

# Combining Ability Analysis in Intervarietal Crosses for Component Traits in Hexaploid Wheat

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## ABSTRACT

Five hexaploid bread wheat varieties, selected on the basis of morphological evaluation, were crossed in all possible combinations to test their combining ability and nature of gene action involved by using Griffing's technique. Genotypes showed significant differences for all the characters. General Combining ability (GCA) variance was highly significant for all the characters except number of spikelets per spike. The variance was more than the specific combining ability (SCA), indicating additive gene effects for all the characters. However, variances for SCA and reciprocals were non-significant. Considering all the characters together, Inqlab 91 was good general combiner for 1000-grain weight and grain yield per plant. While highest value of SCA effects for grain yield per plant were recorded in the cross Chakwal 86 x Inqlab 91.

**Key Words:** Hexaploid wheat; Varieties; Cross breeding; Yield; Component traits

## INTRODUCTION

Breeding efforts have resulted in various varieties of hexaploid wheat having improved yield and grain characters. Varieties and advanced lines with different morphological and economic characteristics are now available as breeding stock. For further progress knowledge of breeding behavior, particularly of combining ability and type of gene action for the various traits is necessary. The estimates of combining ability variances and effects can give an indication of the relative magnitude of genetic variance. Besides doing haphazard crosses it is necessary to execute only high performing ones. In this context, combining ability provide a guideline for selecting elite parents and desirable cross combinations to be used in formulation of a systematic breeding project for rapid improvement. Griffing's approach has been greatly popular among various breeders like Parashar and Janoria (1994) who indicated greater role of additive gene action in the inheritance of grain yield and its components. Lonc and Zalewski (1996) showed that in the inheritance of productive tillering some dominance was involved. Ali and Khan (1998) reported that mean squares for GCA were highly significant for yield and yield components Kakar *et al.* (1999) showed that SCA was non-significant for all the traits Sheikh and Singh (2000) indicated significant difference for general combining ability and specific combining ability for all the characters Zalewski (2001) reported that all investigated features were determined by additive gene action Mahmood and Chowdhry (2002) reported that the parents LU26S and 4072 were good general combiners. Most of these studies revealed that a large part of total genetic variability for yield and its components was associated with the GCA effects, a measure of additive genetic variance.

The present study was an attempt to predict the performance of these varieties in hybrid combinations

through diallel crosses and to evaluate the type of gene action involved in yield and its primary components in hexaploid wheat.

## MATERIALS AND METHODS

The experimental material comprised of five wheat varieties namely LU 26, Lylpure 73, Chakwal 86, Inqlab 91 and Pirsabak 91. These parents were crossed in all possible combinations at Barani Agricultural Research Station, Fatehjang during the year 2002-03. The F<sub>1</sub> seed along with their parents were sown in randomized complete block design with three replications. Row-to-row and plant-to-plant distances were 30cm and 20cm respectively. The data on plant height, number of tillers per plant, spike length, number of spikelets per spike, 1000-grain weight and grain yield per plant were recorded from ten randomly selected plants. Analysis of variance was run on the means of the selected plants for above mentioned traits using standard method of Steel and Torrie (1984). Combining ability analysis was done by using Griffing's Method I, Model II (1956).

## RESULTS AND DISCUSSION

The differences among the genotypes were highly significant for all the traits (Table I). The variances for GCA were highly significant for all the characters except spikelets per spike, which showed non-significant difference. However, SCA and reciprocals were non-significant for all the traits indicating the absence of epistatic and dominant gene effects (Table II). The variances for GCA were greater than the mean squares for specific combining ability and reciprocals for all the characters which indicated that additive type of gene effects were more pronounced than those of non-additive ones (Table V). These results are supported by Parashar and Janoria (1994), Lonc and Zalewski (1996), Ali and Khan (1998), Kakar *et al.* (1999),

Sheikh and Singh (2000), Zalewski (2001) and Mahmood and Chowdhry (2002).

General combining effects revealed that Lylpur 73 showed highest GCA effects for plant height, and grains per spike (Table III). For tillers per plant and spikelets per spike, Chakwal 86 was the best general combiner. Highest GCA effects for 1000-grain weight and grain yield per plant were observed in Inqlab 91. It was obvious from the results of SCA effects that the cross LU 26 x Lylpure 73 had high SCA effects for plant height and grains per spike (Table IV). The cross LU 26 x Chakwal 86 possessed highest positive SCA effects for tillers per plant. For spikelets per spike the highest SCA effects were exhibited by the cross Lylpure 73 x Chakwal 86. SCA effects were maximum for 1000-grain weight in the cross LU 26 x Inqlab 91. The highest value of SCA effects for grain yield per plant were recorded in the cross Chakwal 86 x Inqlab 91.

