Pak. J. Agri. Sci.
25(2), 117, 1988

COMBINING ABILITY FOR YIELD AND ITS COMPONENTS IN MAIZE SINGLE CROSSES

M. Saleem and M. Ashraf Javed*

Department of Plant Breeding and Genetics,
University of Agriculture, Faisalabad.

Combining ability analysis was done for grain yield and its components in a diallel set involving six inbred lines of maize. Mean squares due to general combining ability and specific combining ability were highly significant for kernels per row, 100-grain weight and grain yield per plant. Both GCA and SCA effects contributed significantly to yield and its components. Specific ability effects were relatively of greater importance than general combining ability effects.

INTRODUCTION

Sprague and Tatum (1942) provided experimental evidence on the relative role of general and specific combinig ability in maize single crosses and suggested the use of diallel technique to evaluate a set of inbred lines for the two types of combining abilities. Griffing (1956) further elaborated this technique and presented a theoretical discussion on its use for estimating general and specific combining ability. The present study is an attempt to obtain information on the relative importance of general and specific combining ability for grain yield as well as for various components for utilization in the selection of inbred lines during generations of inbreeding.

MATERIAL AND METHODS

The experimental material comprised six inbred line of maize viz. WF 9-5, Minn Syn, N 84, Q 66, Opapque 2 and W 187 R. The inbred lines were grown in the field during the year 1985 and crossed *inter se* to obtain seed of fifteen possible single crosses and their reciprocals. In the next growing season the fifteen single crosses and their reciprocal crosses alongwith the six parental lines were planted in a randomized complete block design with three replications.

The planting plan consisted of two 450 cm rows per experimental unit planted 60 cm apart and plant to plant distances 30 cms.

At maturity ten randomly competitive plants were selected for recording data for various characters including number of ears per plant, kernel rows per ear, number of kernels per row, 100-grain weight (gm) and grain yield per plant (gm). Analysis of variance was carried out to test the significance of differences The design of analysis used corresponded to Model I Griffing, 1956).

RESULTS AND DISCUSSION

Analysis of variance (Table 1) revealed significant differnces for all the characters under study. Mean squares for general combining ability, specific combining ability and reciprocal effects are presented in Table 2 Mean squares for general combining ability and reciprocal effects were significant for kernels per row, 100-grain weight and yield per plant. Except for ears per plant, mean squares for specific combining ability were significant for all other characters. These results show that total variability for most of the traits was associated with both general and specific combining ability effects.

General combining ability effects of individual parents for each character are given in Table 3. Inbred line Minn-Syn had highest positive general combining ability effect for yield, ears per plant and 100-grain weight. The same trend was apparent for Opapue 2. Inbred line Q 66 had the highest negative general combining ability effect for most of the characters. This would indicate that certain inbreds might contribute to higher yield through their influence on individual yield components.

Specific combining ability effects were used to study the performance of lines in specific combinations and are presented in Table 4. The overall assessment for all the characters indicated that the highest specific effect for grain yield in the cross combination N 48 x W 187 R was accompanied by intermediat specific effect for kernel rows per ear, kernels per row, 100-grain weight and negative effect for ears per plant. Single cross WF 9.5 x N 84 with the second highest specific effect for grain yield was high for kernels per row, kernel rows per ear and intermediate for ears per plant and grain weight. Single

Table 1. *Analysis of variance of six inbred lines alongwith 15 possible single crosses and their reciprocals.*

Source of variation	Degrees of Freedom	Mean Squares: Ears per plant	Kernel rows per ear	Kernels per row	100-grain weight	Yield per plant
Genotypes	35	0.047*	6 05**	40.08**	20.34**	2000.24**
Replications	2	0 005	0.025	1.18	0.14	1.35
Error	70	0.005	0.22	3.83	0.18	7.015

* P = 0.05-0.01

** P = 0.01-0.001

Table 2. *Mean squares due to general combining ability, specific combining ability and reciprocal effects for yield and yield components*

