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Genetic Analysis for Some Yield Traits In *Triticum aestivum* L.

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Abstract
Combining ability (CA) studies for yield contributing traits in spring wheat were carried out in a 4 × 4 diallel cross. Mean squares for General Combining Ability (GCA) were highly significant for all characters. The mean squares due to specific combining ability (SCA) effects were significant for number of grains per spike and 1000-grain weight. Reciprocal effect was significant in number of spikelets per spike. Additive gene action was found in all characters except number of grains per spike, which showed non-additive type of gene action. Variety Chakwal 86 was found to be good general combiner for spike length, number of spikelets per spike and 1000-grain weight.

Key words: *Triticum aestivum*; yield components; dialled crosses, quantitative characters; Pakistan.

Introduction
Wheat production can be increased partly due to better inputs, proper production technnology and also due genetic manipulation. Genetic manipulation has a significant role to boost up wheat yield. Therefore, the estimation of genetic variation in different plant parameters and sufficient understanding of their mode and extent of inheritance is important to start with productive wheat breeding programme.

For the last few years it has been felt that breeding programmes including hybridization should be built on the basic knowledge of genetic make up and nature of gene action. Diallel cross analysis for combining ability developed by Griffing (1956) is greatly helpful for this purpose. Combining ability provides valuable information about the nature of genetic variance and the magnitude of each of its components after only one generation. It also provides an opportunity to discard or select the breeding material for further studies. The success of most of the plant breeding programmes aiming at the evaluation of high yielding varieties depends primarily on the selection of suitable parents for hybridization. So wheat breeder equipped with information on combining ability can evolve productive varieties. Combining ability analysis provides the nature and the magnitude of various types of gene action involved in the expression of quantitative and qualitative characters as emphasized by Bhutta *et al*. (1997) and Alam *et al*. (1987). Combining ability indicates the potentialities of a line/variety to yield in hybrid combination.

The information obtained through combining ability is of great importance in formulating and executing an efficient breeding programme in order to achieve the maximum genetic gain with minimum resources and time.

The results of Brown *et al*. (1966) on combining ability (CA) analysis revealed that a greater part of total variation in yield and other characters were associated with general combining ability (GCA). Saleem and Hussain (1986) reported highly significant GCA and SCA effects for 1000-grain weight and number of grains per spike. The findings of Alam *et al*. (1987) indicated that GCA mean square was highly significant for spike length.

The major objective of present study was to evaluate a set of lines/varieties of wheat to obtain information on the relative importance of general combining ability and specific combining ability for grain yield and its components. The information so derived would be used for breeding high yielding and improved quality hybrids of wheat.

Materials and Methods
The research studies were carried out in the experimental area of the Department of Plant Breeding and Genetics, University of Agriculture, Faisalabad. Four varieties/lines viz., Pak. 81, Punjab 85, Chakwal 86 and 4943 were grown and were crossed in all possible combinations during 1995-96.

At maturity seeds were collected from all crosses and parents. Seeds of F_1s along with their parents were sown in the field during November, 1996 in a triplicated randomized complete block design. The seeds were dibbled in rows. Plant to plant and row to row distances were maintained 15 and 30 cm, respectively. Each row of 5 meter length was used as an experimental unit. At maturity ten guarded plants from each row were tagged randomly and data were recorded on spike length, number of spikelets per spike, number of grains per spike and 1000-grain weight.

Results and Discussion
The data presented (Table 1) predicted that mean squares for GCA were found to be highly significant for spike length, number of spikelets per spike, number of grains per spike and 1000-grain weight. The mean squares due to SCA effects were also highly significant for number of grains per spike and 1000-grain weight while non-significant for spike length and number of spikelets per spike. The mean squares for reciprocal effects were

Table 1: Combining ability analysis for spike length, number of spikelets per spike, number of grains per spike and 1000-grain weight in a 4 × 4 diallel cross of wheat.

Source of variation	d.f.	Spike length (cm)	No. of spikelets per spike	No. of grains per spike	1000-grain weight (g)
General combining ability	3	7.54**	9.75**	20.08**	59.26**
Specific combining ability	6	0.54^{NS}	0.95^{NS}	8.01**	5.59**
Reciprocal effects	6	1.27^{NS}	2.81*	2.29^{NS}	0.92^{NS}
Error	30	0.12	0.26	7.40	0.45

* = Significant ($P<0.05$), ** = Significant ($P<0.001$), NS = Non-significant

Table 2: Estimates of GCA effects for spike length, number of spikelets per spike, number of grains per spike and 1000-grain weight in a 4 × 4 diallel cross of wheat.

