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EVALUATION OF SOME EXOTIC YELLOW MAIZE INBRED LINES FOR COMBINING ABILITY USING LOCAL OPEN-POLLINATED TESTERS

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ABSTRACT

The main objective of this study was directed to evaluate combining ability effects of exotic lines, and to determine the mode of gene action, which control, grain yield and its components, as well as some morphological and earliness traits of yellow maize. Thus, four exotic yellow maize inbred lines were top crossed with two local populations as testers. The results from the evaluation of these genotypes revealed that Lines differ in their order performances, when crossed with each of male parent (tester). All top crosses showed significant heterotic effect over their mid and better parents for ear length, number of kernels per row, 100 kernels weight and grain yield per plant. Line 1 (Mv 09) proved to be a good general combiner for earliness, ear height, ear diameter, number of rows per ear and grain yield per plant . Whereas, line 2 (Mo 17) was the best general combiner for tallness, ear length, number of grain/row and grain yield/plant. Tester 2 (Composite 45) was found to be a good general combiner for tallness and most of yield component traits.

The results showed that the magnitudes of additive genetic variance were positive and lower than those of non additive genetic variances for 50% silking, plant height and yield and its components. This fact could be verified by the dominance degree ratio, which was more than one for all traits, indicating that over dominance played a major role in the inheritance of these traits. The promising top crosses, which resulted from exotic lines and local tester exhibited desirable specific combining ability (SCA) effects and high heterotic values. Therefore, these superior crosses offer a good chance for possibility of improving yellow maize in Egypt

INTRODUCTION

Selection of parents is of great importance in breeding programs. Jenkins (1978) stated that the top crossing have been widely used for the preliminary evaluation of combining ability of new inbred lines. Line x tester analysis is an extension of the top cross method in which several testers are used (Kempthorne, 1957). In this respect, AL- Naggar *et al.* (1997) and Amer *et al.* (2003) used single crosses, three way crosses, open–pollinated varieties and inbred lines as tester to evaluate combining ability of newly selected lines and found that inbred lines exhibited a highly significant genetic variation in the progenies of test crosses for most studied traits. Therefore, testers could be used for distinguishing the new inbreds for their combining ability.

Many investigators indicated that additive genetic variance played a major role in the inheritance of yield and it's components (Mostafa *et al.*, 1995, EL-Zeir *et al.*, 2000, Amer *et al.*, 2002 and EL-Shouny *et al.*, 2003).

While, Mosa (2001) and EL-Kady *et al* (2002) concluded that the opposite was true for the same traits . This study was directed to evaluate combining ability effects for exotic lines, and determining the mode of gene action, which control grain yield and its components, as well as some morphological and earliness traits.

MATERIALS AND METHODS

Four exotic yellow maize inbred lines provided by Maize Research Department, Agriculture Research Institute, Hungarian Academy of Sciences, Martonvasar, Hungary were chosen for this study. These lines were named: Mv 09 (L1), Mo17(L2), A632 (L3) and Mv 5414 (L4) . During 2001 season these lines were crossed with two local testers, which were open-pollinated varieties i.e Composite 21 (T1) and Composite 45 (T2), which were supplied by Sakha Agricultral Research Station, Maize Section, ARC, Giza. In 2002 season, eight top crosses and their six parents (4 line x 2 tester) were evaluated at the Experimental Station of Fac. Agric., Mansoura Univ.

These genotypes were arranged in Randomized complete Blocks design with three replications . Plot size was one row, 6 m Long, 80 cm apart and 25 cm between hills. All agricultural field operations were practiced as usual with ordinary field maize cultivation. Data were recorded on ten guarded plants, which were chosen at random in each plot on the following traits : days to 50% silking (50%S), plant height in cm (P.H), ear Length (E.L), ear diameter (E.D), number of rows/ear (N.R/E), number of kernels/row (N.K/R),100 kernels weight in gm (100 K.W) and average grain yield/plant in gm (G.Y/P). Grain yield was adjusted to 15.50 moisture.

The ordinary analysis of variance for all studied traits was made according to Steel and Torrie (1980) . Combining ability analysis was carried out according to Kempthorne (1957) and described by Singh and Chaudhary (1985).

RESULTS AND DISCUSSION

Analysis of variance

Results in Table 1 showed highly significant differences among genotypes (parents and crosses) for all studied traits. Parents vs. crosses mean squares as an indication of average heterosis over crosses were found to be highly significant for all studied traits. Further partitioning of crosses mean squares using the line x tester analysis indicated that while, the difference due to female parents (lines) for all studied traits were highly significant, the male parents (tester) showed insignificant mean squares for days to 50% silking, ear Length and 100 kernels weight. Further more Lines x testers interactions mean squares revealed the presence of highly significant differences for all studied traits, indicating that parents (Lines) differ in their order performance in crosses with each of male parent (tester). These results are in agreement with EL-Zeir *et al.* (2000) and Amer *et al.* (2003).

