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GENETICS OF QUANTITATIVE CHARACTERS IN BREAD WHEAT

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The gene effects for five quantitative characters were studied in ten crosses of bread wheat. The dominance component was positive and highly significant for all the traits in all the crosses except for spike length. The additive component was also present in sizeable proportion. Additive x additive for spike length and grain weight, additive X dominance for productive tillers and grain yield/plant and dominance X dominance for grains/spike were the major components of genetic variance. Complementary type of epistasis was more common for productive tillers, grains / spike and grain yield/ plant. Four crosses, 'Kalyansona' x HD 1949, ''Kalayansona' x 'K68'. 'Lerma rojo' x 'HD 1949' and 'HD 1949' x 'K 68' were identified as promising. They could be used in wheat breeding programme to exploit both additive and additive x additive components in varietal improvement programmes through the use of biparental mating in F_2 generation.

It is difficult to combine all desirable quantitative characters in one variety. Accordingly, it may be advisable to incorporate genes governing quantitative characters in an otherwise agronomically acceptable strain. Quantitative trait like yield is a complex character but its component traits are relatively less complex Therefore. an estimation of the components of genetic variance is essential to formulate effective breeding procedure for the improvement of desired attributes It depends largely upon the nature and relative magnitude of the components of genetic variances and gene action involved. It is in this context that the present investigation on genetics of important attributes was undertaken.

MATERIALS AND METHODS

The material consisted of six genetical populations (P_1,P_2,F_1,F_2,B_1 and B_2 of ten crosses involving 'Kalyansona' (1), 'M 261' (2)· 'Lerma rojo' (3). 'HD 1949' (4) and 'K 68' (5). These populations were raised in randomized block design with three replications during *rabi* 1979-80 at College Farm with a spacing of 15 x 30 cm. within and between rows. Parents, F_1s, B_1s, and B_2s were sown in one row plots, whereas F_2s were accommodated in five row plots. The data were recorded on five quantitative characters, namely productive tillers/plants, spike length (cm), grains/ spike, 1000 grain weight (g) and grain yield/plant (g).

The gene effects were estimated according to Hayman (1958) and scaling tests of Mather (1949) were performed to detect deviation due to non-allelic interactions.

RESULTS AND DISCUSSION

The estimates of gene effects and, scaling tests for the five quantitative characters of ten crosses used for studying genetic architecture are presented in Table 1.

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Estimation of gene effects revealed that the dominance $(\hat{h})$ component played a major role in the expression of the genetic variation and was positively significant in all crosses for all the characters except for spike length On the other hand, additive $(\hat{d})$ gene effects were also present in a sizeable proportions and were found to be positively significant in majority of the crosses for productive tillers, spike length, grain weight and in some of the crosses for remaining traits. In general, the magnitude of dominance gene effect was more than that of additive. Thus, highly singnificant and positive dominance gene effects present in all the crosses indicated the possibility of exploiting hybrid vigour. These results are in conformity with the findings of Nandpuri *et al* (1984) in triticale.

Scaling tests indicated presence of non-allelic interactions for all the characters in all crosses. The epistatic effects were in general, much larger than additive component and smaller than dominance gene effects Of the three digenic effects, spike length and grain weight were found to be controlled by more of additive x additive $(\hat{i})$ type of interaction component; productive tillers and grain yield/plant by additive x dominance $(\hat{j})$ and grains/spike by predominance of dominance x dominance $(\hat{h})$ interaction effects. Moreover, it is evident from the results on gene effects that positive and significant additive x additive interactions prevailing in some crosses for all the traits showed that selection would be advantageous in further generations. While the presence of negatively significant dominance x dominance gene effects in most of the crosses for productive tillers, spike length and grain weight indicated that a diminishing effect due to this types of gene action could occur. These findings are in confomity with the results reported in bread wheat by Singh (1979). On the basis of opposite signs of $(\hat{h})$ and $(\check{l})$ components, several crosses showed the operation of complementary type of epistasis for productive tillers, grains/spike and grain yield/plant, thus indicating fixable nature of the characters under selection in advanced generations. For spike length and grain weight duplicate epistasis was more frequent. Gulati and Murty (1982) also reported the predominant role of duplicate epistasis for grain weight in barley. The additive x additive interactions coupled with duplicate type of epistasis in some crosses for all the traits indicated the possibility of improvement for higher grain yield through yield components. Predominant role of duplicate epistasis is also reported by Dahiya and waldia (1982) in black gram.

Among the ten crosses studied, four *viz.*, 'Kalyansona' x 'HD 1949' 'Kalyansona' x 'K 68', 'Lerma rojo' x 'HD (1949) and 'HD 1949' x 'K 68' could be used successfully in wheat breeding programme because they showed high mean performance for yield and some of

