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## Assessment of genetic variability, heritability and genetic advance in wheat (*Triticum aestivum* L.) under sodic soil

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### Abstract

The experiment on 108 treatments of wheat along with 80 F<sub>1</sub>'s, 24 parental lines (20 females + 4 males) and four standard variety (KH-65, KRL-1702, KRL-1714, NW-1014) of wheat was conducted to work out the genetic variability, heritability and genetic advance effects of their various attributes on grain yield. The high estimates (>15%) of phenotypic (PCV) and genotypic (GCV) coefficients of variation were recorded in case of tiller per plant (PCV=16.37%, GCV=9.14%). High estimates of broad sense heritability (> 75%) were recorded for plant height (80.00%), and Tiller/plant showed moderate estimate of genetic advance in percent of mean (10-20%). High heritability and genetic advance indicate that the additive nature of gene action and reliability of those characters for selection and emerged as ideal traits for improvement through selection.

**Keywords:** Variability, heritability, genetic advance

### Introduction

Wheat is the principal food crop in most areas of the world and also occupies prominent position in Indian agriculture after rice. It is nutritionally important cereal essential for the food security, poverty alleviation and for livelihoods. *Triticum aestivum* (bread wheat) is an allohexaploid would then have 42 chromosomes; i.e. six complete genomes each of 7 chromosomes. Wheat (*Triticum aestivum* L. em. Thell.;  $2n=6x=42$ ) is a self-pollinated crop of the member of *Poaceae* family. It is the most important food crop of India and is a main source of protein and energy. In India, wheat is the second most important food crop after rice both in terms of area and production. It has been described as the 'King of cereals' because of the acreage it occupies, high productivity and the prominent position it holds in the international food grain trade. The wheat grown in India is spring type belonging to species *Triticumaestivum* (bread wheat). Wheat is more nutritive as compared to the other cereals. It has good nutrition profile with 12.1 per cent protein, 1.8 per cent lipids, 1.8 per cent ash, 2.0 per cent reducing sugars, 6.7 per cent pentosans, 5.9 per cent starch, 70 per cent total carbohydrates and provides 314K cal / 100g of food. It is also a good source of minerals and vitamins viz. calcium (37 mg / 100g), iron (4.1 mg / 100g), thiamine (0.45mg /100g), riboflavin (0.13 mg / 100g) and nicotinic acid (5.4 mg / 100mg), (Lorenz and Kulp, 1991). Unlike other cereals, wheat contains a high amount of gluten, the protein that provides the elasticity necessary for excellent bread making. Hard wheat had high protein (10-17%) and yield a flour rich gluten, making it particularly suitable for yeast breads. The low-protein (6 to 10%) softer type yields flour lower in gluten and therefore, suited better for tender baked products, such as biscuits, pastries cakes.

The perusal of state wise production of wheat indicated that Uttar Pradesh top the list with 32.09 mt, followed by Madhya Pradesh (18.58 mt), Punjab (18.21 mt), Haryana (12.07 mt), Rajasthan (10.57 mt) and Bihar (6.55mt), These top six states together contributed about 93 per cent of the total production (Anonymous 2019-20). Improvement in wheat production is essential for future purposes because of ever increasing population pressure. We need to develop such varieties that fulfill our nutritional requirements.

Breeding objectives for bread wheat include suitability of different maturity groups for early, mild, and late planting and also special importance are given on high yield, resistance to diseases, resistance to lodging, wide adaptation, better milling, baking and nutritional qualities. Heritability and genetic advance are important to plant breeders as they not only serve as predictive function of crop performance in a succeeding generation but also guide the breeder in selection. The magnitude of heritability is of paramount significance in selection because high heritability makes the selection process a straightforward job. However, the use of heritability alone in advance generations is not adequate to bring significant improvement through selection if not accompanied with sufficient amount of genetic advance. Therefore, heritability when coupled with genetic advance could further strengthen the effectiveness of selection. For a successful breeding program, the presence of genetic variability plays a vital role. It is true that the more diverse plants, the greater chance of exploiting high heterotic crosses or to generate productive recombinants and broad variability in segregating generations during genetic improvement (Mohammadi and Prasanna, 2003; Verma *et al.*, 2013) [13, 12]. Rauf *et al.* (2012) [12].