Table 1: Analysis of variance and mean squares of the four lines, tow testers and their eight top crosses for all studied traits.

S.V	d.f	50%Silk.	P.H	E.I	E.D	N.R/E	N.K/R	100 KW	G.Y/P
Reps	2	28.78	8.59	1.74	1.24	0.09	0.45	3.15	3.17
Genotypes	13	61.87**	3240**	84.62**	24.02**	33.59**	384.3**	125.5**	532.5**
Parents (P)	5	110.32**	2072**	12.46**	19.96**	33.95**	134.99**	39.26**	1454**
Crosses(C)	7	17.06**	1040**	33.45**	2.73**	7.65**	65.08**	19.15**	949.2**
P. vs. C.	1	116.2**	23438**	770.1**	19.07**	105.72**	3800.5**	1282.6**	51856**
Lines (L)	3	24.94**	249.8**	86.71**	3.39**	11.72**	87.89**	31.39**	925.7**
Testers (T)	1	0.67	6112**	0.042	4.17**	4.16**	32.67**	2.67	1418**
L X T	3	20.33**	487.2**	2.99**	2.50**	7.27**	74.78**	18.78**	1132**
Error	26	2.84	15.13	0.53	0.49	1.33	4.58	1.62	6.45

** Significant at 1 % level of probability.

Heterosis

Estimates of heterosis over mid and better parents for all studied traits are presented in Table 2.. High positive values of heterosis would be of interest in m ost t raits, e xcept f or d ays t o 5 0% s ilking, w here h igh n egative values would be desirable from breeder's point of view.

All crosses were significantly taller than their mid parents for plant height when compared to better parent. The crosses (L4 X T1), (L1 X T2), (L2 X T2), (L3 X T2) and (L4 X T2) showed highly significant heterotic effect toward tallness. For days to 50% silking, most of top crosses exhibited significant heterotic effects against mid and better parents. Concerning yield and its components, all top crosses showed significant heterotic effect over their mid and better parents for ear length (EL), number of kernels per row (N.K/R), 100 kernels weight (100 K.W) and grain yield per plant (G.Y/P). However, the heterotic value were desirable highly significant over mid-parents in the case of ear diameter (E.D) and number of rows/ear, it was negative againest the better parent for number of rows/ear in some top crosses (L2 X T1, L3 X T1 and L4 X T1). The heterotic effects were detected previously in yellow maize by Rizk (1992), EL-Diasty (1996) and EL-Kady *et al.* (2002) for most of studied crosses in yield and it´s components.

The obtained high heterotic values expressed in this study reflect high degree of genetic diversity among the parental lines and support the important role of non-additive gene action controlling these traits.

Combining ability

Estimates of general combining ability effects (g_i) of each line and tester are shown in Table 3. The results indicated that L1 (Mv 09) proved to be a good general combiner for earliness, ear height, ear diameter (ED), number of rows per ear (N.R/E) and grain yield per plant (GY/P). Whereas, L2 (M0 17) was the best general combiner for tallness, ear length, number of kernels/row and grain yield / plant.

Tester 1 (Composite 21) was poor general combiner for most studied traits except for earliness. On the contrary, tester 2 (Composite 45) was considered to be a good general combiner for tallness and most of yield components.

Table 2: Estimates of heterosis over mid parents and better parent of each cross for all studied traits

Crosses	50% SilK.		P.H		E.L		E.D		N.R/E		N.K/R		100 K.W		G.Y/P	
	M.P	B.P	M.P	B.P	M.P	B.P	M.P	B.P	M.P	B.P	M.P	B.P	M.P	B.P	M.P	B.P
L1 x T1	2.11	6.32**	24.48**	5.64	47.60**	26.28**	34.30**	13.10**	22.25**	0.00	83.61**	21.50**	77.48**	37.18**	109.83**	20.07**
L2 x T1	0.27	9.95**	17.68**	2.67	108.13**	99.92**	44.25**	15.78**	35.40**	-4.57**	172.66**	84.58**	75.34**	58.65**	207.44**	69.00**
L3 x T1	-1.37	4.68**	25.71**	4.45	58.73**	42.06**	26.70**	0.00	31.21**	-4.57**	76.43**	15.37**	34.48**	23.95**	122.64**	27.87**
L4 x T1	-7.61**	-0.58	56.41**	19.29**	77.27**	44.67**	19.93**	2.60**	5.58**	-13.63**	83.60**	38.44**	58.24**	53.69**	122.53**	31.58**
L1 x T2	-5.88**	6.32**	35.89**	8.99**	60.64**	35.92**	42.45**	17.55**	63.64**	42.07**	134.86**	59.28**	95.81**	49.19**	322.35**	296.40**
L2 x T2	-12.65**	-11.55**	61.24**	32.64**	99.92**	89.77**	30.19**	2.55**	42.72**	5.21**	151.13**	74.53**	46.38**	30.14**	427.70**	213.14**
L3 x T2	-7.93**	-6.25**	47.38**	15.93**	44.96**	28.23**	32.33**	2.55**	31.02**	0.00	170.84**	81.34**	33.32**	20.62**	282.54**	144.72**
L4 x T2	-6.56**	-6.09**	58.29**	15.16**	74.5**	41.00**	34.29**	2.53**	33.36**	15.78**	91.20**	49.11**	45.00**	38.09**	291.21**	162.70**
L.S.D 5%	2.82	2.45	6.57	5.69	1.23	1.07	1.17	1.00	1.93	1.66	3.60	3.10	2.14	1.85	4.25	3.68
1%	3.79	3.29	8.85	7.67	1.66	1.44	1.58	1.36	2.60	2.24	4.85	4.18	2.88	2.49	5.65	4.96

