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Combining ability for yield and maturity traits in elite inbred lines of maize (*Zea mays* L.)

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ABSTRACT

Line x tester analysis involving 15 females and 3 males from diverse origin was carried out in maize inbreds. Analysis of variance and estimates of the components of genetic variance revealed that significant differences existed among the lines and lines x testers for all the traits. Based on estimated, higher magnitude of s^2sca in relation to s^2gca implied the greater importance of non-additive gene effect than additive gene effect for all traits thus favour by hybrid production. None of the parents/crosses was found to be good general/specific combiner for all traits, 1391, 151A and 142A were good general combiners for grain yield. Crosses viz., 139A x 153A, 106C-2 x C-6, 106C-1 x Super 1 and 106C-1 x 153A showed significant and highest sca effects as well as better parent heterosis. Such crosses are suited to be used directly in hybrid production programmes in order to utilize the hybrid vigour. The promising crosses were the result of High x Low or High x Medium general combiners as parents.

Key words : Combining ability, Heterosis (*Zea mays* L.).

INTRODUCTION

Maize (*Zea mays* L.) is the third most important cereal crop in India next to rice and wheat. It is joint significant importance on account of its growing demand for diversified end uses, especially feed and industrial uses. Hybrid vigour in maize has assumed tremendous significance in view of spectacular yield increase achieved through maize hybrid. The grain yield is the primarily trait targated for improvement in both favourable and unfavourable environments from its present level. In unfavourable environment early maturing genotypes may play an important role for improvement in grain yield. The present investigation was therefore, undertaken to assess both gca and sca for maturity and yield contributing traits and identify best general combiner inbred lines and also the best hybrids with respect to sca effects and economic heterosis for grain yield.

MATERIALS AND METHODS

Fifteen diverse, vigorous and productive maize inbred lines viz., 102D, 102A-2, 106 B, 106C-1, 132C-2, 132C, 139A, 139B, 140 E-2, 141 B-1, 142 A, 146B, 147C, 150B and 151A coded as L_1, L_2, L_3, L_4, L_5, L_6, L_7, L_8, L_9, L_{10}, L_{11}, L_{12}, L_{13}, L_{14} and L_{15} three well adapted of varying genetic base viz., T_1 (C_6) composite, T_2 (Super-1) synthetic and T_3 (153A) inbred line were crossed in line x tester design during kharif 2004 at K.D. Research Farm SKUAST-K, to generate 45 hybrids. (Table 2) and three well adapted testers of varying genetic base viz., T_1-(C-6), T_2-(Super-1) T_3 (153A) were crossed in line x tester design during kharif 2004 to generate a total of 45 hybrids. These 45 hybrids with 18 parents were planted in randomised block design with 3 replication in a single row plot of 5 meters length having 60 x 25 cm crop geometry during kharif 2005 at K.D. Research Farm SKUAST-K, . The data was recorded on maturity and yield contributing traits on ten randomly selected competitive plants. Heterosis was calculated as per standard procedure and combing ability analysis was done according to procedure of Kempthorne (1957).

RESULTS AND DISCUSSION

Analysis of variance revealed highly significant mean square differences for all the traits among cross (Table 1) reflecting thereby presence of adequate genetic diversity in material chosen for study. Mean square due to parent v/s crosses were also significant for most traits thus confirming result of Choudary and Choudhary (2002). Analysis of variances for line x tester effect was significant for all the traits. Similarly line effects revealed significant mean squares for all traits except ear height. Variance due to sca was significant for all the traits whereas variance due to gca was also significant for most traits except days to 50 per cent anthesis, ear girth and number of kernel rows per ear^{-1}. Based on the estimates higher magnitude of σ^2gca in relation to σ^2gca implied the greater importance of non-additive gene effects for maturity related traits, grain yield and its component traits. Prevalence of greater magnitude of non additive genetic component of variance relative to additive in present study

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favours production of hybrid cultivars. The results are in agreement with earlier results of (Joshi *et al*. 2002 and Dubey *et al*. 2001).