Source of variation	Spike length (cm)	No. of spikelets per spike	No. of grains per spike	1000-grain weight (g)
4943	0.12	-0.67	-3.60	2.48
Pak. 81	-0.18	0.05	0.35	-1.85
Chakwal 86	0.42	0.71	5.95	-0.68
Punjab 85	0.36	-0.09	-2.69	0.05
SE (g_i - g_j)	0.20	0.29	1.57	0.39

Table 3: Estimates of specific combining ability effects for spike length, number of spikelets per spike, number of grains per spike and 1000-grain weight in a 4 × 4 diallel cross of wheat.

Source of variation	Spike length (cm)	No. of spikelets per spike	No. of grains per spike	1000-grain weight (g)
4943 × Pak. 81	0.08	-0.26	1.05	1.22
4943 × Chakwal 86	-0.20	-0.09	0.01	-0.74
4943 × Punjab 85	-0.02	0.14	0.88	1.78
Pak. 81 × Chakwal 86	0.24	-0.31	2.29	0.22
Pak. 81 × Punjab 85	0.05	-0.30	1.42	-0.53
Chakwal 86 × Punjab 85	0.04	0.11	-2.36	-0.31
SE (S_{ij} - S_{ik})	0.45	0.66	3.51	0.87
SE (S_{ij} - S_{kl})	0.40	0.59	3.14	0.77

Table 4: Estimates of reciprocal effects for spike length, number of spikelets per spike, number of grains per spike and 1000-grain weight in a 4 × 4 diallel cross of wheat.

Source of variation	Spike length (cm)	No. of spikelets per spike	No. of grains per spike	1000-grain weight (g)
4943 × Pak. 81	0.46	0.50	4.80	0.21
4943 × Chakwal 86	-0.04	-1.23	-3.31	0.81
4943 × Punjab 85	0.41	0.34	2.58	0.48
Pak. 81 × Chakwal 86	0.20	-0.40	0.13	-0.10
Pak. 81 × Punjab 85	-0.80	0.38	1.60	0.54
Chakwal 86 × Punjab 85	0.20	0.38	1.43	-0.11
SE (r_{ij} - S_{kl})	0.34	0.51	2.72	0.67

Table 5: Estimates of relative proportion of variance component for GCA, SCA, reciprocal effects and error for spike length, number of spikelets per spike, number of grains per spike and 1000-grain weight in a 4 × 4 diallel cross of wheat.

Source of variation	Spike length (cm)	No. of spikelets per spike	No. of grains per spike	1000-grain weight (g)
General combining	0.11	0.29	7.52	3.05
ability effects	(50.58)	(36.99)	(14.54)	(63.98)
Specific combining	-0.03	-0.01	32.01	1.28
ability effects	(-15.78)	(-0.78)	(61.86)	(26.80)
Reciprocal effects	0.02	0.24	4.79	-0.02
	(8.12)	(30.62)	(9.20)	(-0.37)
Error	0.12	0.26	7.40	0.45
	(57.08)	(33.1 7)	(14.30)	(9.51)
Total	100.00	100.00	99.90	99.94

non-significant for spike length, number of grains per spike, number grains per spike and 1000-grain weight whereas significant for number of spikelets per spike.

The results showed that variety Chakwal 86 was conditioned with high positive GCA effect for spike length (0.42), while Pak. 81 exhibited the highest negative GCA effect (-0.18) for the same character (Table 2). The largest positive effects for number of spikelets per spike (0.71) and number of grains per spike (5.95) were obtained from variety Chakwal 86, whereas the greatest negative effects were observed in genotype 4943 for number of spikelets per spike (-0.676) and number of grains per spike (-3.60). In 1000-grain weight the highest value for GCA effect (2.48) was shown by genotype 4943. The variety Chakwal 86 exhibited largest positive GCA effects for spike length, number of spikelets per spike and number of grains per spike and thus was found good general combiner.