** Significant at 1 % level of probability.

L1, L2, L3 and L4 are Mv 09, M0 17, A 632 and Mv 5414 lines, respectively.

T1 and T2 are Composite 21 and Composite 45 varieties as testers, respectively.

It could be noticed that line 1, line 2 and tesrer 2 may possess desirable genes for improving most studied traits. Thus, these promising inbreds may be utilized in maize breeding program to produce high yielding yellow maize hybrids.

Table 3: Estimates of general combining ability effect (g_i) for the four lines and two testers of all studied traits

	50% Silk	P.H	E.H	E.L	E.D	N.R/E	N.K/R	100 K.W	G.Y/P
L1 (Mv09)	-2.92	-7.29	-7.63	-2.54	0.92	2.08	-2.67	0.92	9.93
L2 (M017)	1.75	6.38	6.04	5.63	0.08	-0.58	5.67	1.08	11.36
L3 (A632)	0.92	-3.46	6.54	-2.04	-0.92	-0.92	-1.17	-3.42	-12.70
L4 (Mv5414)	0.25	4.38	1.04	-1.04	-0.08	-0.58	-1.83	1.42	8.59
SE_{gi} lines	0.75	1.85	0.93	0.25	0.29	0.49	1.02	0.58	1.34
T1(Composite 21)	-0.17	-15.96	-4.29	0.04	-0.42	-0.42	-1.17	0.33	-7.69
T2(Composite 45)	0.17	15.96	4.29	-0.04	0.42	0.42	1.17	-0.33	7.69
SE_{gi} tester	0.53	1.31	0.66	0.18	0.20	0.35	0.72	0.41	0.95

***, ** Significant at 5% and 1% levels of probability, respectively.**

Table 4: Estimates of specific combining ability effect (s_{ij}) of the eight top crosses for all studied traits

Crosses	50% Silk.	P.H	E.I	E.D	N.R/E	N.K/R	100 K.W	G.Y/P
L1 x T1	0.17	4.63	-0.88	-0.25	-1.25	-1.33	-2.17	-20.5
L2 x T1	2.17	-12.38	0.29	0.92	0.75	4.00	2.00	8.42
L3 x T1	0.00	-0.54	0.63	-0.08	1.08	-4.17	-0.50	6.95
L4 x T1	-2.33	8.29	-0.04	-0.58	-0.58	1.50	0.67	5.14
L1 x T2	-0.17	-4.63	0.88	6.25	1.25	1.33	2.17	20.5
L2 x T2	-2.17	12.38	-0.29	-0.92	-0.75	-4.00	-2.00	-8.42
L3 x T2	0.00	0.54	-0.63	0.08	-1.08	4.17	0.50	-6.95
L4 x T2	2.33	-8.29	0.04	0.58	0.58	-1.50	-0.67	-5.14
SE s_{ij}	1.06	2.62	0.35	0.40	0.69	1.45	0.82	1.90

***, ** Significant at 5% and 1% levels of probability, respectively.**
L1, L2, L3 and L4 are Mv 09, M0 17, A 632 and Mv 5414 lines, respectively.
T1 and T2 are Composite 21 and Composite 45 varieties as testers, respectively.

