Original Research Article

Variability, Heritability and Genetic Advance Analysis in Bread Wheat (*Triticum aestivum* L.) Genotypes

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**A B S T R A C T**

A study was undertaken to estimate the heritability, genetic advance and coefficient of variation analysis of yield and yield contributing traits in 36 wheat cultivars grown in randomized block design with three replications at Research Farm, Department of Genetics and Plant Breeding, CCS University, Meerut, during *rabi* season 2011-12. The analysis of variance revealed that the treatments were highly significant for all the characters except flag leaf width. The higher magnitudes of phenotypic coefficient of variation (PCV) were recorded for grain yield per plant. The high heritability was estimated for the characters days to 50% flowering, plant height, flag leaf length, spike length and number of grains per spike. High value of heritability indicates that it may be due to higher contribution of genotypic components. High heritability coupled with high genetic advance as percent of means were recorded for plant height, spike length and grains per spike that indicated predominance of additive gene action in the inheritance of these traits.

**Keywords**

Heritability, Genetic advance and Bread wheat.

**Article Info**

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**Introduction**

Wheat (2n=6x=42) belongs to family Poaceae and Triticum genera. Spring wheat or bread wheat (*Triticum aestivum* L. em Thell), which comes under *aestivum* species, is the most common and widely grown wheat at global level as well as in India. Other wheat like *Triticum durum, Triticum dicoccum* are also grown in a limited area for their some special significance in developing products for human consumption. Wheat flour is the main product of wheat produce, by which various kinds of human foods are being developed. Wheat straw is a major source of animal feed in the country like India. Gluten which is a major part of wheat protein (about 75% of the total protein present in the wheat grain), has a unique quality for making the processed food puffy, with increase in perforated volume. Because of its versatility in adaption and utility in various ways, wheat is grown in more 44 countries at global level.

**Materials and Methods**

The 36 genotypes of wheat (*Triticum aestivum* L.) were obtained from the Directorate of Wheat Research (DWR) Karnal, Haryana sown in the research area of Department of Genetics and Plant Breeding, Faculty of Agriculture, C.C.S. University, Meerut on December 2011-12. The experiment was laid out in randomized block
design with three replications. All the genotypes were evaluated and characterized for various traits i.e. plant height, spike length (cm), number of grains spike, grain yield per plant (g) and 1000-grain weight (g). The mean data were subjected to analysis of variance to test the level of significance among the genotypes for different characters according to Steel & Torrie (1980). The following parameters were estimated by following the Burton (1952) and Johnson et al., (1955).

Genotypic coefficient of variation (GCV %) = \( \frac{\sigma_2 g}{x} \times 100 \)

Phenotypic coefficient of variation (PCV %) = \( \frac{\sigma_2 g + \sigma_2 gy + \sigma_2 e}{x} \times 100 \)

Heritability

It was calculated by the following formula suggested by Crumacker and Allard (1962), which is based on the component analysis:

\[
\hat{h}^2 = \frac{1/4\hat{D}}{1/4\hat{D} + 1/4\hat{H} + 1/4\hat{F} + \hat{E}}
\]

Genetic advance

The genetic advance was calculated by the formula given by Robinson et al., (1949) as:

\[
G.A. = K \times \hat{h}^2 \times \sigma^2_{ph}
\]

And, Genetic advance over mean of the character

\[
G.A. (%) = \frac{G.A.}{\bar{x}} \times 100
\]

Results and Discussion

Analysis of variance for the experiment with thirty six treatments for twelve characters viz., days to 50% flowering, plant height, number of tillers per plant, spike length, number of grains per spike, flag leaf length, flag leaf width, 1000 grains weight, seed vigour index, germination % after harvesting, germination % before harvesting and grain yield per plant was carried out for testing the significance of variance among the treatments for each character through ‘F’ test (Table 1). The ‘F’ test indicated that variance due to treatments were highly significant for all the characters except flag leaf width under study. The variance due to known and unknown causes was worked out using the method suggested by Choudhary and Prasad (1967) and Lush (1949) (Table 1).

Coefficient of variation

Phenotypic and genotypic coefficient of variation, heritability estimates and predicted genetic advance as per cent of mean for characters are studied presented in table 2. The estimates of coefficient of variation, i.e. genotypic coefficient of variation (GCV) and phenotypic coefficient of variation (PCV) along with general mean and range for all the traits are presented in table 2. Moderate genotypic coefficient of variation (10-25%) observed for Plant height, number of tillers per plant, spike length, number of grains per spike and grain yield per plant. Days to 50% flowering, flag leaf length, flag leaf width, 1000 grains weight, seed vigour index, germination % after harvesting and germination % before harvesting low (<10%) genotypic coefficient of variation (Table 2).

