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COMBINING ABILITY FOR GRAIN YIELD AND SOME RELATED TRAITS OF NEWLY YELLOW MAIZE (*Zea mays* L.) INBRED LINES

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ABSTRACT

Nine S_5 newly yellow maize inbred lines were developed from segregated generation of different Hungarian sources were topcrossed with two testers i.e., inbred line Giza (Gz)-656 and single cross SC-166 at Ismailia Agricultural Research Station during 2009 growing season. In 2010 summer season, the 18 topcrosses and two yellow commercial check hybrids; SC-162 and TWC-352 were evaluated on two locations; Sakha and Ismailia Agricultural Research Stations. The studied traits were grain yield (GY ard/fed), ear length (EL cm), ear diameter (ED cm), No. of rows ear^{-1} (RE^{-1}), days to 50% silking (SD day) and plant height (PH cm). Results showed that the differences between two locations were significant for all studied traits, indicating that environmental conditions were different at both locations. The crosses and their partionining to lines were significant for all studied traits except RE^{-1} trait for lines. Mean squares due to (L x Loc) were significant for RE^{-1}, SD and PH traits. On the other hand, the interaction of (T x Loc) and (L x T x Loc) were insignificant for all studied traits except GY and PH traits for (L x T x Loc) interaction which were significant. The topcrosses (L_1 x T_1) (36.37 ard/fed), (L_2 x T_1) (36.80 ard/fed) were significantly out yielded the check hybrid SC-162 (32.40 ard/fed). Meanwhile, the topcrosses L_1 x T_1 (36.37 a ard/fed), L_2 x T_1 (36.80 ard/fed), L_7 x T_1 (35.53 ard/fed), L_2 x T_2 (34.32 ard/fed) and L_7 x T_2 (33.50 ard/fed) were highly significant compared with the check hybrid TWC-352 (30.20 ard/fed). The inbred lines L_1, L_2 and L_7 have desirable GCA effects for GY and some yield components. Also, the inbred lines L_3 and L_8 exhibited desirable negative GCA effects for earliness and shorter plants. The relative relationship between GY GCA effects and the yield component traits (YCTs) GCA effects suggested that the direction of grain yield GCA effects (i.e., positive or negative) was largely determined by the number of YCTs GCA effects in the same direction. That is, if a line had significantly positive GY GCA effects, it usually had more YCTs with significantly positive GCA effects, and if as line had significantly negative GY GCA effect, it generally had a greater number of YCT s showing significantly negative GCA effects. The additive genetic effects (σ^2GCA) seemed to have played an important role than non additive genetic effects (σ^2SCA) in the expression of grain yield, ear length, ear diameter and silking date traits, while the σ^2SCA played the major role in the inheritance of No. of rows ear^{-1} and plant height traits.

Keywords: Maize, Combining ability, Topcrosses, Genetic variances, GY and YCTs.

INTRODUCTION

Maize (*Zea mays* L. 2n = 20) is one of the important cereal crops in Egypt as well as the world after wheat and rice. It is cultivated and produced in wide area for human, animal and the other industrial purposes. Then, the National Egyptian Maize Breeding Program (NEMBP) is adopting the policy of covering all the area devoted to maize with high yielding single and three way cross hybrids. The first step, selection maize inbred lines from segregated generation through visual selection between and within ear-to-row progenies. Second step, choice the desirable mating design method to test this inbred lines for performance in hybrid combination (Hallauer, 1990). Line x tester mating design is one of procedures which were designed to evaluate general combining ability and subsequently additive effects. Because of the change to single and three way crosses hybrid, testing procedures having maximum efficiency require greater emphasis on non-additive effects. Topcrosses procedure was suggested by Davis (1927) to test superior inbred lines for hybrid development programs.

Ear length (EL cm), ear diameter (ED cm) and no. of rows ear^{-1} (RE^{-1}) and no. of kernels row^{-1} are the most important yield components (YCTs) of grain yield (GY) in maize. However, one only report until 2008 on the relationship between GY combining abilities and the yield component traits (YCT s) combining abilities. Fan *et al.,*(2008) reported that the GCA effects of GY were related to the yield component traits (YCTs) GCA effects in an inbred line and the SCA effects of GY were also related to the yield component traits (YCTs) SCA effects in the same crosses. Many investigations have been reported that the variance components of SCA for GY and other traits were lager than those due to GCA, indicating that the importance of non-additive gene action in the inheritance of these traits; Kumar *et al*., (1998) for RE^{-1}; Crossa *et al*., (1990), Paul and Dural (1991) and Damborsky *et al*., (1994) for GY, Aly and Amer (2008) for GY and RE^{-1} and Manal Hefny (2010) for SD, EL, RE^{-1} and GY traits. On the other hand, Vasal *et al* (1992) for GY, Petrovic (1998) for PH; Mathur *et al* (1998) for RE^{-1}, Aly and Mousa (2008) for SD and PH and Manal Hefny (2010) for ED, they reported that the additive genetic variance played an important role in the inheritance of these traits.