From the foregone discussion it was obvious that GCA effects were predominant for yield and its components. It therefore, appeared that selection for yield and its components may be effective in segregating generations. Highest GCA effects for 1000-grain weight and grain yield per plant were observed in Inqlab 91, the most widely grown cultivar in Pakistan. These results indicated its importance as a breeding stock for improving these traits. While the cross Chakwal 86 x Inqlab 91 gave the highest

**Table I. Mean squares for some metric traits in a 5 × 5 diallel cross of wheat**

SOV	d.f	Plant height	Tillers/ plant	Spikelets/ pike	Grains/ spike	1000-grain wt	Grain yield/ plant
Replications	2	0.13 <sup>NS</sup>	0.11 <sup>NS</sup>	0.42 <sup>NS</sup>	0.74 <sup>NS</sup>	0.18 <sup>NS</sup>	0.11 <sup>NS</sup>
Genotypes	24	38.69**	0.25*	2.14**	64.29**	12.22*	2.65**
Error	48	0.35	0.13	0.40	2.55	0.93	0.21

\* Significant at P<0.05; \*\* Significant at p<0.01; <sup>NS</sup> Non-significant

**Table II. Combining ability analysis for some metric traits in a 5 × 5 diallel cross of wheat**

Source variance	d.f	Plant height	Tillers/ plant	Spikelets/ spike	Grains/spike	1000-grain wt	Grain yield/ plant
GCA	4	66.44**	0.32**	1.48 <sup>NS</sup>	17.55*	19.12*	4.20**
SCA	10	4.04 <sup>NS</sup>	0.03 <sup>NS</sup>	0.61 <sup>NS</sup>	1.03 <sup>NS</sup>	1.85 <sup>NS</sup>	0.36 <sup>NS</sup>
Reciprocals	10	0.41 <sup>NS</sup>	0.04 <sup>NS</sup>	0.52 <sup>NS</sup>	0.13 <sup>NS</sup>	0.27 <sup>NS</sup>	0.07 <sup>NS</sup>
Error	48	5.57	2.00	6.36	40.86	14.90	3.30

\* Significant at P<0.05; \*\* Significant at p<0.01; <sup>NS</sup> Non-significant

**Table III. Estimates of general combining ability effects for some metric traits in a 5 x 5 diallel cross of wheat**

Parents	Plant height	Tillers/ plant	Spikelets/ spike	Grains/ spike	1000-grain wt	Grain yield/plant
LU26	-0.36	0.05	-0.15	-0.16	-0.18	-0.30
Lylpure73	3.31	-0.04	0.37	1.63	-0.79	0.24
Chakwal86	1.66	0.27	0.45	0.96	-0.41	-0.26
Inqlab91	-1.28	-0.23	-0.40	-0.76	2.40	1.00
Pirsabak91	-3.33	-0.03	-0.26	-1.68	-1.03	-0.68

**Table IV. Estimates of specific combining ability effects for some metric traits in a 5×5 diallel cross of wheat**

Crosses	Plant height	Tillers/ plant	Spikelets/ spike	Grains/ spike	1000-grain wt	Grain yield/ plant
LU26 x Lylpure73	1.83	-0.05	-0.22	0.89	-0.97	0.08
LU26 x Chakwal86	-0.71	0.22	0.38	-0.24	0.20	0.13
LU26 x Inqlab91	0.03	-0.10	0.63	-0.03	1.18	-0.22
LU26 x Pirsabak91	-0.89	-0.14	-0.33	-0.52	0.57	-0.01
Lylpure73 x Chakwal 86	1.13	-0.04	1.09	0.55	0.97	-0.31
Lylpure73 x Inqlab 91	0.66	0.01	-0.34	0.34	1.13	0.54
Lylpure73 x Pirsabak91	1.10	0.06	0.00	0.58	-0.26	0.11
Chakwal86 x Inqlab91	0.57	0.12	-0.31	0.35	0.20	0.56
Chakwal86 x Pirsabak91	0.07	-0.03	-0.30	0.02	-0.30	-0.21
Inqlab91 x Pirsabak91	-0.47	0.08	0.37	-0.19	-1.05	0.33

**Table V. Estimates of relative proportion of variance components for general and specific combining ability, reciprocals and error for some metric traits in a 5 x 5 diallel cross of wheat**

Components of variation	Plant height	Tillers/ plant	Spikelets/ spike	Grains/spike	1000-grain wt	Grain yield/ plant
Vg	2.28	-0.07	-0.22	-0.97	0.10	0.02
Vs	-0.91	-1.17	-3.42	-23.71	-7.77	-1.75
Vr	-2.58	-0.98	-2.92	-20.36	-7.31	-1.62
Ve	5.57	2.00	6.36	40.86	14.90	3.30

value of SCA effects for grain yield per plant. This cross can be utilized to improve grain yield, unfortunately both of these parents are now gone susceptible to various yellow rust races. A three way cross including a resistant source can give better results. Further Chakwal 86 is well known for its tolerance to drought, combining it with grain weight and grain yield of Inqlab 91 can give outstanding results.

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