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COMBINING ABILITY OF S_1 LINES IN MAIZE (*ZEA MAYS* L.)

M.A. El Morshidy[2], E.M. Taha[1], A.E. El Karamity[1] and Amal G. Darwish[1]

[1]Agron. Dept., Fac. Agric., Minia University
[2]Agron. Dept., Fac. Agric., Assiut University

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ABSTRACT

The present study was carried out at the Exp. Farm, Fac. of Agric., Minia University during the two seasons of 2011 and 2012. In the first season, 200 plants from the yellow exotic population IY 176 were selfed and top crossed with each of the two testers, i.e. Sakha21 (T_1) and Twc 352 (T_2). At harvest, 81 S_1lines and their 162 top crosses which have enough seeds were selected. In the second season, the 81 S_1lines and their 162 top crosses were evaluated. Results showed that mean squares due to S_1lines, testers and their interaction were significant or highly significant for all studied traits.The earliest five S_1 lines were no. 6, 16, 17, 26 and 44, while T_2 1, 46 and 64 for 100-kernel weight and no. 2, 21, 62, 75 and 80 for was earlier than T_1. The best five S_1 lines were no. 3, 8, 63, 78 and 81 for ear length, no. 2, 28, 33, 65 and 79 for no. of rows/ear, no.18, 35, 4grain yield/plant. Tester 1 (Sakha21) surpassed tester 2 (Twc352) in all traits.

The S_1lines no. 6, 16, 17, 26 and 44 exhibited negative significant or highly significant GCA effects for days to 50%silking. Eight, five, one and twenty four S_1lines showed positive either significant or highly significant GCA effects for ear length, no. of rows/ear, 100-kernel weight and grain yield /plant, respectively. With regard to SCA effects, six top crosses showed negative and significant or highly significant SCA for days to 50%silking. Moreover, 2, 2, 1 and 33 top crosses exhibited positive and significant or highly significant SCA effects for ear length, no. of rows/ear, 100-kernel weight and grain yield /plant, respectively.

Phenotypic coefficient of variability (PCV%) for days to 50% silking, ear length, no. of rows/ear, 100-kernel weight and grain yield/plant for S_1 lines were 1.38, 4.89, 5.41, 4.34 and 5.26%, while genotypic coefficients of variability(GCV%) with values of 0.64, 2.71, 3.82, 2.63 and 5.00% for the same traits, respectively.

Heritability estimates were high for no. of rows/ear (49.12) and grain yield/plant (90.23). However, it was low for days to 50%silking (21.33), ear length (30.91) and 100-kernel weight (37.50). These low heritability estimates may be due to the large experimental error variances.

INTRODUCTION

Maize (*Zea mays* L) is one of the most important cereals in the world and Egypt together with wheat and rice. It ranks the second in terms of acreage and the first in total production.

In Egypt, there is a gap between domestic demand and production of such crop accounted by about 5 million tons annually. So, increasing the productivity of maize via cultivating high yielding hybrids with proper agricultural practices in limited cultivated area is a must. High yielding genotypes could be obtained by many ways via improvement of available genetic resources. One of these ways improvement of populations using recurrent selection.

Recurrent selection has been widely used for enhancing populations performance. It is a cyclical process, which, except for mass selection includes three phases: (1) development of progenies, (2) progeny evaluation and (3) recombination of selected progenies (Weyhrich *et al*., 1998). The top cross procedures suggested by (Davis 1927) was used to evaluate the combining ability of inbred lines to determine the usefulness of the lines for hybrid development. Line x tester analysis is an extension of this method in which several testers are used (Kempthorne 1957). The concepts of general combining ability (GCA) and specific combining ability (SCA) defined by (Sprague & Tatum 1942) have been used extensively in breeding of several economic crop species. For maize yield, they found that GCA was relatively more important than SCA for non selected inbred lines, whereas SCA was more important than GCA for previously selected lines. The concepts of GCA and SCA become useful for characterization of inbred lines in crosses and often have been included in the description of an inbred line (Hallauer & Miranda 1988). Amer and El-Shenawy (2007) evaluated 42 top crosses. They found that the mean squares for testers and lines were significant over the two locations for all traits, except plant height for testers. Significant differences were also, detected for lines x testers interaction in all the studied traits except plant height. However, Osman and Ibrahim (2007) evaluated 40 top crosses derived from 20 inbred lines crossed with two testers i.e. Gm. 1021 and Gm-1002. Mean squares due to lines (L) were significant for all traits. Meanwhile, mean squares due to testers (T) were significant for days to 50% silking, ear position, number of rows/ear and grain yield. Mean squares due to L x T were significant for all the studied traits except ear position, ear length and ear diameter. Their results also indicated that the mean values for most of the top crosses including inbred line Gm.1021 as tester were higher for grain yield and most of the studied traits than those included inbred line Gm. 1002 as tester. Mosa (2010) evaluated top crosses used to determine the relative potential of maize inbred lines in a hybrid breeding program. Best parental inbred lines which revealed desirable GCA effects were SK10 for days to 50% silking, grain yield, ear diameter and number of kernels/row; Sk5027 for grain yield, ear diameter, number of rows/ear and number of kernels/row; Sk5026 for plant and ear height , grain yield and number of rows/ear; Sk 5002 for day to 50 % silking, grain yield and number of rows/ears and SK8001 for plant height and number of rows/ear. Abuali *et al*. (2012) used five inbred lines (2, 3, 6, 227 and 405) as lines and two inbred lines namely (66Y and 160) as (testers). These lines were crossed together according to line x tester technique. The analysis of variance for combining ability revealed that both GCA and SCA variances were highly significant for most the studied characters indicating importance of additive as well as non–additive types of gene action in controlling these traits. Abrha *et al*. (2013) estimated general and specific combining ability effects of the inbred lines to evaluate the test cross performance of hybrids for grain yield and yield related traits. They found significant mean square due to lines GCA for all the traits, while tester GCA was significant only for grain yield and ear height.

