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COMBINING ABILITY ANALYSIS FOR YIELD AND ITS CONTRIBUTING TRAITS IN MAIZE (*ZEA MAYS* L.)

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ABSTRACT

Hybrids were synthesised in a 11 x 11 diallel fashion excluding reciprocals and analysis of combining ability was undertaken for yield and its component traits in maize. Non-additive genetic variance played a preponderant role in the inheritance of plant height, leaf length, number of grains per row and seed yield per plant. Based on general combining ability, parent UMI 757 was found to be a good combiner for improving yield and yield contributing traits. Three cross combinations *viz.,* UMI 852 x UMI 615, UMI 852 x UMI 577 and UMI 852 x UMI 556 had highly significant *sea* effect for most of the yield contributing traits.

INTRODUCTION

Combining ability analysis is considered a very useful technique in classifying parental lines according to their potential to yield good hybrids and to aid in selecting parents which when crossed could give rise to better segregants in later generations. The first attempt to utilise varietal hybrids in maize (*Zea mays* L.) for increasing yield was made by Beal (1980). Interest in the heterotic patterns of varietal crosses was limited during the early stages of commercial use of double crosses and single crosses, but it witnessed a spurt after 1950 with the understanding of the theoretical background of recurrent selection.

After the attempts of Lonnquist and Gardner (1961) and Moll *et al.* (1962), variety or population diallel has been widely used to evaluate genotypes for several traits with the primary emphasis on yield. In the present study, an attempt has been made to examine the combining ability of some maize accessions and their hybrids.

MATERIAL AND METHODS

Genetic material for the present investigation comprised of 11 maize inbred lines *viz.,* (UMI-946, UMI-852, UMI-757, UMI-679, UMI-615, UMI-577, UMI-556, UMI-532, UMI-497, UMI-470 and UMI-438) and hybrids generated by crossing the above inbreds in all possible combinations excluding reciprocals. The 11 parents and 55 hybrids, along with check hybrid CoH3, were raised in RBD with three replications at Millet Breeding Station, Tamil Nadu Agricultural University, Coimbatore during *kharif* 2001. All the management practices were followed uniformly. Observations on six yield contributing characters *viz.,* plant height, leaf length, ear length, ear diameter, number of grains per row and seed yield per plant were recorded on five randomly selected plants per genotype per replication. The observations were subjected to combining ability analysis by Griffing's (1956) model II method 2, which is a fixed effects model.

RESULTS AND DISCUSSION

Analysis of variance indicated that variance due to parents was significant for the characters plant height, leaf length and seed yield per plant which indicated the existence of considerable variation among the parents for these characters. In case of hybrids, considerable variation was noticed for all the characters studied, as indicated by the significance of variance due to hybrids for all the characters (Table 1). Variance due to general combining ability (GCA) and specific combining ability (SCA) were significant for plant height, leaf length, number of grains per row and seed yield per plant. This indicates

Table 1. Analysis of variance (MS) for combining ability

Source	df	Plant height	Leaf length	Ear length	Ear diameter	Number of grains per row	Seed yield per plant
Replication	2	602.91**	89.63*	1.69	0.04	19.24	24.24
Progenies	65	1549.41**	160.09**	20.19**	0.42**	156.44**	44.51
Parents	10	997.74**	176.86**	8.22	0.20	30.04	747.67
Hybrids	54	808.37**	105.06**	16.14**	0.34**	51.16**	1253.78
Parents vs Hybrids	1	47082.30**	2964.32**	359.14**	0.99**	7105.59**	21577.89**
Error	130	121.12	22.47	6.664	0.10	21.96	280.29
GCA	12	539.26	72.26	2.53	0.03	14.01	495.78
SCA	55	512.35	49.93	4.32	0.42	51.60	1663.55
Error	130	40.38	7.49	0.662	0.10	3.68	93.44

** - Significant at 0.01 per cent;
* - Significant at 0.05 per cent.

that both additive and non-additive gene action are important in controlling the expression of these characters. This is in accordance with the results of Rao *et al.* (1996) and Mahato and Ganguli (2003).

GCA variance, which is indicative of additive and additive x additive gene action, was found to be preponderant for the characters plant height and leaf length. In case of number of grains per row and seed yield per plant predominance of non-additive gene action was indicated by the estimate of SCA variance, which was greater than GCA variance. So for improvement of these traits, heterosis breeding and pedigree breeding can be resorted to. In case of ear diameter, negative variance of additive effect might be due to inflation of the environmental component. Predominance of non additive gene actions for the above characters was reported by several authors (Damborsky *et al.*, 1994; Joshi *et al.*, 1998; Mathur *et al.*,1998, Kumar *et al.*, 1999 and Mahato and Ganguli, 2003). Thus the genetic material available in the present study is suitable for evolving desirable hybrids as well as synthetics. In the later case, some sort of intermating within segregating progenies at various stages would be more desirable to harness additive and additive x additive type of variance.

