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RESEARCH ARTICLE

Study of genetic parameters in selfed and sib-mated populations in common wheat (*Triticum aestivum* L.)

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SUMMARY

The present study has been designed to compare the mean performance and genetic parameters in selfed and sib-mated populations in two crosses of common wheat. The mean performance of sib's was better than the selfs for all the characters in both the crosses except for spikelets per spike (cross I), harvest index (cross II) and for plant height (cross I and cross II). Further, the estimates of heritability and coefficients of variability (GCV and PCV) were high for grain yield, tiller number and biological yield in sib's than their corresponding F_3 selfs.

Key Words : Sib-mating, Co-efficients of variation, Grain yield, Heritability

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In traditional method of breeding by continuous selfing and selection, there is no chance to regain the desirable genes that may have lost in the selected plants. Thus, the routine breeding methods are inadequate to explore the range of available useful genetic variability for complex characters like yield. In order to achieve maximum gene recombination and maximum fitness in self-pollinated crops, Palmer (1953) and Andrus (1963) suggested inter-crossing in early segregating generation and recognized the chances of getting better segregants after inter-crossing. The random inter-mating/sib-mating is expected (i) to break the undesirable linkages, (ii) retain variability for several cycles of selection, (iii) elevate the population mean and (iv) improve the chances of assembling the maximum number of potentially useful genes leading to the isolation of table and widely adapted genotype (s). In view of the above, an attempt was made to compare the mean performance and genetic parameters in selfed and sib's populations in two crosses of common wheat.

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MATERIAL AND METHODS

The material for the present study comprised of two F_2 populations of wheat *viz.*, Kundan/HD 2329 (cross I) and HW 3081/HD 2839 (cross II). In each F_2 population, 150 random plants were selfed and crossed in pairs (sib-mating) to obtain 150 F_3 selfs and 75 sib's. The F_3 and sib's progenies of each of the cross I and cross II were separately evaluated along with their respective parents in Randomized Block Design (RBD) experiments with three replications at Research Farm of Kisan P.G. College, Simbhaoli (Ghaziabad) during 2008-09. All the progenies (F_3 selfs and sib's) in each replication were evaluated in a single row plot of 2 m length with a distance of 30 cm and 15 cm between rows and plants, respectively. All the recommended cultural practices were adopted to raise the good crop. The data were recorded on all plants except border plants in each plot on the following ten characters *viz.*, grain yield (g), plant height (cm), spikelets per spike, grains per spike, 100 grain weight (g), tiller number, biological yield (g), days to heading and days to maturity. Plot means were used for the different statistical analysis. The heritability in broad sense and co-efficients of variation were estimated following Lush (1940) and Burton and De Vane (1953), respectively. The data were subjected to analysis of variance for the character estimated on the basis of mean values (Panse and Sukhatme, 1985). The estimates of PCV and GCV were classified as given by (Sivasubramanian and Madhavamenon, 1973).

Heritability estimates in broad sense for yield components of castor genotypes was estimated and the heritability estimates were categorized as suggested by Robinson et al. (1949), while genetic advance was worked out as per Johnson *et al.* (1955).

RESULTS AND DISCUSSION

The analysis of variance (ANOVA) in the two populations *i.e.* F_3 and sib's of cross I and cross II showed significant differences among progenies for all the characters except for tiller number in F_3 and harvest index in sib's of cross I (Table 1-4). The parents of the two crosses differ significantly for grain yield, plant height, grains per spike, tiller number, biological yield and days to maturity (Table 5 and 6). The mean values for grains per spike and tiller number (cross I and cross II), grain yield, spikelets per spike and biological yield (cross I) and plant height and days to heading (cross II) were significantly higher in F_3 than their parental mean. Further, the mean values for grain yield, plant height, spikelets per spike, grains per spike, tiller number, biological yield and days to maturity in both the crosses were significantly higher in sib's than their parental mean. The significant deviation of the mean values of F_3 and sib's populations from the mean values of the parents for different

Table 1: Analysis of variance (ANOVA) for ten characters in F_3 population of cross I

Source of variation	d.f	Mean squares									
		Grain yield (g)	Plant height (cm)	Spikelets per spike	Grains per spike	100-grain weight (g)	Tiller number	Biological yield (g)	Harvest index (%)	Days to heading	Days to maturity
Replication	2	31.25	11.42	5.33	13.34	0.25	9.23	8.35	18.45	2.20	3.74
Treatments	149	18.25**	165.40**	13.30**	95.65**	9.34**	4.80	135.65**	19.23**	56.23**	52.20**
Error	298	9.75	28.23	5.35	37.56	0.19	3.75	63.28	7.64	7.60	6.66

** indicate significance of value at P=0.01

Table 2 : Analysis of variance (ANOVA) for ten characters in SIB's population of cross I.

