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Estimation of General and Specific Combining Ability in a 5 × 5 Diallel Cross of Wheat (*Triticum aestivum L.*)

Ahmad Rizwan and Abdus Salam Khan

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

Abstract: General and specific combining ability effects and variances for five yield related characters were studied involving five parent diallel including reciprocals. Mean squares for GCA were highly significant for tillers/plant, spike length and 1000 grain weight whereas SCA effects were highly significant for spike length, grains per spike and yield per plant. Reciprocal effects for spike length were found to be highly significant. Both additive and non-additive genetic variances played important role in the inheritance of all the characters studied. The non-additive genetic variance was larger in magnitude for grain yield, number of grains per spike and spike length where as additive variance was greater in the case of number of tillers per plant, 1000-grain weight. Inqalab 91 possessed highest GCA effect for spike length and 1000-grain weight where as Pasban 90 for number of grains per spike. Cross combination Pasban 90 × KTDH-6 had the highest SCA effects for number of tillers per plant, number of grains per spike and grain yield per plant.

Key words: Combing ability, additive variance, GCA and SCA effects, (*Triticum aestivum L.*)

Introduction

Wheat being the most valuable staple food is highly esteemed in the world, especially in the homeland of ours. Plant breeders of the present days are making strenuous efforts to evolve highly yielding, wheat genotypes which are agronomically superior and genetically adaptive to a wide range of agro-climatic conditions. The success of most of the plant breeding programmes depend primarily on the selection of suitable parents for hybridization. Combining ability analysis proposed by Griffing (1956), is a viable technique to study the nature of gene effects in quantitatively inherited traits and in classifying parental lines in terms of their hybrid performance as emphasized by Ali and Khan (1998), Asad *et al.* (1992), Bhutta *et al.* (1997), Shahzad *et al.* (1998) and Yadav *et al.* (1998). The information thus derived may be utilized more effectively to devise further breeding strategies for sustained genetic improvement 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. Five wheat genotypes viz; Inqalab 91, Pasban 90, 6500, KTDH-6 and 4072 were crossed in 5 × 5 diallel fashion. F₁ seed thus produced was used to raise the F₂ population during the crop season of 1998-1999. The F₁'s seeds along with their parents were sown in the field in a triplicated randomized complete block design. Each replicate has 25 lines each of 5 meter, length. The plant to plant and row-row distance was 15 and 30 cm, respectively. Sowing was done with dibbler. At maturity ten guarded plants were selected to record the data on tillers per

plant, spike length number of grains per spike, 1000-grain weight and grain yield per plant. The mean values computed for each character were subjected to analysis of variance technique and traits showing significant genotypic differences were further analysed for combining ability using Griffing's techniques (1956) method I, model I).

Results and Discussion

The data presented in Table 1 revealed that mean squares for GCA were highly significant for number of tillers per plant (Ali and Khan, 1998), spike length (Chaudhry *et al.* 1994) and 1000 grain weight (Mohy-ud-din and Shahzad, 1998) where as non-significant for grains per spike (Asad *et al.*, 1992; Khan and Ali, 1998) and grain yield per plant. SCA mean squares were highly significant for spike length (Chaudhry *et al.*, 1994) grains per spike (Shahzad *et al.*, 1998) and yield per plant. Reciprocal effects were highly significant only for spike length and 1000-grain weight and all other were non-significant as also found by (Chaudhry *et al.*, 1992a, b). General combining ability effects are given in Table 2. In case of number of tillers per plant KTDH-6 showed the highest positive GCA effects and lowest by Pasban 90. For spike length Inqalab 91 is the only variety possessing positive GCA value, rest have the negative value with the minimum in the case of KTDH-6. For number of grains per spike Pasban 90 gained the highest positive value where as KTDH-6 has the lowest value. The top scorer for 1000-grain weight and grain yield per plant was variety Inqalab 91. Pasban 90 proved to poor general combiner for 1000-grain weight while genotype 6500 appeared to be the poorest for grain yield per plant.

Table 1: Combining ability analysis for some metric characters in a 5 × 5 diallel cross of wheat
Mean square

Sov	df	Number of tillers per plant	Spike length	Number of grains per spike	1000-grain weight	Grain yield per plant
GCA	4	3.47 **	2.00 **	21.05 N.S	21.56 **	0.50 N.S
SCA	10	0.52 N.S	0.36 **	27.80 * *	4.46 N.S	4.05 **
Reci	10	0.83 N.S	0.78 **	9.56 N.S	12.84 **	1.28 N.S
Error	48	0.49	0.06	8.32	3.60	0.81

* Significant (p = 0.05)

** Significant (p = 0.01), NS = non-significant

Table 2: Estimates of GCA effects for some metric characters in a 5 × 5 diallel cross of wheat

Varieties	Number of tillers per plant	Spike length	Number of grains per spike	1000 grain weight	Grain yield per plant
Inqalab 91	0.24	0.76	0.49	2.28	0.20
Pasban 90	-0.70	-0.12	1.68	-1.47	0.12
6500	0.29	-0.06	0.91	0.50	-0.35
KTDH-6	0.84	-0.48	-1.83	-0.44	0.11
4072	-0.19	-0.17	-1.17	1.87	-0.09

It is obvious from the Table 3 that the cross combination Pasban 90 × KTDH-6 was the top scorer for number of tillers per plant, number of grains per spike and grain yield per plant whereas 6500 × 4072 showed the lowest SCA effect for tillers per plant. The cross combination Inqalab 91 × Pasban 90 showed the greatest positive specific combining ability effect for spike length while largest negative SCA effect for this trait was found in the cross Pasban 90 × 6500. The lowest value for number of grains per plant was a found in cross combination Inqalab 91 × 4072. For 1000-grain weight, highest positive SCA effect was exhibited by the cross Pasban 90 × 4072 while cross 6500 × 4072 proved to be the poor specific

combiner showing the lowest value.

