

# Genetic Behaviour and Analysis of Quantitative Traits in Five Wheat Genotypes

M. FAISAL ANWAR MALIK, SHAHID IQBAL AWAN<sup>1</sup> AND SHIRAZ ALI

Barani Agricultural Research Station, Fatehjang

<sup>1</sup>Corresponding author's email: shahid1857@yahoo.com

## ABSTRACT

General combining ability (GCA), specific combining ability (SCA) and reciprocal effects were computed from all possible crosses of five widely adapted local wheat varieties viz., Maxipak 65, Pak. 81, Potohar 93, Kohistan 97 and Margalla 99. Mean squares for all characters were highly significant. Mean squares for GCA were highly significant for plant height and number of tillers per plant, significant for days to flowering, spike length and number of spikelets per spike while non-significant for flag leaf area, days to maturity, 1000-grain weight and grain yield per plant. However, mean squares for specific combining ability and reciprocals were found to be non-significant for all the characters studied. All investigated features were determined by additive gene action. Margalla 99 was the best general combiner for most of the traits studied, while the cross Pak. 81 x Margalla 99 proved to be the best specific combiner.

**Key Words:** *Triticum aestivum*; Specific combining ability; General combining ability; quantitative traits

## INTRODUCTION

Improvement in crop plants depends upon the extent of genetic variability present or induced through hybridization and other methods. As the new variability for the quantitative traits is generated it is likely to alter the pattern of variability of its component traits as well. So it is very important for the development of productive cultivars that the estimates of combining ability, type of gene action and magnitude of genetic variances for various plant characters in a particular set of a cross are known. This information provides a guideline for selecting elite parents and desirable cross combinations which could be taken forward to later segregating generations for the development of new cultivars. The technique of combining ability is being utilized by many research workers to predict the behavior of cross combinations in segregating generations Khaliq *et al.* (1991) stated that GCA and SCA variances were significant while Sattar *et al.* (1992) reported that additive gene effects were more prominent for yield and yield components Kalwar *et al.* (1995) indicated that GCA variances were significant for grain yield and highly significant for plant height Bhutta *et al.* (1997) indicated the preponderance of additive type of gene action for flag leaf area Mahmood and Chowdhry (2000) reported that the parents LU 26S and 4072 were good general combiners for traits like flag leaf area Saeed *et al.* (2001) reported that about 67% of the hybrids showed positive SCA effects for flag leaf area and number of tillers per plant Mahmood and Chowdhry (2002) showed that the additive variance was greater than dominance one for flag leaf area, tillers plant<sup>1</sup>, 1000-grain weight and grain yield plant<sup>1</sup>.

The present studies were conducted to determine the

combining ability estimates of parents and to ascertain the type of genetic mechanism involved in the expression of yield related traits.

## MATERIALS AND METHODS

To evaluate the combining abilities of different wheat varieties, studies were carried out at Barani Agricultural Research Station, Fatehjang during the year 2003-04. The experimental material comprised of five wheat varieties viz; Maxipak 65, Pak. 81, Potohar 93, Kohistan 97 and Margalla 99. The varieties were sown and crossed in all possible combinations. The F<sub>1</sub> seed along with their parents were sown in randomized complete block design with three replications. Three rows of five-meter length served as experimental unit keeping row-to-row and plant-to-plant distances of 30cm and 20cm respectively. The data were recorded from ten randomly selected plants from each experimental unit for various plant characters like flag leaf area, days to flowering, days to maturity, plant height, number of tillers per plant, spike length, number of spikelets per spike, 1000-grain weight and grain yield per plant. The means of the selected plants were analyzed for each trait using standard method of Steel and Torrie (1984). Parameters exhibiting significant differences among genotypes were subjected to combining ability analysis by using Griffing's Method I, Model II (1956).

## RESULTS AND DISCUSSION

The data revealed that mean squares for general combining ability were greater than the mean squares for specific combining ability and reciprocals for all the

characters were highly significant (Table I, II). These results are supported by Sattar *et al.* (1992), Bhutta *et al.* (1997) and Mahmood and Chowdhry (2002). Mean squares for general combining ability were found to be highly significant for plant height and number of tillers per plant, significant for days to heading, spike length and number of spikelets per spike while non-significant for flag leaf area, days to maturity, 1000-grain weight and grain yield per plant (Table I). These findings are closely related to the findings of Khaliq *et al.* (1991), Sattar *et al.* (1992), Kalwar *et al.* (1995) and Mahmood and Chowdhry (2002). However, mean squares for specific combining ability and reciprocals were found to be non-significant for all the characters studied.

The partitioning of variance into its components (Table V) showed that general combining ability variance was greater than the specific combining ability variance for all the characters indicating the inheritance of additive type of gene action except for flag leaf area in which the specific combining ability variance was greater than the general combining ability variance, indicating a preponderance of non-additive gene action.

General combining ability effects revealed that Maxipak 65 showed highest GCA effects for flag leaf area

and days to maturity (Table III). For tillers per plant and 1000-grain weight, Pak. 81 was the best general combiner. Highest GCA effects for days to heading and number of spikelets per spike were observed in Potohar93. Kohistan97 was the best general combiner for grain yield per plant. While Margalla 99 exhibited highest value of GCA effects for plant height and spike length.

Data regarding specific combining ability effects showed that the cross Maxipak 65 x Pak. 81 had highest SCA effects for flag leaf area, days to heading and days to maturity (Table IV). Maximum value of SCA effects for 1000-grain weight was recorded in cross Maxipak 65 x Potohar 93. The cross Pak. 81 x Potohar 93 and exhibited highest SCA effects for number of spikelets per spike followed by the cross Maxipak 65 x Margalla 99. SCA effects were maximum for plant height in the cross Pak. 81 x Kohistan 97. While Pak. 81 x Margalla 99 showed maximum SCA effects for spike length, number of tillers per plant and grain yield per plant. It indicates that this cross can be exploited to obtain better segregants for these traits in early generations for these traits. Mahmood and Chowdhry (2000), Saeed *et al.* (2001) and Mahmood and Chowdhry (2002) also showed similar results.

