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Diallel analysis of inbred lines in maize (*Zea mays* L.)

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ABSTRACT
A diallel analysis with eight diverse inbreds revealed highly significant GCA and SCA variances indicating importance of additive and non-additive gene action for all the traits. The estimated components of SCA variances were higher in magnitude for all the traits except plant height and days to maturity, indicating the predominance of non-additive or dominant gene action. The inbreds Pant 7421-S_6-194-3-⊗-#, Jogia local-S_6-2-1⊗-# and M9-S_6-11-⊗-# were a good general combiners for majority of the characters which gave high gca effects for yield per plant with positive and significant gca effects for many of the yield characters. The crosses (M9 x CM 601) S_6-7-8-⊗-# x Pant 7421-S_6-194-3-⊗-#, AB (W)S_5-3-2-⊗-# x Jogia local S_6-2-1-⊗-#, Jogia local S_6-2-1-⊗-# x CM 601-S_5-8-7-⊗-#, (CM 400 x CM 300)-S_5-⊗-# x CM 601-S_5-8-7-⊗-# and M9-S_6-11-⊗-# x Pant 7421-S_6-194-3-⊗-# exhibited significant SCA effects for grain yield and some other characters. It is proposed that inbred Pant 7421-S_6-194-3-⊗-#, Jogia local S_6-2-⊗-# and M9-S_6-11-⊗-# may be utilized to exploit additive and additive x additive type of gene action, whereas the hybrids M9-S_6-11-⊗-# x Pant 7421-S_6-194-3-⊗-# and (M9 x CM 601) S_6-7-8-⊗-# x Pant 7421-S_6-194-3-⊗-#, x manifested significant sca effect which could be more rewarding in a hybrid breeding programme.

Key words : Combining ability, Maize, *Zea mays* L.

INTRODUCTION

Combining ability analysis is one of the useful genetical tool which gives the estimate of combining ability effects and provides a guide line to select desirable parents and crosses for further exploitation. The present investigation was, therefore, undertaken with eight maize inbreds on the basis of genetic divergence, from the fifty-five inbred lines, developed under All India Coordinated Maize Improvement Project, at T.C.A. Dholi, to meet the diallel and estimate the combining ability effects.

MATERIALS AND METHODS

Selected eight diverse inbred lines (Table 1) were crossed in all possible combinations, excluding reciprocals at the maize breeding plot of Tirhut College of Agriculture Dholi Farm. The 28F_1S, eight parents and 4 hybrids viz., CM 400 x CM 300, CM 202 x CM 211, RH-1 and RH-2 served as checks hybrids were planted in RBD with 3 replications. Each entry was planted in a two-row plot of 5 m length with spacing of 75 cm x 25 cm. Observations were recorded on randomly competitive selected ten plants from each entry in each replication for the days to 75 per cent tassel, days to 75 per cent silk, days to maturity, plant height, ear length, ear diameter, kernel rows per ear and yield per plant. Combining ability effects and variance were worked out by following methods 2, model I of Griffing (1956).

Table 1 : Composition of clusters based on D^2- Statistics of fifty-five inbred lines of Maize

