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COMBINING ABILITY ANALYSIS OF GRAIN YIELD AND SOME OF ITS ATTRIBUTES IN MAIZE (*ZEA MAYS* L.)

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ABSTRACT

A9 x 9 diallel combining ability analysis showed the predominant role of nonadditive type of gene action in the inheritance of grain yield, ear diameter and 1000-kernel weight. Ear length, kernel rows per ear and kernels per row indicated equal importance of both additive and nonadditive genes. Greater importance of gca x environment (E) interaction, than of sca x E interaction, was revealed for ear length and diameter, while only sca x E was important for kernel rows per ear and 1000-kernel weight. G x E interaction was of no importance for grain yield and kernels per row. Two inbreds (P7 and P9) and two crosses (P2 x P8 and P4 x P7) exhibited significant and positive gca and sca effects, respectively, for grain yield and some of its attributes.

Key words: *Zea mays,* maize, combining ability.

Utilization and exploitation of yield and yield contributing characters require a clear cut understanding of their mode of inheritance. Since the quantitative characters are considerably influenced by the environment, a study under different locations and years is likely to bring out genotype-environment interaction for estimating the gene effects precisely and predicting the advance under selection. The present study has been carried out to estimate the combining ability of nine maize inbreds for six quantitative traits tested over three environments.

MATERIALS AND METHODS

Nine maize inbreds, derived from Eto 25, CM 201, CM 105, Eto 81, Eto 297, Eto 182, Syn C(8b), Cuba 43 and CM 110, were used in this study. They were designated as P1, P2, P3, P4, P5, P6, P7, P8 and P9, respectively. These inbreds were crossed in all possible combinations, excluding reciprocals to make a diallel set. All the inbreds and their 36 crosses were grown in randomised block design with 3 replications at Delhi during kharif (rainy season), 1979 and 1980, and at Kalyani during rabi (winter) 1980-81. Each entry was grown in two-row plot of 5 m length in 75 cm x 25 cm crop geometry. Observations were recorded on grain yield per plot

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(adjusted to 15% moisture and shelling) (kg), ear length (cm), ear diameter (cm), kernel rows per ear, kernels per row and 1000-kernel weight (g). Data for grain yield per plot were recorded on the basis of whole plot whereas, the rest of the data were taken from ten random plants in each plot. Mean data pooled over environments were analysed for combining ability according to [1, 2] using method 2, model I of [3]. Relative importance of gca and sca was calculated by the ratio $(2\sigma_g^2 + \sigma_s^2)$ given by [4] for fixed effect model, where σ_g^2 and σ_s^2 are the equivalent components of gca and sca, respectively.

RESULTS AND DISCUSSION

Pooled analysis of variance for combining ability (Table 1) revealed that the variances due to gca and sca were highly significant for all the characters indicating importance of both additive and nonadditive gene effects in their inheritance. Both gca and sca showed nonsignificant interaction with environments for grain yield and number of kernels per row. Similar results were also obtained by Shehata et al. [5] for grain yield. Mean squares due to gca x environment (E) were significant both for ear length and ear diameter, while the sca x E mss were significant for the the former only. These results are in agreement with those of [6]. Nonsignificant gca x E mean squares and significant sca x E mean squares for kernel rows per ear and 1000–kernel weight indicated that the nonadditive effects were more influenced by the environment than that of additive effects for these traits. The report of El-Rouby et al. [7] supports the present findings.

Table 1. Analysis of variance for combining ability pooled over environments

Source	d.f.	Mean squares					
		grain yield	ear length	ear diameter	kernel rows per ear	No. of kernels per row	1000-kernel weight
gca	8	2.15**	17.15**	0.305**	5.43**	131.35**	1532**
sca	36	1.00**	3.98**	0.127**	1.39**	24.47**	1068**
Environments (E)	2	21.97**	67.71**	5.307**	13.34**	399.49**	47513**
gca x E	16	0.42	1.18**	0.024*	0.22	4.40	498
sca x E	72	0.34	0.55*	0.018	0.30**	3.25	591**
Error	264	0.29	0.39	0.014	0.16	2.74	376
$2\sigma_g^2/(2\sigma_g^2 + \sigma_s^2)$		0.31	0.46	0.32	0.44	0.52	.02.

