https://doi.org/10.29321/MAJ.10.A03379

Madras agric. J. 61 (5): 111—117, May, 1974

Correlation Between Yield and Yield Components and Their Combining Abilities in Maize (*Zea mays* L.)

BY

SATISH KUMAR[1]

ABSTRACT

The study of a diallel cross involving ten well adapted maize inbreds indicated high correlation of yield with ear weight, kernels per ear, 100-kernel weight, and the cob weight. Additive as well as non-additive effects of the genes were found to be quite important for all other characters except 100-kernel weight. The magnitude of specific combining ability was high in case of yield, ear weight, kernels per ear and cob weight, while general combining estimates were higher in case of 100-kernel weight and days to silking only. The specific combining ability for correlated characters like ear weight, kernels per ear, 100-kernel weight and the cob weight may be an useful index for select ing the cultures on the basis of the components.

INTRODUCTION

The use of combining ability for different components of yield along with the combining ability for yield may improve the precision of the top cross test as suggested by Grafius (1963). The presented study was undertaken to find out the correlations between different yield components and the yield in single crosses of a set of ten inbred lines and the relationship between the general and specific combining ability for the different components and yield.

MATERIALS AND METHODS

A diallel set, excluding the reciprocals, was made by intercrossing ten well adapted maize inbreds viz., C.I. 21 Fla 5B-48, Fla 3H-94, MP 414, CM 104, CM 111, Eto 25A, (Venz 1 x Venz 400), MF 9. The 45 F_1s were sown in a randomized block design with four replications, during *kharif*, 1966. Each plot consisted of two rows of 10 meter length, 75 cm apart with plant distance of 25 cm. Ten competitive plants were taken from each plot to record observations on plant height, ear height, ear weight, ear length, kernel rows per ear, kernels per row, kernels per ear, hundred kernel weight, cob weight, yield per plant and days to 75 per cent silking.

Plot means were used for analysis of variance. Correlations between yield and all other characters were worked out by using overall mean of

1. Department of Plant Breeding, Punjab Agricultural University, Ludhiana.

four replications. Phenotypic and genotypic correlation co-efficients were worked out in all possible combinations between some of these characters showing highly significant correlations with yield in the preliminary analysis and some other characters considered important for the study. The analysis of varionce for combining ability and estimation of various effects was done following Griffing (1956). Rank correlations of general and specific combining ability effects between yield and other characters were worked out to find out the association between the combining ability for the yield and the yield components.

RESULTS AND DISCUSSION

The analysis of variance showed significant differences between the crosses for all the characters except plant height and ear length.

The phenotypic and genotypic correlation coefficients in all possible combinations between characters are presented in Table 1. Significant phenotypic as well as high genotypic correlations were observed between yield and ear weight, yield and kernels per ear, yield and cob weight, ear weight and kernels per ear, ear weight and cob weight, kernels per ear and cob weight, 100-kernel weight and cob weight and between cob weight and silking days. High genotypic correlations were found between per plant yield and silking days, kernels per ear and silking days and between 100-kernel weight and silking days, while high phenotypic correlations were observed for ear weight with 100-kernel weight and days for silking (Table 1).

The analysis of variance for combining ability (Table 2) indicated highly significant general and specific combining ability variances for all the characters except for 100-kernel weight which had non-significant specific combining ability variance. Estimates of general combining ability and specific combining ability variances showed that yield, ear weight, kernels per ear and cob weight had much larger specific combining ability variances in comparison to general combining ability variances. Hundred kernel weight and days to silking had higher general combining ability variance in comparison to specific combining ability variances.

The general combining ability effects for yield (Table 3) showed the the parents C. I. 21, and M. P. 414 only had significant and positive values. These parents had significant positive general combining ability effect for ear weight, 100-kernel weight and cob weight also. Parent Fla-94 had a positive general combining ability effect for yield as well as ear weight, kernels per ear, cob weight and silking days. Similarly CM 111 had significant and negative general combining ability effect for yield, ear weight and 100 kernel weight. Parents Fla 58-48, CM,104 (Venz 1 x Venz 400) and W. F. 9 had high negative general combining ability values for yield, ear weight, 100-kernel weight and cob weight. These results indicated that the general combining ability effects for yield, ear weight, 100 kernel weight and cob weight tended to be similar. The rank correlation co-

TABLE 1. Phenotypic [P] and genotypic [G] correlations for various yield components