Cluster	No. of inbred lines included	Line included in clusters with their pedigree
I	9	CM 601-S_5-1-8-⊗-#, CM 601-S_5-2-2-⊗-#, CM 300-S_5-1-⊗-#, AB(W)-S_5-3-2-⊗-#, AB(W)-S_5-4-2-⊗-#, M_9 X CM 601-S_6-2-⊗-#, X_1-S_5-10-1-⊗-#, Across 8331-S_5-76-1-⊗-#, Pant 7421-S_6-107-1-⊗-#,
II	16	CM 601-S_5-2-3-⊗-#, CM 601-S_5-87-⊗-#, AB(W)-S_5-4-3-⊗-#, M_9-S_5-2-1-⊗-#, M_9-S_5-62-2-⊗-#, M_9 X CM 601-S_5-1-⊗-#, X_1-S_5-9-3-⊗-#, Across 8331-S_5-18-1-⊗-#, Across 8331-S_5-63-1-⊗-#, M_9 X CM 400-S_5-14-2-⊗-#, Pant 7421-S_5-76-1-⊗-#, Pant 7421-S_6-133-3-⊗-#, Pant 7421-S_6-166-1-⊗-#, Pant 7421-S_6-194-3-⊗-#, Pant 7421-S_6-228-1-⊗-#, Pant 7421-S_6-238-2-⊗-#,
III	9	CM 601-S_5-14-1-⊗-#, CM 601-S_5-14-2-⊗-#, CM 601-S_5-14-3-⊗-#, M_9-S_6-11-1-⊗-#, AB(W)-S_5-5-2-⊗-#, M_9-S_5-37-2-⊗-#, Across 8331-S_5-71-1-⊗-#, Jogia local –S_6-2-1-⊗-#, Pant 7421-S_6-22-1-⊗-#,
IV	11	M_9-S_6-36-1-⊗-#, M_9-S_6-37-1-⊗-#, M_9 -S_5-37-3-⊗-#, M_9 X CM 601-S_6-7-8-⊗-#, Across 8331-S_5-3-2-⊗-#, Across 8331-S_5-68-1-⊗-#, M_9 X CM 400-S_6-2-1-⊗-#, M_9 X CM 400-S_6-14-1-⊗-#, Jogia local-S_6-78-⊗-#, CM400 X CM 300-S_5-⊗-#, Pant 7421-S_6-93-1-⊗-#,
V	10	CM 601-S_5-1-2-⊗-#, CM 601-S_5-2-8-⊗-#, AB(W)-S_5-4-4-⊗-#, M_9 X CM 601-S_6-6-8-⊗-#, Across 8331-S_5-3-3-⊗-#, Jogia local –S_6-12-1-⊗-#, Jogia local –S_6-72-1-⊗-#, Jogia local –S_6-72-2-⊗-#, Jogia local –S_6-75-⊗-#, Pant 7421-S_6-129-1-⊗-#,

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RESULTS AND DISCUSSION

Combining ability analysis (Table 2) revealed that mean squares due to general and specific combining ability (GCA and SCA) were highly significant for all the characters indicating that both additive as well as non-additive type gene actions were involved in the control of these characters. The estimated components of SCA variance were higher than GCA variance for all the traits studied except plant height and days to maturity, indicating predominant role of non-additive gene action in the inheritance of these traits. However, for plant height and days to maturity , additive gene action was predominant. These results were in conformity with the earlier views findings of Sharma and Bhalla (1993) in maize.

The GCA effects with *per se* performance of the parents are given in Table 3, showed that the parents Pant 7421-S_6-194-3⊗-#, Jogia local S_1-2-1⊗-# and M9-S_1-11-1⊗-# were best general combiners for majority of the traits. All other parents were poor combiners possessing significant and negative GCA effects for at least one or two of the traits studied. It was observed that parents having best *Per se* performance also happened to be best general combining for days to 75 per cent tassel, days to maturity, ear length, kernel rows *per se* and yield per plant. However, this was not true for other traits Singh *et al*. (2002) gave similar conclusion in this crop.

Table 2 : Analysis of variance of combining ability of eight quantitative characters in maize

Source	d.f.	Mean squares							
		Days to 75 % tassel	Days to 75% silk	Days to maturity	Plant height	Ear length	Ear diameter	Kernel rows per ear	Grain yield per plant
GCA	7	7.87**	7.94**	20.33**	214.09**	2.37**	0.35**	2.04**	135.29**
SCA	28	10.09**	12.33**	8.67**	126.45**	3.98**	0.42**	4.02**	301.88**
Error	10	0.73	1.08	0.80	10.89	0.70	0.02	0.25	7.64

** Significant at 1 per cent level of probability.

Table 3 : Estimates of general combining ability effects and mean performance of the eight attributes in maize.

Parents	Days to 75 % tassel		Days to 75 % silk		Days to maturity		Plant height	
	GCA effects	Mean	GCA effects	Mean	GCA effects	Mean	GCA effects	Mean
(M 9 x CM 6001) S_6-7-8-⊗-#	0.47	132.67	0.52	135.33	-0.03	185.67	-2.15**	150.25
Across 8331 S_5-3-3-⊗-#	0.00	130.67	-0.08	134.33	-0.57*	185.33	-1.43	169.33
AB(W) S_5-3-2-⊗-#	0.27	131.67	-0.08	135.67	0.47	186.00	0.80	159.51
M9-S_6-11-⊗-#	1.07**	134.33	1.06**	137.33	1.93**	191.00	-7.69**	137.82
CM 400 x CM 300-S_5-⊗-#	0.50*	132.33	0.19	134.00	0.27	184.33	1.33	158.47
Jogia local S_6-2-1-⊗-#	1.40**	128.00	-1.21**	131.67	-2.37**	182.00	2.27*	159.32
Pant 7421-S_6-194-3-⊗-#	-1.13**	132.00	-1.34**	135.33	-1.30**	184.33	8.58**	157.82
CM 601-S_5-8-7-⊗-#	0.77**	131.67	0.92**	135.67	1.60	185.67	-1.69	152.46
S.E.(gi) ±	0.25		0.31		0.26		0.98	
S.E. (gi-gi) ±	0.38		0.46		0.40		1.48	