The main objective of this investigation was to estimate GCA of S_1 lines and SCA effects for their top crosses for earliness, grain yield and some of its components.

MATERIALS AND METHODS

The present investigation was carried out at Exp. Farm of Fac. of Agric., Minia University, during the two seasons of 2011 and 2012, to study general and specific combining ability of S_1lines and their top crosses with two testers.

* Procedures and field experiments:

In 2011 season, 200 plants from the yellow exotic population IY 176 were selfed and top crossed with two testers, i.e. Sakha21 (T_1) and Twc 352 (T_2). At harvest, 81 S_1lines and their 162 top crosses with the two testers which have enough seeds were selected.In 2012 season, two experiments were carried out. In the first experiment, the 81 S_1lines *per se* were evaluated in sets within replications (9 × 9) with three replicates, as explained by Hallauer & Miranda (1988). In the second experiment, the 162 top crosses were evaluated in a Randomized complete Block Design (RCBD) with three replications. In the two experiments the plot size was one row, three meters long and 70 cm apart and 30 cm between hills within rows (2.1 m^2). Seedling were thinned to one plant/hill before the first irrigation (three weeks after sowing). Nitrogen fertilizer in form of urea (46%N) was applied at the rate of 120 kg/fad. in two equal doses before the first and the second irrigations and phosphorus fertilizer was added during soil preparation in form of calcium superphosphate (15.5%P_2O_5) at the rate of 150 kg/fad. Other cultural practices were applied as recommended in El-Minia district.

The studied characters :

Data recorded on number of days to 50 % silking, ear length (cm), number of rows/ear (row), 100 – kernel weight (g) and grain yield/plant (g).

Statistical analysis:

1-Evaluation of S_1lines *per se*:

The experimental design used for evaluation was a set within reps (9×9) with two replicates (Hallauer and Miranda 1988). The expectation of mean squares over sets for a single location for S_1family selection is given in Table 1.

Table 1. Analysis of variance for S_1family in single location.

S.O.V	d.f	M.S	E.M.S
Reps (r)	r-1		
Sets (s)	s-1		
Sets × Reps	(s-1) (r-1)		
S_1families/sets	s (f-1)	M_2	$\sigma^2e + r\,\sigma^2g$
Error	s (r-1) (f-1)	M_1	σ^2e

Where;

σ^2g = genotypic variance among S_1lines.

f = number of S_1lines per set.

The expected mean squares were used to estimate the following genetic parameters:

1. Genetic variance $\sigma^2_g = \frac{M_2 - M_1}{r}$

2. Phenotypic variance $\sigma^2_{ph} = \sigma^2_g + \frac{\sigma^2_e}{r}$

3. Genotypic coefficient of variability (gcv) = $\frac{\sqrt{\sigma^2_g}}{\bar{X}}$ x 100

4 Phenotypic coefficient of variability (pcv) = $\frac{\sqrt{\sigma^2_{ph}}}{\bar{X}}$ x 100

5. Heritability in broad sense $h^2 = \frac{\sigma^2_g}{\sigma^2_{ph}} \times 100$

2- Evaluation of top crosses:

The analysis of variance of top crosses is presented in Table 2.

Table 2. Analysis of variance for evaluated traits involving top crosses in 2011 season.

Source of variance	d.f	MS	EMS
Replication	r – 1		
Crosses (C)	c – 1		
Lines (L)	l-1	M_1	$\sigma^2e + r\,\sigma^2lt + rt\,\sigma^2l$
Tests(T)	t – 1	M_2	$\sigma^2e + r\,\sigma^2lt + rl\,\sigma^2t$
Line x tester (L x T)	(l-1) (t-1)	M_3	$\sigma^2e + r\,\sigma^2lt$
Error	(r – 1) (lt – 1)	M_4	σ^2e

Where r, l, t, c and refer to no. of replication, lines, testers and crosses, respectively

2- Estimation of GCA and SCA effects:

The model used to estimate GCA and SCA effects of the ijk th observation was Yijk = M+ gi + gj + Sij – eijk

Where; M = overall population mean

gi = GCA effects of the i^{th} line parent .

gj= GCA effects of the j^{th} tester parent

Sij=SCA effects of the ij^{th} combination

eijk=the error associated with any observation .

3- 1. Estimation of GCA effects for S_1 lines:

$$g_i \frac{y_1}{tr} - \frac{y...}{ltr}$$

Where; yi = total of i^{th} line over all testers and replications.

y = total of all lines over testers and replications.

3 -2. Estimation of GCA effects for testers:

$$g_i \frac{y_i}{lr} - \frac{y...}{ltr}$$

3-3. Estimation of SCA effects (Sij) :

$$S_{ij} \frac{y_{ij}}{r} - \frac{y_i}{tr} - \frac{y_i}{lr} + \frac{y...}{ltr}$$

3-4. Estimation of standard errors (SE) for combining ability effects:

SE GCA for lines = $(Me/rt)^{1/2}$

SE GCA for testers = $(Me/rl)^{1/2}$

SE GCA effects = $(Me/r)^{1/2}$

The test of significance for general and specific combining ability effect was tested as follows:

L.S.E. (least significant effect) = SE GCA x t_α .