High percentage of phenotypic coefficient of variation (more than 25%) was observed for grain yield per plant. Moderate phenotypic coefficient of variation (10-25%) observed for Plant height, number of tillers per plant, spike length, 1000 grains weight, seed vigour index and number of grains per spike. Days to 50% flowering, flag leaf length, flag leaf width, germination % after harvesting and germination % before harvesting low (<10%) phenotypic coefficient of variation (Table 2).
**Table 1** Analysis of variance for yield and yield components in wheat (*Triticum aestivum* L.)

| Source of variance | d.f. | Day of 50% flowering | Plant Height (cm) | Flag leaf length (cm) | Flag leaf width (cm) | Tillers/plant | Spike length (cm) | Grains/spike | 1000 grain weight in (g) | Seed vigour index | Germination % after harvesting | Germination % before harvesting | Grain yield per plant (g) |
|--------------------|------|----------------------|-------------------|----------------------|---------------------|--------------|-------------------|--------------|------------------------|-----------------|-----------------------------|-----------------------------|-------------------------|
| Replication        | 2    | 0.120                | 1.311             | 0.154                | 0.012               | 1.926        | 0.616             | 52.287      | 59.615                 | 4858.621        | 21.732                      | 11.676                      | 30.934                  |
| Treatments         | 35   | 39.857**             | 277.271**         | 10.025**             | 0.045               | 5.749**      | 8.102**           | 129.139**   | 67.292**               | 238920.672**    | 25.533**                    | 13.618**                    | 33.786**               |
| Error              | 70   | 1.816                | 6.046             | 1.228                | 0.018               | 1.374        | 0.416             | 19.753      | 21.177                 | 119191.500     | 8.560                       | 6.752                       | 15.665                  |

**Table 2** Mean, range, GCV, PCV, Heritability and genetic advance in wheat (*Triticum aestivum* L.)

| Character                       | Mean  | Range          | GCV  | PCV  | Heritability (%) | Genetic Advance | Genetic Advancement as % of mean |
|---------------------------------|-------|----------------|------|------|------------------|-----------------|----------------------------------|
| Day of 50% flowering            | 77.343| 63.333-82.000  | 4.604| 4.923| 87.500           | 6.861           | 8.871                            |
| Plant height (cm)               | 89.414| 65.900-117.287 | 10.634| 10.984| 93.700           | 18.963          | 21.209                           |
| Flag leaf length (cm)           | 21.281| 17.900-24.767  | 8.046| 9.585| 70.500           | 2.961           | 13.915                           |
| Flag leaf width (cm)            | 1.663 | 1.400-2.033    | 5.761| 9.869| 34.100           | 0.115           | 6.927                            |
| Number of tiller per plant      | 8.769 | 6.000-12.333   | 13.773| 19.192| 51.500           | 1.785           | 20.361                           |
| Spike length (cm)               | 10.376| 7.100-13.600   | 15.427| 16.631| 86.000           | 3.059           | 29.479                           |
| Number of grain per spike       | 40.731| 27.333-55.000  | 14.825| 18.408| 64.900           | 10.018          | 24.595                           |
| 1000 grain weight (g)           | 42.450| 35.467-52.833  | 9.236| 14.242| 42.100           | 5.238           | 12.339                           |
| Seed vigour index               | 2552.593| 2137.330-3381 | 7.826| 15.626| 25.100           | 206.114         | 8.075                            |
| Germination % after harvesting  | 88.157| 81.333-92.667  | 2.698| 4.277| 39.800           | 3.091           | 4.493                            |
| Germination % before harvesting | 91.352| 85.667-95.333  | 1.656| 3.291| 25.300           | 1.568           | 2.200                            |
| Grain yield per plant (g)       | 15.283| 8.623-22.160   | 16.081| 30.484| 27.800           | 2.671           | 17.476                           |
These findings are similar in agreement with earlier reported by Yousaf et al., (2008), Kaul and Singh (2011), Dhananjay et al., (2012) and Tripathi et al., (2011).

**Heritability**

High heritability (> 60%) was observed for the characters namely days to 50% flowering, plant height, flag leaf length, spike length and number of grains per spike. Moderate (30-60%) heritability was recorded for flag leaf width, 1000 grains weight, number of tillers per plant and germination % after harvesting and low (less than 30%) heritability was recorded for seed vigour index, grain yield per plant and germination % before harvesting (Table 2). These findings are similar in agreement with earlier reported by Tanna et al., (1985), Sarkar et al., (2001), Pawar et al.,(2003), Gupta et al., (2004), Saxena et al., (2007), Lal et al., (2009) and Yadav et al., (2011).

**Expected genetic advance as percentage of mean**

Expected genetic advance expressed as percentage of mean was observed high (> 20%) for plant height, number of tillers per plant, spike length and number of grains per spike. Moderate genetic advance as percent of mean (10-20%) was recorded for flag leaf length, 1000 grains weight and grain yield per plant. Whereas, days to 50% flowering, flag leaf width, seed vigour index, germination % after harvesting and germination % before harvesting showed low GA (<10%) (Table 2). These findings are similar in agreement with earlier reported by Kaul and Singh (2011).

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