The objectives of this study were; (1) to estimate the general combining ability of the new yellow maize inbred lines, (2) to determine the most important mode of gene action and examine the relationship between grain yield (GY) combining abilities and the combining abilities of the yield component traits (YCTs) and (3) to recognize the best lines and topcrosses to be recommended for future use in maize breeding programs..

MATERIALS AND METHODS

Nine S_5 newly yellow maize inbred lines were developed through selection among selfed segregated generation which originated from different Hungarian sources crossed with yellow commercial hybrids by the breeding program at Ismailia Agricultural Research Station. These lines were topcrossed with two testers i.e., inbred line Giza (Gz)-656 and single cross SC-166 at Ismailia Agricultural Research Station during 2009 growing season. In 2010 summer season, the 18 topcrosses and two yellow check commercial hybrids; SC-162 and TWC-352 were evaluated at two locations; Sakha and Ismailia Agricultural Research Stations. A randomized complete block design (RCBD), with four replications was used. Plot size was one row, 6 m. long and 0.8 m. apart. Seeds were planted in hills evenly spaced at 0.25 m. along the row at the rate of two kernels hill^{-1}. Seedling was thinned to one plant hill^{-1} after 21 days from planting. All agronomic field practices were applied as recommended for maize cultivation. Data were recorded for grain yield (GY ard/fed), adjusted to 15.5% moisture content (one ardab=140 kg and one feddan = 4200 m^2), ear length (EL cm), ear diameter (ED cm), No. of rows ear^{-1} (RE^{-1}), No. of days to 50% silking (SD day) and plant height (PH cm).

Data were analyzed using SAS software. Data from each location were adjusted to ANOVA separately to detect the significance of genotypic differences. Bartlett's test was conducted to determine the homogeneity of variance (Steel and Torrie, 1980) before a combined ANOVA. The genotypes effects were considered fixed and locations random in the analysis of variance. The procedure of line x tester analysis according to Kempthorne (1957) was used for estimating general and specific combining ability effects and variances, as described by Singh and Chaudhary (1979) based on line x tester general linear model for combined environments;

$Y_{ij} = \mu + g_i + g_j + s_{ij} + e_{ij}$

Where; Y_{ijk} = performance of the hybrid when i^{th} line is crossed to j^{th} tester, μ = overall mean, g_i = general combining ability of i^{th} line, g_j = general combining ability of the j^{th} tester, S_{ij} = specific combining ability when i^{th} line is crossed to j^{th} tester and e_{ij} = random error term.

RESULTS AND DISCUSSION

The analysis of variances showed significant differences among locations for all studied traits viz, GY ard/fed, EL cm. ED cm, RE^{-1}, SD day and PH cm in Table 1, indicating that environmental conditions were different at both locations. These results are in agreement with those of Aly and Amer (2008) and Mosa (2010). Results revealed that the crosses and their partionining into lines were significant for all studied traits except RE^{-1} for lines. This indicates that the inbred lines behaved differently in their respective topcross according to their combining ability. The interaction C x Loc was significant for GY ard/fed, ED cm, SD day and PH cm. Mean squares due to (L x Loc) were significant for RE^{-1}, SD and PH traits. On the other hand, the interaction of (T x Loc) and (L x T x Loc) were insignificant for all studied traits, except GY and PH traits for (L x T x Loc) interaction. Similar results were obtained by El-Shenawy *et al*., (2003), Mosa (2010) and Ibrahim and Mousa (2011).

