Estimation of Genetic Parameters and Character Association in Wheat

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ABSTRACT

Heritability estimates measure the relative importance of additive portion of genetic variance and it has crucial role in selection criteria for yield improvement. Broad sense heritability, genetic advance and correlation coefficients for various plant characters in six wheat varieties and their twelve F_2 progenies were investigated. The genotypes were significantly different for plant height, number of tillers per plant, number of spikelets per spike, grains per spike and grain yield per plant. The magnitude of broad sense heritability of plant height, tillers per plant, grains per spike and grain yield was high with values 0.94, 0.98, 0.92 and 0.91 respectively, and was low in case of number of spikelets per spike (0.24). The values of genetic advance ranged from 0.044 in 1000 grain weight to 25.289 in plant height. Fairly high estimates of heritability and genetic advance for plant height, number of tillers, and grains per spike suggested that selection for these traits could be practiced more effectively. Plant height had significantly positive correlation with number of tillers both at phenotypic and genotypic levels. Tillers per plant displayed negative relationship with spikelets per spike and 1000 grain weight and number of grains per spike. Grain yield was positively and significantly correlated with number of grains per spike and 1000 grain weight. Hence the traits be given emphasis during selection of wheat genotypes for improving productivity.

Key words: Wheat, Heritability, Genetic advance, Correlation coefficient, Grain yield and yield related attributes.

INTRODUCTION

Wheat (*Triticum estivum* L.) is the major staple food of Pakistan and it occupies a prominent position in the cropping pattern of the country. A great deal of research work has been done in the domain of wheat breeding through genetic manipulation. However increasing population and the changing circumstances in the country necessitate the breeders for further breakthrough in this food crop. For bringing improvement in heritable characters, estimation of genetic parameters is of prime importance in any breeding programme.

Heritability estimates provide the information about index of transmissibility of the quantitative characters of economic importance and are essential for an effective crop breeding strategy. The magnitude of heritability also helps in predicting the behaviour of succeeding generations by devising the appropriate selection criteria and assessing the level of genetic improvement. Similarly, genetic advance gives clear picture and precise view of segregating generations for possible selection. Higher estimates of heritability coupled with better genetic advance confirm the scope of selection in developing new genotypes with desirable characteristics. Ajmal *et al*. (1995), Singh *et al*. (1999), Ghimirary and Sarkar (2000) and Shazly *et al*. (2000) found high heritability estimates along with greater values of genetic advance for number of spikes per plant, number of grains per spike, 100 grain weight, grain yield and plant height. However Afiah *et al*. (2000) reported low to high estimates of heritability and genetic advance for these traits except plant height.

Determination of correlation coefficients between various characters helps to obtain best combinations of attributes in wheat crop for obtaining higher return per unit area. Nabi *et al.* (1998), Silva *et al.* (1998), Amar (1999), Dokuyueu and Akkaya (1999), and Shah *et al.* (1999) reported positive correlation of grain yield with plant height, number of tillers per plant, grains per spike and 100 grain weight both at genotypic and phenotypic levels.

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Present study was undertaken to envisage the heritability estimates, genetic advance and relationship among various yield related attributes in twelve F_2 progenies of wheat crosses and their parental lines at Department of Plant Breeding and Genetics, PMAS Arid Agriculture University, Rawalpindi

MATERIALS AND METHODS

Twelve F_2 progenies were developed at Department of Plant Breeding and Genetics, PMAS Arid Agriculture University Rawalpindi using six wheat varieties viz. Blue Silver, Pak 81, Inqilab 91, Parwaz 94, Kohistan 97, and WL 711. The old wheat genotypes possessing certain desirable attributes were included in hybridization programme. Seed of the parent varieties and F_2 progenies were space planted in the field following randomized complete block design with three replications. Each plot comprised of three rows of five-meter length with 30 cm row to row spacing. All cultural practices were conducted during the cropping season according to the recommended package of technology. Plant height, number of tillers per plant, spikelets per spike, number of grains per spike, 1000 grain weight, and grain yield per plant were recorded for 15 and 30 plants each from parent varieties and F_2 progenies.

The data for all these attributes were subjected to analysis of variance following Steel and Torrie (1980) to evaluate the significant differences among the genotypes. Phenotypic and genotypic coefficients of variation and heritability estimates (Broad Sense) were computed out according to the method described by Hansen *et al*. (1956). Genetic advance was computed following the procedure elaborated by Singh and Chaudhary (2004). Association of various traits with grain yield and among themselves was worked out at phenotypic and genotypic levels according to the method given by Kwon and Torrie (1964).

RESULTS AND DISCUSSION

Mean squares revealed highly significant differences among F_2 progenies and their parents for all the characters under study except 1000 grain weight (Table 1) indicating the presence of considerable amount of genetic variability for these traits. Whereas, 1000 grain weight showed non significant differences among the genotypes. Non significant differences among wheat lines regarding 1000 grain weight suggested a uniform genetic back ground in these genotypes for this particular trait.

