Pak. J. Agri. Sci., Vol. 43(1-2), 2006

STUDIES ON VARIABILITY AND SOME GENETIC PARAMETERS IN SPRING WHEAT

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All possible cross combinations involving five genotypes of wheat were evaluated for genetic variability and inheritance for number of productive tillers/plant, spike length, number of spikelets/spike, number of grains/spike, 1000-grain weight and grain yield/plant under rainfed conditions. The genotypes and their cross combinations exhibited significant differences for all the plant traits studied. A considerable amount of genetic variability present in the research material indicated the possibility of selection for further improvement. Broad sense heritability estimates were observed as 61.62, 72.05, 47.38, 75.58, 79.94 and 80.59% respectively, for number of productive tillers/plant, spike length, number of spikelets/spike, number of grains/spike, 1000-grain weight and grain yield/plant. Genetic advance values at 5% selection intensity were obtained as 0.967, 1.230, 1.336, 5.658, 4.110 and 1.826 respectively, for the plant traits studied. The study suggested that selection based on plant traits such as productive tillers/plant, spike length, grains/spike and 1000-grain weight could effectively be practiced for developing high grain yielding wheat varieties for the rainfed areas.
Key words: Wheat, variability, broad sense heritability, genetic advance.

INTRODUCTION

The success of a breeding programme depends on the presence of genetic variability in a material in hand. To make the heritable improvement in characters, estimation of genetic parameters and index of their transmissibility is required. Heritability estimates provide information about the extent to which a particular character can be transmitted to the successive generations. Knowledge of heritability of a trait thus guides a plant breeder to predict behaviour of succeeding generations and helps in making desirable selections. Conventional analysis of variance and statistical parameters like phenotypic and genotypic coefficients of variability, heritability and genetic advance have been used to assess the nature and magnitude of variation in wheat breeding material.

Chowdhry *et al.* (1997) found moderate heritability with high genetic advance for number of tillers/plant whereas high heritability coupled with high genetic advance was reported for this trait by Ghimiray and Sarkar (2000), Gupta and Verma (2000), and Firouzian *et al.* (2003). Low to moderate heritability and genetic advance (Firouzian *et al.*, 2003; Safeer-ul-Hassan, 2003) and moderate heritability with high genetic advance (Chowdhry *et al.*, 1997) was reported for spike length. Muhammad *et al.* (2001) and Safeer-ul-Hassan (2003) observed low to moderate heritability and genetic advance for spikelets/spike. Moderate heritability (Muhammad *et al.*, 2001), low to moderate heritability and genetic advance (Safeer-ul-Hassan, 2003), moderate heritability and high genetic advance (Chowdhry *et al.*, 1997) and high heritability with high genetic advance (Deswal et al., 1996; Ghimiray and Sarkar, 2000; Gupta and Verma, 2000; Firouzian *et al.*, 2003; Salim *et al.*, 2003) was observed for number of grains/spike. Low to moderate heritability and genetic advance (Safeer-ul-Hassan, 2003), high heritability (Muhammad *et al.*, 2001) while high heritability with high genetic advance (Deswal *et al.*, 1996; Shukla *et al.*, 2000) was reported for 1000-grain weight. Safeer-ul-Hassan (2003) observed low to moderate heritability with high genetic advance for grain yield/plant whereas Ozkan *et al.* (1997), Shukla *et al.* (2000), Firouzian *et al.* (2003) and Salim *et al.* (2003) reported high heritability with high genetic advance for this trait.

The present study was carried out to evaluate the genetic variability and inheritance of yield and some related plant traits to develop desirable wheat genotypes for the rainfed areas.

MATERIALS AND METHODS

A diallel cross involving five wheat genotypes viz., GPW-235, GPW-273, GPW-272, GPW-36 and GPW-37 was used in this study. Seeds of twenty possible crosses along with five parents were planted in three meter long single rows following randomized complete block design with three replications during 2002-2003 crop season at Barani Agricultural Research Institute Chakwal under rainfed conditions. Rows were spaced at 30cm apart. Normal cultural practices were carried out through out the crop season. At maturity, ten guarded plants from each plot were selected to record data for number of productive tillers/plant, spike length (cm) of the main tiller, number of spikelets of the main

spike, number of grains of the main spike, 1000-grain weight (g) and grain yield/plant (g).