Mean performances of the 20 entries (18 topcrosses and the two check hybrids) for six traits over two locations are showed in Table 2. Results revealed that for GY, the topcrosses ranged from 23.13 ard/fed for the topcross (L_8 x T_1) to 36.80 ard/fed for the topcross (L_2 x T_1). The topcrosses (L_1 x T_1, 36.37 ard/fed), (L_2 x $T_{1,}$ 36.80 ard/fed) were significantly out yielded the check hybrids SC-162 (32.40 ard/fed). Meanwhile, the topcrosses L_1 x T_1 (36.37 ard/fed), L_2 x T_1 (36.80 ard/fed), L_7 x T_1 (35.53 ard/fed), L_2 x T_2 (34.32

ard/fed) and L_7 x T_2 (33.50 ard/fed) were highly significant compared with the check hybrid TWC-352 (30.20 ard/fed). For EL, topcrosses ranged from 18.82 cm for (L_8 x T_1) to 21.30 cm for (L_2 x T_1), while check hybrid SC-162 possessed significantly longer ears than all other topcrosses. On the other hand, L_4 x T_2 (20.45 cm) and L_6 x T_2 (20.33 cm) were significantly longer ear length than the check hybrid TWC-352. For ED cm, topcrosses ranged from 4.31 cm (L_8 x T_1) to 4.78 cm (L_6 x T_1), meanwhile, the topcrosses L_2 x T_1 (4.76cm), L_4 x T_1 (4.76 cm) and L_6 x T_1 (4.78 cm) were significantly compared with the check hybrid SC-162. Results indicated that the topcrosses ranged from 16.03 cm (L_8 x T_1) to 17.45 cm (L_7 x T_2) for RE^{-1} trait. The all topcrosses when lines crossed by tester-1 (Gz-656) showed highest values of RE^{-1} compared with the SC-162 (14.18 cm). The all topcrosses when lines crossed by tester-2 (SC-166) appeared non significant differently than the hybrid check TWC-352 (16.63 cm). Regarding to SD trait, the topcrosses ranged from 54.25 day (L_8 x T_1) to 58.00 day (L_7 x T_1) and all topcrosses were earlier and significantly earlier compared with the two check hybrids; SC-162 (60.50 day) and TWC-352 (59.38 day). For PH trait, the topcrosses ranged from (232.62 cm) for topcross (L_8 x T_1) to (264.37) for topcross (L_6 x T_2). All topcrosses were shorter compared with the two check hybrids; SC-162 (288.00 cm) and TWC-352 (275.63 cm).

Table 1. Analysis of variance for eight traits of maize over two locations

S.O.V.	D.F.	GY (ard/fed)	EL (cm)	ED (cm)	RE^{-1}	SD (day)	PH (cm)
location (Loc.)	**1**	1541.48**	492.84**	12.43**	22.88**	16.06*	27087.67**
Rep/Loc.	**6**	28.55	1.24	0.04	0.27	2.69	1247.41
Crosses (C)	**17**	102.55**	3.95*	0.13*	2.19*	8.2**	704.17*
Lines (L)	**8**	175.6**	5.29*	0.23*	3.93	15.41**	1001.13*
Testers (T)	**1**	56.85	12.25	0.02	0.38	2.51	333.06
L x T	**8**	35.2	1.57	0.03	0.68	1.69	453.61
C x Loc.	**17**	28.66**	1.46	0.06*	1.22	1.67*	269.76*
L x Loc.	**8**	20.96	0.99	0.04	2.12*	2.41**	277.85*
T x Loc.	**1**	4.26	0.36	0.09	1.03	0.17	57.51
L x T x Loc.	**8**	39.41**	2.08	0.05	0.35	1.11	288.21*
Pooled Error	**114**	10.83	1.13	0.03	0.83	0.84	132.27

*** and ** indicate significance at 0.05 and 0.01 levels of probability, respectively.**

Estimates of general combining ability (GCA) effects of nine inbred lines and two testers for six traits over two locations are illustrated in Table 3. Results showed that the best inbred lines for GCA effects were L_1, L_2 and L_7 for grain yield (GY); L_1 and L_4 for ear length (EL); L_1, L_2, L_4 and L_6 for ear diameter (ED); L_6 and L_7 for rows ear number (RE^{-1}). On the other hand, several inbred lines possessed negative and significantly GCA effects that desirable values; L_8 and L_9 for silking date (SD) toward earliness and L_3, L_5 and L_8 for plant height (PH) toward shorter plants. For testers, the best tester possessed GCA effects were inbred lines Gz-656 as tester-1 for grain yield; the single cross SC-166 as tester-2 for earliness. The superiority of inbred lines as good testers was noticed by many investigators among them Al-

Naggar *et al* (1997). On the other hand, the superiority of single crosses as good testers was reported by Horner *et al*., (1976) and Mosa (2010).