Parents	Ear Length		Ear diameter		Kernel rows per ear		Grain yield per plant	
	GCA effects	Mean	GCA effects	Mean	GCA effects	Mean	GCA effects	Mean
(M 9 x CM 6001) S_6-7-8-⊗-#	-0.65**	7.93	-0.07*	2.77	-0.15	9.33	-2.57**	36.22
Across 8331 S_5-3-3-⊗-#	-0.71**	9.07	-0.08*	2.60	-0.43**	8.77	-4.30**	31.50
AB(W) S_5-3-2-⊗-#	-0.09	9.13	-0.30**	2.89	-0.34*	9.33	-4.37**	31.08
M9-S_6-11-⊗-#	0.74**	12.44	0.19**	3.71	0.14	9.46	4.97**	48.58
CM 400 x CM 300-S_5-⊗-#	0.03	9.97	0.15**	3.10	0.07	10.37	-0.86	34.13
Jogia local S_6-2-1-⊗-#	0.34	10.00	-0.19**	2.74	0.35*	9.28	2.77**	33.05
Pant 7421-S_6-194-3-⊗-#	0.10	8.73	0.21**	3.10	0.85**	10.80	4.24**	41.00
CM 601-S_5-8-7-⊗-#	0.24	10.72	0.08*	3.95	-0.49	9.25	0.19	41.88
S.E.(gi) ±	0.25		0.04		0.15		0.82	
S.E. (gi-gi) ±	0.37		0.06		0.22		1.24	

Significant at 5 and 1 per cent level of significance, respectively.

The crosses showing positive and significant specific combining ability (Table 4) revealed that the crosses (M9 x CM 601) S_6-7-8-⊗-# x Pant 7421-S_6-194-3-⊗-#, AB (W)S_5-3-2-⊗-# x Jogia local S_6-2-1-⊗-#, Jogia local S_6-2-1-⊗-# x CM 601-S_5-8-7-⊗-#, (CM 400 x CM 300)-S_5-⊗-# x CM 601-S_5-8-7-⊗-# and M9-S_6-11-⊗-# x Pant 7421-S_6-194-3-⊗-# exhibited significantly positive estimate for grain yield. These crosses also possessed significant positive SCA effects for at least three of the other traits.

Results from the present investigation conclude that the inbred Pant 7421-S_6-194-3-⊗-#, Jogia local-S_6-2-1⊗-# and M9-S_6-11-⊗-# which were good general combiners for majority of the characters including grain yield, may prove useful in breeding programme to exploit additive and additive x additive types of gene action. The hybrids M9-S_6-11-⊗-# x Pant 7421-S_6-194-3-⊗-# and (M9 x CM 601) S_6-7-8-⊗-# x Pant 7421-S_6-194-3-⊗-# manifested high SCA effect for grain yield and many other traits indicating such

Table 4 : Better Five crosses selected on the basis of SCA effects with respect to eight traits in maize

