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Study of Grain Yield Contributing Traits and Their Combining Ability in Bread Wheat (Triticum Aestivum L)

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Selection of suitable paren6ts and their cross combinations for effective hybridization is pre-requisite in order to frame a systematic breeding programme leading to rapid and sustained improvement. The combining ability analysis furnishes such useful information on these aspects. During the past three decades, wheat production in India has increased more than four times. During this period, area under wheat cultivation has gone up in two fold and the wheat contribution to total food has increased over the same period from 13 per cent of 42 per cent, but the rate of improvement is still far behind than the population growth rate and breeder has to again think about the genetic improvement of wheat crop.

***Key words**: General combining ability, specific combining ability, per sec.*

I. INTRODUCTION

An experiment comprising 10 parents and their 45 F_1s derived from 10 parent diallel mating design excluding reciprocals was conducted. The parents involved where HD2285, K8305, UP2121, K8565, K8020, HUW234, PBW226, K8103, HUW300 and HP1633. All the 55 treatments were grown in Randomized Block Design with three replications at Crop Research Farm, Chandra Shekhar Azad University of Agriculture and Technology, Kanpur. The treatments were grown in two row plots of 1.5m lengthwith inter and

Table 1. Anova for combining ability and related statistics

Sources of Variation	d.f.	Days to reproductive phase	Flag leaf area	Spikearea	Plant height	Number of productive tillers per plant	Grian weightper spike	Number of grains per spike	Harvest index	1000-grain weight	Grain yield per plant
gca	9	69.82**	31.83**	41.24**	33.66**	1.84**	0.03**	33.36**	4.04**	8.86**	23.02**
sca	45	25.90**	8.15**	6.90**	34.96**	3.22**	0.07**	46.58**	7.72**	11.30**	15.79**
ERROR	108	0.62	0.67	0.46	0.64	0.41	0.01	1.43	0.65	0.24	1.09
6_2g		51.67	23.37	30.58	24.76	1.07	0.015	24.32	2.54	6.46	16.45
6_2s		1169.10	336.60	289.80	1544.4	26.45	2.70	2036.25	318.15	497.70	661.50
6_2e		0.92	0.67	0.46	0.64	0.41	0.01	1.43	0.65	0.24	1.09
GPR		0.08	0.12	0.17	0.30	0.008	0.005	0.023	0.016	0.02	0.05

** Significant at 1% level

Table 2. Estimates of gca effects along with their mean performance

	Days to productive phase		Flag leaf area		Spike area		Plant height		Number of productive tillers per plant		Grain weight per spike		Number of grains per spike	
Parent	gca effect	mean	gca effect	mean	gca effect	mean	gca effect	mean	gca effect	mean	gca effect	mean	gca effect	mean
HD 2285	0.36	52.90	-2.90**	26.75	0.73**	41.12	-2.48**	81.67	0.14	15.67	0.022	2.43	1.29**	59.00
K 8305	-181**	48.79	0.52*	35.35	1.07**	44.98	-0.05	79.17	0.61**	19.00	0.031**	2.39	2.93**	71.33
UP 2121	1.01**	44.17	0.6/8**	38.06	0.50***	37.51	1.07**	93.67	-0.31	15.83	-0.093**	2.32	1.68**	62.00
K 8565	-1.40**	58.25	-0.05	35.89	-0..07	44.36	-0.93**	78.50	-0.60**	15.00	0.012	2.67	-0.62	52.00
K 8020	2.32**	61.66	1.04**	35.20	2.18**	45.27	-1.66**	85.67	0.03	14.40	-0.061**	2.46	1.79**	64.67
HUW 234	-2.46**	43.61	-1.18**	33.58	-3.77**	43.32	1.88**	75.77	-0.01	16.00	0.081**	2.18	0.16	62.67
PBW 226	2.44**	45.32	2.60**	34.31	2.29*	44.95	3.12**	94.52	0.49**	19.33	0.011	3.03	-1.98	47.67
K 8103	2.09**	57.60	1.51**	37.79	-1.66**	39.80	-0.30	84.73	-0.03	14.00	-0.087	2.51	-2.40**	54.67
HUW 300	1.97**	54.27	-1.72**	34.50	-1.41**	40.02	0.31	80.33	-0.06	16.00	0.051	2.66	-1.88**	54.33
HP 1633	-1.51**	44.98	-0.51*	31.80	0.14	40.50	-0.09**	92.00	-0.81**	13.67	0.076**	2.70	0.99**	54.00
SE (gi) ±	0.26		0.22		0.18		0.22		0.18		0.015		0.32	
SE (gi-gi) ±	0.36		0.33		0.27		0.33		0.27		0.022		0.48	

