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Combining ability analysis for grain yield and yield attributing traits in two-rowed barley

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Abstract
The field experiment was carried out in randomized block design with three replications. Twenty eight F_1's alongwith their 8 parents were evaluated at the instructional farm, AICW & BIP, College of Agriculture, Rewa (M.P.) during Rabi 2016-17. Twenty eight cross combinations obtained from 8 parental diallel were chosen for this study on the basis of their yield potential and agronomical traits. The estimates of general combining ability (GCA) effects revealed that parents DWRUB 64 and RD 2849 were good general combiners for spike weight, spike length, grains /spike, biological yield /plant and days to 50% flowering out of twenty eight crosses.

Keywords: Combining ability, barley, two rowed barley

Introduction
A rational choice of parents promotes the improvement process leading to a well planned hybridization programme. The success in identifying such parents mainly depends on the gene action that controls the trait under improvement. The study of combining ability help to provide the information about the genetic mechanism which control quantitative inhertitance of studied traits and enable us to assess the prevalence of parents in hybrid combinations. In the present study, therefore effort was made to study the combining ability analysis for grainyield and its attributing traits in barley (*Hordeum vulgare* L.).

Material and Methods
The present study was carried out at Instructional farm JNKVV, College of Agriculture, Rewa. The experimental material consists of 8 parents viz., DWRUB 52, DWRUB 64, DWRB 92, DWRB 101, RD 2849, BH 902, BH 946 and PL 891 alongwith their 28 F_1's and planted in Ramdomized block design with three replication during rabi 2016-17. Each plot consists of paired row of 4 m. Long, alongwith rows and plants spacing of 23 cm and 6 cm respectively. Observations were recorded on days to 50% flowering, plant height, tillers per plant, spike weight, spike length, number of grain / spike, grain weight / spike, 1000 grain weight, biological yield / plant and grain yield / plant.
The combining ability analysis was carried out according to Griffing's approach (1956) method II and model I.

Table 1: Analysis of variance for combining ability in barley

SOV	df	Days to 50% flowering	Plant height (cm)	Tillers/ plant	Spike weight (g)	Spike length (cm)	Number of grains/ spike	Grain weight/ spike (g)	1000-grain weight (g)	Biological yield/ plant (g)	Grain yield/ plant (g)
GCA	7.00	28.1**	140.85**	2**	0.44**	2.47**	31.18**	0.14**	22.68**	46**	4.77**
SCA	28.00	24.87**	65.81**	2.53**	0.1	1.94**	44.65**	0.06	4.35**	49.45**	8.91**
Error	70.00	2.41	5.81	0.52	0.08	0.76	0.89	0.04	1.68	2.6	0.66

Result and Discussion
The analysis of variance due to general combining ability (GCA) and specific combining ability (SCA) were highly significant for all the traits studied except spike weight and grain weight / spike. Similarly, the differences among F_1 hybrids were found significant for all the traits.
Theestimates of general combining ability (gca) effects revealedthat parents DWRUB 64and RD 2849 were found as good general combiners for grainyield/plant.

The parent DWRUB 52 manifested desirable significant and positive GCA effect for the traits days to 50% flowering, spike length, grains/ spike and biological yield/ plant. DWRUB 64 considered as good general combiner for traits viz; days to 50% flowering, tillers/ plant, spike weight, spike length, grains/ spike, biological yield/ plant and grain yield/ plant while, poor general combiner for 1000- grain weight was DWRB 92 showed desirable significant and positive GCA effect for the traits grains/ spike and 1000-grain weight. However, desirable significant butnegative GCA effect for plant heightconsidered as good general combiner for this trait whereas, parents showed poor general combiner for tillers/ plant showing undesirable significant and negative GCA effect. Parent DWRB 101 showed desirable significant negative GCA effect for traits days to 50% flowering and plant height considered as good general combiner for days to 50% flowering and plant height while, parents showed as poor general combiner for the biological yield/ plant and grain yield/ plant; RD 2849 was found as very good and effective general combiner for the traits grain weight/ spike, biological yield/ plant and grain yield/ plant while, parent BH 902 was considered as a poor general combiner for the traits like, days to 50% flowering, plant height, grains/ spike, 1000-grain weight, biological yield/ plant and grain yield/ plant. Parent BH 946 was observed as a good general combiner for the traits plant heightand tillers/ plant, while poor general combiner for the traits days to 50% flowering, grains/ spike and 1000-grain weight; PL 891 was recorded as good general combiner for only one trait i.e., plant height while, it waspoor general combiner for spike weight, grains/ spike, grain weight/ spike, biological yield/ plantand grain yield/ plant