Source of variation	Degrees of freedom	Mean Squares: Ears per plant	Kernels rows per ear	Kernels per row	100-grain weight	Yield per plant
GCA	5	0.156	1.17	17.70**	14.37**	1343.70**
SCA	15	-0.016	2.81*	19.93**	7.81**	947.57**
Reciprocal	15	0.0014	1.58	5.34*	4.09*	160.32**
Error	70	0.005	0.22	3.83	0.18	7.02

*P = 0.05-0.01

**P = 0.01-0.001

Table 3. *Estimates of relative general combining ability effects for yield and yield components of six inbred lines*

Inbred lines	General combining ability effects				
	Ears per plant	Kernel rows per ear	Kernels per row	100 grain weight	Yield per plant
WF9-5	0.01	0.16	1.03	0.13	5.47
Minn-Syn.	0.07	0.20	0.40	1.49	9.79
N84	-0.11	-0.46	-2.02	-1.64	-18.04
Q66	-0.01	0.25	0.44	-0.71	-7.46
Opaque-2	0.07	0.18	1.04	1.02	5.79
W187R	-0.02	-0.34	-5.64	-0.61	4.47

Table 4. *Estimates of specific combining ability effects for yield and its components for 15 possible single crosses among six inbred lines*

SPECIFIC COMBINING ABILITY EFFECTS

Single crosses		Ears per plant	Kernel rows per ear	Kernels per row	100-grain weight	Yield per plant
WF9-5	x Minn-Syn	0.05	0.33	1.73	0.55	13.81
WF9-5	x N84	0.03	0.97	2.18	1.34	15.42
WF9-5	x Q66	0.05	0.70	1.85	1.63	4.60
WF9-5	x Opaque-2	0.04	0.97	0.39	1.74	9.02
WF9-5	x W187R	0.01	-0.35	2.81	0.59	0.65
Minn-Syn	x N84	-0.03	-0.01	2.07	0.33	10.77
Minn-Syn	x Q66	0.02	-0.26	0.58	0.67	7.35
Minn-Syn	x Opaque-2	0.09	1.07	0.55	0.83	10.22
Minn.Syn	x W187R	0.03	0.25	1.07	1.12	11.34
N84	x Q66	0.06	0.79	1.24	2.03	9.88
N84	x Opaque-2	0.04	-0.85	2.63	-0.14	0.64
N84	x W187R	-0.03	0.88	1.67	1.06	15.66
Q66	x Opaque-3	-0.03	0.91	0.89	-0.79	3.05
Q66	x W187R	0.00	0.67	-0.41	0.08	-0.37
Opaque-2	x W187R	0.05	0.17	-0.85	-0.15	14.06

Table 5. *Estimates of reciprocal effects for yield and its components for 15 possible reciprocal crosses among six inbred lines.*

RECIPROCAL EFFECTS

Reciprocal crosses		Ears per plant	Kernel rows per ear	Kernels per row	100-grain weight	Yield per plant
Minn-Syn	x WF9-5	-0.015	0.075	0.42	0.80	4.26
N84	x WF9-5	0.05	-0.165	1.66	2.09	11.29
Q66	x WF9-5	-0.02	0.93	-3.24	0.52	7.09
Oqaque-2	x WF9-6	0 015	-1 34	0.55	0.42	2.53
W187R	x WF9-5	0.015	0.50	-0.56	-6.71	-10.96
N84	x Minn-Syn	0.05	0.87	0-.00	0.38	7.41
Q66	x Minn-Syn	-0.035	-0.15	2.09	-0.89	9 78
Opaque-2	x Minn-Syn	0.015	0.41	1.48	0.56	-1.49
W187R	x Minn-Syn	0.015	-1.03	0.74	-0.067	-0.23
Q66	x N84	0.00	-0.97	1.65	-0.56	0.68
Opaque-2	x N84	-0.015	1.03	2.34	2.17	0.09
W187R	x N84	0.00	1.055	2.02	2.92	-2.70
Opaque-2	x Q66	0.035	0.61	0.69	0.095	22.37
W187R	x Q66	0.02	1.57	2.44	-2.09	14 77
W187R	x Opaque-2	0.00	0.87	0.53	0-.63	0.88