L.S.E for SCA effects = SE SCA x t_α .

RESULTS AND DISCUSSION

1- Analysis of variance:

The analysis of variance (Table 3) revealed significant differences among the evaluated S_1lines for all studied traits. The analysis of variance for top crosses (Table 4) revealed highly significant differences among S_1lines and testers for all the studied traits except days to 50% silking for testers. Moreover, the L × T interaction was highly significant for all the studied traits.

Table 3. Mean squares of S_1lines for all studied traits.

S.O.V	d.f	M.S				
		Days to 50% silking	Ear length	NO. of rows/ear	100-kernel weight	Grain yield/plant
Reps (R)	2	3.87	0.77	0.66	7.60	1.03
Sets (S)	8	3.07	3.82**	2.22**	3.43	217.98**
Sets×Reps	16	1.75	0.87	1.03	2.18	8.66
S_1lines/S	72	2.24**	1.67**	1.73**	4.08**	150.10**
Error	144	1.76	1.15	0.88	2.55	14.67

*,** significant and highly significant at 5% and 1% levels of probability, respectively

Table 4. Mean squares of days to 50% silking, ear length, no. of rows/ear, 100-kernel weight and grain yield/plant for top crosses.

S.O.V	d.f	M.S				
		Days to 50% silking	Ear length	NO. of rows/ear	100- kernel weight	Grain yield/plant
Reps.	2	6.26	15.57	6.51	13.37	11.51
Geno.	161	2.93**	2.75**	2.56**	3.98	134.37**
Lines (L)	80	3.21**	2.52**	12.01**	15.28**	131.25**
Testers (T)	1	1.12	47.29**	135.69**	16.83*	2184.62**
L × T	80	2.68**	2.41**	6.45**	4.16**	111.86**
Error	322	1.33	1.47	1.02	2.20	7.65

*,** significant and highly significant at 5% and 1% levels of probability, respectively

2- Mean performance:

The range and the mean performance of S_1lines *per se* and their top crosses are presented in (Table 5). It is clear that S_1lines ranged from 61.13 to 65.53 days with an average of 62.88 for days to 50% silking. For ear length, S_1 lines ranged from 13.07 to 17.07 cm with an average of 15.13 cm. For no. of rows/ear, S_1lines ranged from 12.27 to 15.87 row with an average of 13.86 row. For 100-kernel weight, S_1lines ranged from 24.90 to 28.70 g with an average of 26.95 g. For grain yield/plant, S_1lines ranged from 118.60 to 152.40 g with an average of 134.42 g. With regard to the two testers, it cloud be concluded that tester 1 ranged from 61.27 to 65.93 days with an average of 63.28 days, while tester 2 ranged from 61.80 to 66.00 days with an average of 63.14 days to 50% silking. For ear length, tester 1 ranged from 14.53 to 19.13 cm with an average of 16.60 cm, while tester 2 ranged from 14.13 to 18.13 cm with an average of 15.98 cm. For no. of rows/ear, tester 1 ranged from 13.20 to 17.20 row with an average of 15.26 row, while tester 2 ranged from 12.67 to 17.07 row with an average of 14.20 row. For 100-kernel weight, tester 1 ranged from 26.53 to 30.67 g with an average of 28.06 g, while tester 2 ranged from 25.50 to 29.40 g with an average of 27.71 g. For grain yield/plant, tester 1 ranged from 131.87 –169.27 g with an average of 147.86 g, while tester 2 ranged from 128.33-157.67 with an average of 143.63 g.

3- Combining ability effects:

General combining ability of S_1lines and specific combining ability of the top crosses with each of the two testers for the studied traits are presented in (Table 6 and 7). S_1Lines 6, 16, 26, 44 and 17 possessed negative either significant or highly significant GCA effects for days to 50% silking, indicating that these lines considered to be a good combiners for earliness. However, the crosses (line-57×T_2), (line-61×T_1), (line-68×T_2), (line-80×T_1), (line-19×T_2) and (line-49×T_2) had negative either significant or highly significant SCA effects for days to 50% silking, indicating that these crosses are good combinations and promising for earliness. These findings are in accordance with those obtained by Abuali *et al*. (2012).

Out of 81 parental lines, eight lines (8, 81, 63, 78, 3, 13, 36 and 55) exhibited significant or highly significant positive GCA effects for ear length, five lines (33, 65, 2, 49 and 28) had significant or highly significant positive GCA effects for number of rows/ear and only one line (64) showed highly significant GCA effects for 100-kernel weight. Moreover, twenty four lines (80, 62, 2, 75, 21, 56, 53, 74, 50, 58, 30, 15, 35, 34, 67, 45, 79, 72, 10, 4, 43, 47, 55 and 33) possessed highly significant positive GCA effects, indicating that these lines considered to be good combiners for grain yield/ plant. General combining ability of testers are presented in Tables 6 and 7. It is clear that general combining ability of the two testers were insignificant for days to 50% silking and 100-kernel weight. General combining ability of the two testers were highly significant for ear length, no. of rows/ear and grain yield/plant. The present findings are in line with those obtained by Mosa (2010) and Abrha *et al*. (2013).