### Materials and Methods

The study was designed to work out the status of association of different grain yield traits on grain yield per plant among 108 genotypes at field experiment under present investigation was conducted during *ravi*, 2019-20 at the Main Experimental Station of A.N.D. University of Agriculture & Technology, Narendra Nagar (Kumarganj), Ayodhya, u.p. India. The experimental materials of studies comprised of 108 genotypes with four check varieties *viz.*, KH-65, KRL-1702, KRL-1714, NW-1014. The experiment was laid out in randomized block design. The observation were recorded on twelve different grain yield traits *viz.*, days to 50% flowering, days to maturity, plant height (cm), tillers per plant, flag leaf area (cm), spike length(cm), peduncle length(cm), number of grains per spike, grain yield per plant (g), test weight (g), biological yield per plant (g), harvest index. The certain selected statistical approaches were used for data analysis. Analysis of variance for randomized block design. Phenotypic (PCV), genotypic (GCV) and environmental (ECV) coefficients of variation for different characters were estimated by formulae suggested by Burton and de Vane (1953). Heritability in broad sense ( $h^2_b$ ) was calculated as suggested by Hanson *et al.* (1956) [15]. The expected genetic advance ( $G_a$ ) was estimated using formula suggested by Johnson *et al.*, (1955) [6].

### Results and Discussion

The success of selection in improving plant characters depends mainly on presence substantial genetic variability and nature of heritability and gene action. The genetic variability is the raw material of plant breeding programme on which selection acts to evolve superior genotypes. The phenotypic, genotypic and environmental coefficients of variation can be used for assessing and comparing the nature and magnitude of variability existing for different characters in the breeding materials. Heritability in broad sense quantifies the proportion of heritable genetic variance to total phenotypic variance, while heritability in narrow sense represents the ratio of fixable additive genetic variance to total phenotypic variance. Estimates of heritability help in estimating expected progress through selection. The genetic advance in per cent of mean provides indication of expected

selection response by taking into account the existing genetic variability and heritability of the character.

### Analysis of variance

Analysis of variance for randomized block design was carried out for twelve characters to test the significance of differences among various treatments (checks) and is presented in Table 1. The mean squares due to treatments were highly significant for all the characters studied except peduncle length 2.62 while, mean squares due to replications were found non-significant for all the characters in both parents and  $F_1$ .

### Coefficient of variation

The phenotypic and genotypic coefficients of variation for all the twelve characters have been given in Table 2. In general, the magnitude of phenotypic coefficient of variation was higher than corresponding genotypic coefficient of variation for all the characters. The high estimates (>15%) of phenotypic (PCV) coefficients of variation were recorded in case of tiller per plant (PCV=16.37%) while the tiller per plant (GCV=9.14%) showed moderate estimate of genotypic coefficient of variation. Exhibited moderate estimates (>5 <15%) of PCV and GCV recorded for the characters, spike length (PCV=7.79, GCV = 5.84), number of seed per spike (PCV= 9.34, GCV = 5.56), harvest index (PCV= 6.67, GCV= 9.34), biological yield (PCV= 6.67, GCV =5.43) grain yield per plant (PCV=9.34, GCV =5.56). The low estimates (< 5%) of phenotypic and genotypic coefficients of variations were observed for days to 50% flowering (PCV=3.28%, GCV= 0.83%), days to maturity (PCV=1.81%, GCV= 1.36%), plant height (PCV= 4.23%, GCV=3.80%), flag leaf area (PCV= 4.15%, GCV=1.50%) and 1000 seed weight (g) (PCV= 3.46%, GCV=2.00 %).