It was observed from the present studies that the

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

Source of variance	of	Flag area	leaf Days flowering	to Days maturity	to Plant height	Tillers/ plant	Spike length	Spikelets/spike	1000-grain weight	Grain yield/ plant
Replications	2	24.99**	11.37 <sup>NS</sup>	11.45 <sup>NS</sup>	32.78*	0.16 <sup>NS</sup>	17.94*	4.84**	0.10 <sup>NS</sup>	35.32 <sup>NS</sup>
Genotypes	24	490.71**	10.69*	30.04**	32.56**	1.97**	30.12**	1.66**	18.79**	332.63**
Error	48	0.00	5.61	3.70	10.19	0.20	5.13	0.32	1.58	42.00

\* 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 of variance	of d.f	Flag area	leaf Days flowering	to Days maturity	to Plant height	Tillers/ plant	Spike length	Spikelets/spike	1000-grain weight	Grain yield/ plant
GCA	4	154.83 <sup>NS</sup>	8.79*	17.84 <sup>NS</sup>	38.06**	2.36*	23.33**	1.57*	12.50 <sup>NS</sup>	206.13 <sup>NS</sup>
SCA	10	78.54 <sup>NS</sup>	1.95 <sup>NS</sup>	5.77 <sup>NS</sup>	5.67 <sup>NS</sup>	0.43 <sup>NS</sup>	3.35 <sup>NS</sup>	0.31 <sup>NS</sup>	5.19 <sup>NS</sup>	165.65 <sup>NS</sup>
Reciprocals	10	12.09 <sup>NS</sup>	3.08 <sup>NS</sup>	11.12 <sup>NS</sup>	5.16 <sup>NS</sup>	0.20 <sup>NS</sup>	5.18 <sup>NS</sup>	0.39 <sup>NS</sup>	4.84 <sup>NS</sup>	18.00 <sup>NS</sup>
Error	48	0.00	89.75	59.25	163.07	3.15	82.08	5.09	25.30	671.97

\* Significant at P<0.05

\*\* Significant at p<0.01

NS. Non-significant

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

Parents	Flag area	leaf Days flowering	to Days maturity	to Plant height	Tillers/ plant	Spike length	Spikelets/spike	1000-grain weight	Grain yield/ plant
Maxipak65	4.92	0.10	2.17	-2.31	0.09	-1.16	0.09	-1.88	2.55
Pak.81	-4.93	-0.73	-1.46	-1.77	-0.86	2.56	0.30	0.85	-5.63
Potohar93	-0.12	1.57	0.01	0.75	0.18	0.25	0.43	-0.16	-4.07
Kohistan97	-2.53	-0.27	-0.26	1.10	0.27	-0.69	-0.50	0.54	4.61
Margalla99	2.66	-0.67	-0.46	2.23	0.31	-0.96	-0.31	0.65	2.54

Values in Table No III, IV & V are estimates not means, which are calculated when the results of ANOVA are significant and DMRT is applied for mean comparison, if still there is some method please suggest. Thanks.

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

Crosses	Flag area	leaf Days flowering	to Days maturity	to Plant height	Tillers/ plant	Spike length	Spikelets/spike	1000-grain weight	Grain yield/ plant
Maxipak65 x Pak.81	5.99	1.23	1.99	-0.57	0.14	-1.04	-0.22	0.14	3.22
Maxipak65 x Potohar93	3.19	0.27	0.69	1.04	0.28	-0.71	0.25	2.14	7.85
Maxipak65 x Kohistan97	5.57	-0.40	1.79	-1.32	0.29	0.63	0.18	-1.18	-5.52
Maxipak65 x Margalla99	2.60	0.50	0.16	-0.90	-0.20	0.12	0.39	-0.11	-4.33
Pak.81 x Potohar93	-0.12	-0.90	-1.67	-0.70	0.00	-1.67	0.44	-1.50	-19.97
Pak.81 x Kohistan97	-1.69	-0.73	-0.07	2.67	0.01	1.11	0.12	1.82	4.51
Pak.81 x Margalla99	2.78	-0.67	0.79	1.26	0.56	1.23	0.28	0.84	12.85
Potohar93 x Kohistan97	0.54	-0.70	-0.71	-2.43	-0.17	-0.05	-0.21	0.92	5.07
Potohar93 x Margalla99	5.70	-0.47	1.33	0.92	0.47	0.85	0.20	0.93	5.45
Kohisatn97 x Margalla99	-2.12	0.03	-1.91	-0.83	0.30	0.55	-0.17	0.97	-4.45

**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 variation	of Flag area	leaf Days flowering	to Days maturity	to Plant height	Tillers/ plant	Spike length	Spikelets/spike	1000-grain weight	Grain yield/ plant
Vg	3.20	-3.31	-1.88	-5.22	-0.05	-2.48	-0.15	-0.71	-24.94
Vs	46.75	-52.26	-31.83	-93.69	-1.62	-46.87	-2.84	-11.97	-301.38
Vr	6.05	-43.33	-24.07	-78.96	-1.47	-38.45	-2.35	-10.23	-326.99
Ve	0.00	89.75	59.25	163.07	3.15	82.08	5.09	25.30	671.97

variety Margalla 99 was the best general combiner as it exhibited good GCA effects for most of the characters like plant height, number of tillers per plant, flag leaf area 1000-grain weight and grain yield per plant. While the cross Pak. 81 x Margalla 99 proved to be the best specific combiner.

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