The cross Pak. 81 × Chakwal 86 (Table 3) showed the highest SCA effects for spike length (0.24) and number of grains per spike (2.29). The maximum positive effect for number of spikelets per spike (0.14) was observed in cross 4943 × Punjab 85, while largest negative effect was found in the cross Pak. 81 × Chakwal 86 for number of spikelets per spike (-0.31). A cross combination 4943 × Punjab 85 exhibited the highest SCA effect for 1000-grain weight (1.78), whereas the lowest effect was noticed in the cross 4943 × Chakwal 86 for 1000-grain weight (-0.74).

Reciprocal effects and their corresponding standard errors for all characters under study are shown in Table 4. The highest positive reciprocal effects for spike length (0.46), number of spikelets per spike (0.50) and number of grains per spike (4.80) were noticed in the cross 4943 × Pak. 81. The cross 4943 × Chakwal 86 exhibited maximum reciprocal effect for 1000-grain weight (0.81), while largest negative reciprocal effect was observed in cross Chakwal 86 × Punjab 85 for 1000-grain weight (-0.11).

The variance components and their relative proportions for GCA, SCA and reciprocal effects for all characters under study are presented in Table 5. .The proportion of these components were calculated in term of percentage in order to obtained estimates of relative importance of additive and non-additive effects of genes that control the expression of these characters. It is obvious from Table 5 that variances due to GCA were higher than SCA and reciprocal effects for spike length (50.58%), number of spikelets per spike (36.99%) and 1000-grain weight (63.98%). The highest value of SCA variance component was observed in number of grains per spike (61.86%). Similar effects in wheat have been reported by Asad *et al*. (1992), Bhutta *et al*. (1997) and Saleem and Hussain (1986). The results revealed that the characters like spike length, number of spikelets per spike and 1000-grain weight were controlled by additive type of gene action. These results are in agreement with the findings of Alam *et al*. (1987), Asad *et al*. (1992), Bebyakin and Korobova (1989), Bhullar *et al*. (1981). Dalvir *et al*. (1982) and Malik *et al*. (1988). It is obvious from the results that number of grains per spike was controlled by non-additive gene effect with overdominance. Bhullar *et al*. (1981), Chowdhry *et al*. (1980), Dalvir *et al*. (1982) and Tandon *et al*. (1989) reported similar results regarding non-additive gene effects for number of grains per spike.

References

Alam, K., M.A. Chaudhry and A.S. Khan, 1987. Combining ability in a seven parent diallel cross of spring wheat. Pak. J. Agric. Sci., 24: 268-273.

Asad, M.N., K. Alam and M.A. Chowdhry, 1992. Combining ability computation from diallel crosses comprising five bread wheat cultivars. J. Agric. Res., 30: 307-314.

Bebyakin, V.M. and N.I. Korobova, 1989. Combining ability of winter wheat varieties and gene effects determining grain quality characters. Biologicheskie Nauki, USSR, pp: 76-80.

Bhullar, G.S., S.P.S. Brar and K.S. Gill, 1981. Combining ability for yield and its component characters in durum wheat. Indian J. Agric. Sci., 51: 842-846.

Bhutta, M.A., S. Azher and M.A. Chowdhry, 1997. Combining ability studies for yield and its components in spring wheat (*Triticum aestivum* L.). J. Agric. Res., 35: 353-359.

Brown, C.M., R.O. Weibel and R.D. Seif, 1966. Heterosis and combining ability in common winter wheat. Crop Sci., 6: 382-383.

Chowdhry, A.R., M.A. Chowdhry and B. Ahmad, 1980. Combining ability analysis of four wheat varietries. Pak. J. Agric. Sci., 17: 5-14.

Dalvir, S., R.B. Srivastava and V.P. Singh, 1982. Combining ability in bread wheat. Indian J. Agric. Sci., 52: 355-359.

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

Malik, A.J., A.R. Chaudhry, M.M. Rajpur and K.A. Siddiqui, 1988. General and specific combining ability estimates in spring wheat diallel crosses. Pak. J. Agric. Res., 9: 10-15.

Saleem, M. and S. Hussain, 1986. Combining ability analysis in diallel set involving six wheat varieties. J. Agric. Res., 24: 97-102.

Tandon, G., V. Chawla, O.P. Luthra and S. Uppal, 1989. Combining ability analysis of brown rust resistance and yield attributes in wheat. Haryana Agric. Univ. J. Res., 19: 1-5.