Table 2. Mean performances of 20 entries (18 topcrosses and two checks hybrids) for six traits of maize over two locations

Line x tester	GY (ard/fed)	EL (cm)	ED (cm)	RE^{-1}	SD (day)	PH (cm)
L_1x T_1	36.37	21.13	4.48	16.60	57.25	247.75
L_2 x T_1	36.80	21.30	4.76	17.05	57.88	243.13
L_3 x T_1	31.05	20.15	4.64	16.30	56.00	240.75
L_4 x T_1	31.53	21.15	4.76	16.50	56.50	240.00
L_5 x T_1	30.29	19.98	4.59	15.95	56.13	241.25
L_6 x T_1	33.46	19.98	4.78	16.80	56.50	256.38
L_7 x T_1	35.53	20.20	4.66	17.28	58.00	262.88
L_8 x T_1	23.13	18.82	4.31	16.03	54.25	232.62
L_9 x T_1	32.25	20.05	4.60	15.95	56.00	260.63
L_1 x T_2	31.61	20.18	4.55	16.18	56.00	249.13
L_2 x T_2	34.32	19.70	4.75	16.30	57.13	251.25
L_3 x T_2	33.03	19.30	4.53	16.15	56.38	241.50
L_4 x T_2	31.40	20.45	4.63	16.23	56.13	257.00
L_5 x T_2	30.21	19.10	4.55	15.45	56.25	245.00
L_6 x T_2	32.67	20.33	4.75	17.15	57.25	264.37
L_7 x T_2	33.50	19.73	4.65	17.45	57.13	260.13
L_8 x T_2	26.23	19.20	4.48	16.65	54.37	244.13
L_9 x T_2	26.12	19.53	4.51	16.28	55.50	240.25
SC-162	32.40	20.58	4.55	14.18	60.50	288.00
TWC-352	30.20	18.75	4.80	16.63	59.38	275.63
LSD 0.05	3.26	1.05	0.17	0.90	0.91	11.39

Table 3. General combining ability (GCA) effects for nine inbred lines and two testers over two locations

Lines & Testers	GY (ard/fed)	EL (cm)	ED (cm)	RE^{-1}	SD (day)	PH (cm)
L_1	2.35**	0.64*	0.10*	0.06	0.26	-0.35
L_2	3.92**	0.49	0.15**	0.23	1.13**	-1.60
L_3	0.40	-0.29	-0.23**	-0.22	-0.18	-7.66**
L_4	-0.18	0.79**	0.09*	-0.18	-0.06	-0.28
L_5	-1.39	-0.48	-0.04	-0.74**	-0.18	-5.66*
L_6	1.42	0.14	0.15**	0.53*	0.51	11.59**
L_7	2.88**	-0.05	0.05	0.92**	1.19**	12.72**
L_8	-6.96**	-1.00**	-0.21**	-0.26	-2.06**	-10.41**
L_9	-2.45**	-0.23	-0.05	-0.33	-0.62*	1.65
SE (g_i)	0.822	0.265	0.043	0.227	0.229	2.875
SE (g_i-g_j)	1.163	0.375	0.061	0.322	0.324	4.066
T_1	0.75*	-0.29*	0.01	0.05	0.23*	-1.52
T_2	-0.75*	0.29*	-0.01	0.05	-0.23*	1.52
SE (g_i)	0.387	0.125	0.020	0.107	0.108	1.355
SE (g_i-g_j)	0.548	0.177	0.028	0.151	0.152	1.916

*** and ** indicate significance at 0.05 and 0.01 levels of probability, respectively.**

Fig-1 histogram was plotted with a new variable, GCA ratio (GR) to graphically show the relationship between grain yield (GY) GCA effects and the yield component traits (YCTs) GCA effects. To obtain GR for individual trait, we first calculated the mean of absolute GCA effects (MAGCA) for individual traits, then the GCA/MAGCA ratio for GY, EL, ED and RE^{-1} were computed of each line and called them GY_r, EL_r, ED_r, and RE^{-1}_r, respectively. The GR removed the variation caused by different units of different traits, and the graph of GRs show relative importance of each yield component traits (YCTs) GCA effects to grain yield GCA effects of each line. From the results in Fig. 1, the relative relationship between GY GCA effects and YCTs GCA effects suggested that the direction of grain yield GCA effects (i.e., positive or negative) was largely determined by the number of YCT's GCA effects in the same direction. That is, if a line had significantly positive GY GCA effects, it usually had more YCTs with significantly positive GCA effects, and if as line had significantly negative GY GCA effect, it generally had a greater number of YCT□s showing significantly negative GCA effects (Fan *et al*., 2008).