Evaluation of parents and their forty five F_1 hybrids was carried out to determine nicking ability the analysis of combining ability effects revealed that none of the parent possessed desirable gca for all the traits (Table 2). However, desirable and significant gca effect for grain yield was revealed by lines 139A, 151A, 142A and 147C. Regarding maturity related traits lines 132 C, 139B and 146B whereas, for yield component traits 147C (ear length), 106 C-2 and 102A2 (100-grain weight) 106 C-1 and 102A-1 ear girth showed desirable and significant gca effects, respectively. These parents should be extensively used in crossing programme to exploit maximum genetic variability and isolate transgressive segregant for grain yield and its components. The estimates of specific combining ability (Table 3) revealed the none of the cross combination exhibited superior sca effects for all traits for grain yield sixteen cross combinations showed desirable and significant sca effects and among them 139A x 153A, 132C-2X C6, 106C-IX Super1, 106C-1x153-A and 102A x super-1 showed significant sca effects as well as better parental heterosis. The hybrids however, showed inconsistent correspondence with mean *per se* performance thus confirming the results of Sain Dass and Arora (1998). Those crosses with significant positive sca effect and better parental heterosis could be fruitfully exploited for hybrid production. Sedham (1994) also opined the importance of sca for exploitation of hybrid production.

The promising crosses were the result of high x low or high x medium general combines as parents and confirmed earlier reports of Venkatesh *et al*. (2005). It could be explained on the basis that lines were having divergent gene complexes for all the traits and under heterozygous condition resulted in high heterosis due to accumulation of divergent gene complexes at different loci. The result, therefore, revealed that high gca value of a parent is no guarantee of high sca effect of their crosses and conforming the earlier reports of Dubey *et al*., (2001).

139A x 153A single cross hybrid involving inbred tester was identified as superior most combination with respect to maturity and yield. The cross, therefore, merits extensive testing to verify stability of its performance for commercial exploitation. The results of the present study suggest that heterosis coupled with high sca effects may be considered as a criterion for selecting the best cross combination for further improvement of grain yield in maize.

Table 1 : Analysis of variance (mean squares) for combining ability for different traits in line x tester cross of maize (*Zea mays* L.).

Source of variation	d.f.	Days to 50% silking	Days to 50% husk browning	Ear length (cm)	Ear girth (cm)	Kernel row ear^{-1}	Kernels row^{-1}	100-grain weight	Grain yield (q/ha)
Replication	2	6.466*	13.340**	1.066	0.496	1.207	1.451	13.540**	8.022
Crosses	44	2.900**	8.605**	12.190**	4.206**	5.628**	42.438**	43.037**	371.130**
Line effect	14	6.257**	14.093*	17.377*	5.9997*	-8.102*	68.235*	52.213*	562.457*
Tester effect	2	0.155	4.140	33.066*	11.562*	19.340*	19.874	231.607**	532.466
Line x tester effect	28	1.417**	61.80**	8.105**	2.785**	3.412**	31.151**	24.980**	263.942**
Error	88	0.413	0.181	1.172	0.958	0.957	2.254	1.555	13.135
Total	134	1.320	3.144	-4.789	2.018	2.494	15.437	15.355	130.609
σ^2_{line}		0.649*	1.545*	1.800*	0.559*	0.793*	7.331*	5.628*	61.035*
σ^2_{Tester}		-0.005	0.088	0.708*	0.235	0.108	0.391	5.112*	11.540**
σ^2_{gca}		0.103*	0.330*	0.890**	0.289*	0.472*	1.548*	5.198*	19.789*
σ^2_{sca}		0.334**	1.999*	2.311**	0.608**	0.818**	9.632**	7.808**	83.602**
σ^2_A (F-0.75)		0.045	6.730	0.389	0.126	0.206	0.677	2.274	8.658
σ^2_D (F=0.75)		0.253	108.472	1.769	0.466	0.026	7.374	5.077	64.005

**significant at 5%, *, significant at 1%

Table 2 : Estimates of general combining ability effects for maturity, yield and yield contributing traits in maize (*Zea mays* L.).