Concerning SCA effects, significant positive SCA effects were detected for sex top crosses for days to 50% silking and two crosses (line-23×T_1 and line-75×T_2) with regard to ear length, two crosses (line-6×T_1 and line-33×T_2) for number of rows/ear and only one cross(line-4×T_1) concerning 100-kernel weight, Moreover, 33 crosses out of 162 crosses exhibited significant or highly significant positive SCA effects for grain yield/plant. Similar results were recorded by Jenweerawat *et al*. (2009) and Abuali *et al*. (2012) indicated that the mean squares for SCA were significant for grain yield for interpopulation hybrid, indicating that SCA was important for this trait.

In conclusion, among of these crosses, three crosses (line-5×T_1, line-7×T_1 and line-21×T_1) had highly significant positive SCA effects and were among the best five crosses for grain yield/plant. Therefore, it could be concluded that these crosses are most promising for high yielding and should be involved to further studies for obtaining high yielding crosses.

4- Variance components and heritability:

Variance components, genotypic and phenotypic coefficients of variability and heritability in broad sense for the studied traits are presented in (Table 8). It is clear that P.C.V% values were 1.38, 4.89, 5.41, 4.34 and 5.26% for days to 50%silking, ear length, no. of rows/ear, 100-kernel weight and grain yield/plant, respectively. The corresponding values of G.C.V% were 0.64, 2.71, 3.82 ,2.63 and 5.00% for the above mentioned traits. El-Morshidy *et al.* (2002) found that PCV was higher than GCV for all studied traits. Ibrahim (2004) found that the PCV for various traits were relatively higher than GCV for S_1 families derived from different populations. values of PCV values for 100-kernel weight and grain yield/plant of S_1family were 14.44 and 26.99% and GCV value were 12.01 and 24.14%, respectively.It can be seen that σ^2e was lower than 5.0 for all traits, except grain yield/plant, which were higher than 10.0. This might be attributed that grain yield/plant as a quantitative traits were more affected by environmental conditions than other studied traits.

Table 5. The range (R) and the mean (M) of S_1lines *per se* and their top crosses for the studied traits.

Traits		S_1lines *per se*	Top crosses	
			T_1	T_2
Days to 50%silking	R	61.13 — 65.53	61.27—65.93	61.80—66.00
	M	62.88	63.28	63.14
Ear length	R	13.07 — 17.07	14.53—19.13	14.13—18.13
	M	15.13	16.60	15.98
No.of rows/ear	R	12.27 — 15.87	13.20—17.20	12.67—17.07
	M	13.86	15.26	14.20
100-kernel weight	R	24.90 — 28.70	26.53—30.67	25.50—29.40
	M	26.95	28.06	27.71
Grain yield/plant	R	118.60—152.40	131.87—169.27	128.33—157.67
	M	134.42	147.86	143.63

Table (6): General and specific combining ability effects for days of 50% silking, ear length and No. of rows/ear.

Lines No.	Days to 50%silking			Ear length			No. of rows/ear		
	General combining ability	Specific combining ability		General combining ability	Specific combining ability		General combining ability	Specific combining ability	
		T_2	T_1		T_2	T_1		T_2	T_1
1	0.07	0.25	-0.25	0.64	0.15	-0.15	0.33	0.27	-0.27
2	-0.23	0.15	-0.15	-0.06	0.32	-0.32	1.13**	-0.66	0.66
3	-0.83	-0.18	0.18	1.22*	0.64	-0.64	-0.13	-0.06	0.06
4	-0.53	-0.68	0.68	-0.14	-0.23	0.23	0.60	0.94	-0.94
5	-0.33	-0.68	0.68	0.21	-0.58	0.58	-0.77	0.17	-0.17
6	-0.97*	-0.44	0.44	0.81	0.79	-0.79	0.53	1.40*	-1.4*
7	-0.23	-0.38	0.38	-0.78	0.67	-0.67	0.47	0.00	-0.00
8	0.33	-0.88	0.88	2.00**	0.94	-0.94	-0.67	-0.60	0.60
9	-0.83	0.15	-0.15	-0.70	0.59	-0.59	-1.47**	-0.06	0.06
10	-0.50	0.09	-0.09	0.61	0.29	-0.29	0.53	-0.20	0.20
11	-0.63	0.02	-0.02	-0.74	0.67	-0.67	0.20	-0.66	0.66
12	0.70	1.22	-1.22	-0.32	0.59	-0.59	-0.13	0.34	-0.34
13	1.03*	1.15	-1.15	1.04*	0.72	-0.72	0.00	0.74	-0.74
14	0.40	-0.01	0.01	-0.61	-0.40	0.40	-0.13	0.20	-0.20
15	-0.23	-0.71	0.71	-0.36	-0.18	0.18	0.40	0.20	-0.20
16	-1.20*	-0.81	0.81	-0.14	0.67	-0.67	0.40	0.60	-0.60
17	-1.37**	-0.11	0.11	-0.13	-0.81	0.81	0.67	0.07	-0.07
18	-0.83	-0.05	0.05	0.49	-0.20	0.20	0.47	0.54	-0.54
19	0.47	1.85**	-1.85**	-1.24*	-0.83	0.83	-0.33	-0.13	0.13
20	0.18	-0.13	0.13	-0.77	0.90	-0.90	-0.40	0.07	-0.07
21	0.30	-0.31	0.31	-0.79	1.05	-1.05	0.60	0.00	-0.00
22	-0.43	-0.05	0.05	0.04	-0.85	0.85	-0.87*	0.67	-0.67
23	-0.87	0.32	-0.32	0.37	1.65*	-1.65*	0.00	0.07	-0.07
24	0.73	0.65	-0.65	-1.28**	-0.43	0.43	-0.33	-0.26	0.26
25	-0.53	-0.08	0.08	-0.56	0.15	-0.15	0.07	1.07	-1.07
26	-1.10*	0.09	-0.09	0.42	0.24	-0.24	0.00	0.34	-0.34
27	0.20	-0.75	0.75	-0.14	0.50	-0.50	0.07	0.80	-0.80
28	-0.53	0.72	-0.72	-0.76	-0.51	0.51	0.83*	0.70	-0.70
29	0.70	0.69	-0.69	-0.69	0.62	-0.62	0.53	0.34	-0.34
30	-0.60	-0.95	0.95	-0.78	-0.66	0.66	-0.13	0.07	-0.07
31	-0.80	-0.95	0.95	0.02	-1.30	1.30	0.60	0.27	-0.27
32	-0.23	0.69	-0.69	0.02	-0.36	0.36	0.27	0.34	-0.34
33	-0.63	0.55	-0.55	0.44	0.05	-0.05	1.60**	-1.26*	1.26*
34	0.43	0.49	-0.49	0.01	-0.81	0.81	0.80	0.60	-0.60
35	1.47**	0.79	-0.79	0.34	0.32	-0.32	-0.27	0.07	-0.07
36	-0.20	-0.88	0.88	1.02*	0.57	-0.57	0.40	0.87	-0.87
37	1.33**	-0.35	0.35	-0.01	0.34	-0.34	0.40	0.20	-0.20
38	-0.43	-0.11	0.11	-0.34	1.14	-1.14	-0.27	-0.46	0.46
39	0.17	0.89	-0.89	0.29	0.07	-0.07	-0.47	0.14	-0.14
40	-0.50	-0.25	0.25	-0.14	0.37	-0.37	0.33	0.94	-0.94
41	-0.53	-0.81	0.81	-0.51	-0.63	0.63	0.13	-0.20	0.20
42	-0.13	-0.35	0.35	-0.19	0.29	-0.29	0.47	-0.13	0.13
43	0.10	0.02	-0.02	-0.21	0.27	-0.27	-0.13	0.07	-0.07
44	-1.03*	0.02	-0.02	-0.23	0.12	-0.12	0.00	0.20	-0.20
45	-0.27	0.05	-0.05	-0.49	0.19	-0.19	-0.13	-0.46	0.46