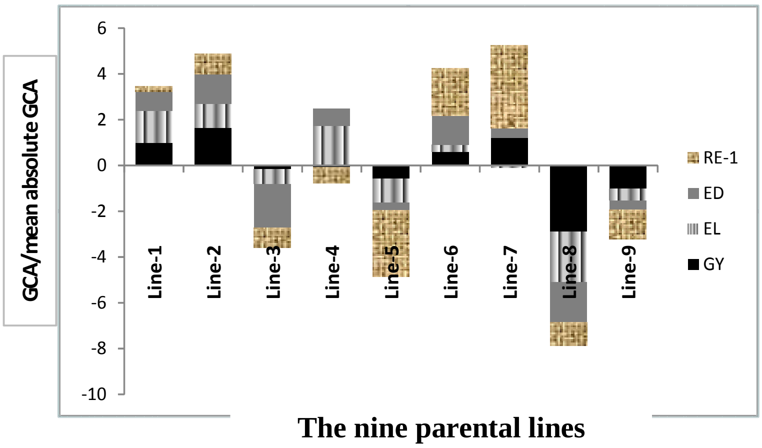

Figure 1. Impact of yield components (YCTs) GCA effects on grain yield (GY) GCA effects

Specific combining ability effects of the 18 topcrosses for all studied traits over two locations are presented in Table (4). Results revealed that the significant desirable SCA effects were detected by (L_1x T_1), (L_7 x T_1), (L_9 x T_1), (L_3 x T_2) and (L_8 x T_2) for grain yield (GY); (L_2 x T_1), (L_6 x T_2) and (L_8 x T_2) for EL; (L_8 x T_2) for ear diameter (ED); (L_2 x T_1) for ears row number (RE^{-1}); (L_6 x $T_{1)}$ and (L_1 x $T_{2)}$ for silking date (SD) toward earliness and crosses (L_4 x T_1), (L_8 x T_1) and (L_9 x T_2) for plant height (PH) toward shorter plants. This may suggests using of these topcrosses in maize breeding program is useful to produce the best inbred lines with respect to these traits.

Table 4. Specific combining ability effects of 18 topcrosses for six traits over two locations

Line x Tester	GY (ard/fed)	EL (cm)	ED (cm)	RE-1	SD (day)	PH (cm)
L_1x T_1	2.751*	0.183	-0.048	0.161	0.893**	0.833
L_2 x T_1	0.613	0.728*	-0.004	0.724*	0.243	-2.542
L_3 x T_1	-2.75*	0.133	0.046	0.024	-0.621	1.146
L_4 x T_1	-0.565	0.058	0.058	0.086	0.056	-10.979**
L_5 x T_1	-0.486	0.146	0.008	0.199	-0.194	-0.354
L_6 x T_1	-0.233	-0.767*	0.002	-0.226	-0.907**	-2.479
L_7 x T_1	2.351*	-0.054	-0.004	-0.139	0.306	2.896
L_8 x T_1	-2.278*	-0.979**	-0.292**	-0.214	-0.194	-8.429*
L_9 x T_1	2.434*	-0.029	0.033	-0.214	0.118	11.708**
L_1x T_2	-2.910**	-0.183	0.068	-0.161	-0.893**	-0.733
L_2 x T_2	0.543	-0.808*	0.054	-0.724*	-0.243	2.542
L_3 x T_2	2.621*	-0.133	-0.046	-0.024	0.721*	-1.046
L_4 x T_2	-1.965	-0.078	-0.058	-0.086	-0.056	11.979**
L_5 x T_2	0.386	-0.146	-0.008	-0.199	0.194	0.354
L_6 x T_2	-1.546	0.767*	-0.002	0.226	0.837**	2.479
L_7 x T_2	1.555	0.054	0.014	0.139	-0.336	-2.896
L_8 x T_2	2.478*	0.879*	0.212**	0.214	0.194	8.229*
L_9 x T_2	-2.989**	0.229	-0.033	0.214	-0.118	-12.708**
SE (S_{ij})	1.163	0.375	0.061	0.322	0.324	4.066
SE (S_{ij}-S_{kl})	1.645	0.531	0.086	0.455	0.458	5.750