Estimates of SCA effects (S_{ij}) of the eight top crosses for all studied traits are presented in Table 4. The results indicated that the top crosses (L4xT1) and (L2xT2) which were a result of crossing (poor x poor) and (good x good) general combiners, respectively were the most promising for both earliness and tallness. The top cross (L2 X T1) and (L1 X T2), including two good general combiners, showed desirable SCA effects for yield and its component traits. It's worthily to notice that the promising crosses, which exhibited desirable SCA effects, revealed as previously mentioned high heterotic values. Thus, the excellent cross combinations were obtained from (good x good), (poor x good) and (poor x poor) general combiners. Therefore, it is not necessary that parents having high estimates of GCA effects would also give high estimates of SCA effects in their respective cross combinations. The same trend was observed earlier by Abd EL-Maksoud (1997) and EL- Morshidy *et al.* (2003).

Gene action

Estimates of additive (σ^2A), non additive (σ^2D) variances and degree of dominance ($\sigma^2D/\ \sigma^2A$) are given in Table 5. The results showed that the magnitudes of additive genetic variance (σ^2A) were positive and lower than those of non additive genetic variances (σ^2D) for 50% silking, plant height and yield and its components. This fact could be verified by the ratio ($\sigma^2D/\ \sigma^2A$) which was more than one for all traits, indicating that non additive gene action played a major role in the inheritance of these traits. These results are in good agreement with those obtained by El-Zeir *et al* (2000), Soliman *et al* (2001) and El-Morshidy *et al.* (2003). This finding explains the presence of heterosis over mid and better parents in most top crosses for all studied traits.

In conclusion, parents vs. crosses mean squares were highly significant, supporting high estimates values of heterosis for all studied traits. This finding insures the existence of high degree of genetic diversity between the exotic lines and the local testers. Consequently, the promising top crosses, resulted from exotic lines and local tester exhibited desirable SCA effects and high heterotic values. Therefore, these superior crosses offer a good chance for possibility of improving yellow maize production in Egypt.

Table 5: Estimates of additive and dominance genetic variances for all studied traits.

Genetic Parameters	50%Silk.	P.H	E.L	E.D	N.K/E	NK/R	100 K.W	G.Y/P
σ^2_A	0.92	106.2	4.29	0.20	0.53	3.69	1.30	51.04
σ^2_D	5.65	155.5	0.70	0.67	1.94	22.83	5.57	373.99
$(\sigma^2_D/\sigma^2_A)^{0.5}$	2.48	1.21	0.40	1.84	1.91	2.49	2.07	2.71

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تقييم بعض سلالات الذرة الصفراء المستوردة لقدرتها علـى التـآلف بإسـتخدام كشافات محلية مفتوحة التلقيح

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تهدف هذه الدراسة إلى تقييم بعض سلالات الذرة الصفراء المستوردة لقدرتها على التالف وتحديد طبيعة الفعل الجينى لمحصول الحبوب ومكوناته بالإضافة إلى بعض الصفات المورفولوجية والتبكير ومن أجل هذا الهدف إستخدم أربعة سلالات من الذرة الصفراء والتى تم تلقيحها قميا مع أثنين من الكشافات المحلية مفتوحة التلقيح.

- وتشير النتائج المتحصل عليها من تقييم هذه التراكيب الوراثية إلى إختلاف السلالات من حيث سلوكها مع الكشاف. أظهرت كل الهجن القمية الناتجة قوة هجين معنوية بالمقارنة بمتوسط الآباء وأفضل الآباء لصفة طول الكوز ، عدد الحبوب فى الصف ، وزن مائة حبة ومحصول الحبوب للنبات. فقد تبين أن السلالة رقم ١ (Mv09) أحسنهم فى القدرة العامة على التآلف لصفات التبكير ، إرتفاع الكوز ، عدد الحبوب للكوز و محصول الحبوب للنبات. بينما السلالة رقم ٢ (M017) هى الأفضل فى القدرة العامة على التآلف لطول النبات ، طول الكوز وعدد الحبوب للصف وأيضا" محصول الحبوب للنبات. وكان الكشاف رقم ٢ (الصنف التركيبى ٤٥) هوالأفضل للقدرة العامة على التآلف لصفة طول النبات ومعظم صفات المحصول.

أظهرت النتائج أيضا" ان قيم التباين الوراثى الإضافى كانت موجبة وأقل من قيم التباين الوراثى الغير إضافى لصفة عدد الأيام لظهور ٥٠ % حريرة ، طول النبات والمحصول ومكوناته. مما يشير إلى مساهمة كل من الفعل الجينى الإضافى و الغير الإضافى فى توريث هذه الصفات بينما الفعل الجينى الغير اضافى خاصة السيادة الفائقة (حيث ان درجة السيادة كانت أكبر من الواحد الصحيح لهذه الصفات) تلعب الدور الرئيسى فى توريث هذه الصفات.

أظهرت الهجن القمية المبشرة قدرة خاصة على التآلف مرغوبة وقوة هجين عالية ولذلك يمكن إستخدامها لتحسين إنتاجية الذرة الصفراء فى مصر.