Table (6): Continued

Lines No.	Days to 50%silking			Ear length			No. of rows/ear		
	General combining ability	Specific combining ability		General combining ability	Specific combining ability		General combining ability	Specific combining ability	
		T_2	T_1		T_2	T_1		T_2	T_1
46	0.17	0.22	-0.22	0.29	-0.36	0.36	-0.53	-0.06	0.06
47	0.83	0.75	-0.75	0.22	0.37	-0.37	-0.33	-0.13	0.13
48	0.53	-0.88	0.88	0.32	0.97	-0.97	-1.27**	-0.13	0.13
49	0.83	1.82**	-1.8**	-1.31**	-0.20	0.20	1.00*	-0.66	0.66
50	1.33**	-0.75	0.75	-1.21*	0.50	-0.50	-0.07	0.00	-0.00
51	-0.53	0.12	-0.12	0.06	0.17	-0.17	-0.40	0.07	-0.07
52	-0.37	-0.51	0.51	-1.06*	-0.91	0.91	0.07	-0.40	0.40
53	-0.13	-0.01	0.01	-0.61	-0.28	0.28	-0.10	-0.43	0.43
54	-0.27	0.99	-0.99	-0.54	-1.00	1.00	-1.13**	-0.93	0.93
55	0.30	-0.98	0.98	0.99*	-0.56	0.56	0.00	-0.20	0.20
56	-0.70	-0.58	0.58	-0.11	-0.86	0.86	-0.73	0.14	-0.14
57	0.73	1.32*	-1.32*	-0.03	-0.21	0.21	-1.00*	0.00	-0.00
58	0.73	-1.08	1.08	0.82	-0.20	0.20	0.07	-0.66	0.66
59	-0.30	0.09	-0.09	-0.04	-0.10	0.10	-0.33	0.27	-0.27
60	1.30**	1.15	-1.15	-0.86	-0.41	0.41	-0.20	0.00	-0.00
61	1.33**	-1.48*	1.48*	-0.38	-0.73	0.73	-0.20	-0.40	0.40
62	0.63	-0.38	0.38	0.04	0.75	-0.75	0.33	-0.66	0.66
63	0.03	-1.18	1.18	1.27**	-0.88	0.88	-0.67	-0.06	0.06
64	0.17	1.02	-1.02	0.82	1.24	-1.24	-0.53	0.07	-0.07
65	-0.43	-0.25	0.25	0.19	-0.30	0.30	1.47**	-0.73	0.73
66	0.33	0.25	-0.25	0.34	-0.45	0.45	-0.60	-0.66	0.66
67	-0.57	-0.11	0.11	-0.54	0.24	-0.24	-0.07	-0.40	0.40
68	0.33	1.39*	-1.39*	-0.31	-0.20	0.20	-0.07	-0.66	0.66
69	0.57	0.15	-0.15	0.01	-0.01	0.01	-0.40	-0.33	0.33
70	-0.03	-0.71	0.71	0.69	-0.26	0.26	-0.13	-0.20	0.20
71	-0.70	0.22	-0.22	-0.49	-0.41	0.41	-0.20	0.27	-0.27
72	1.20*	0.39	-0.39	0.19	-0.70	0.70	0.73	-0.93	0.93
73	-0.23	-0.85	0.85	0.11	-0.15	0.15	0.07	-0.26	0.26
74	-0.63	0.22	-0.22	0.37	-0.35	0.35	-0.60	0.00	-0.00
75	0.13	0.32	-0.32	0.52	-1.60*	1.60*	0.40	-0.73	0.73
76	0.33	-0.48	0.48	0.22	-0.23	0.23	-0.87*	0.00	-0.00
77	0.00	0.72	-0.72	0.56	0.70	-0.70	-0.70	0.10	-0.10
78	0.37	-0.11	0.11	1.26*	-0.06	0.06	-0.33	-0.13	0.13
79	1.03*	0.95	-0.95	0.17	-0.55	0.55	-0.07	0.14	-0.14
80	0.53	-1.68*	1.68*	0.19	0.50	-0.50	0.40	0.34	-0.34
81	-0.03	0.09	-0.09	1.31**	-0.68	0.68	0.67	0.07	-0.07
T_1	0.05			0.31**			0.53**		
T_2	-0.05			-0.31**			-0.53**		
LSE for GCA L	5% 0.93	1% 1.22		5% 0.97	1% 1.27		5% 0.81	1% 1.06	
LSE for GCA L	5% 0.14	1% 0.18		5% 0.16	1% 0.21		5% 0.12	1% 0.16	
LSE for GCA L	5% 1.32	1% 1.74		5% 1.38	1% 1.81		5% 1.14	1% 1.50	

