed comparatively better GCV and PCV for grain yield, followed by 100 kernels weight, ear height, no. of kernels/row, ear length, plant height, no. of rows/ear, ear diameter and silking date. Expected genetic advance in response to selection was higher for all studied traits and the maximum values of genetic advance were (14.647) for ear length, (12.696) for no. of kernels/row, (6.782) for grain yield, (6.703) for 100 kernels weight, (6.364) for plant height, (4.027) for no. of rows/ear, (3.490) for ear height, (3.396) for silking date and (1.838) for ear diameter.

Table (7): Estimates of phenotypic (σ^2p), genotypic (σ^2g) variances, phenotypic (PCV), genotypic (GCV) coefficient variability and genetic advance (Gs%) for all traits for 36 crosses of maize combined data over the two growing seasons 2005 and 2006.

Characters	σ^2p	σ^2g	σ^2e	PCV	GCV	Gs%
Grain yield (ard/fed)	14.845	6.566	8.279	14.051	9.345	6.782
Ear length (cm)	3.133	2.032	1.101	10.962	8.028	14.647
Ear diameter (cm)	0.046	0.014	0.032	4.527	2.497	1.838
No. of rows/ear	0.767	0.248	0.519	6.043	3.437	4.027
No. of kernels/row	15.082	8.341	6.741	11.144	8.287	12.696
100-kerenls weight (g)	16.944	4.535	12.409	12.157	8.889	6.703
Plant height (cm)	342.212	156.721	185.491	6.746	4.565	6.364
Ear height (cm)	248.88	143.38	105.50	11.36	8.630	3.490
Silking date (days)	4.009	1.935	2.074	3.416	2.373	3.396

The data in Table-8 depicted genotypic and phenotypic correlation coefficient (r_g and r_p) between grain yield and other traits over the two growing seasons 2005 and 2006. The results revealed that the genotypic correlation (r_g) values were higher than their corresponding phenotypic correlation (r_p) for studied traits. All studied traits had significant genotypic and phenotypic correlation with grain yield. These results are in agreement with those by Khatum *et al.* (1999), Rather *et al.* (1999), Mohan *et al.* (2002) and Akbar *et al.* (2008) for correlation between grain yield with (plant height and silking date); Ibrahim (2004) who found that both no. of kernels/row and kernels weight had high positive direct effects on grain yield. Ear length had highly significant genotypic and phenotypic correlation with no. of rows/ear, no. of kernels/row, plant height and silking date. Genotypic and phenotypic correlation coefficient between no. of rows/ear was highly significant with (no. of kernels/row, plant height and silking date) but non-significant with 100 kernels weight. The results showed that the r_g and r_p between no. of kernels/row with (100 kernels weight, plant height and silking date); 100 kernels weight with (plant height and silking date) were positively and significant. While, the genotypic and phenotypic correlation between plant height and silking date was non-significant. These results are partially in agreement with Alvi *et al.* (2003) and Akbar *et al.* (2008), they reported the positive and weak correlation between plant height and silking date.

Table (8): Estimates of genotypic correlation (r_g) and phenotypic correlation (r_p) coefficient between grain yield and other traits for 36 crosses of maize combined data over the two growing seasons 2005 and 2006.

Characters		Grain Yield (ard/fed)	Ear length (cm)	No. of rows/ear	No. of kernels/ row	100 kernels weight (gram)	Plant height (cm)
Grain yield (ard/fed)	r_g	-----	-----	-----	-----	-----	-----
	r_p	-----	-----	-----	-----	-----	-----
Ear length (cm)	r_g	0.582**	-----	-----	-----	-----	-----
	r_p	0.535**	-----	-----	-----	-----	-----
No. of rows/ear	r_g	0.176*	0.533**	-----	-----	-----	-----
	r_p	0.141*	0.396**	-----	-----	-----	-----
No. of kernels/row	r_g	0.970**	0.634**	0.960**	-----	-----	-----
	r_p	0.549**	0.296**	0.720**	-----	-----	-----
100 kernels weight (g)	r_g	0.288**	0.691**	0.008^{ns}	0.915**	-----	-----
	r_p	0.239**	0.084^{ns}	0.012^{ns}	0.740**	-----	-----
Plant height (cm)	r_g	0.769**	0.828**	0.984**	0.990**	0.959**	-----
	r_p	0.629**	0.716**	0.712**	0.613**	0.914**	-----
Silking date (day)	r_g	0.900**	0.980**	0.916**	0.912**	0.346*	0.117^{ns}
	r_p	0.847**	0.747**	0.904**	0.724**	0.217*	0.115^{ns}

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

CONCLUSION

Results of our investigation indicated that the lines L-2, L-4, L-7, L-8, L-9, L-11, L-13 and line-14 proved as good general combiners for almost studied traits i.e., grain yield, ear length, ear diameter, no. of rows/ear, no. of kernels/row, 100 kernels weight, plant height, ear height, and silking date. Three topcrosses i.e., L_2 x T_2 (32.99), L_5 x T_2 (31.50), L_8 x T_2 (30.98 ard/fed) were significantly superior to the best commercial hybrid check SC-155 (26.99 ard/fed). In addition that, six topcrosses; L_1 x T_2 (29.77), L_4 x T_1 (29.76), L_6 x T_1 (29.90), L_9 x T_2 (29.50), L_{11} x T_2 (29.88) and L_{14} x T_2 (29.67 ard/fed) were highly significant than another check SC-3084 (25.57 ard/fed) in the same time not differ significantly from the best check SC-155 (26.99 ard/fed). These crosses can be used in maize breeding program.