	Harvest index		1000-graint weight		Grain Yield per plant		Seed hardness		Protein content		Tryptophan content	
Parent	gca effect	mean	gca effect	mean	gca effect	mean	gca effect	mean	gca effect	mean	gca effect	mean
HD 2285	-1.41**	39.87	1.57**	40.95	1.94**	38.83	-0.78**	10.17	0.12	12.27	-0.17**	1.49
K 8305	0.48*	47.84	-0.92**	36.73	2.17**	46.45	-0.29	9.08	0.27**	13.45	-0.17**	1.46
UP 2121	0.40	46.25	0.74**	38.92	-0.15	44.89	0.53**	12.48	0.37**	11.50	0.01	1.26
K 8565	0.18	42.25	0.15	37.88	-0.20	42.02	-0.46**	13.00	-0.08	12.93	-0.08**	1.49
K 8020	-0.51**	47.21	-181**	34.50	-1.76**	38.87	-0.26*	9.00	0.08	12.30	0.14**	1.41
HUW 234	0.12	44.52	-0.42**	36.38	0.10	39.90	0.30*	13.00	-0.31**	12.28	0.04*	2.09
PBW 226	0.03	44.48	0.33**	38.30	0.74**	46.50	0.02	11.32	0.10	11.85	0.04*	1.69
K 8103	0.28	41.92	0.36**	38.38	-0.36	38.92	0.70**	12.33	-0.26**	11.23	-0.03	1.54
HUW 300	0.22	46.74	0.61**	40.38	-2.52**	36.53	0.27*	13.67	-0.27**	11.22	0.01	1.72
HP 1633	0.69**	42.22	0.65**	43.81	0.78**	46.63	-0.04	11.50	0.01	12.42	0.12	2.19
SE (gi) ±	0.22		013		0.29		0.13		0.09		0.02	
SE (gi-gi) ±	0.33		0.20		0.44		0.20		0.13		0.03	

Table 3: Best specific combiners for grain yield per plant and theirperformance in other traits.

Desirable cross	sca effect	Per se performance	gca effect		Desirable sca effect performance in other traitsin a 10-parent -diallel cross of F1 in bread wheat
			P1	P2	
HUW234×PBW226	9.18**	47.73	0.10	0.75**	III(5.08**), V(2.60**), VI (0.41**)
UP2121×HUW300	5.29**	55.95	-0.15	-2.52**	II(2.76**), III (1.31**), IV(-15.12**), V(4.10**), IX(2.51**)
K8020×PBW226	4.53**	56.95	-1.76**	0.74**	I(8.61**), II (4.90**), V(2.23**), VI(0.41**), VIII(2.58*)
UP2121×PBW226	4.45**	56.70	-0.15	0.74**	III(2.16**), VII(8.55**), XI(0.89*)
UP2121×HUW300	4.37**	49.28	-1.76**	-2.52**	I(6.15**) VI(0.47**)
K8305×PBW226	4.30**	43.50	2.17**	0.74**	IV(-0.15**), VI(0.48**), IX(1.84*)
PBW226×HUW300	4.04**	52.90	0.74**	-2.52**	I(5.27**), II (1.83**), IV(-13.14**), VII(9.71**)
HD2285×HP1633	3.56**	33.87	1.94**	0.78**	I(6.86**), IV(-8.32**), V(3.41**), VII(2.80**), IX(2.3**)
UP2121×K8103	3.35**	48.58	-0.15	-0.36	I(4.08**), II(6.38**), VII(4.46**)
K8565×K8103	3.21**	49.80**	-0.20	-0.36	III(1.80**), V(1.83**), VI(0.29**)
HUW234×HUW300	3.05**	54.09	0.10	-2.52**	VI(0.21**), VII(5.74**)
K8305×HP1633	2.92**	49.93	2.17**	0.78**	II(3.32**), VI(0.36**), IX(5.22**)
K8020×K8103	2.82**	49.72	-1.76**	-0.36	I(1.78*), II(3.17**), VIII(4.35**), IX(1.94**)
HUW234×K8103	2.38**	48.40	0.10	-0.36	VI(0.15**), VII(5.74**), IX(3.57**)
K8305×HUW300	2.03*	49.11	2.17**	-2.52**	III(2.34**), IV(-2.34**), VII(4.24**)
K8305×K8565	1.97*	58.15	2.17**	-0.20	III(3.30**), VII(2.30**), IX(2.36**)
K8305×UP221	1.90*	51.42	2.17**	-0.15	II(3.10**), VII(12.99**), VIII(3.14**)
K8305×HUW234	1.88*	58.33	2.17**	0.10	V(-1.75*), VII(9.18**), IX(2.72**), VII(0.91**)
K8565×HUW300	1.73*	56.88	-0.20	-2.52**	IV(-2.62**), V(2.85**), VII(2.85**), VIII(0.51**)

