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Combining Ability Estimates for Some Quantitative Traits in Five Spring Wheat (*Triticum aestivum* L.) Genotypes

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Abstract: Combining ability studies were performed for plant height, spike length, number of spikelets per spike, number of grains per spike, grain weight per spike and 1000-grain weight in a set of diallel crosses involving five spring wheat genotypes. Significant variation was found in all six characters. General combining ability (GC), specific combining ability (SCA) and reciprocal effects were significant. Additive gene action was found for the characters under study. Best general combiners and the best cross combinations were identified for future breeding programme.

Key words: Wheat, yield, combining ability, reciprocal effects, diallel

Introduction

The basic knowledge of genetic make up, nature of gene action and combining ability are pre-requisite for the development of new varieties. The study of combining ability is useful in classifying parental lines in term of their hybrid performance and thus aids in selecting parents for a meaningful breeding programme and for the evolution of better quality and high yielding cultivars. Rasal *et al.* (1991) derived information on combining ability from data on seven quantitative characters and found additive gene action to be predominant for grains per spike, plant height and spikelets per spike. Mishra *et al.* (1994) also reported the pre-dominant role of additive gene for the expression of traits contributing grain yield in bread wheat and identified the good general combiners. Vojdani and Sepahvand (1994) identified best general combiners and best cross combinations while crossing eight bread wheat cultivars in a diallel fashion for eight yield components. Similarly El-Hennawy (1996) indicated the predominant role of additive gene action in the inheritance of seven yield components and best general combiners with superior hybrids for grain yield and most of the yield components were identified. The present study was thus conducted to get the comprehensive knowledge about the combining ability that could be helpful for further testing to evolve new varieties.

Materials and Methods

Five spring wheat genotypes viz. Pasban 90, Rawal 87, 8073, 8120 and 8060 were crossed in complete diallel fashion in the experimental area of the department of Plant Breeding and Genetics, University of Agriculture, Faisalabad. The F_1 generation along with their parents was space planted during the normal crop season during 1996-97 in randomized complete block design, replicated thrice. The plant to plant and row to row distance was kept 6 inch and 12 inches respectively. Thinning was done to maintain one plant per hill. Data were recorded at maturity on ten guarded plants frum each row for plant height, spike length, number of spikelets per spike, number of grains per spike, grain weight per spike and 1000-grain weight and was subjected to analysis of variance using technique developed by Steel and Torrie (1984). GCA, SCA and reciprocal effects were estimated using Method-I, Model-II of Griffing (1956).

Results and discussions

All the five genotypes and their crosses showed highly significant differences for all the characters under study (Table 1). Mean square for GCA, SCA and reciprocal effects were also significant for all the characters. This indicated that both GCA and SCA controlled the total variability for the characters under study. The estimates of variance components and their relative proportions for GCA, SCA and reciprocal effects for all the characters under study that indicated that variances due to GCA were higher in magnitude than SCA for all the traits showing thereby the involvement of additive type of gene action for these traits. The results are in accordance with the findings of Rasal *et al*. (1991), Mishra *et al*. (1994) and El-Hennawy (1996) (Table 2, 3). The results regarding the General combining ability effects revealed that Rawal 87 proved to be the best general combiner for plant height, number of spikelets per spike and number of grains per spike while genotypes 8120 proved to be the best general combiner for grain weight per spike and 1000 grain weight. The line 8060 implied best general combiner for spike length.

Specific combining ability effects showed highest positive values by Rawal 87 x 8120 for plant height, Rawal 87 x 8073 for spike length, Pasban 90 x 8060 for number of spikelets per spike, Pasban 90 x 8073 for number of grains per spike and grain weight per spike whereas Pasban 90 x 8120 stood first for 1000-grain weight (Table 4).

Table 1: Analysis of variance for certain plant characters in wheat

Source of variation	Degree of freedom	Plant height	Spike length	Number of spikelets per spike	Number of grains per spike	Grain weight per spike	1000-grain weight
Treatment	24	145.103**	1.504**	1.688**	19.569**	0.437**	109.591**
Replication	2	6.388	0.023	0.076	3.530	0.001	0.251
Error	48	5.835	0.043	0.022	0.260	0.004	0.195

** = Highly significant

Table 2: Analysis of variance to GCA, SCA and reciprocal effects for certain plant characters in wheat