Table 1. Analysis of variance for certain quantitative plant characters in wheat genotypes.

SoV	DF	Plant height cm	Tillers plant^{-1}	Spikelets plant^{-1}	Grains spike^{-1}	1000-grain weight g	Grain yield plant^{-1}
Genotypes	**17**	**235.020****	**2.590****	**83.342****	**79.446****	**0.114**	**2.620****
Repeats	**2**	**21.570**	**1.125**	**0.104**	**10.416**	**0.062**	**7.242**
Error	**34**	**4.880**	**0.590**	**1.684**	**2.11**	**0.092**	**1.653**

** Significant at 1 % level of probability

Table 2 revealed the results regarding genotypic and phenotypic coefficients of variation, heritability in broad sense and genetic advance expressed as percentage of mean for the attributes under study. Higher values of genotypic and phenotypic coefficient of variation were recorded in case of grain yield per plant indicating a wide range of variation. The estimates of broad sense heritability were from low to high for various plant characters. The magnitude was high in plant height, number of tillers, number of grains per spike and grain yield per plant indicating large heritable variance among the F_2 progenies. Heritability was medium in case of 1000 grain weight while it was low in number of spikelets per spike. The heritability value alone provides no indication of the amount of genetic progress that would result in selecting the best individual, but heritability estimates alongwith the genetic advance is considered more useful.

Genetic advance expressed as percentage of mean (using 10% selection intensity) revealed variable behaviour of the traits. It is worth mentioning that the progenies involved in these combination inherited favourable genes for these traits indicating that the traits are more amenable to selection and could be improved by simple method. The results of present study

Table 2. Estimates of genotypic and phenotypic coefficients of variation, broad sense heritability and genetic advance for some quantitative traits in wheat

Parameters	Plant height cm	Tillers plant^{-1}	Spikelets spike^{-1}	Grains spike^{-1}	1000-grain weight	Grain yield plant^{-1}
Phenotypic coefficient of variation	9.06	13.603	3.323	9.222	2.304	27.874
Genotypic coefficient of variation	9.344	18.049	6.688	9.593	8.663	29.14
Heritability (BS)	0.94	0.983	0.247	0.924	0.075	0.911
Genetic advance (%)	25.289	15.749	3.151	14.454	0.044	11.598

corroborate high habitability associated with high genetic advance in case of plant height indicated that additive gene effects are important in determining this character. Characters like number of tillers per plant, number of grains per spike and grain yield per plant showed high heritability coupled with moderate genetic advance indicating the chance of effective selection of these traits for improvement of grain yield. Number of spikelets per spike displayed low heritability with similar pattern of genetic advance. Non-additive (dominance/epistasis) gene effects were more important for these traits.

In general, correlation coefficients at genotypic level were higher than those of phenotypic level (Table 3). It might be due to depressing effect of environment on character association as reported earlier for wheat crop (Ahmad *et al.*, 1978; Proda and Joshi, 1970). The correlation of plant height was positive with all the characters except number of spikelets per spike, where it had negative association. However, the relationship of plant height was significant only with number of tillers and number of spikelets per spike. Tillers per plant had significantly negative association with spikelets per spike and grains per spike but non significant and negative with 1000- grain weight. The association of number of tillers per plant with grain yield was positive and non significant. The relationship of spikelets per spike with number of grains per spike was positive and significant at genotypic level. Number of grains per spike and 1000- grain weight had positive and significant correlation with grain yield per plant. These results are partially supported with other researchers (Nabi *et al.*, 1998; Silva *et al.*, 1998; Amar, 1999;

Table 3. Phenotypic (p) and genotypic (g) correlation coefficient among some quantitative traits in wheat

	Tillers plant^{-1}	Spikelets spike^{-1}	Grains spike^{-1}	1000-grain weight	Grain yield plant^{-1}
Plant height	**p 0.135***	**p 0.316***	**p 0.309**	**p 0.245**	**p0.025**
	g 0.193*	**g 0.689****	**g 0.337**	**g 0.032**	**g0.004**
Spikelets spike^{-1}			**p 0.290**	**p 0.120**	**p0.09**
			g 0.585**	**g 0.860**	**p0.213**
Grains spike^{-1}				**p 0.142**	**0.205***
				g 0.475	**0.229***
1000-grain weight					**0.293***
					0.295*

*, ** significant at 5 % and 1 % level of probability respectively

Dokuyueu and Akkaya, 1999; Shah *et al.,* 1999) who generally reported positive relationship of most of the plant traits with grain yield. Although number of tillers, spikelets per spike, grains per spike and 1000 grain weight had positive relationship with grain yield, yet grains per spike and 1000 grain weight were important as contributing traits towards yield.

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