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COMBINING ABILITY FOR GRAIN YIELD AND OTHER RELATED TRAITS IN WHEAT (*TRITICUM AESTIVUM* L. EM. THELL)

Ihsan Khaliq, M. Aslam Chowdhry and Khurshid Alam
Department of Plant Breeding and Genetics,
University of Agriculture, Faisalabad

A 5 x 5 complete diallel cross of wheat was analysed for combining ability of traits like plant height, number of fertile tillers per plant, days to heading, days to maturity, grain weight per ear, 100-grain weight and grain yield per plant. General and specific combining ability variances were significant except for grain weight per ear. Specific combining ability variances were significant for plant height, days to heading as well as maturity and grain yield per plant. While reciprocal effects were also significant for plant height, days to heading, number of fertile tillers per plant, grain weight per ear and grain yield per plant. Additive gene effects controlled the expression of all the traits under study as is evident by greater mean squares for general combining ability.

INTRODUCTION

For any breeding programme aiming at hybridization, the knowledge of genetic system controlling quantitative characters and combining ability of parents are the pre-requisites. Combining ability analysis developed by Griffing (1956) helps the plant breeders in providing such information in early generations. The present study was conducted to assess the relative magnitudes of GCA and SCA of some wheat cultivars so as to accelerate wheat breeding efforts of this department.

The results of Ahmad *et al.* (1984) revealed that general and specific combining ability (GCA & SCA) effects in wheat were significant for plant height. Guseinova (1985) found that general combining ability variances in wheat were significant for productive tillers while general and specific combining ability mean squares differed non-significantly for grain weight per ear. Widner and Lebsock (1973) revealed significant general and specific combining ability mean squares for days to maturity and grain yield per plant. Shen *et al.* (1982) found highly significant general and specific combining ability mean squares in days to heading. Bhullar *et al.* (1981) estimated highly significant general combining ability mean squares for 100-grain weight.

MATERIALS AND METHODS

The experimental material comprised five different lines/varieties of bread wheat, namely Pb-85, LU-26, Pak-81, S-1018 and S-131. All the twenty crosses, derived from these varieties by crossing in a diallel fashion, were planted along with their parents in a triplicated randomized complete block design during 1986-87. Each replication had one row of 5 meter long for each treatment while plant to plant and row to row distance was 15 cm and 30 cm, respectively. Other cultural and agronomic treatments were kept constant for the whole experiment. Ten guarded plants from each genotype were selected randomly at maturity for recording data on various plant

traits. Analysis of variance techniques (Steel & Torrie, 1980) were applied to determine the significance among genotypes and where the difference were significant, data were further subjected to combining ability analysis. The design of analysis corresponded to method I, Model I (Griffing, 1956).

RESULTS AND DISCUSSION

Plant height: Combining ability analysis (Table 1) yielded highly significant mean squares for general and specific combining ability. Reciprocal mean squares were also highly significant. Similar effects in wheat have been reported by Ahmad *et al.* (1984). The highest GCA effect for plant height was exhibited by lines S-131 (4.774). It is obvious (Table 3) that two crosses namely Pb-85 (Pb-85 x S-1018) and Pb-85 x S-131 had high SCA effects for plant height. The highest reciprocal effect was obtained from the cross LU-26 x Pb-85.

Number of fertile tillers per plant: Statistical analysis (Table 1) shows significant general combining ability mean squares while SCA mean squares were non-significant. Reciprocal mean squares were significant. These observations find support from the earlier findings of Guseinova (1985). The highest positive GCA effects were exhibited by line S-1018 (Table 2). For SCA effects, it is apparent that cross Pak-81 x S-131 (Table 3) possessed positive SCA effect while the highest positive reciprocal effect was recorded in the cross Pb-85 x S-131.