Reciprocal effects for all the characters under study are presented in Table 4. For tillers per plant maximum reciprocal effects were recorded in the cross combination Inqalab 91 × 6500. The largest positive effect for spike length appeared in the cross Inqalab 91 × 4072. The top scorer for grains per spike was the cross Pasban 90 × 4072. As far as 1000-weight is concerned, the greatest reciprocal effect was shown by the cross Inqalab 91 × 4072. The leader for grain yield per plant was the cross Pasban 90 × KTDH-6. Percent estimates of variance components for GCA, SCA and

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Table 3: Estimates of SCA effects for some metric characters in a 5 × 5 diallel cross of wheat

Varieties	Number of tillers per plant	Spike length	Number of grains per spike	1000 grain weight	Grain yield per plant
Inqalab 91 × Pasban 90	-0.012	0.59	-4.48	-0.88	-0.10
Inqalab 91 × 6500	-0.19	0.18	-2.11	0.91	0.74
Inqalab 91 × KTDH-6	-0.14	0.24	-0.80	1.77	0.81
Inqalab 91 × 4072	0.26	-0.22	1.86	-0.61	-0.66
Pasban 90 × 6500	-0.01	-0.79	-2.86	-0.18	0.01
Pasban 90 × KTDH-6	0.48	-0.10	1.88	0.58	2.36
Pasban 90 × 4072	-1.01	0.29	0.68	3.03	-0.46
6500 × KTDH-6	-0.41	0.28	-0.92	-0.41	0.55
6500 × 4072	-0.31	0.30	-2.32	-1.10	0.98
KTDH-6 × 4072	0.30	-0.37	-4.03	-0.30	0.12

Table 4: Estimates of reciprocal effects for some metric characters in a 5 × 5 diallel cross of wheat

Varieties	Number of tillers per plant	Spike length	Number of grains per spike	1000-grain weight	Grain yield per plant
Inqalab 91 × Pasban 90	-0.13	0.05	0.43	0.12	-0.10
Inqalab 91 × 6500	0.93	0.84	0.16	1.18	-0.18
Inqalab 91 × KTDH-6	0.53	0.44	-0.93	1.48	0.35
Inqalab 91 × 4072	0.76	1.09	-4.60	5.14	0.87
Pasban 90 × 6500	0.66	-0.83	-1.00	2.12	0.38
Pasban 90 × KTDH-6	0.16	-0.68	-2.53	4.10	1.33
Pasban 90 × 4072	-1.23	-0.74	3.20	-3.07	-1.21
6500 × KTDH-6	-0.26	0.24	0.96	-1.56	1.13
6500 × 4072	-0.33	0.19	2.63	0.94	-0.74
KTDH-6 × 4072	0.50	0.12	-0.16	0.13	0.51

Table 5: Components of variance for GCA, SCA and reciprocal effects for some metric characters in a 5 × 5 diallel cross of wheat

Varieties	Number of components	Spike length	Number of grains per spike	1000 grain weight	Grain yield per plant
Vg	0.1940 (21.04)	0.2986 (29.93)	12.732 (30.93)	1.7921 (16.51)	0.031 (0.71)
Vs	0.3024 (32.80)	0.0345 (3.46)	19.479 (47.33)	0.8232 (7.58)	3.2406 (74.95)
Vr	0.3591 (38.95)	0.1727 (17.31)	0.6195 (1.52)	4.5948 (42.35)	0.2333 (5.40)
Ve	0.0664 (7.21)	0.4918 (49.30)	8.3214 (20.22)	3.6385 (33.56)	0.8189 (18.94)
Total	0.9219 (100.0)	0.9976 (100.0)	41.1528 (100.0)	10.8486 (100.0)	4.324 (100.0)

N.B: (Values showed in parenthesis showed percentage)

reciprocal effects are presented in Table 5. The position of these components in the total variance gives the idea of relative importance of non-additive and additive effects of genes that control the expression of these characters. The variance components showed that both additive and non-additive type of gene actions are involved in the expression of the characters studied.

The highest value for GCA variance component was observed in number of grains per spike and lowest in case of grain yield per plant. The highest value of SCA variance component was found in grain yield per plant while the lowest value was shown by number of tillers per plant. The variance due to reciprocal effect was highest in 1000 grain weight and lowest value was found in number of grains per spike. The characters like number of tillers per plant and 1000-grain weight were governed by additive gene effect because the variance components due to GCA were greater than SCA. Similar effects were reported by Ali and Khan (1998), Bhutta et al. (1997), Hassan et al. (1996), Khaliq et al. (1992), Shahzad et al. (1998) and Yadav et al. (1998). The variance component due to SCA was greater for spike length, number of grains per spike, and grain yield per plant than GCA so controlled by additive type of gene action. These results are in accordance with the finding of Mohy-ud-din and Shahzad (1998). Variety Inqalab 91 proved to be good general combiner for spike length, 1000 grain weight and grain yield per plant. Cross combination Pasban 90 × KTDH-6 was the best specific combiner for number of tillers per plant, number of tiller per plant, number of grains per spike and grain yield per plant. So these can be used in breeding programmes to get better, hybrid combinations or wheat lines for increased wheat production.

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