Source of variation	d.f	Mean squares									
		Grain yield (g)	Plant height (cm)	Spikelets per spike	Grains per spike	100-grain weight (g)	Tiller number	Biological yield (g)	Harvest index (%)	Days to heading	Days to maturity
Replication	1	11.78	3.70	1.66	6.90	0.40	14.25	107.44	17.24	12.72	26.20
Treatments	74	26.25**	372.20**	8.94**	42.05**	9.25**	19.23**	117.30**	21.20	34.36**	75.23**
Error	148	4.55	35.65	2.76**	15.70	0.08	3.58	33.66	19.90	9.40	23.85

** indicate significance of value at P=0.01

Table 3: Analysis of variance (ANOVA) for ten characters in F_3 population of cross II

Source of variation	d.f	Mean squares									
		Grain yield (g)	Plant height (cm)	Spikelets per spike	Grains per spike	100-grain weight (g)	Tiller number	Biological yield (g)	Harvest index (%)	Days to heading	Days to maturity
Replication	2	17.25	77.60	18.27	26.57	0.23	31.45	105.38	101.25	12.35	12.21
Treatments	149	24.70**	102.65**	9.40**	74.42**	0.40**	17.20**	74.54**	37.45**	41.70**	31.43**
Error	298	11.35	29.53	4.47	33.30	0.17	4.98	39.85	15.56	11.48	9.30

** indicate significance of value at P=0.01

Table 4 : Analysis of variance (ANOVA) for ten characters in SIB's population of cross II

Source of variation	d.f	Mean squares									
		Grain yield (g)	Plant height (cm)	Spikelets per spike	Grains per spike	100-grain weight (g)	Tiller number	Biological yield (g)	Harvest index (%)	Days to heading	Days to maturity
Replication	2	15.75	105.40	1.95	10.02	0.80	14.31	65.30	10.35	2.24	4.54
Treatments	74	31.05**	147.23**	7.67**	107.31**	9.47**	27.25**	116.26**	40.50**	109.65**	77.57**
Error	148	7.23	39.54	1.99	44.24	0.29	5.40	14.54	13.25	13.70	9.38

** indicate significance of value at P=0.01

Table 5: Mean values for ten characters in parents, F_3 and SIB populations of cross I

Sr. No.	Characters	Kundan (P_1)	HD2329 (P_2)	Mid-parental value	F_3	SIB's
1.	Grain yield (g)	10.48[aa]	7.37	8.92	9.56[b]	13.88[ccdd]
2.	Plant height (cm)	85.45[aa]	78.64	81.05	83.86	85.85[c]
3.	Spikelets per spike	17.55	15.80	16.68	18.38[bb]	20.65[cc]
4.	Grains per spike	47.63[aa]	54.60[a]	51.11	56.88[bb]	61.68[ccd]
5.	100 grain weight (g)	5.40[a]	4.36	4.88[cc]	4.20[d]	3.45
6.	Tiller number	5.15[aa]	3.90	4.52	5.63[b]	8.45[ccd]
7.	Biological yield (g)	28.50[aa]	22.40	25.45	32.60[bb]	39.40[ccd]
8.	Harvest index (%)	36.77	32.90	35.04[bb]	29.32	35.22[dd]
9.	Days to heading	82.80	88.55[aa]	85.67[cc]	87.40[d]	82.60
10.	Days to maturity	124.36	133.80[aa]	129.08	126.08	131.66[cd]

a, aa = P_1 vs. P_2, means significantly higher at P= 0.05 and P = 0.01 levels, respectively; b, bb = mid-parental value vs. F_3, means significantly higher at P = 0.05 and P = 0.01 levels, respectively; c, cc = mid-parental value vs. SIB's, means significantly higher at P = 0.05 and P =0.01 levels, respectively; d= F_3 vs. SIB's, mean significantly higher at P = 0.05 and P = 0.01 levels, respectively

Table 6: Mean values for ten characters in parents, F_3 and SIB populations of cross II

Sr.No.	Characters	HD2839 (P_1)	HW3081 (P_2)	Mid-parental value	F_3	SIB's
1.	Grain yield (g)	16.45[a]	12.40	14.42	14.56	18.60[ccd]
2.	Plant height (cm)	91.06[aa]	81.85	86.45	91.50[bb]	92.86[c]
3.	Spikelets per spike	20.72[a]	17.08	18.90	19.06	21.78[cd]
4.	Grains per spike	56.65[aa]	46.68	51.66	58.48[bb]	68.50[ccdd]
5.	100 grain weight (g)	4.05	4.45	4.25[c]	4.25[d]	3.78
6.	Tiller number	6.76[a]	4.05	5.40	6.77[b]	9.66[ccd]
7.	Biological yield (g)	37.40[a]	30.46	33.93	36.40	44.56[ccdd]
8.	Harvest index (%)	43.98	40.70	42.49[c]	40.00	41.74
9.	Days to heading	87.68	91.05	89.36[cc]	91.88[bd]	82.90
10.	Days to maturity	129.45	134.60[aa]	132.02	136.60	142.66[cd]

a, aa = P_1 vs. P_2, means significantly higher at P= 0.05 and P = 0.01 levels, respectively; b, bb = mid-parental value vs. F_3, means significantly higher at P = 0.05 and P = 0.01 levels, respectively; c, cc = mid-parental value vs. SIB's, means significantly higher at P = 0.05 and P =0.01 levels, respectively; d= F_3 vs. SIB's, mean significantly higher at P = 0.05 and P = 0.01 levels, respectively