The data were subjected to analysis of variance following Steel and Torrie (1980). Phenotypic (PCV) and genotypic (GCV) coefficients of variability were calculated according to Johnson et al. (1956). Estimation of broad sense heritability (h^2) and genetic advance (GA) at 5 percent selection intensity were calculated using formulae reproduced by Allard (1960) as follows:

$$h^2 (B.S) \% = [V (G) / V (P)] \times 100 \text{ and}$$

$$GA = (k) (op) (H)$$

where op is standard deviation of phenotypic variance and k is selection differential which is 2.06 at 5% selection intensity. Genetic advance as percent of the mean was calculated as:

$$GA \% = (100 \times GA)/x$$

where x is mean of the population for a particular trait.

RESULTS AND DISCUSSION

Analysis of variance showed highly significant differences among genotypes for number of productive tillers/plant, spike length, number of spikelets/spike, number of grains/spike, 1000-grain weight and grain yield/plant (Table-1). Mean data of different plant traits (Table-2) revealed a considerable amount of variability for all the traits studied. Estimates of mean, range, genotypic coefficients of variability (GCV), phenotypic coefficients of variability (PCV), heritability in broad sense ($h^{2)}$ and genetic advance (GA) values at 5% selection intensity are presented in Table-3.

Number of productive tillers/plant ranged from 3.97 to 5.72 with a mean value of 4.91. Maximum number of productive tillers/plant (5.72) were produced by the cross GPW-235 x GPW-36 followed by GPW-36 x GPW-37 (5.65) while the genotype GPW-273 produced the minimum number of tillers/plant (3.97). Estimates of broad sense heritability were observed as 61.62% with a genetic advance value of 0.967 for tillers/plant. These findings are in conformity with those of Chowdhry *et al.* (1997), Ghimiray and Sarkar (2000), Gupta and Verma (2000) and Firouzian *et al.* (2003) who reported moderate to high heritability with high genetic advance for this trait. GPW-235 x GPW-37 produced the largest spikes of 12.05 cm followed by GPW-272 x GPW-37 (11.99 cm) whereas the genotype GPW-272 produced the smallest spikes of 9.60 cm. Heritability and genetic advance for this plant trait were estimated as 72.05% and 1.230, respectively. Moderate to high heritability with high genetic advance were reported for spike length by Chowdhry *et al.* (1997) and Firouzian *et al.* (2003).

Maximum number of spikelets/spike (21.57) were observed in the cross GPW-235 x GPW-36 followed by GPW-235 x GPW-272 (21.32) while the minimum number of spikelets/spike (18.20) were obtained in the genotype GPW-36. This trait manifested heritability estimates of 47.38% with genetic advance value of 1.336. Low to moderate heritability and genetic advance for number of spikelets/spike were reported by Muhammad *et al.* (2001) and Safeer-ul-Hassan (2003). Number of grains/spike ranged from 49.73 to 61.72 with a mean value of 56.33. Maximum number of grains/spike (61.72) were observed in the cross GPW-272 x GPW-37 followed by GPW-235 x GPW-37 producing 59.70 grains/spike. The genotype GPW-37 produced the lowest number of grains/spike (49.73). High estimates of heritability (75.58% and genetic advance (5.658) were observed for this plant trait which were in accordance with those of Deswal *et al.* (1996), Chowdhry *et al.* (1997), Ghimiray and Sarkar (2000), Gupta and Verma (2000), Firouzian *et al.* (2003) and Salim *et al.* (2003). The deviations of these findings with those of Muhammad *et al.* (2001) and Safeer-ul-Hassan (2003) may be due to different research material and environmental conditions used by them.

1000-grain weight ranged from 33.53g to 41.89g with a mean value of 39.85g. Highest 1000-grain weight of 41.89g was obtained from the cross GPW-273 x GPW-272 followed by GPW-273 x GPW-36 exhibiting grain weight of 41.17g whereas GPW-235 gave the lowest 1000-grain weight of 33.53g. High heritability estimates of 79.94% with genetic advance of 4.110 were observed for this plant trait. Similar findings were reported for 1000-grain weight by Deswal *et al.* (1996), Shukla *et al.* (2000) and Muhammad *et al.* (2001). Cross combination of GPW-272 x GPW-37 gave the highest grain yield of 9.40g/plant followed by GPW-272 x GPW-36 with a grain yield/plant of 9.24g. GPW-273 produced the lowest grain yield/plant (5.77g). Grain yield/plant manifested high heritability estimates of 80.59% with high genetic advance value of 1.826. These findings are in conformity with those of Ozkon *et al.* (1997), Shukla *et al.* (2000), Firouzian *et al.* (2003) and Salim *et al.* (2003) who also reported high heritability and high genetic advance for grain yield/plant.