*** and ** indicate significance at 0.05 and 0.01 levels of probability, respectively.**

Estimates of the variance due to general combining ability (GCA), specific combining ability (SCA) and their interaction with locations for six traits are shown in Table (5). Results showed that estimates of $\boldsymbol{\sigma^2}GCA_L$ were higher in magnitude than those of $\boldsymbol{\sigma^2}GCA_T$ for all studied traits, indicating that most of the total GCA variances were due to the inbred lines. Similar results were obtained by Aly *et al.,* (2011). The contributions of lines were higher than those the contribution of the testers for these traits, indicated that the lines played important role toward improving most of these traits. The contribution values were (80.58%) for GY, (63.04%) for EL, (87.62%) for ED, (84.38%) for RE^{-1}, (88.49%) for SD and (66.90%) for PH. The contribution of testers and (L x T) was low for all studied traits. These results are in agreement with those obtained by Aly (2004) and Aly and Mousa (2008). The additive genetic effects ($\boldsymbol{\sigma^2}$GCA) seemed to have played an important role than non additive genetic effects ($\boldsymbol{\sigma^2}$SCA) in the expression of GY, EL, ED and SD traits, while the $\boldsymbol{\sigma^2}$SCA played the major role in the inheritance of RE^{-1} and PH traits. This result supports the finding of Nawar and El-Hosary (1984) for ED and RE^{-1}, El-Shenawy (2005) for GY and Mosa (2010) for EL, ED and RE^{-1}. From the same table, results revealed that the variance interaction of σ^2GCA_L x Loc was higher than σ^2GCA_T x Loc for GY, RE^{-1}, SD and PH, indicating that the σ^2GCA for lines was affected more by environmental than by testers for these traits. Results showed that the σ^2SCA x Loc were more than those of σ^2GCA x Loc for all studied traits except RE^{-1} trait. Similar results were reported by Mosa (2010) for GY, ED and SD traits.

Table 5. Estimated values of genetic variance components for all studied traits over two locations

Genetic parameters	GY (ard/fed)	EL (cm)	ED (cm)	RE^{-1}	SD (day)	PH (cm)
σ^2 L = σ^2 (GCA)$_L$	9.665	0.269	0.012	0.113	0.813	45.205
σ^2 T = σ^2 (GCA)$_T$	0.730	0.165	-0.001[@]	-0.009[@]	0.033	3.827
σ^2 GCA	2.355	0.184	0.001	0.013	0.175	11.350
σ^2 L x T = σ^2 (SCA)	-0.526[@]	-0.064[@]	-0.003[@]	0.041	0.073	20.675
σ^2 L x Loc = σ^2 (GCA$_L$ x Loc)	1.266	-0.018[@]	0.001	0.161	0.196	18.198
σ^2 T x Loc = σ^2 (GCA$_T$ x Loc)	-0.183[@]	-0.021[@]	0.002	0.006	-0.019[@]	-2.077[@]
σ^2 GCA x Loc	0.080	-0.020	0.002	0.034	0.020	1.609
σ^2 L x T x Loc = σ^2 (SCA x Loc)	3.573	0.119	0.003	-0.060[@]	0.034	19.493
Contribution of Lines	80.58	63.04	87.62	84.38	88.49	66.90
Contribution of Tester	3.26	18.24	0.95	1.02	1.8	2.78
Contribution of L x T	16.15	18.71	11.42	14.6	9.7	30.31

@ Variance estimate preceded by negative sign is considered zero (Robinson *et al*., 1955).**Acknowledgement**

In this connection, Lonnquist and Gardner (1961) and Shehata and Dhawn (1975), found that SCA x environment interaction was significantly larger than GCA x environment interaction. In the contrast, the non-additive of the genetic variance was more affected by the environment than additive component. Silva and Hallauer (1975) found that GCA x Environment interaction was significantly larger than SCA x environment interaction, even though the variance estimates of SCA was more than of GCA.

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REFERENCES

Al-Naggar, A.M.; H.Y. El-Sherbieny and A.A. Mahmoud (1997). Effectiveness of inbreds, single crosses and populations as tester for combining ability in maize. Egypt. J. Plant Breed., 1: 35 – 46.

Aly, A.A. (2004). Combining ability and gene action of new inbred maize lines (*Zea mays* L.) using line x tester analysis. Egypt. J. Appl. Sci., 19(12 B): 492 – 518.

Aly, R.S.H. and E.A. Amer (2008). Combining ability and type of gene action for grain yield and some other traits using line x tester analysis in newly yellow maize inbred lines (*Zea mays* L.). J. Agric. Sci. Mansoura Univ., 33(7): 4993-5003.