Characters	Correlation type	Ear weight	Kernel number per ear	100-kernel weight	Cob weight	Silking days
Per plant yield	P	0.849**	0.474**	0.236	0.395**	0.274
	G	0.594	0.448	0.038	0.339	0.465
Ear weight	P	...	0.605**	0.317*	0.586**	0.328*
	G	...	0.626	0.017	0.564	0.060
Kernel number per ear	P	...	...	0;088	0.594**	0.215
	G	...	...	0.041	0.634	0.323
100-kernel weight	P	...	...	...	0.396**	0.242
	G	...	...	...	0.432	0.458
Cob weight	P	...	...	...	...	0.309*
	G	...	...	...	...	0.660
Silking days	P	...	...	...	...	...
	G	...	...	...	...	...

efficient between general combining ability effects (Table 4) were highly significant for yield with ear weight and 100-kernel weight. Highly significant correlations between general combining ability effects were also observed for ear weight with 100-kernel weight and cob weight and kernels per ear with cob weight.

The results for rank correlations between specific combining ability effects for different crosses (Table 4) revealed that there was a high inter-relationship between yield, ear weight, kernels per ear, 100-kernel weight and significant correlation was also observed between cob weight and silking days. A comparison of genotypic, phenotypic and general combin-

TABLE 2. ANOVA for combining ability variances

Sources	D. F.	Yield/plant	Ear weight	Kernel number per ear	100-kernel weight	Cob weight	Silking days
G. c. a.	9	277.04*	385.99**	6502.54**	21.31**	23.93**	11.74**
S. c. c.	35	232.01*	253.81**	1205.54**	0.27	6.06**	1.22**
Error	132	128.41	36.34	125.44	0.56	0.49	0.12
$\sqrt{g^2}$	—	5.63	16.52	662.12	2.63	2.23	1.31
$\sqrt{s^2}$	—	1.3.60	217.47	1080.10	−0.29	5.57	1.10

ing ability effect correlations showed that yield with ear weight, ear weight with 100-kernel weight, ear weight with cob weight, keunel numbers per ear with cob weight had high values for all these types of correlations but the situation was not similar in other cases. Significant phenotypic correlation or high genotypic correlation between the latter combination did not produce high correlation in the general combining ability effects of the characters and vice-versa. The rank correlations between these types of correlations were low for phenotypic and general combining ability (r=0.148) and for genotypic and general combining ability (r=0.024) effects correlations. In the case of specific combining ability effect correlations the situation was similar for the association between genotypic and specific combining ability effects correlation (r=1 0.236). It was significant in the case of comparison between phenotypic and specific combining ability correlation coefficient (r=0.746)

High correlation coefficient for yield with ear weight, kernels per ear, 100-kernel weight and cob weight were observed. These results are in confirmity with Biggar (1919), Richey (1925) and Murty and Roy (1957). Lack of association between yield and days to silking found in the present study is in accordance with the findings of Biggar (1919). All possible correlations between ear weight, kernels per ear 100-kernel weight and cob weight except 100-kernel weight x kernels per ear were significant. Significant correlations were also observed for silking days with ear weight and cob weight.

All the characters except 100-kernel weight had significant general combining ability and specific combining variances. This suggested that additive as well as non-additive effects of the genes were quite important for

TABLE 3. General combining ability effects for parents

Crosses	Yield/plant	Ear weight	Kernels/ear	100-kernel weight	Cob weight	Silking days
CI 21	7.99**	11.22**	15.82**	1.86**	2.45**	0.80**
Fla 5 B-48	−3.00	−4.15*	20.19**	−0.30**	−0.99**	1.35**
Fla 3 H 94	5.44	7.97**	62.38**	−1.25**	2.70**	0.02**
MP 411	9.43**	9.97**	−23.44**	0.70**	0.70**	0.66**
CM 105	−0.74	−2.12	−5.43	0.39**	−1.21**	0.02**
CM 104	−3.25	−2.80	−4.45	−0.02	−0.22**	0.31**
CM 111	−9.67**	−8.68**	2.29	−2.19**	−1.15**	−0.01
Eto 25A	−0.77	−3.70*	−24.42**	−1.26**	−2.77**	0.81**
(Venz 1×Venz 400)	−2.45	−3.55*	−39.40**	0.39**	−0.94**	0.25**
WF 9	−2.98	−4.04**	−3.54	0.94**	−0.90**	−2.94**
C. D. at 5%	7.43	9.92	7.33	0.04	0.04	0.02
C. D. at 1%	5.97	3.15	5.89	0.03	0.03	0.01