*Significant at 5% level; ** Significant at 1% level

I Days to reproductive phase, II Flag leaf area, III Spike area, IV Plant height, V Number of productive tillers per plant, VI Grain weight per spike, VII Number of grains per spike, VIII Harvest index and IX 1000-grian yield per plant.

intra-row distance of 25 and 15 cm., respectively. The observations on 10 various characters namely, days to reproductive phase, flag leaf area, spike area, plant height, number ofproductive tillers per plant, grain weight per spike, number of grains per spike, harvest index, 1000 grain weight and grain yield per plant were recorded and subjected to combining ability analysis as per procedure suggested by Griffing's Method2[1], Model-1 Analysis of variance forcombining ability and estimates of various effects were worked out.

Highly significant variances due to both gca and sca in F_1 generation of present studyfor all the traits revealed that additive as well as non-additive genetic effects were involved indetermining the traits (Table 1). Estimated variances and predictability ratio (GPR) indicated higher contribution of non-additive gene effects for all the traits in F_1 generation. Sharma *et al.,*[2]. reported the same result.

The *per se* performance of the parents and gca effects in F_1 generation for all the traitsunder study varied from character to character (Table 2). None of the parents was found good general combiner for all the 10 attributes. The best *per se* performer did not in all the case happen to be the best general combiner except for plant height.

The relative ranking of parents on the basis of *per se* performance and gca effect indicated K8020 and K8305 for flag leaf area, K8565 and HD2285 for plant height, PBW226 and K8305 for number of productive tillers per plant, HP1633 and HUW300 for grain weight per spike, K8305, K8020 and UP2121 for number of

grain per spike, K 8305 for harvest index, HP1633, HD2285, HUW300 and UP2121 for 1000 grain weight and HP1633, K8305 and PBW226 for grain yield per plant.

On the basis of overall performance, the parent K 8305 was best general combiner for days to reproductive phase, flag leaf area, spike area, number of productive tillers, grain weightper spike, number of grain per spike, harvest index and grain yield per plant followed by PBW226 and UP2121 each for seven traits, K8020 and HP1633 each for five traits and HUW300 and HD2285 each for four traits (Table 2).

The specific combing ability effect for grain yield per plant was significant and desirable in 19 hybrids. The hybrids involved all the three possible combinations between highand low gca effects. The hybrids namely, K8305 × PBW226, HD2285×HP1633 and K8305×HP1633 were in category of high ×highgea effect indicating the presence of dominanceand epistemic types of gene action.

The superior eight combinations for grain yield namely, HUW234×PBW226, K8020×PBW226, UP2121×PBW226 PBW226×HUW300, K8305×HUW300, K8305×K8565,

K8305×UP2121 and K8305×HUW234 involving high (significant and desirable) × low (non-significant and undesirable) general combiners reflecting the presence of additive × dominance genetic effects. Eight hybrid combinations (UP2121×HUW300, K8020×HUW300, UP2121×K8103, K8565×803, HUW234×HUW300, K8020 ×K8103, HUW234×K8103 and
K8565×HUW300 were associated with low ×lowgca effects indicating non-additive effects.

On the basis of above finding, the parents should be marked and involved in wheat cropimprovement programme.

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