Table 2: General combining ability (GCA) effect for for grain yield and its components in two – rowed barley

Parents	Days to 50% flowering	Plant height (cm)	Tillers/ plant	Spike weight (g)	Spike length (cm)	Number of grains/ spike	Grain weight/ spike (g)	1000-grain weight (g)	Biological yield/ plant (g)	Grain yield/ plant (g)
DWRUB 52	-1.31**	0.97	0.02	0.03	0.53*	2.16**	-0.11	0.22	-1.25*	-0.09
DWRUB 64	-2.51**	0.24	0.55*	0.28**	0.77**	1.45**	-0.01	-1.43**	3.22**	1.14 **
DWRB 92	0.54	-5.81**	-0.47*	0.06	-0.14	1.64**	0.02	3.28**	0.76	0.29
DWRB 101	-1.58**	-2.02**	-0.55*	-0.04	-0.67*	-0.01	0.08	0.32	-1.11*	-0.22
RD 2849	0.25	2.71**	0.08	0.02	0.02	0.36	0.18**	0.41	2.81**	0.59 *
BH 902	2.38**	4.77**	-0.16	0.06	0.27	-2.7**	0.09	-1.12**	-0.95*	-1.00 **
BH 946	1.68**	3.4**	0.71**	0.06	-0.35	-0.84**	-0.06	-1.09**	-0.39	0.04
PL 891	0.56	-4.26**	-0.18	-0.47**	-0.44	-2.06**	-0.18**	-0.59	-3.08**	-0.74 **

Table 3: Specific combining ability (SCA) effect for for grain yield and its components in two – rowed barley

	Days to 50% Flowering	Plant Height (cm)	Tillers/ Plant	Spike Weight (g)	Spike Length (cm)	Grains/ Spike	Grain Weight/ Spike (g)	1000-Grain Weight (g)	Biological Yield/ Plant (g)	Grain Yield/ Plant (g)
DWRUB 52/DWRUB 64	2.84	-4.31	-1.67*	-0.06	-0.57	5.11**	0.05	1.27	-2.8	-1.56*
DWRUB 52/DWRB 92	-7.35**	9.03**	0.69	-0.01	1.3	4.91**	-0.58**	3.73**	-7.41**	-4.51**
DWRUB 52/DWRB 101	-0.66	-11.09**	-2.5**	0.13	0.83	5.57**	-0.07	-3.31**	-6.41**	-2.5**
DWRUB 52/RD 2849	-4.49**	-1.79	2.68**	0.29	0.25	-10.81**	-0.21	0.09	-6.1**	-2.57**
DWRUB 52/BH 902	-0.12	3.39	0.18	0.29	0.5	-5.11**	0.12	-1.31	0.01	-1.65*
DWRUB 52/BH 946	3.08*	5.12*	-0.06	-0.04	0.31	2.06*	0.33	0.39	-3.87*	0.97
DWRUB 52/PL 891	3.46*	-1.58	-0.77	0.22	0.91	0.78	0.25	-2.48*	-0.6	0.02
DWRUB 64/DWRB 92	-2.58	-12.13**	0.49	-0.29	0.27	-16.71**	0.12	0.28	-1.11	-2.71**
DWRUB 64/DWRB 101	-6.33**	5.98*	-0.33	-0.32	-0.34	0.94	0.19	-1.06	-5.41**	-2.36**
DWRUB 64/RD 2849	-1.99	2.92	1.08	-0.22	0.21	1.57	-0.17	0.57	3.07*	1.43
DWRUB 64/BH 902	-2.08	6.52**	0.65	-0.19	1.73*	4.3**	-0.12	0.2	4.9**	0.45
DWRUB 64/BH 946	-1.25	-3.81	0.64	0.11	-1.36	7.44**	-0.07	-1.86	2.27	0.23
DWRUB 64/PL 891	-2.67	-5.35*	1.74*	-0.3	-0.13	-4.94**	-0.18	1.24	-8.5**	0.65
DWRB 92/DWRB 101	-7.88**	4.39	-0.14	-0.14	-1.46	9.42**	-0.07	3.0*	3.59*	1.89*
DWRB 92/RD 2849	5.65**	-15.64**	-1.47*	0.66*	-0.25	1.71	0.19	1.83	-8.47**	-2.58**
DWRB 92/BH 902	3.33*	-13.77**	-1.23	-0.21	-1.3	-1.23	0.32	-0.77	-5.31**	-1.66*
DWRB 92/BH 946	4.36**	4.9*	-3.14**	0.16	-3.15**	-1.09	0.3	-4.47**	-0.51	-3.11**
DWRB 92/PL 891	1.84	6.2**	-1.54*	-0.22	-0.15	0.8	0.35	-3.53**	-2.08	-0.63
DWRB 101/RD 2849	-4.79**	0.14	-1.22	-0.24	-0.32	4.7**	0.07	1.26	-7.8**	-3.21**
DWRB 101/BH 902	-3.42*	-14.19**	-0.55	-0.2	-2.07*	5.09**	0.33	-1.01	-4.84**	-2.99**
DWRB 101/BH 946	7.48**	0.51	2.28**	-0.17	0.08	-9.77**	-0.26	2.59*	-6.77**	1.17
DWRB 101/PL 891	1.27	-0.79	0.91	-0.11	-1.59	-2.78**	-0.14	1.49	-3.21*	-2.48**
RD 2849/BH 902	-7.41**	13.18**	2.19**	-0.1	-0.38	2.72**	0.03	-1.31	4.64**	0.97
RD 2849/BH 946	0.78	1.15	0.55	-0.44	1.2	4.86**	0.18	1.66	9.04**	2.99**
RD 2849/PL 891	-2.1	3.75	0.08	-0.15	-1.24	1.94*	-0.24	-1.17	-0.1	-0.46
BH 902/BH 946	-0.48	10.16**	-0.95	0.1	0.51	-13.08**	-0.17	1.59	-3.43*	-0.59
BH 902/PL 891	-2.46	3.99	-0.72	-0.01	-1.19	0.41	-0.21	1.76	-2.83	-0.77
BH 946/PL 891	-0.59	-8.18**	-0.69	-0.31	0.22	-5.89**	-0.23	2.36	-3.67*	-1.79*
Sij <> 0 at 95%	2.89	4.48	1.34	0.52	1.62	1.76	0.39	2.41	3.0	1.51
Sij--Sik at 95%	4.28	6.63	1.99	0.77	2.4	2.6	0.58	3.57	4.44	2.24
Sij--Skl at 95%	4.03	6.25	1.87	0.72	2.27	2.45	0.55	3.36	4.18	2.11