Estimation of general combining ability effects (*gca*) effects of eleven parents indicated that parent UMI 757 had highly significant *gca* for five of the six characters studied while for plant height, it had positive *gca*. Comparison of *gca* with the *per se* performance of the genotype provides a wholesome view of its breeding worth. In the present study, it was noticed that for most of the characters, *per se* performance and magnitude of *gca* corresponded well for the parent UMI 757. Hence this parent can be employed in breeding programmes for overall improvement. The next best choice would be UMI 946, which had significant *gca* for three and positive *gca* for two characters. This parent will be better suited if the aim is primarily to improve yield. In case of the parent UMI 438, *gca* effects were significant in the negative direction for most of the characters.

Among the 55 hybrids, UMI 852 x UMI 615, UMI 852 x UMI 577 and UMI 852 x UMI 556 had highly significant *sea* effect for all the characters. Even though UMI 852 had highly significant negative *gca* for plant height and poor *per se* performance, it has contributed favourably in many crosses. Further, these combinations involved one good combiner and one poor combiner for seed yield. Such occurrence of good hybrids by the

Table 2. Estimates of general combining ability (*gca*) of parents

Source	Plant height	Leaf length	Ear length	Ear diameter	Number of grains per row	Seed yield per plant
UMI 946	8.06**	2.16**	0.22	0.03	-0.02	7.10**
UMI 852	-8.14**	4.00**	-0.37	0.13**	-0.19	6.10*
UMI 757	1.69	3.69**	0.69**	0.15**	1.97**	7.79**
UMI 679	-0.30	-0.39	-0.21	-0.02	-0.34	-1.77
UMI 615	-2.11	-2.28**	-0.24	-0.18**	-0.07	-0.77
UMI 577	2.88	-0.09	0.44*	-0.06	-1.43**	-4.87**
UMI 556	13.30**	0.16	-0.18	0.05	0.24	-1.49
UMI 532	-1.53	-1.67*	0.32	-0.10*	-0.17	-3.26
UMI 497	-4.93**	-2.65**	-0.19	-0.01	0.18	-7.99**
UMI 470	-0.96	-0.51	-0.07	0.02	1.43	7.68
UMI 438	-7.96**	-2.42**	-0.90**	0.00	-1.59**	-8.44**
SE(gi)	1.68	0.724	0.215	0.049	0.507	2.556

** - Significant at 0.01 per cent;
* - Significant at 0.05 per cent.

Table 3. *Per se* performance and *sca* of some promising crosses

Crosses	Plant height		Leaf length		Ear length		Ear diameter		No. grains per row		Seed yield per plant	
	Per se	*sca*	*Per se*	*sca*	*Per se*	*sca*	*Per se*	*sca*	*Per se*	*sca*	*Per se*	*sca*
UMI 852 x UMI 615	172.58	18.43**	92.30	13.02**	19.18	2.08**	4.76	0.66**	38.23	4.39**	165.40	42.49**
UMI 852 x UMI 577	183.48	34.17**	87.67	6.20**	19.07	1.76**	4.60	0.44**	42.17	9.70**	169.36	50.55**
UMI 852 x UMI 556	184.59	15.03**	87.84	6.12**	18.77	2.08**	4.62	0.30**	40.96	6.82**	155.78	33.59**
UMI 757 x UMI 615	191.06	27.08**	84.96	5.98**	18.82	0.64*	4.04	-0.07	39.46	3.46**	152.91	28.31**
UMI 757 x UMI 497	175.98	14.81**	77.84	-0.76	20.51	2.76**	4.81	0.53**	42.42	6.18**	163.63	46.25**
UMI 61 5 x UMI 470	179.17	17.83**	75.93	1.16	18.50	1.09**	4.47	0.48**	38.67	3.12**	171.13	46.64**
UMI 556 x UMI 470	214.82	38.07**	85.04	7.83**	17.43	0.44	4.58	0.36**	39.82	4.06**	152.70	28.92**
SE	6.30		2.18		1.48		0.18		2.68		18.80	
CD (at 5% level)	12.35		4.26		2.89		0.36		5.26		18.80	

** - Significant at 0.01 per cent;
* - Significant at 0.05 per cent.

combination of one good and one bad combiner may be due to accumulation of favourable genes and partly due to dominance and recessive interaction (Duhoon *et al.*, 1983). Biparental mating can be adopted in such combinations so as to realise transgressive segregants. Between two parents chosen based on *gca*, UMI 757 was found to be involved in several combinations with high *sea* for more than three characters.

Some cross combinations resulted due to crossing between parents with poor *gca* and yet the hybrids had highly significant *sea*. These could be because of cancellation of undesirable effects (Duhoon *et al.*, 1983 and Sambamurthy and Ranganadhacharyaly, 1999). In such combinations, to obtain better productive segregants, selection may be postponed to later generation.

Thus based on *gca*, the inbred UMI 757 could be a better choice for improvement of yield and component traits through hybridisation. The crosses UMI 852 x UMI 615, UMI 852 x UMI 577 and UMI 852 x UMI 556 which had highly significant *sca* effect for most of the yield contributing traits may be exploited for the development of single cross hybrids and also through the population improvement programme for the development of suitable high yielding composite varieties after knowing the extent of depression which inbreeding could reign in the F_2 and subsequent generations.

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