Days to heading: Combining ability analysis (Table 1) shows highly significant general and specific combining ability mean squares. Reciprocal mean squares were highly significant. Similar findings have been reported earlier by Shen *et al.* (1982). The highest positive GCA effect was exhibited by the variety Pak-81 (Table 2). It is apparent

Table 1. Combining ability analysis for plant height, yield and its components

Source of variation	df	Mean squares						
		Plant height (cm)	Number of fertile tillers/ plant	Days to heading	Days to maturity	Grain weight per ear (g)	100-grain weight (g)	Grain yield/ plant (g)
GCA	4	97.06**	7.773*	79.524**	1.945**	0.119NS	0.368**	21.436**
SCA	10	6.73**	1.627NS	9.141**	0.922**	0.068NS	0.055NS	11.632**
Reciprocal effects	10	4.02**	4.009*	6.447**	0.173NS	0.169**	0.065NS	19.451**
Error	48	1.292	1.892	1.559	0.201	00.46	0.036	1.739

* = P<0.05

** = P<0.01

NS = Non-significant

that crosses Pak-81 x S-131 and LU-26 x S-1018 possessed reasonable values of SCA effect while reciprocal effect showed that cross S-131 x S-1018 possessed good value (Table 3).

100-Grain weight: General combining ability mean squares were highly significant while specific and reciprocal mean squares were non-significant (Table 1). These observations are in conformity with the findings already reported by Bhullar *et al.* (1981). The highest positive general combining ability effect was exhibited by the variety LU-26 (Table 2). The cross LU-26 x S-1018 possessed positive specific combining ability effect and the cross LU-26 x Pb-85 showed positive reciprocal effects (Table 3).

Table 2. Estimates of GCA effects for five wheat varieties

Variety/ line	Plant height (cm)	Number of fertile tillers/ plant	Days to heading	Days to maturity	Grain weight per ear (g)	100-grain weight (g)	Grain yield/ plant
LU-26	0.439	-1.313	-4.293	0.013	0.182	0.300	-1.731
Pak-81	0.372	-0.047	2.803	0.182	-0.012	-0.069	1.941
Pb-85	-2.559	0.221	-0.493	-0.754	-0.044	-0.212	-1.092
S-131	4.774	-0.015	2.273	0.179	-0.111	0.052	0.104
S-1018	-3.026	1.154	-0.293	0.379	-0.014	-0.869	0.770
SE (gi-gj)	0.508	0.615	0.558	0.201	0.096	0.084	0.589

Days to maturity: Highest GCA effect was found by the line S-1018 (Table 2). It is evident (Table 3) that two crosses LU-26 x Pb-85 and Pb-85 x S-131 possessed remarkable value of positive SCA effects and the highest positive reciprocal effect was 0.335 from the cross LU-26 x S-131 and Pak-81 x Pb-85.

Grain weight per ear: Combining ability analysis (Table 1) shows that GCA and SCA mean squares are non-significant while reciprocal mean squares are highly significant. The results are in agreement with the findings reported by Guseinova (1985). The highest positive GCA effects were recorded in variety LU-26 (Table 2). For SCA effects cross Pak-81 x Pb-85 possessed a positive value of 0.264 and the highest positive reciprocal value 0.323 was exhibited by the cross LU-26 x S-131 (Table 3).

Grain yield per plant: Analysis of combining ability (Table 1) shows highly significant mean squares for general, specific and reciprocal effects. Similar effects in wheat have also been reported earlier by Widner and Lebsock (1973). The highest positive GCA effects for grain yield per plant was exhibited by the variety Pak-81 (Table 2). The cross LU-26 x S-1018 possessed positive SCA effects for this trait and the highest positive reciprocal value was 4.094 in the cross involving varieties Pak-81 and S-131 (Table III).