Aly, R.S.H. and S.Th.M. Mousa (2008). Estimation of combining ability for newly developed white inbred lines of maize (*Zea mays* L.) via line x tester analysis. Egyptian J. Applies Sci., 23 (2B): 554-564.

Aly, R.S.H.; E.M.R. Metweli and S.Th.M. Mousa (2011). Combining ability of maize (*Zea mays* L.) inbred lines for grain yield and some agronomic traits using topcross mating design. Global J. of Molecular Sci., 6(1): 01-08.

Crossa J.; S.K. Vasal and D.L. Bekc (1990), combining ability estimates of CIMMYT's tropical late yellow maize germplasm. Maydica,35(3): 273-278.

Damborsky, M.; O. Chlaupek and J. Ehrenbergerova (1994). Variability of maize lines and diallel cross hybrids. Genetika-a-slechteni, 30(4): 297-303.

Davis, R.L. (1927). Report of the plant breeder. Puerto Rico Agriculture Experimental Station Annual Report, pp.14-15.

El-Shenawy, A.A. (2005). Estimation of genetic and environment parameters for new white inbred lines of maize (*Zea mays* L.). J. Agric. Res. Tanta Univ. 31: 647-662.

El-Shenawy, A.A.; E.A. Amer and H.E. Mosa (2003). Estimation of combining ability of newly developed inbred lines of maize by (line x tester) analysis. J. Agric. Res. Tanta Univ., 29(1): 50-63.

Fan, X.M.; H.M. Chen; J. Tan; C.X. Xu; Y.D. Zhang; L.M. Luo; Y.X. Huang and M.S. Kang (2008). Combining abilities for grain yield components in maize. Maydica, 53: 39-46.

Hallauer, A.R. (1990). Methods used in developing maize inbreds. Maydica, 35: 1-16.

Horner, E.S.; M.C. Lutrick; W.H. Chapman and F.G. Martin (1976). Effect of recurrent selection for combining ability with a single cross tester in maize. Crop Sci. 16: 5-8.

Ibrahim, Kh.A.M. and S.Th.M. Mousa (2011). Genetic correlation and combining ability o some yellow maize inbred lines via line by tester analysis. Egypt. J. Plant Breed. 15(1): 161-177.

Kempthorne, O. (1957). An introduction to genetic statistical. John Wiley-Sons Inc., New York U.S.A.

Kumar, A; M.G. Ganshetti and A. Kumar (1998). Gene effects in some metric traits of maize (*Zea mays* L.). Annals of Agricultural and Biological Research, 3(2): 139-143.

Lonnquist, J.H. and C.O. Gardner (1961). Heterosis in intervarietal crosses in maize and its implication in breeding procedure. Crop Sci. 1: 179-183.

Manal Hefny (2010). Genetic control of flowering traits, yield and its components in maize (Zea mays L.) at different sowing date. Asian J. of Crop Sci., 2(4): 236-249.

Mathur, R.K.; S.K. C. Bhatnagar and V. Singh (1998). Combining ability for yield, phonological and ear characters in white seeded maize. Indian Journal of Genetics and Plant Breeding, 58(2): 117-182.

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): 1-16.

Nawar, A.A. and A.A. El-Hosary (1984). Evaluation of eleven testers of different genetic sources of corn. Egypt. J. Cytol., 13: 227-237.

Paul, S.K. and P.K. Dural (1991). Combining ability for yield and maturity in maize (*Zea mays* L.). International Journal of Tropical Agriculture, 9(4): 205-254.

Petrovic, Z. (1998). Combining abilities and mode of inheritance of yield and yieldcomponents in maize (Zea mays L.). Novi Sad (Yugoslavia), p.85.

Robinson, J.O., R.E. Comstock and P.H. Harvey (1955). Genetic variance in open pollinated varieties of corn. Genetics. 40: 45-60.

Shehata, A.H. and L.L. Dhawn (1975). Genetic analysis of grain yield in maize as manifested in genetically diverse varietal populations and their crosses. Egypt. J. Genet. Cytol. 4: 96-116.

Silva, J.C. and A.R. Hallauer (1975). Estimation of epistatic variance in Iowa Stiff stalk synthetic maize. J. Heredity 66: 290-296.

Singh, R.K. and D.B. Chaudhary (1979). Biometrical methods in quantitative genetic analysis. Kalyani Publisher, Baharate, Ram Road, Daryagani, New Delhi, India.

Steel, R.G. and J.H. Torrie (1980). Principal and procedures of statistics. Mc Grow Hill Inc., New York U.S.A.