Present study revealed that the plant traits such as number of productive tillers/plant, spike length, number of spikelets/spike, number of grains/spike, 1000-grain weight and grain yield/plant exhibited significant differences in their mean performance. A considerable amount of genetic variability was present for all the traits studied. Moderate heritability and genetic advance was observed for number of spikelets/spike. High estimates of heritability with high genetic advance were found for number of tillers/plant, spike length, grains/spike, 1000-grain weight and grain yield/plant suggesting that the selection based on these plant traits could effectively be practiced for developing high grain yielding wheat varieties for the rainfed areas.

Table 1. Mean squares for some plant traits in wheat.

Source of variation	D.F.	Tillers/plant	Spike length	Spikelet per spike	Grains/Spike	1000-Grain weight	Grain Yield/Plant
Variety	24	1.298**	1.676**	3.650 **	33.178**	16.186**	3.163**
Rep.	02	0.168	0.161	0.587	11.232*	0.382	0.020
Error	48	0.223	0.192	0.986	3.225	1.249	0.235
Total	74						

*, ** Significant at 5% and 1% level of probability respectively.

Table 2. Mean data for some plant traits in wheat.

Parents/ Crosses	Tillers/ Plant	Spike Length (cm)	Spikelet per Spike	Grains/Spike	1000-Grain Weight (g)	Grain Yield/ Plant (g)
GPW-235	4.50	10.53	18.37	52.87	33.53	6.57
GPW-273	3.97	11.50	21.00	56.97	37.70	5.77
GPW-272	4.50	9.60	18.77	52.23	44.40	6.97
GPW-36	4.03	10.20	18.20	57.90	35.37	7.03
GPW-37	4.27	9.70	18.33	49.73	35.53	6.47
GPW-235 x GPW-273	5.57	11.67	21.02	55.40	38.85	8.59
GPW-235 x GPW-272	5.43	11.82	21.32	56.65	40.32	8.15
GPW-235 x GPW-36	5.72	11.84	21.57	54.55	40.02	8.55
GPW-235 x GPW-37	4.72	12.05	21.30	59.70	40.62	8.99
GPW-273 x GPW-272	4.44	11.98	20.17	52.82	41.89	7.83
GPW-273 x GPW-36	4.49	11.47	20.67	53.60	41.17	8.62
GPW-273 x GPW-37	5.42	11.94	20.30	56.55	40.62	9.09
GPW-272 x GPW-36	4.77	10.94	21.24	58.95	40.74	9.24
GPW-272 x GPW-37	4.42	11.99	19.85	61.72	40.27	9.40
GPW-36 x GPW-37	5.65	11.62	20.50	59.33	40.40	8.95
CV %	9.61	3.88	4.86	3.19	2.80	5.83
LSD 5%	0.775	0.731	1.630	2.948	1.835	0.796
LSD 1%	1.034	0.975	2.175	3.933	2.448	1.062

Table 3. Some statistical parameters for plant traits in wheat.

Statistical Parameter	Tillers/ Plant	Spike Length	Spikelets per Spike	Grains/ Spike	1000-Grain Weight	Grain Yield/ Plant
Minimum	3.97	9.60	18.20	49.73	33.53	5.77
Maximum	5.72	12.05	21.57	61.72	41.89	9.40
Mean	4.91	11.44	20.42	56.33	39.85	8.30
V(G)	0.358	9.495	0.888	9.984	4.979	0.976
GCV %	12.19	6.15	4.61	5.61	5.60	11.90
V(P)	0.581	0.687	1.874	13.209	6.228	1.211
PCV %	15.52	7.24	6.70	6.45	6.26	13.26
h^2 %	61.62	72.05	47.38	75.58	79.94	80.59
GA	0.967	1.230	1.336	5.658	4.110	1.826
GA % *	19.70	10.75	6.54	10.04	10.31	22.00

- as percent of the mean.

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