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المعايير الوراثية لبعض السلالات الصفراء من الذرة الشامية لمحصول الحبوب وبعض الصفات الأخرى بإستخدام تحليل السلالة فى الكشاف تحت ظروف الأراضى الرملية

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مركز البحوث الزراعية – معهد بحوث المحاصيل الحقلية – برنامج بحوث الذرة الشامية

الملخص العربي

استخدمت لهذه الدراسة ١٨ سلالة صفراء من الذرة الشامية تم تهجينها مع إثنين من الكشافات وهما السلالة جميزة-١٠٠٢ والسلالة جميزة-١٠٢١ فى الموسم الزراعى٢٠٠٤ بمحطة البحوث الزراعية بالجميزة. تم تقييم الهجن القمية الناتجة (٣٦ هجين قمى) بالإضافة إلى إثنين من هجن المقارنة وهما الهجينين الفرديين ١٥٥ ، ٣٠٨٤ بمحطة البحوث الزراعية بالإسماعيلية تحت نظام الرى بالرش وظروف التربة الرملية خلال الموسمين الزراعيين ٢٠٠٥ و ٢٠٠٦ . وكانت أهم النتائج المتحصل عليها تتلخص فيما يلى:-

١ – وجود إختلافات معنوية بين السنوات لكل الصفات المدروسة ما عدا صفة عدد الحبوب بالسطر. كذلك وجدت إختلافات معنوية بين الهجن القمية ومجزناتها لكل الصفات المدروسة ما عدا صفة محصول الحبوب وعدد الحبوب بالسطر بالنسبة للسلالات ، صفات قطر الكوز ، عدد السطور بالكوز ووزن ١٠٠ حبة بالنسبة للكشافات بينما صفات محصول الحبوب ووزن ١٠٠ حبة بالنسبة للسلالة فى الكشاف. بينما كان التفاعل ما بين هذه الهجن القمية ومجزناتها مع السنوات غير معنوياً لمعظم الصفات المدروسة.

٢ – كان ترتيب السلالات بالنسبة لإمتلاكها أفضل قدرة عامة على التآلف كما يلى:

* – السلالة رقم ٣ لصفات محصول الحبوب ، قطر الكوز ، عدد السطور بالكوز ، عدد الحبوب بالسطر ، إرتفاع الكوز وعدد الأيام حتى ظهور ٥٠% من حرايز النورات المؤنثة.
* -- السلالات أرقام ٧ ، ٨ ، ٩ ، ١٣ لصفات إرتفاع النبات ، إرتفاع الكوز والتزهير وذلك تجاة قصر النبات وموقع كوز أقل على النبات والتبكير على الترتيب. بينما السلالتين ١١ و ١٤ بالنسبة لصفات طول الكوز ، قطر الكوز ووزن ١٠٠ حبة.

٣ – كانت السلالة الكشاف T_2 (Gm-1021) أفضل كشاف لتأثير القدرة العامة على التآلف لصفة محصول الحبوب وبعض مكوناته بينما السلالة الكشاف T_1 (Gm-1002) أفضل كشاف لتأثير القدرة العامة على التآلف لصفات إرتفاع النبات ، إرتفاع الكوز وعدد الأيام حتى ظهور ٥٠% من حراير النورات المؤنثة.

٤ – كان تباين الفعل الجينى الغير مضيف أكثر أهمية من الفعل الجينى المضيف لكل الصفات المدروسة فيما عدا قطر الكوز ، إرتفاع النبات ، إرتفاع الكوز وعدد الأيام حتى ظهور ٥٠% من حراير النورات المؤنثة. علاوة على ذلك كان تباين الفعل الجينى الغير مضيف أكثر تأثراً وتفاعلاً بالظروف البيئية لكل الصفات المدروسة فيما عدا صفة محصول الحبوب ، طول الكوز ، عدد الحبوب فى السطر ووزن ١٠٠ حبة.

٥ – كان كلاً من التباين المظهرى ومعامل الإختلاف المظهرى أعلى من التباين الوراثى ومعامل الإختلاف الوراثى لكل الصفات تحت الدراسة. إلى جانب ذلك كان معامل الإرتباط الوراثى والمظهرى على المعنوية بين صفة محصول الحبوب وكل الصفات المدروسة.

٦ – أشارت النتائج تفوق تسعة هجن قمية عن هجينى المقارنة فى محصول الحبوب منهم ثلاثة هجن قمية وهى: سلالة-٢ x كشاف-٢ (٣٢,٩٩ أردب/فدان) ، سلالة-٥ x كشاف-٢ (٣١,٥٠ أردب/فدان) وسلالة-٨ x كشاف-٢ (٣٠,٩٨ أردب/فدان) تفوقت تفوقاً معنوياً عن أعلى هجن المقارنة وهو الهجين الفردى ١٥٥ (٢٦,٩٩ أردب/فدان) بينما الستة هجن القمية الأخرى وهى : : سلالة-1 x كشاف-٢ (٢٩,٧٧ أردب/فدان) ، سلالة-٤ x كشاف-١ (٢٩,٧٦ أردب/فدان) ، سلالة-٦ x كشاف-١ (٢٩,٩٠ أردب/فدان) ، سلالة-٩ x كشاف-٢ (٢٩,٥٠ أردب/فدان) ، سلالة-١١ x كشاف-٢ (٢٩,٨٨ أردب/فدان) وسلالة-١٤ x كشاف-٢ (٢٩,٦٧ أردب/فدان) تفوقت تفوقاً معنوياً عن هجين المقارنة الأخر الهجين الفردى ٣٠٨٤ (٢٥,٥٧ أردب/فدان) وفى الوقت ذاته فإن هذه الهجن الستة لم تختلف معنوياً عن هجين المقارنة الأعلى والأفضل هجين فردى ١٥٥. وبذلك يمكن الإستفادة من هذه الهجن فى برامج تربية الذرة الشامية المستقبلية.