Table 6. *Estimates and relative proportions of variance components for general combining ability, specific combining ability, reciprocals, and error for yield and its components.*

Variance components	Ears per plant Value	(%)	Kernel rows per ear Value	(%)	Kernels per row Value	(%)	100-grain weight Value	(%)	Yield per plant Value	(%)
6^2G	-0.827	-8.63	-0.13	-0.37	0.14	0.99	0.57	8.21	35,54	5.35
6^2S	-0.012	3.84	15.62	44.94	9.35	66.41	4.28	60.95	545.52	82.07
6_2r	-0.0018	-0.58	4.0	11.08	0.76	5.51	1.19	28.24	76.65	11.53
6_2e	0.35	111.89	15.27	43.93	3.83	27.20	0.18	2.59	7.02	1.06

crosses N 84 x Opapue 2 and WF 9-5 x W 187 R with the lowest specific effects for yield were also low for ears per plant and grain weight.

Estimates of reciprocal effects were made for all the characters under study and are presented in Table 5. The greatest positive effect for yield was noticed for the crosses Opaque 2 x Q 66 and W 187 R x Q 66, whereas the highest negative effect was obtained for the cross W 187 R x WF 9-5. For ears per plant reciprocal crosses N 84 x WF 9-5 and N 84 x Minn-syn gave the maximum effects. Regarding kernels per row, cross W 187 R x Q 66 revealed the highest reciprocal effects. Reciprocal cross W 187 R x N 84 generated highest effect for 100-grain weight.

Estimates of variane components are presented in Table 6. The proportions of these components were calculated in terms of percentage in order to obtain an estimate of the relative importance of additive and non-additive gene effects. With the exception of ears per plant, the variance components of specific combining ability were larger than variances of general combining ability for all the characters, an observation which corroborates the findings of Neihous and Ricket (1966), Beil and Atkins (1967) and Shahidullah (1968). The value of variance components for ears per plant is, in general, in negative form and is in accord with the results of Debnath et al. (1983) and Inoue (1983). Assuming that differences in GCA resulted primarily from differences in the additive gene effects and that differences in specific combining ability and reciprocal sffects were due to differences in non-additive effects, it was apparent that in the material under study, non-additive gene effects were more important.

REFERENCES

Beil, G. M., and R. E. Atkins. 1967. Estimates of general and specific combining ability in F1 hybrids for grain yield and its components in grain sorghum, *Sorghum vulgare* Pers. Crop Sci., 7 : 225-228.

Debnath, S. C., K. S. Sarker and D. Singh. 1983. Combining ability analysis in maize (*Zea mays* L.) 3 : Ear and grain characteristics. Proceedings 8th Bangladesh Sci. Conf. Bangladesh. Association for the Advancement of Sci. Dhaka, 1983 p. 46.

Griffing, B. 1956. Concept of general and specific combining ability in relation to diallel crossing system. Aust. J. Biol. Sci., 9 : 463-493.

Inoue, Y. 1983. Specific combining ability between six different types of maize obtained from a diallel set of eleven open-pollinated varieties. Jap. J. Breed., 34 (1) ; 17-28.

Neibous, M, H., and R, C Rickett. 1966. Heterosis and combining ability in a diallel cross in *Sorghum vulgare*, Crop Sci., 6 : 33-36.

Sprague, G. F., and L. A. Tatum. 1942. General vs specific combining ability in single crosses of corn, J. Amer. Soc. Agron. 34 ; 923-32.

Shahidullah, M. 1968. Combining ability for yield and components of yield in maize single crosses. Ph. D. Thesis, WPAU, Lyallpur.