Source of variation	Degree of freedom	Plant height	Spike length	Number of spikelets/spike	Number of grains/spike	Grain weight per spike	1000-grain weight
GCA	4	364.165*	2.320**	2.051**	27.459**	0.679**	146.367**
SCA	10	5.335**	0.136**	0.301**	1.152**	0.027**	2.952**
Reciprocal	10	5.107*	0.144**	0.232**	3.157**	0.051**	26.156**
Error	48	1.943	0.014	0.007	0.087	0.001	0.065

** = Highly Significant * = Significant

Table 3: Estimates of Components of variation due to GCA, SCA and reciprocal effects for certain plant characters in wheat

Source of variation	Plant height	Spike length	Number of spikelets per spike	Number of grains per spike	Grain weight per spike	1000-grain weight
GCA	25.899	0.219	0.176	2.610	0.065	14.255
	(82.37)	(59.19)	(37.45)	(51.29)	(61.32)	(49.19)
SCA	2.019	0.072	0.175	0.848	0.015	1.178
	(6.42)	(19.46)	(37.230)	(16.72)	(14.15)	(5.89)
Reciprocal	1.582	0.065	0.112	1.535	0.025	13.045
	(5.03)	(17.57)	(23.830)	(30.27)	(23.58)	(44.70)
Error	1.943	0.014	0.007	0.087	0.001	0.65
	(6.18)	(3.78)	(1.49)	(1.72)	(0.94)	(0.22)

Values in the parenthesis indicate the percentage of variance components

Table 4: Estimates of General Combining ability for certain plant characters in wheat

Genotypes	Plant height	Spike length	Number of spikelets per spike	Number of grains per spike	Grain weight per spike	1000-grain weight
Pasban 90	-0.145	-0.455	0.154	-0.842	-0.173	-4.599
Rawal 87	8.096	0.246	0.603	2.288	0.067	2.640
8073	-1.641	-0.313	-0.474	-0.919	-0.050	-2.178
8120	-0.195	-0.199	0.150	1.160	0.411	4.995
8060	-6.113	0.723	-0.431	-1.688	-0.256	-0.856

Table 5: Estimates of specific combining ability and reciprocal effects for certain characters in wheat

Crosses	Plant height	Spike length spikelets/spike	Number of grains per spike	Number of grain per spike	Grain weight per spike	1000-grain weight
Pasban 90 x Rawal 87	-2.731	-0.090	-0.766	-1.292	-0.006	-0.598
	1.310	-0.385	0.435	-0.015	-0.200	-3.885
Pasban 90 x 8073	-1.400	-0.170	-0.230	0.100	0.117	0.150
	1.416	-0.126	0.176	0.300	0.048	-0.245
Pasban 90 x 8120	0.840	-0.020	-0.200	-0.355	-0.025	6.850
	1.990	0.310	0.152	1.156	0.212	-1.458
Pasban 90 x 8060	-0.085	0.210	0.115	-0.515	-0.025	4.030
	0.723	0.288	0.218	-0.016	-0.052	0.613
Rawal 87 x 8073	1.575	0.425	-0.185	-0.950	-0.077	0.235
	1.370	0.048	0.412	0.450	0.061	1.261
Rawal 87 x 8120	3.315	-0.080	-0.820	-0.950	0.017	-0.265
	0.084	0.079	-0.247	-0.589	0.063	1.788
Rawal 87 x 8060	0.600	0.070	-0.355	-2.530	-0.067	-0.265
	0.077	0.087	0.219	1.039	0.034	0.039
8073 x 8120	-2.484	-0.317	-0.355	-0.052	-0.022	0.561
	2.480	0.0335	0.085	-1.120	-0.228	-5.610
8073 x 8060	0.804	0.191	-0.389	-1.404	-0.090	0.207
	0.850	-0.265	0.180	-0.180	0.127	-1.015
8120 x 8060	0.208	-0.308	-0.098	-0.433	-0.008	-0.131
	0.820	-3.350	-0.065	2.430	0.347	4.450

Note: The estimates of SCA are in first row and reciprocal effects are in second row

Reciprocal effects revealed highest positive effect by 8120 x 8073 for plant height, 8120 x Pasban 90 for spike length, Rawai 87 x Pasban 90 for number of spikelets per spike and 8060 x 8120 for number of grains per spike, grain weight per spike and 1000-grain weight (Table 5).

It is concluded that the utilization of best general combiner in the hybridization results in better combinations which could be helpful in future breeding programme. This is in agreement with the findings of Chowdhry *et al*. (1996) and El-Hennawy (1996).

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