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

Ajeet Kumar*, Amit Kumar, Vikas Rathi and Kushal Pal Singh Tomer

Department Genetics and Plant Breeding, C.C.S. University Meerut-250001, UP, India
**Corresponding author*

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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.

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 puffly, 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) and1000-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 %) = (σ2g/x) x 100

Phenotypic coefficient of variation (PCV %) = [(σ2 g+ σ2gy+ σ2e)/x] x 100

Heritability

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

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

Genetic advance

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

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

And, Genetic advance over mean of the character

$$G.A.\ (\%) = \frac{G.A.}{\overline{X}} \times 100$$

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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