Table(7): General and specific combining ability effects for 100-kernel weight and grain yield/plant.

Lines No.	100-kernel weight			Grain yield per plant		
	General combining ability	Specific combining ability		General combining ability	Specific combining ability	
		T_2	T_1		T_2	T_1
1	-0.74	-0.01	0.01	0.60	2.01	-2.01
2	0.04	1.11	-1.11	8.60**	1.75	-1.75
3	0.24	1.01	-1.01	-0.57	3.18*	-3.18*
4	-0.46	1.67*	-1.67*	3.93**	3.61*	-3.61*
5	-0.23	0.07	-0.07	1.23	9.11**	-9.11**
6	0.31	0.27	-0.27	0.06	9.75**	-9.75**
7	0.29	-0.38	0.38	1.13	9.28**	-9.28**
8	0.67	0.37	-0.37	-7.20**	-0.59	0.59
9	-0.48	0.16	-0.16	-8.87**	0.61	-0.61
10	0.27	1.17	-1.17	3.96**	-0.15	0.15
11	0.77	-0.89	0.89	-7.70**	-6.22**	6.22**
12	-0.28	0.89	-0.89	-8.34**	-0.72	0.72
13	0.66	-0.14	0.14	-3.80**	-2.92	2.92
14	0.12	0.39	-0.39	-7.04**	8.25**	-8.25**
15	0.64	-0.03	0.03	5.33**	-2.19	2.19
16	0.34	0.44	-0.44	-0.94	-2.19	2.19
17	-0.81	-0.01	0.01	-3.70**	-0.89	0.89
18	1.17	0.44	-0.44	-3.74**	1.81	-1.81
19	0.27	0.31	-0.31	-1.47	7.08**	-7.08**
20	0.32	-1.14	1.14	-1.90	0.05	-0.05
21	0.22	0.46	-0.46	7.40**	14.01**	-14.01**
22	0.92	1.19	-1.19	-0.27	4.81**	-4.81**
23	0.47	0.07	-0.07	-0.97	-1.09	1.09
24	0.52	1.26	-1.26	-3.14**	2.28	-2.28
25	-0.34	-0.61	0.61	-2.04	-0.75	0.75
26	0.17	-0.29	0.29	1.56	-3.82*	3.82*
27	-0.38	0.62	-0.62	-2.97**	5.11**	-5.11**
28	-0.28	-0.24	0.24	-1.80	2.48	-2.48
29	-0.96	0.01	-0.01	-5.67**	-7.52**	7.52**
30	-0.89	0.51	-0.51	0.96	2.25	-2.25
31	-0.76	-0.33	0.33	-2.44*	0.38	-0.38
32	-0.93	-0.06	0.06	0.66	1.55	-1.55
33	-0.38	-0.04	0.04	3.33**	-5.52**	5.52**
34	0.82	0.39	-0.39	4.83**	1.85	-1.85
35	0.97	0.84	-0.84	5.00**	0.08	-0.08
36	-0.14	0.19	-0.19	5.43**	3.38*	-3.38*
37	0.04	-0.19	0.19	-2.07	-2.99	2.99
38	0.01	0.14	-0.14	-1.24	-2.35	2.35
39	-0.98	-0.54	0.54	0.90	-5.49**	5.49**
40	0.26	-0.34	0.34	0.56	2.78	-2.78
41	0.99	0.02	-0.02	-12.84**	10.09**	-10.09**

