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AN ANALYSIS OF GENERATION MEANS FOR YIELD AND ITS COMPONENT TRAITS IN BREADWHEAT

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ABSTRACT

Five generations (P_1, P_2, F_1, F_2, and F_3) of two wheat crosses, namely, WH 147 × HD 2285 and HD 2009 × WH 147, were raised in randomized block design with three replications during rabi 1985. The means of the five generations recorded for grain yield and its three main component traits, tillers per plant, grains per spike, and 1000-grain weight, were subjected to C-scaling test [1] and five-parameter method [2] to detect epistasis and estimates of *m*, (*d*'), (*h*), (*i*) and (*l*) parameters. There was evidence of epistasis for all the four characters in both crosses. All three kinds of gene effects (additive, dominance and epistatic) were involved in the inheritance of the characters studied. The additive gene effects were relatively more important than the dominance gene effects for grain weight bnt a reverse situation was observed for grain yield. Six out of eight cases indicated predominance of complementary epistasis.

Key words: Generation means, component traits, breadwheat, epistasis, gene effects.

The genetic research done on wheat improvement in the recent past has revealed that grain yield in this crop is mainly determined by three component traits, namely, effective number of tillers per plant, kernel weight, and average number of grains per spike. The knowledge about the nature and magnitude of gene effects of these metric traits may greatly help the wheat breeder in formulating an efficient breeding programme to achieve desired genetic improvement in this important cereal. The study of gene effects not only tells about the relative importance of various kinds of gene effects in the control of characters but also provides information about the causes of heterosis. In view of this, the present study aims to detect the presence of epistasis, estimate different kinds of gene effects, and obtain information regarding the relative importance of these gene effects in the inheritance of grain yield and its main component traits.

MATERIALS AND METHODS

The experimental material comprised two crosses, namely, WH 147 × HD 2285 and HD 2009 × WH 147, involving three commercially adapted wheat varieties.

Five generations, namely, P_1, P_2, F_1, F_2 and F_3 of each of these two crosses were raised in a randomized block design with three replications in 3 m long rows with row-to-row distance of 23 cm and plant to plant 10 cm. Each parent and F_1 generation was represented by two rows, and F_2 and F_3 generations by 20 rows. The data were recorded on five randomly selected competitive plants in each row for four metric traits: effective tillers per plant, grains per spike, 1000-grain weight (g), and grain yield per plant (g). The data were first subjected to the C-scaling test of [1] to detect the presence of epistasis and then the five-parameter model [2] was fitted to the data to obtain estimates of m, (d'), (h), (i) and (l) parameters since the generations produced in the present study allowed only the fitting of five-parameter model.

RESULTS AND DISCUSSION

The values of C-scaling test and the estimates of m, (d'), (h), (i) and (l) parameters for four metric traits in two wheat crosses are given in Table 1. The C-scaling test values were significant for all the four characters in both crosses and thus indicated inadequacy of the additive-dominance model, i.e., epistasis was present in all the eight cases.

Table 1. Values of C-scaling test, estimates of gene effects and type of epistasis for four metric traits in two wheat crosses

Trait	Cross	C-scaling test	Gene effects					Type of epistasis
			m	(d')	(h)	(i)	(l)	
Tillers/plant	WH 147 × HD 2285	−4.7*	13.2**	3.3*	2.5*	5.1*	4.3*	Complementary
	HD 2009 × WH 147	3.8*	12.4**	3.8*	−4.6*	2.6*	12.9	Duplicate
Grains/spike	WH 147 × HD 2285	−12.6*	54.8**	9.6**	14.1*	23.2**	−6.1*	Duplicate
	HD 2009 × WH 147	−11.9*	56.3**	7.4*	4.1*	14.2*	13.3*	Complementary
1000-grain wt.	WH 147 × HD 2285	−0.9*	44.4**	3.6*	3.1*	5.0*	2.9*	Complementary
	HD 2009 × WH 147	−1.3*	43.7**	4.9**	2.1*	17.2**	10.7*	Complementary
Yield/plant	WH 147 × HD 2285	−9.9*	23.4**	3.1*	4.8*	8.4*	3.6*	Complementary
	HD 2009 × WH 147	−8.4*	24.2**	2.1*	2.9*	4.8*	5.1*	Complementary

* $P \leq 0.05$ and ** $P \leq 0.01$.

The fitting of five-parameter model to the data indicated involvement of all three kinds of gene effects (additive, dominance and epistatic) in the inheritance of all the four characters, since the estimates of all the five parameters were significant for grain yield as well as its three component traits studied. The presence of both additive and nonadditive gene effects was also reported for tiller number and grain number [3] and for 1000-grain weight and grain yield [4] in wheat.

As regards the relative magnitude of additive and dominance gene effects, the higher values of (d') than those of (h) for tiller number in cross WH 147 × HD 2285, grain number in cross HD 2009 × WH 147, and 1000-grain weight in both crosses indicated that additive gene effects were relatively more important in these

cases. On the other hand, dominance gene effects were more important than the additive gene effects for grain number in the former cross, tiller number in the latter cross, and grain yield in both crosses.

Among the interaction components, the additive × additive epistasis was more important than dominance × dominance component in six (except tiller number and grain yield per plant in cross HD 2009 × WH 147) out of eight cases. In the remaining two cases, however, the magnitude of the latter component was higher than that of the former type of epistasis.

Regarding the classification of epistasis, which largely depends on the signs of (*h*) and (*l*) (similar signs of the two parameters indicate predominance of complementary epistasis, while different signs indicates duplicate interaction), a predominance of complementary type of epistasis was observed for all the traits in both crosses, except grain number in cross WH 147 × HD 2285 and tiller number in cross HD 2009 × WH 147, for which duplicate type of epistasis was predominantly present. Singh and Singh [5] also reported predominance of complementary epistasis.

The negative value of (*h*) observed for tiller number in cross HD 2009 × WH 147 indicated that the alleles responsible for less tillers were dominant over the alleles controlling more number of tillers.

The results of the present study thus indicate a relatively greater importance of additive and additive × additive gene effects in the control of component traits of yield, especially for 1000-grain weight. Therefore, genetic improvement in grain yield per plant would be easier through indirect selection for component traits like 1000-grain weight and grain number per spike than through direct selection for grain yield itself.

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