The number of crosses possessing negative and significant SCA effects for plant height wereDWRUB 52/DWRB 101, DWRUB 64/DWRB 92, DWRUB 64/PL 891, DWRB 92/RD 2849, DWRB 92/BH 902, DWRB 101/BH 90 and BH 946/PL 891; these crosses were found as a good specific combiners for short stature plant height. The best four crosses namely DWRUB 52/RD 2849, DWRB 101/BH 946, RD 2849/BH 902 and DWRUB 64/PL 891 exhibited good specific combiners for tillers/ plant showing positive and significant SCA effects cross DWRB 92/RD 2849 and DWRUB 64/BH 902 wereidentified as good specific combiners for the spike weight and spike length, respectively which possessed positive and significant SCA effects. Three crosses recorded positive and significant SCA effects for grains/spike viz., DWRUB 52/DWRUB 64, DWRUB 52/DWRB 92 and DWRUB 52/DWRB 101.

Out of twenty-eight crosses, three crosses viz., DWRUB 52/DWRB 101, DWRB 92/DWRB 101 and DWRB 101/BH 946 emerged as good specific general combiners for 1000-grain weight having positive and significant SCA effects. Cross combinations viz; DWRUB 64/RD 2849, DWRUB 64/BH 902, DWRB 92/DWRB 101, RD 2849/BH 902 and RD 2849/BH 946 were identified as good specific combiners for biological yield/ plant.

The critical examination of results revealed that the crosses exhibiting high order significant and desirable SCA effects for different characters involved parents having all types of combinations of GCA effects such as high × high (H × H), high × average (H × A), high × low (H × L), average × average (A × A), average × low (A × L) and low × low (L × L). Madic *et al*. (2014) [7] have also observed the involvement of high x high (H x H) and low x high (L x H) general combiner parents in manifestation of high order significant and desirable SCA effects for grain yield/plant and its components. The foregoing observation clearly indicated that there was no particular relationship between positive and significant SCA effects of crosses with GCA effects of theirparents for the characters under study and also supported by earlier workers viz; Esparza martinez and Foster (1998); Budak (2000); Zeng and Chen (2001); Sharma *et al*. (2002); Yadav *et al*. (2002); Sharma *et al*.(2003); Joshi *et al*.(2004); Nazir *et al*. (2005); Aghamiri *et al*. (2012); Bornare *et al*. (2013) and Madic *etal*. (2014) in barley.

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