Vasal, S.K.; N.G. Srinivasan; D.L. Beck; J. Crossa; S. Pandey and D.E. Andey and D.E. Leon (1992). Heterosis and combining ability of CIMMYT's tropical late white maize germplasm. Maydica, 37(2): 217-223.

قدرة التآلف لمحصول الحبوب وبعض الصفات المرتبطة فى مجموعة من سلالات الذرة الشامية الصفراء الجديدة

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تم فى هذه الدراسة إختبار تسعة سلالات صفراء جديدة ومبشرة من الذرة الشامية عن طريق تهجينهم مع إثنين من الكشافات الصفراء هما السلالة جيزة – 656 والهجين الفردى 166- بمحطة البحوث الزراعية بالإسماعيلية خلال الموسم الزراعى 2009. تم تقييم الـ (18 هجين القمى) مقارنة بإثنين من الهجن التجارية هما الهجين الفردى –162 والهجين الثلاثى – 352 فى محطتى البحوث الزراعية بسخا والإسماعيلية خلال الموسم الزراعى 2010. تم عمل التحليل الوراثى للقدرة على الإئتلاف باستخدام تصميم السلالة فى الكشاف طبقاً لما إقترحه Kempthorne 1957 لصفات محصول الحبوب ، طول الكوز ، قطر الكوز ، عدد السطور فى الكوز ، عدد الأيام حتى ظهور حرايرـ50% من النباتات وارتفاع النبات.

ويمكن تلخيص أهم النتائج للتحليل المشترك للموقعين فيما يلى:

1 – وجدت إختلافات معنوية بين الموقعين لجميع الصفات تحت الدراسة ، كذلك وجدت إختلافات معنوية بين الهجن القمية والسلالات لجميع الصفات المدروسة فيما عدا صفة عدد السطور فى الكوز.

2 – أعطت الهجن القمية (سلالة-1 x كشاف-1 36,37 أردب/فدان) ، (سلالة-2 x كشاف-1 36,80 أردب/فدان) زيادة معنوية فى محصول الحبوب مقارنة بهجينى المقارنة بينما أنتجت الهجن القمية (سلالة-1 x كشاف-1 36,37 أردب/فدان) ، (سلالة-2 x كشاف-1 36,80 أردب/فدان) ، (سلالة-7 x كشاف-1 35,53أردب/فدان) ، (سلالة-2 x كشاف-2 34,32 أردب/فدان) و (سلالة-7 x كشاف-2 33,50 أردب/فدان) بزيادة غير معنوية مقارنة بالهجين الفردى 166 بينما تفوقت تلك الهجن الثلاثة تفوقاً معنوياً مقارنة بالهجين الثلاثى – 352

(30,20 أردب/فدان) . وبذلك يمكن الإستفادة من هذه الهجن القمية فى برامج تربية الذرة الشامية.

3 – كانت أفضل السلالات للقدرة العامة على التآلف السلالات سلالة-1 ، سلالة-2 ، سلالة-7 لصفة المحصول وبعض المكونات المحصولية الآخرى. بينما أظهرت السلالات السلالة-3 و السلالة-8 قدرة ائتلافية مرغوبة لصفتى التبكير وقصر النبات .

4 – أظهرت النتائج العلاقة بين القدرة الإئتلافية لصفة المحصول والقدرة الإئتلافية لمكونات المحصول حيث أن القدرة على الإئتلاف لصفة المحصول سواء كانت سالبة أو موجبة مرتبطة إرتباطاً مباشراً بالقدرة الإئتلافية لمكونات المحصول فى نفس الإتجاة بمعنى أن السلالة التى تمتلك قدرة إئتلافية عامة موجبة ومعنوية لصفة المحصول فإن هذه السلالة عادة تمتلك قدرة إئتلاف موجبة ومعنوية لمعظم مكونات المحصول الآخرى. وكذلك لو أن أحد السلالات تمتلك قدرة إئتلاف عامة سالبة ومعنوية لصفة المحصول فإنها تشير إلى إمتلاكها قدرة إئتلافية سالبة ومعنوية لمعظم صفات مكونات المحصول الاخرى.

5 – كان التباين الوراثى المضيف أكثر أهمية فى وراثة صفات محصول الحبوب ، طول الكوز ، قطر الكوز وعدد الأيام حتى ظهور حرايرا50% من النباتات. بينما كان التباين الوراثى غير المضيف أكثر أهمية فى وراثة صفتى عدد السطور بالكوز وإرتفاع النبات.

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