Table (7): Continued

Lines No.	100-kernel weight General combining ability	100-kernel weight Specific combining ability T_2	100-kernel weight Specific combining ability T_1	Grain yield per plant General combining ability	Grain yield per plant Specific combining ability T_2	Grain yield per plant Specific combining ability T_1
42	0.59	-0.64	0.64	-5.57**	-1.49	1.49
43	-0.74	-0.34	0.34	3.93**	0.41	-0.41
44	-0.29	0.77	-0.77	-1.35	1.33	1.33
45	-0.26	-0.03	0.03	4.33**	-4.12*	4.12*
46	1.09	0.02	-0.02	1.76	-4.62**	4.62**
47	0.69	-0.51	0.51	3.86**	1.55	-1.55
48	-0.21	-0.68	0.68	-5.70**	-0.22	0.22
49	-0.56	-0.43	0.43	0.83	-4.89**	4.89**
50	0.54	-0.03	0.03	5.56**	0.71	-0.71
51	0.47	-0.99	0.99	2.20	-1.19	1.19
52	-1.03	0.07	-0.07	-0.80	-4.45**	4.45**
53	0.52	-0.61	0.61	6.53**	-4.05*	4.05*
54	0.37	0.44	-0.44	-3.74**	-5.19**	5.19**
55	-1.08	0.52	-0.52	3.75**	-3.04	3.04
56	0.09	0.59	-0.59	6.60**	2.41	-2.41
57	-0.38	-0.28	0.28	-9.50**	-6.49**	6.49**
58	0.17	-0.49	0.49	5.53**	-4.65**	4.65**
59	-0.48	-0.88	0.88	-5.77**	-1.15	1.15
60	-0.08	-0.41	0.41	-1.27	-7.19**	7.19**
61	0.31	-0.66	0.66	-5.17**	-2.29	2.29
62	-0.68	-0.78	0.78	9.16**	-4.89**	4.89**
63	0.84	0.74	-0.74	0.90	1.05	-1.05
64	1.66**	0.96	-0.96	-5.27**	2.21	-2.21
65	-0.84	-0.28	0.28	0.90	2.11	-2.11
66	-1.19	-0.16	0.16	-4.37**	0.51	-0.51
67	-1.06	-0.46	0.46	4.43**	-3.35*	3.35*
68	-0.24	-0.21	0.21	-2.70*	-1.42	1.42
69	-0.03	-0.76	0.76	-1.57	-6.22**	6.22**
70	-1.17	-0.18	0.18	-2.34*	8.21**	-8.21**
71	0.14	-0.33	0.33	0.43	3.51*	-3.51
72	0.62	0.29	-0.29	4.20**	2.68	-2.68
73	0.09	-0.58	0.58	-2.54*	-1.79	1.79
74	-0.44	0.89	-0.89	5.80**	-3.32*	3.32*
75	0.22	-0.64	0.64	8.36**	-1.22	1.22
76	0.22	-0.68	0.68	-0.04	-0.55	0.55
77	-0.04	0.29	-0.29	0.46	3.15*	-3.15*
78	-0.29	-0.63	0.63	-0.97	0.98	-0.98
79	-0.43	-0.29	0.29	4.33**	1.35	-1.35
80	0.31	-0.93	0.93	10.23**	2.18	-2.18
81	0.17	-0.36	0.36	-0.04	1.45	-1.45
T_1	0.16			2.12**		
T_2	-0.16			-2.12**		
LSE for GCA L	5% 1.20	1% 1.58		5% 2.23	1% 2.93	
LSE for GCA T	5% 0.20	1% 0.26		5% 0.35	1% 0.47	
LSE for SCA	5% 1.44	1% 1.89		5% 3.15	1% 4.14	

The results showed that genetic variance estimates for all studied traits were less than phenotypic variance. This is due to that the genetic variance depend upon the effect of additive and dominance but the phenotypic variance is due to the effect of both genetic components and environmental variances.

Heritability is considered to be one of the important parameters to express relative genetic variability. Heritability (H%) for S_1lines were high for no. of rows/ear (49.12) and grain yield/plant (90.23). However, it was low for days to 50%silking (21.33), ear length (30.91) and 100-kernelweight (37.50). These low heritability estimates may be due to the large experimental error variances. These results are in agreement with those obtained by Abou El-Saad *et al*. (1994) found that heritability estimates were 42.3 and 49.0% for grain yield/plant and days to 50% silking, respectively. El-Morshidy *et al*.(2002) found that heritability estimates were 42.67, 67.44, 75, 70.55 and 74.89% for days to 50% silking, ear length, no. of rows/ear, 100-kernel weight and grain yield.

Generally, it could be seen that heritability estimates for the studied traits varied greatly. Heritability estimates were low for some traits may be due to the large experimental error variances and low genetic variance associated with it. These results are in agreement with those obtained by Ibrahim (2004) and Garbuglio *et al*. (2009) obtained high heritability estimates for ear height and grain yield/plant. Mahmoud *et al*. (1999)found that heritability estimates were 74.3% for grain yield and 89.5% for number of days to 50% silking.

Table 8. Estimates of (GCV%), (PCV%), variance components and heritability in broad sense for all studied traits.

Estimate	Days to 50% silking	Ear length	No. Of rows/ear	100-kernel weight	Grain yield /plant
σ^2g	0.16	0.17	0.28	0.51	45.14
σ^2e	1.76	1.15	0.88	2.55	14.67
σ^2ph	0.75	0.55	0.57	1.36	50.03
G.C.V%	0.64	2.71	3.82	2.63	5.00
P.C.V%	1.38	4.89	5.41	4.34	5.26
HB%	21.33	30.91	49.12	37.50	90.23

REFERENCES

Abrha, S.W.; H.Z. Zeleke and D.W. Gissa. 2013. Line × tester analysis of maize inbred lines for grain yield and yield related traits. Asi. J. P. Sci. Res., 3: 12-19.

Abou El-Saad, Sh.F.; M. M. A. Ragheb and A. A. Abd El Aziz. 1994. Genetic variance and correlation studies in a yellow maize population. Bull. Fac. Agric., Univ. Cairo, 811-826.

Abuali, A.I; A.A. Abdelmulla; M.M. Khalafalla; A.E. Idris and A.M. Osman. 2012.Combining ability and heterosis for yield and yield components in maize. Asu. J. Bas. And Appl. Sci., 6(10):36-41.