* Significant at P = 0.05 ** Significant at P = 0.01

various characters in the cross combinations under study. The general combining ability variances were greater than the specific combining ability variances in the case of 100-kernel weight and silking days, which indicate that these characters are predominantly controlled by the additive effects of the genes. Yield, ear weight, kernels per ear and cob weight had high specific combining ability variances and had therefore a predominance of dominant and non-allelic interaction effects. High magnitude of epistatic effects for ear weight has been reported by Sprague and Tatum (1949), Gardner *et al.* (1953), Robinson *et al.* (1956) and Gorsline (1963) while low epistatic effects for days to silking have been reported by Robinson *et al.* (1949).

The correlations between general combining ability effects were significant for yield with ear weight, yield

TABLE 4. Rank correlations from g. c. a. and s. c. a. effects for various yield components

Characters	Rank correlations from	Ear weight	Kernel numbers per ear	100-kernel weight	Cob weight	Silking days
Per plant yield	g. c. a. effect	0.855**	0.091	0.485**	0.212	0.024
	s. c. a. ,,	0.988**	0.526**	0.486**	0.381**	0.138
Ear weight	g. c. a. ,,		0.018	0.546**	0.406**	0.073
	s. c. a. ,,		0.584**	0.508**	0.483**	0.140
Kernel numbers per ear	g. c. a. ,,		—	0.170	0.576**	0.182
	s. c. a. ,,			0.439**	0.534**	0.053
100-kernel weight	g. c. a. ,,			—	0.073	0.151
	s. c. a. ,,			—	0.555**	0.058
Cob weight	g. c. a. ,,				—	0.230
	s. c. s. ,,				—	0.300*
Silking days	g. c. a. ,,					—
	s. c. a. ,,					—

with 100-kernel weight, ear weight with 100-kernel weight, kernels per ear with cob weight. This suggested that there was a tendency among the parents to have similar combining effects for more than one character.

In the case of specific combining ability effects a number of component characters have shown significant association with specific combining ability effects for yield. This could result from the interaction of genes controlling different yield component characters, (Grafius, 1964). The significant rank correlations between the specific combining ability effects suggest that the specific combining ability for correlated characters like ear weight, kernels per ear, 100-kernel weight and the cob weight may be an useful index for selecting the cultures for yield. The use of these correlated components will reduce the bias which is caused by high interaction present in the estimates for yield alone (Grafius, 1963).

REFERENCES

BIGGAR, H. H. 1919. The relation of certain ear characters to yield in Corn. *J. Amer. Soc. Agron.* **2** : 230–8.

GARDNER, C. C., P. H. HARVEY, R. E. COMSTOCK and H. F. ROBINSON. 1963. Dominance of gene controlling quantitative characters in Maize. *Agron. J.* **45** : 186–91.

GORSLINE, G. W. 1961. Phenotypic epistasis for ten quantitative characters in Maize. *Crop. Sci.* **1** : 55–8.

GRIFFING, B. 1956. Concept of general and specific combining ability in relation to diallel crossing systems. *Aust. J. biol. Sci.* **19** : 463–93.

GRAFIUS, J. E. 1963. Vector analysis applied to crop Eugenics and Genotype-environment interaction. In statistical genetics and plant breeding. pp. 197–217. Publication No. 982. National Academy of Science – National Research Council, Washington, D. C.

GRAFIUS, J. E. 1964. A geometry for plant breeding. *Crop. Sci.* **4** : 241–6.

MURTY, G. S. and N. N Roy. 1957. Study of the Indian collection of Maize varieties with special reference to relationship between yield and other characters. *Indian J. Genet.* **17** : 73–89.

RICHEY, F. D. 1925. Corn judging and the productiveness of corn. *J. Amer. Soc. Agron.* **17** : 313–8.

ROBINSON, H. F, R. E. COMSTOK, and P. H. HARVEY 1949. Estimates of heritability and the degree of dominance in corn. *Agron. J.* **41** : 353–9.

SPRAGUE, G. F. and L. A. TATUM. 1942. General v/s specific combining ability in single crosses of corn. *Amer. Soc. Agron.* **34** : 922–32.