Table 7: Estimates of genotypic co-efficients of variation (GCV) and phenotypic co-efficients of variation (PCV) for ten characters in F_3 and SIB populations of cross I

Sr. No.	Characters	Genotypic co-efficient of variation (GCV)		Phenotypic co-efficient of variation (PCV)	
		F_3	SIB's	F_3	SIB's
1.	Grain yield (g)	17.77	24.19	37.46	28.82
2.	Plant height (cm)	8.15	15.35	10.36	16.90
3.	Spikelets per spike	8.87	8.81	15.45	12.14
4.	Grains per spike	8.09	5.97	13.86	8.84
5.	100 grain weight (g)	5.21	8.05	11.37	11.11
6.	Tiller number	10.03	36.71	34.35	44.34
7.	Biological yield (g)	15.55	16.80	29.87	22.58
8.	Harvest index (%)	6.54	2.26	11.32	12.80
9.	Days to heading	4.55	4.22	5.52	5.58
10.	Days to maturity	3.02	3.97	3.62	5.26

characters may be attributed to the presence of non-additive gene effects *i.e.* dominance and/or epistatic interactions.

A comparison of the mean values of F_3 and sib's populations revealed that the mean values for plant height (cross I and cross II), spikelets per spike (cross I) and harvest index (cross II) in F_3 and sib's did not differ significantly. The mean values of F_3 populations were significantly higher than the means of sib's for 100-grain weight and days to heading in both the crosses. For remaining characters, the means of sib's were significantly higher than the means of the F_3 populations (Table 5 and 6). This may be attributed to the dominance deviations and epistatic interactions in sib's (Mather and Jinks, 1971).

A comparison of the estimates of genotypic co-efficient of variation (GCV) and phenotypic co-efficient of variation (PCV) in F_3 and sib's populations revealed that the estimates of GCV were relatively high in sib's than in the corresponding F_3 populations for all the characters in cross II and for grain yield, plant height, 100 grain weight, tiller number, biological yield and days to maturity in cross I (Table 7 and 8). The increased variation in sib's for the above characters may be due to the presence of repulsion phase linkages in the parents (Randhawa and Gill, 1978). On the converse, for other characters such as spikelets per spike, grains per spike, harvest index and days to heading in cross I, the estimates of GCV were higher in F_3 than in sib's. This indicated the predominance of coupling phase linkages for these characters in the parents. The sib-mating may have broken such linkages and consequently resulted into decreased variability. The estimates of heritability were higher in the sib's than in corresponding F_3 populations for all the characters except harvest index, days to heading and days to maturity in cross I and for 100 grain weight in cross II (Table 9). In agreement with the above results, Randhawa

Table 8: Estimates of genotypic co-efficients of variation (GCV) and phenotypic co-efficients of variation (PCV) for ten characters in F_3 and SIB populations of cross II.

Sr.No.	Characters	Genotypic co-efficient of variation (GCV)		Phenotypic co-efficient of variation (PCV)	
		F_3	*SIB's*	F_3	SIB's
1.	Grain yield (g)	14.65	19.54	27.56	26.79
2.	Plant height (cm)	5.33	7.82	7.92	10.30
3.	Spikelets per spike	6.54	7.68	12.63	10.02
4.	Grains per spike	6.22	8.43	11.53	13.07
5.	100 grain weight (g)	6.35	7.89	11.29	16.05
6.	Tiller number	29.55	34.55	44.11	42.19
7.	Biological yield (g)	9.58	15.87	20.20	17.99
8.	Harvest index (%)	6.65	9.38	11.77	13.18
9.	Days to heading	3.42	8.27	5.01	9.38
10.	Days to maturity	2.00	4.16	3.00	4.70

Table 9 : Estimates of heritability (broad sense) for ten characters in F_3 and SIB population of cross I and cross II

Sr. No.	Characters	Cross I		Cross II	
		F_3	*SIB's*	F_3	SIB's
1.	Grain yield (g)	0.224	0.704	0.281	0.622
2.	Plant height (cm)	0.618	0.825	0.452	0.576
3.	Spikelets per spike	0.331	0.528	0.268	0.587
4.	Grains per spike	0.340	0.456	0.291	0.416
5.	100 grain weight (g)	0.208	0.500	0.316	0.236
6.	Tiller number	0.085	0.685	0.449	0.668
7.	Biological yield (g)	0.275	0.554	0.224	0.777
8.	Harvest index (%)	0.335	0.032	0.319	0.506
9.	Days to heading	0.680	0.570	0.467	0.777
10.	Days to maturity	0.695	0.518	0.442	0.784

and Gill (1978) and Balyan and Singh (1997) also reported high estimates of heritability for grain yield, plant height, tiller number and biological yield in the populations obtained after inter-crossing in segregating generations. The high estimates of heritability, in general, are in agreement with the high co-efficients of variability for these characters and this suggested that the sib mating in F_2 generation of the two crosses resulted into increased genetic variability.

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