Table 3. Estimates of SCA for plant height, yield and its components in a set of diallel crosses among five wheat varieties

	Plant height (cm)	Number of fertile tillers per plant	Days to heading	Days to maturity	Grain weight per ear (gm)	100-Grain weight (gm)	Grain yield per plant (gm)
LU-26 x Pak-81	1.029 (-0.330)	-0.956 (-0.500)	-1.207 (-4.330)	0.046 (-0.335)	-0.087 (-0.310)	(0.161 (0.045)	-2.388 (-4.234)
LU-26 x Pb-85	-1.875 (2.165)	-0.554 (-3.170)	-0.0573 (-1.665)	0.719 (0.165)	0.079 (0.176)	-0.107 (0.312)	-1.922 (0.003)
LU-26 x S-131	0.127 (-1.830)	0.681 (0.830)	-0.174 (-1.500)	0.285 (0.335)	0.102 (0.323)	0.032 (-0.203)	1.421 (2.348)
LU-26 x S-1018	0.427 (0.000)	0.681 (-1.000)	1.392 (1.500)	0.255 (0.165)	0.107 (-0.078)	0.211 (0.072)	3.584 (-1.836)
Pak-81 x Pb-85	-0.808 (-1.835)	1.349 (-1.000)	-1.173 (1.165)	0.0514 (0.335)	0.264 (-0.578)	0.039 (0.155)	2.264 (-3.141)
Pak-81 x S-131	-0.141 (-0.835)	2.429 (1.165)	1.725 (0.500)	0.287 (0.165)	0.054 (0.073)	0.018 (0.112)	2.228 (4.094)
Pak-81 x S-1018	1.494 (1.000)	0.929 (-0.835)	-1.707 (-1.170)	0.587 (0.335)	0.182 (-0.116)	0.136 (-0.092)	1.33 (-2.016)
Pb-85 x S-131	1.960 (0.335)	1.662 (1.665)	0.361 (-1.165)	0.723 (-0.335)	-0.172 (0.300)	0.159 (0.273)	-1.943 (3.154)
Pb-85 x S-1018	3.095 (2.000)	1.162 (-1.335)	1.092 (0.670)	-0.146 (0.335)	0.033 (0.176)	0.024 (-0.216)	1.184 (-5.454)
S-131 x S-1018	-1.908 (1.670)	1.062 (-0.670)	-2.339 (1.665)	-0.081 (-0.335)	-0.035 (-0.366)	-0.079 (0.123)	-1.634 (0.238)
SE (Sij - Sik)	1.017	1.231	1.116	0.601	0.193	0.169	1.179
SE (Sij - Skl)	0.881	1.065	0.967	0.347	0.167	0.146	1.022
SE (rij - rkl)	1.137	1.375	1.248	0.448	0.216	0.189	1.318

Figures in parenthesis are reciprocal effects.

REFERENCES

Ahmad, B., M.A. Chaudhry, M. Sharif, A.S. Khan and M.L. Shah. 1984. Combining ability for grain yield and other related traits in spring wheat. J. Agri. Res. 22: 1-5.

Bhullar, G.S., S.P.S. Boar and K.S. Gill. 1981. Breeding value and combining ability studies in durum wheat. Ind. J. Gen. Pl. Br. 41: 395-400.

Griffing, B. 1956. Concept of general and specific combining ability in relation to diallel crossing system. Aust. J. Biol. Sci. 9: 363-393.

Gvesinova, V.M. 1985. Study of the combining ability of winter bread wheat varieties in diallel crosses. *Izvestiya Akadenii Nauk Azerbaidshanskoi SSR., Bidogicheskikh Nauk*, 5: 74-84.

Shen, D.L., J.S. Wang and G.C. Shen. 1982. Studies on the heterosis and combining ability in wheat. *Zheijiong Nongge Kexne Zheigiaing Agri. Sci.* 5: 238-241.

Steel, R.G.D. and J.H. Torrie. 1980. Principles and Procedures of Statistics: A biometrical approach. McGraw Hill Co. New York.

Widner, J.N. and K.L. Lebsock. 1973. Combining ability in durum wheat. Crop Sci. 13: 164-167.