Crosses	SCA effect	Crosses	SCA effect
Days to 75 % tassel		Days to 75% silk	
M9-S_6-11-⊗-# x Jogia local S_6-2-1-⊗-#	8.41**	M9-S_6-11-⊗-# x Jogia local S_6-2-1-⊗-#	8.30**
AB(W)S_5-3-2-⊗-# x (CM400 x CM 300) S_5-⊗-#	4.97**	(M9 x CM601)S_6-7-8-⊗-# x Pant 7421-S_6-2-1-⊗-#	4.97**
(M9 x CM601)S_6-7-8-⊗-# x Pant 7421-S_6-2-1-⊗-#	4.74**	AB(W)S_5-3-2-⊗-# x (CM400 x CM 300) S_5-⊗-#	4.57**
(M9 x CM 601)S_6-7-8-⊗-# x (CM400x CM300) S_5-⊗-#	2.04**	Jogia local S_6-2-1-⊗-# x Pant 7421-S_6-2-1-⊗-#	3.57**
Across 8331-S_5-3-3-⊗-# x CM 601-S_5-8-7-⊗-#	2.17**	Across 8331-S_5-3-3-⊗-# x AB(W)S_5-3-2-⊗-#	3.30**
Days to maturity		Plant height	
M9-S_6-11-⊗-# x Jogia local S_6-2-1-⊗-#	5.94**	M9-S_6-11-⊗-# x Jogia local S_6-2-1-⊗-#	20.01**
(M9 x CM601)S_6-7-8-⊗-# x Pant 7421-S_6-194-3-⊗-#	3.70**	M9-S_6-11-⊗-# x Pant 7421 –S_6-194-3-⊗-#	17.53**
M9-S_6-11-⊗-# x Pant 7421 –S_6-194-3-⊗-#	3.67**	Across 8331-S_5-3-3-⊗-# x Pant 7421-S_6-194-3-⊗-#	15.35**
Pant 7421-S_6-194-3-⊗-# x CM 601-S_5-8-7-⊗-#	3.34**	AB(W)S_5-3-2-⊗-# x Jogia local S_6-2-1-⊗-#	10.79**
Across 8331-S_5-3-3-⊗-# x Pant 7421-S_6-194-3-⊗-#	3.17**	(M9 x CM601)S_6-7-8-⊗-# x Pant 7421-S_6-194-3-⊗-#	8.21**
Ear length		Ear diameter	
(M9 x CM601)S_6-7-8-⊗-# x Pant 7421-S_6-194-3-⊗-#	2.46**	Across 8331-S_5-3-3-⊗-# x (CM400x CM300) S_5-⊗-#	0.91**
(M9 x CM601)S_6-7-8-⊗-# x Jogia local S_6-2-1-⊗-#	1.76*	(M9 x CM601)S_6-7-8-⊗-# x (CM400x CM300) S_5-⊗-#	0.88**
(CM400x CM300) S_5-⊗-# x Pant 7421-S_6-194-3-⊗-#	1.56*	(M9 x CM601)S_6-7-8-⊗-# x Pant 7421-S_6-194-3-⊗-#	0.79**
AB(W)S_5-3-2-⊗-# x Jogia local S_6-2-1-⊗-#	1.54*	AB(W)S_5-3-2-⊗-# x Pant 7421-S_6-194-3-⊗-#	0.77**
Across 8331-S_5-3-3-⊗-# x (CM400x CM300) S_5-⊗-#	1.45	M9-S_6-11-⊗-# x Pant 7421-S_6-194-3-⊗-#	0.67**
Kernel rows per ear		Yield per plant	
(M9 x CM601)S_6-7-8-⊗-# x Jogia local S_6-2-1-⊗-#	1.86**	(M9 x CM601)S_6-7-8-⊗-# x Pant 7421-S_6-194-3-⊗-#	18.59**
Across 8331-S_5-3-3-⊗-# x Jogia local S_6-2-1-⊗-#	1.73**	AB(W)S_5-3-2-⊗-# x Jogia local S_6-2-1-⊗-#	17.15**
Across 8331-S_5-3-3-⊗-# x M9-S_6-11-⊗-#	1.47**	Jogia local S_6-2-1-⊗-# x CM601-S_6-7-8-⊗-#	13.87**
(M9 x CM601)S_6-7-8-⊗-# x Pant 7421-S_6-194-3-⊗-#	1.41**	(M9 x CM601)S_6-7-8-⊗-# x CM601-S_6-7-8-⊗-#	13.09**
AB(W)S_5-3-2-⊗-# x Pant 7421-S_6-194-3-⊗-#	1.35**	M9-S_6-11-⊗-# x Pant 7421-S_6-194-3-⊗-#	12.02**

Significant at 5% and 1% levels of significance, respectively.

crosses could be more rewarding in hybrid breeding programme of maize.

REFERENCES

Griffing, B. (1956). Concept of general and specific combining ability in relation to diallel crossing system. *Aust. J. Biol. Science,* **99 :** 463.

Sharma, J. K. and Bhalla, S.K. (1993). Combining ability for some drought tolerant characters in maize (*Zea mays* L.). *Indian Journal Genetic and Plant Breeding.* **53 (1) :** 79-84.

Singh, P.K., Choudhary, L.B. and Akthar, S.A. (2002). Heterosis in relation to combining ability in maize. *Journal of Research,* BAU, **14 (1) :** 37-43.

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