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

Low values of $2\sigma_g^2/(2\sigma_g^2 + \sigma_s^2)$ (Table 1) for grain yield, ear diameter and 1000-kernel weight indicated the predominant role of nonadditive gene effects in expression of these characters, as was also reported by [8–10]. As regards the other attributes, nearly equal importance of both additive and nonadditive gene effects was observed. Greater role of additive genetic variance for ear and grain character has been reported [6, 10], although nonadditive component of variation has also been found important in their inheritance [11].

Analysis of mean performance of the parents and their gca effects (Table 2) revealed that per se performance of the parents is a direct reflection of their respective gca effects. Further, inbreds P7 and P9 were good general combiners for grain yield, ear length, ear diameter and number of kernels per row; P3 for ear length, ear diameter and number of kernels per row; P1 and P2 for kernel rows per ear; P4 for 1000-kernel weight; and P5 for ear length and number of kernels per row.

Table 2. Estimates of gca effects and mean values (within parentheses) along with correlation coefficients (r) between gca effects and inbred means for various characters

Parent	Grain yield (kg)	Ear length (cm)	Ear diameter (cm)	Kernel rows per ear	Kernels per row	1000-kernel wt. (g)
P1	−0.14	−0.36**	−0.01	0.56**	0.18	−14.84**
	(2.39)	(11.9)	(3.59)	(14.1)	(24.6)	(168)
P2	0.00	−0.11	−0.01	0.60**	0.26	− 3.11
	(2.13)	(10.9)	(3.51)	(14.2)	(22.4)	(154)
P3	0.13	0.81**	0.12**	0.07	1.72**	2.06
	(2.87)	(14.7)	(4.02)	(14.6)	(29.3)	(194)
P4	−0.40**	−0.93**	−0.20**	−0.65	−3.10**	10.46**
	(1.68)	(9.3)	(3.15)	(11.9)	(15.0)	(203)
P5	0.15	0.83**	−0.03	−0.22**	1.90**	1.03
	(2.96)	(13.9)	(3.61)	(13.6)	(26.4)	(179)
P6	−0.30**	−0.87**	−0.05*	−0.40**	−2.38**	3.21
	(2.39)	(11.2)	(3.62)	(12.2)	(20.7)	(204)
P7	0.27**	0.40**	0.08**	−0.03	1.15**	2.92
	(3.36)	(14.0)	(4.00)	(13.5)	(27.9)	(183)
P8	−0.07	−0.55**	0.00	0.06	−1.94**	0.95
	(3.01)	(11.8)	(3.63)	(13.8)	(22.6)	(190)
P9	0.37**	0.77**	0.10**	0.02	2.20**	−2.68
	(3.68)	(14.3)	(3.87)	(13.0)	(28.2)	(200)
SE (gi)	0.12	0.10	0.02	0.07	0.27	3.18
SE (gi–gj)	0.19	0.15	0.03	0.10	0.41	4.78
SE (mean)	0.18	0.21	0.04	0.13	0.55	6.47
r	0.88**	0.91**	0.96**	0.91**	0.91**	0.62

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

Table 3. Hybrid combinations with significantly positive specific combining ability effects

Character	Crosses
Grain yield	P2 X P8, P4 X P7
Ear length	P1 X P4, P2 X P3, P2 X P4, P2 X P5, P2 X P6, P2 X P8, P3 X P9, P4 X P7, P4 X P8, P5 X P7, P5 X P9
Ear diameter	P1 X P3, P1 X P4, P1 X P9, P2 X P4, P2 XP5, P2 X P6 P2 X P8, P3 X P4, P3 X P8, P5 X P6, P5 X P9, P8 X P9
Kernel rows/ear	P1 X P3, P1 X P9, P2 X P4, P2 X P6, P3 X P4, P5 X P6, P6 X P9, P7 X P8, P7 X P9, P8 X P9
Kernels/row	P1 X P2, P1 X P4, P2 X P3, P2 X P4, P2 X P8, P3 X P9, P4 X P5, P4 X P7, P4 X P8, P5 X P7, P6 X P7
1000-kernel weight	P2 X P4, P2 X P7, P2 X P9, P3 X P4, P5 X P8

The crosses showing positive and significant sca effects for various traits are listed in Table 3. Two crosses, P2 X P8 and P4 X P7, showed significantly positive sca effects for grain yield, ear length and kernels per row. The number of crosses showing positive and significant sca effects for ear length, ear diameter, kernel rows per ear, kernels per row and 1000-kernel weight were 11, 12, 10, 11, and 5, respectively.

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