### Heritability and genetic advance

Heritability in broad sense and genetic advance in per cent of mean for all the twelve yield contributing traits were estimated and findings have been depicted in Table 2. High estimates of broad sense heritability (> 75%) were recorded for plant height in sodic soil. The moderate estimates of heritability (50-75%) were observed for days to 50% flowering (56%), spike length (56%), biological yield (66%) and harvest index (66%) while tiller per plant (31%), Flag leaf area (cm)<sup>2</sup> (13%), peduncle length (8.00%) and grain yield per plant (25.70) showed low estimates of broad sense heritability. Tiller/plant, harvest index showed moderate estimate of genetic advance in percent of mean (10-20%). Rest of the traits showed low estimate of genetic advance in percent of mean in sodic soil. The height to very moderate estimates of direct selection parameters for above mentioned four characters indicated that these would be ideal traits for improvement through selection in context of materials evaluated owing to existence of high genetic variability represented by high coefficients of variation and high transmissibility denoted by high heritability for them. The high estimates of direct selection parameters observed for the above characters are broadly in agreement with earlier reports in wheat (Maurya *et al.*, (2014) [4], Meena *et al.*, (2014) [2], Mecha *et al.* (2016) [3]. Yassin *et al.* 2015 [10], Porumb *et al.* 2016). Biological yield and harvest index having moderate PCV and GCV values with high heritability resulted into high genetic advance to suggest that reasonable response to selection may be obtained for this character owing to high transmissibility even if variability happens to be moderate. In

spite of recording high heritability in broad sense, Plant height (cm) resulted low genetic advance owing to low variability represented by low value of PCV and GCV which indicated

that improving trait through selection in context of present material would be difficult due to lack of genetic variability.

**Table 1:** Analysis of variance for 12 characters in wheat

S. No.	Characters df	Replication	Treatments	Error
		2.00	103.00	206.00
1	Days to 50% Flowering	0.41	15.08**	2.12
2	Days to Maturity	0.20	10.03**	2.01
3	Plant Height (cm)	3.74	27.27**	2.20
4	Tillers/Plant	0.10	0.87**	0.38
5	Flag leaf area (cm) <sup>2</sup>	0.27	0.71	0.49
6	Spike Length (cm)	2.40	2.77**	0.57
7	Peduncle Length (cm)	32.53	2.62**	2.05
8	Number of Grain /spike	0.64	21.57**	8.00
9	Grain Yield/ Plant (g)	0.22	2.92**	0.34
10	Test Weight (g)	5.21	2.61**	1.01
11	Biological Yield/ Plant (g)	12.187	49.87**	6.03
12	Harvest Index (%)	0.65	12.05**	2.06

\*, \*\* significant at 5 and 1 per cent probability levels, respective

**Table 2:** Estimate of range, coefficient of variation (PCV and GCV), heritability, genetic advance and genetic advance in percent of mean for 12 characters in wheat

S. No.	Characters	Range		General mean	Coefficient of variation (%)		h <sup>2</sup> (Broad sense)	Genetic advance 5%	Gen. adv as % of Mean 5%
		Parents	Crosses		GCV (%)	PCV (%)			
1	Days to 50% flowering	73.00-77.33	72.67-80.00	76.94-0.83	0.83	3.28	0.67	3.50	4.55
2	Days to maturity	114.33-122.00	115.33-121.67	118.29±0.82	1.36	1.81	0.56	2.48	2.10
3	Plant height (cm)	71.97-91.53	72.77-85.67	78.89±0.85	3.80	4.23	0.80	5.54	7.03
4	Tillers/plant	3.53-5.50	3.53-5.67	4.56±0.36	9.14	16.37	0.31	0.48	10.53
5	Flag leaf area (cm) <sup>2</sup>	17.77-18.70	17.03-19.17	18.17±0.40	1.50	4.15	0.13	0.20	1.12
6	Spike length (cm)	12.53-14.90	13.47-16.77	14.70-0.44	5.84	7.79	0.56	1.32	9.03
7	Peduncle length (cm)	23.63-26.07	22.30-27.73	24.41-0.82	1.73	6.10	0.08	0.24	1.01
8	Number of seed /spike	32.00-44.33	31.67-42.33	37.77-1.64	5.56	9.34	0.35	2.57	6.82
9	1000 seed weight (g)	33.86-37.67	32.93-38.25	35.52-0.58	2.00	3.46	0.33	0.85	2.39
10	Biological yield	61.19-67.86	63.57-81.88	68.311±1.53	5.43	6.67	0.66	6.21	9.10
11	Harvest index (%)	31.07-36.33	27.13-36.80	33.40±0.87	5.43	6.67	0.66	6.21	9.10
12	Grain yield /plant (g)	20.78-23.01	20.87-25.03	22.74±0.34	5.56	9.34	0.35	2.57	6.82

\*, \*\* significant at 5 and 1 per cent probability levels, respectively

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