Table 1. Gene effects in ten crosses of bread wheat

Cross	Gene effects						Scaling test		
	m	d	h	i	j	l	A	B	C
1	2	3	4	5	6	7	8	9	10
				I. NUMBER OF PRODUCTIVE TILLERS					
1 x 2	19.99**	4.51**	13.45**	−1.90**	1.85	−3.30	xx		xx
1 x 3	19.72**	1.74	14.90**	−2.37	−0.99	2.52*			xx
1 x 4	21.76**	3.12**	31.55**	7.44**	7.18**	−11.58**	xx	xx	xx
1 x 5	21.29**	2.35**	18.61**	−0.26	2.94*	−7.24**	xx	xx	xx
2 x 3	15.38**	2.02**	15.27**	−0.38	6.51**	−1.67	xx	xx	
2 x 4	16.15**	2.94	19.23**	−1.57	14.10**	−7.90**	xx	xx	
2 x 5	18.82**	1.79**	17.64**	−1.71	8.99**	5.27**	xx		xx
3 x 4	18.70**	1.39**	22.38**	1.02*	14.32**	0.96*	xx	xx	
3 x 5	18.54**	1.11	19.09**	0.18	4.94**	−3.70	xx		xx
4 x 5	19.23**	2.21**	26.02**	4.94**	1.60	1.40*	xx	xx	xx
				II. NUMBER OF GRAINS PER SPIKE					
1 x 2	75.15**	3.55	94.41**	23.08**	−1.93	−51.10**	xx	xx	xx
1 x 3	75.23**	0.75	66.42**	−2.21	−12.31	−10.33		xx	xx
1 x 4	71.59**	3.70**	63.98**	2.20*	−14.37**	−18.57**		xx	xx
1 x 5	74.57**	2.65**	66.93**	4.10*	−2.51**	0.97*		xx	xx
2 x 3	42.92**	1.23	34.63**	−3.89	−2.23	49.01**	xx	xx	xx
2 x 4	48.85**	1.33**	15.82**	−27.60**	−10.19**	27.26**	xx	xx	xx
2 x 5	50.45**	0.51	48.34**	−3.49	2.22	39.84**	xx	xx	xx
3 x 4	51.01**	0.97*	45.14**	−2.24*	−6.01**	16.42**	xx	xx	xx
3 x 5	51.01**	−0.97	45.14**	−2.24	−6.01**	16.42**	xx	xx	xx
3 x 5	51.01**	−0.97	45.14**	−2.24	−6.01**	16.42**	xx	xx	xx
4 x 5	52.12**	4.76**	63.93**	8.81**	4.48**	5.34	xx	xx	xx
				III. SPIKE LENGTH					
1 x 2	11.65**	1.59**	2.50	1.90*	3.21**	−2.96	xx		
1 x 3	10.95**	−1.39*	3.28	2.71	−5.85**	−4.96	xx	xx	
1 x 4	10.85**	0.92**	1.46	4.31**	−3.21	−0.53	xx	sx	
1 x 5	12.16**	0.95**	3.25*	1.79*	0.68	−5.98**	xx	xx	xx
2 x 3	11.94**	1.37	3.21**	0.73	1.65	−2.38*	xx		xx
2 x 4	10.29**	−0.56**	2.10	−0.58	−0.65	3.78**	xx	x	xx
2 x 5	12.54**	0.39*	3.07*	2.01	0.59	−6.15**	xx	xx	xx
3 x 4	10.31**	0.84**	−0.17	−0.24	−0.21	2.41*	x		x
3 x 5	11.48**	1.21**	2.56**	2.31**	2.51**	−5.98**	xx	x	xx
4 x 5	11.10**	0.48*	2.10*	1.67*	0.59*	−5.95	xx	xx	xx

1	2	3	4	5	6	7	8	9	10
				IV 1,000 GRAIN WEIGHT					
1 x 2	40.14**	1.59	19.31**	13.01**	−1.48	−21.58	xx	xx	xx
1 x 3	40.23**	−3.19**	11.91**	10.25**	7.21**	−11.95	xx		xx
1 x 4	40 65**	2.01**	8.92**	2 52*	−0.24	11.41*			xx
1 x 5	40.21**	−1.39*	15.02**	11.21**	−5.91**	−19.41*		xx	xx
2 x 3	38.95**	−0.95	25.27**	10.21	−4.32**	− 21.45**		xx	xx
2 x 4	38 58**	−0.81	26.27**	19 41	−5.21**	−25.31	x	xx	x
2 x 5	36.29**	0.58	24.52**	24.92**	6.21*	−39.45**	xx	xx	xx
3 x 4	39.28**	3.20**	21.46**	16.62**	−6.21**	−13.42**	xx		xx
3 x 5	40.28**	1 26	12.75**	−9.78**	6.72**	− 11.78**	xx	x	xx
4 x 5	41.39**	1.90**	15.29**	13.95**	1.65*	− 25.21**	xx	xx	
				V. GRAIN YIELD PER PLANT					
1 x 2	33.94**	0.46	26.58**	−4.48	−15.57	26.39**	xx	xx	xx
1 x 3	33 61**	0.15	40.41**	−4.22	− 0.89	10.43**	xx	xx	xx
1 x 4	46.32**	1 36**	46 85**	−0.04	3.23**	2.47*	xx	xx	xx
1 x 5	46.88**	2.17**	46.19**	−0.94	3.12*	94.25**	{xx		
2 x 3	28.95**	−3.32**	40.97**	−5 59**	4.79**	1.75		xx	xx
2 x 4	29 85**	−1.77	46.03**	−6 54*	13.46**	6.48**		xx	xx
2 x 5	21.75**	−0.32	47.93**	8.64**	15.62**	2.44		xx	xx
3 x 4	41 65**	−0.62*	49.41**	3.92*	4.26*	3.60*		xx	x
3 x 5	43.13**	0 33	51.41**	4.78**	5.16**	−7.90**	xx		
4 x 5	47.27**	2.30**	41.13**	4.44*	4.86**	8.52**		xx	

*, ** Significant at 5% and 1% level.
x, xx Significant at 5% and 1% level.

the yield components and also exhibited the presence of dominance $(\hat{h})$ component and sizable amont of additive $(\hat{d})$ component of genetic variance. Allthese crosses could be used for the exploitation of both additive and additive x additive components through the use of biparental crossing as suggested by Gill *et al.* (1973) in wheat.

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