Amer, E.A. and A.A. El-Shenawy. 2007. Combining ability for new twenty one yellow maize inbred lines. J. of Agric. Sci., Mansoura Univ., 32(9): 7053-7062.

Davis, R.L. 1927.Report of the plant breeding. Ann. Rep. Puerto Rico Agric. Exp. Stat., P: 14-15.

El-Morshidy, M. A.; E. A. Hassaballa; Sh. F. Abou El-Saad and M. A. Abd El-Moula. 2002. Selection for drought tolerance in maize (*Zea mays* L.). The 3rd Sci. Conf. Of Agric. Assiut, Oct.; 173-191.

Hallauer, A.R. and J.B. Miranda 1988. Quantitaive Genetics in Maize Breeding. 2nd ed. Iowa State University Press., Ames, IA.

Ibrahim Kh. A. M. 2004. Improvement of two yellow maize (*Zea mays* L.) populations using reciprocal recurrent selection. M.Sc. Thesis, Fac. Agric., Assiut Univ., Egypt.

Jenweerawat, S.; C. Aekatasanawan; P. Laosuwan and A.R. Hallauer (2009). Interpopulation hybrid development in maize using modified reciprocal recurrent selection. Thai J. Agric. Sci., 42: 139-148.

Kempthorne, D.O.1957.An Introduction to Genetic Statistics. John Wiley and Sons. Inc., New York.,USA.

Mahmoud, A. A.; F. H. S. Soliman and A. M. Shehata. 1999. Evaluation of S1 progenies of maize composite Giza-2 (Ev-8). Egypt. J. plant Breed., 3:115-125.

Mosa, H.E. 2010. Estimation of combining ability of maize inbred lines using top cross mating design. J. Agric. Res., Kafer El-Sheikh Univ., 36(1).

Osman, M.M.A .and M.H.A. Ibrahim. 2007. A study on combining ability of new yellow maize inbred lines using line × tester analysis. J. of Agric. Sci., Mansoura Univ., 32(2): 815-830.

Sprague, G.F. and L.A. Tatum. 1942. General versus specific combining ability in single crosses of corn. Jour. Amer. Soc. Agron., 34: 923-932.

Weyhrich, R.A.; K.R. Lamkey and A.R. Hallauer. 1998. Responses to seven method of recurrent selection in the BS11 maize population. Crop Sci., 38: 308-321.

القدرة على التآلف لسلالات الجيل الأول الذاتي في الذرة الشامية

محمد عبدالمنعم المرشدي[2] ،إيمان محمد طه[1] ، عبدالحميد السيد القراميطي[1] ، أمل جمعه درويش[1]

[1] قسم المحاصيل – كلية الزراعة – جامعة المنيا

[2] قسم المحاصيل – كلية الزراعة – جامعة أسيوط

أجريت الدراسة في مزرعة كلية الزراعة جامعة المنيا في الموسمين 2011 ، 2012. أجري التلقيح الذاتي لعدد 200 نبات من العشيرة الصفراء IY 176 ولقح كل نبات قمياً مع كشافين هما سخا 21، هجين ثلاثي 352 . وعند الحصاد أختبر 81 نبات ملقح ذاتي، 81 هجين قمي مع الكشاف الأول، 81 هجين قمي مع الكشاف الثاني والتي بها حبوب تكلفي تجارب التقييم. قيمت سلالات الجيل الأول الذاتي S_1 في تجربة منفصلة وكذلك قيمت الهجن القمية في تجربة أخري. وأخذت البيانات علي عدد الأيام حتي 50% حريرة، طول الكوز، عدد الصفوف علي الكوز، وزن 100 حبة ومحصول حبوب النبات الفردي. وكانت أهم النتائج المتحصل عليها كما يلي:

1- كانت أفضل السلالات لصفة التبكير هي رقم 6 ، 16 ، 17 ، 6 ، 44 ولصفة طول الكوز رقم 3 ، 8 ، 63 ، 78 ، 81، ولصفة عدد الصفوف/كوز رقم 18 ، 35 ، 41 ، 46 ، 64 ، ولصفة وزن 100 حبة 2، 28 ، 33 ، 65 ، 79 ، ولصفة محصول الحبوب للنبات رقم 2 ، 21 ، 62 ، 75 ، 80.

2- أظهرت 5 سلالات قوة إئتلاف عامة سالبة ومعنوية لصفة التبكير، أظهرت 8 سلالات، 5 سلالات، سلالة واحدة، 24 سلالة قدرة ائتلاف عامة موجبة ومعنوية لصفات طول الكوز، عدد الصفوف/كوز، وزن 100 حبة، محصول حبوب النبات الفردي. أظهرت 6 هجن قمية قدرة إئتلاف خاصة سالبة ومعنوية وكذلك أظهرت 2 ، 2 ، 1 ، 33 سلالة قدرة خاصة موجبة ومعنوية لصفات طول الكوز، عدد الصفوف/كوز، وزن 100 حبة، محصول حبوب النبات.

3- كانت قيم معامل الاختلاف المظهري أعلا من قيم معامل الاختلاف الوراثي لجميع الصفات تحت الدراسة.

4- كانت قيم درجة التوريث بمعناها العريض هي 21.33 ، 30.91 ، 49.12 ، 37.50 ، 90.23% لصفات عدد الأيام حتي 50% حريرة، طول الكوز، عدد الصفوف/كوز، وزن 100 حبة، محصول حبوب النبات، علي الترتيب.