Pedigree	Code	Days to 50% silking	Days to 50% husk browning	Ear length (cm)	Ear girth (cm)	Kernel row ear^{-1}	Kernels row^{-1}	100-grain weight (g)	Grain yield q/ha^{-1}
102A-1	L_1	0.200	-0.709**	2.178**	1.096**	0.193	2.615**	-2.526**	-0.156
102A-2	L_2	0.422	0.615**	-0.156	0.430	-0.130	1.504**	4.030**	-12.378**
106-B	L_3	1.533**	-1.163**	0.178	-1.459**	-0.807*	1.281*	-1.193*	-10.378**
106 C-1	L_4	-0.800**	2.948**	0.178	1.430**	-1.474**	-0.941	-3.415**	0.178
106 C-2	L_5	-0.244	-0.385*	-3.489**	-0.570	0.193	-1.607**	4.141**	-0.489
132-C	L_6	-1.689**	0.615**	1.178**	-0.570	0.193	-0.385	0.585	-14.489**
139 A	L_7	-0.22	2.170**	0.511	0.874*	-0.474	2.948**	-2.526**	14.178**
139 B	L_8	-1.578**	-0.496**	-1.267**	-0.570	2.526**	-5.052**	2.807**	2.178
140E-2	L_9	0.422	-0.163	-0.378	-0.237	-0.141	1.615**	1.141*	3.844**
141B-1	L_{10}	0.200	-0.941**	-0.489	-0.237	-0.807*	-1.052	-1.193*	0.289
142 A	L_{11}	0.756**	-1.052**	0.844*	0.096	-0.141	2.281**	1.252**	6.511**
146 B	L_{12}	0.422	-1.274**	-0.822*	-0.904*	1.193**	-0.385	-2.748**	-3.489*
147 C	L_{13}	0.311	1.059**	2.178**	0.763*	-0.141	2.615**	0.141	5.511**
150 B	L_{14}	0.200	-0.607**	-0.489	-0.571	0.526	0.948	0.696	-1.156
151 A	L_{15}	-0.133	-0.607	-0.156	0.430	-0.807*	-6.385**	-1.193*	9.844**
Standard error									
gca (line) ±		0.214	0.142	0.361	0.326	0.326	0.500	0.415	1.208
gi-gj (line) ±		0.303	0.200	0.510	0.461	0.461	0.707	0.588	1.708

**significant at 5%, *, significant at 1%

Table 3 : Estimates of specific combining ability for grain yield and component traits with better parental heterosis of selected crosses.

Code	Days to 50% silking	Days to 50% gene grain	Ear length	Ear girth	Kernel row ear^{-1}	Kernels row^{-1}	100-grain weight	Grain yield q/ha	Heterosis grain yield q/ha (%)
L_7 x T_3	-1.067*	1.119**	0.356	-0.230	0.659	0.719	0.415**	16.355**	77.083
L_5 x T_1	0.578	1.941**	1.622	0.881	0.007	0.430	2.259**	14.089**	41.666
L_4 x T_2	-0.178	0.719*	0.356	0.237	0.958	1.296	3.452**	12.778**	39.583
L_4 x T_3	-0.622	1.007**	-0.311	-1.119	0.659	1.059	2.637**	12.356**	35.416
L_7 x T_1	0.689	-0.948**	0.622	0.437	0.674	0.126	0.074	10.578**	27.083
L_1 x T_2	0.156	-0.281	2.356**	-0.430	2.319**	3.741**	0.341	10.556**	25.000
L_8 x T_2	-0.733	-0.837**	0.467	0.237	0.015	6.259**	3.326**	10.222**	25.00
L_{11} x T_1	-0.422	-0.059	0.289	0.215	0.341	0.541	5.481**	10.089**	20.833
L_6 x T_3	1.267*	-0.326	-0.311	1.881*	1.674*	2.948**	0.069**	10.022**	14.583
L_9 x T_2	-0.067	0.496*	-0.756	-0.096	-0.348	2.259*	1.993**	8.556**	11.166
Standard error									
Sca (sij) ±	0.371	0.246	0.625	0.565	0.554	0.867	0.139	2.092	
Sij-skjl ±	0.525	0.348	0.884	0.799	0.799	1.226	0.197	2.959	
Sij-Sik ±	1.212	0.803	2.042	1.846	1.845	2.831	0.445	6.834	

**significant at 5%, *, significant at 1%

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