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Assessment of genetic variability, heritability and genetic advance in bread wheat (*Triticum aestivum* L.) Genotypes

Neetu Yadav, Abhay Dashora, Urmila Choudhary, Mayur Dave and Jyotsana Rathore

Abstract
The investigation was carried out using 76 bread wheat genotypes including 4 checks at Instructional Farm, Rajasthan College of Agriculture, MPUAT, Udaipur during *Rabi*, 2019-2020. The experiment was laid out in Augmented Randomised Block Design. Analysis of variance revealed significant difference among the genotypes for most of the characters suggesting sufficient amount of variability in the experimental material under study. High estimates of genotypic coefficient of variation (GCV) and phenotypic coefficient of variation (PCV) were recorded for grain yield per plant, biological yield per plant and sedimentation value indicating the presence of good amount of genetic variability for these traits. High heritability coupled with high genetic gain was observed for grain yield per plant and sedimentation value indicating that all these traits are governed by additive gene action hence the direct selection for these characters may be effective.

Keywords: bread wheat, genetic variability**,** GCV, PCV, heritability, genetic advance

Introduction
Wheat (*Triticum spp*.) is one of the predominant staple foods and a main cereal crop of many diets around the world. It is agronomically and nutritionally most important cereal essential for the food security, poverty alleviation and improved livelihoods. Three species of wheat *viz*., *Triticum aestivum* (bread wheat), *Triticum durum* (macaroni wheat) and *Triticum dicoccum* (emmer wheat) are presently grown as commercial crop in India.

Globally, wheat is cultivated in an area about 224.49 million hectares with a production of 792.40 million tons of grain (Anonymous, 2021) [2]. Wheat has played a very vital role in stabilizing the food grain production in the country over the past few years. India is the second largest wheat producing country next to China. It occupies an area nearly 31.61 million hectares with a production and productivity of 109.52 million tons and 3464 kg/ha, respectively (Anonymous, 2021) [2]. Uttar Pradesh, Punjab, Madhya Pradesh, Haryana, Rajasthan and Bihar are the major wheat producing states in India. The aforementioned six states hold a share of about 92 *per cent* in total wheat production. The highest area and production of wheat is reported in Uttar Pradesh while its productivity is highest in Panjab. Rajasthan ranked fourth in area, fifth in production and third in productivity in India. In Rajasthan, wheat is cultivated on an area of 3.00 million hectares with a production of 11.03 million tons and productivity 3676 kg/ha. The important wheat growing districts of Rajasthan are Ganganagar, Hanumangarh, Bharatpur, Udaipur, Kota, Tonk, Alwar, Jaipur, Sawai-Madhopur, Chittorgarh and Pali.

Information of genetic variability in the genetic system of a particular crop is sought as pre-requisite with any crop improvement programme. Although increased grain yield is the ultimate goal of the plant breeders, grain yield itself is a product of interaction of many component traits which influence it directly or indirectly. Therefore, variability existing within each component trait must be exploited by selection to realize maximum gain in grain yield.

Hence, the present investigation was carried out to explore genetic variability by determining the magnitude of genetic coefficient of variation, heritability estimates and expected genetic advance of yield and yield attributing traits in 76 genotypes of wheat.

Materials and Methods

The experimental material, comprised of 76 wheat genotypes, were sown in an Augmented Block Design with 6 blocks where each block contains 12 test entries and 4 checks (randomly allocated) with the total 96 of genotypes. The plot size was 2 rows of 2.5meter length with row to row and plant spacing of 23 cm and 5 cm, respectively. All the recommended agronomical practices along with necessary plant protection measures were followed timely for the successful raising of the crop.

Five competitive plants per genotype in each replication were randomly selected for recording observations on different characters *viz*., plant height (cm), number of effective tillers per plant, length of main spike (cm), number of grains per spike, grain weight per spike (g), 1000-grain weight (g), grain yield per plant (g), biological yield per plant (g), harvest index (%), sedimentation value (ml) and protein content (%) while data for days to 50% heading and days to maturity were recorded on whole plot basis.

Analysis of variance for Augmented Block Design was done for each character as per the method suggested by Federer (1956) [5]. The phenotypic and genotypic coefficient of variation (Burton, 1952**),** broad sense heritability (Burton and Devane, 1953) [4] and genetic advance (Johnson *et al.* 1955) [6] were computed.

Results and Discussion

Analysis of variance revealed significant differences among genotypes for most of the traits studied indicating presence of significant variability in the materials (Table-1).

The range, general mean, phenotypic coefficient of variation (PCV), genotypic coefficient of variation (GCV), broad sense heritability (h^2), genetic advance (GA) and genetic advance as *per cent* of mean (Genetic Gain) given in Table 2 indicated a wide range of variability for most of the characters.

Table 1: Analysis of Variance for yield and its contributing traits in wheat

S N	Character	Block [5]	Treatment [75]	Check [3]	Genotype [71]	C v/s G [1]	Error [15]
1.	Days to 50% heading	0.67	54.33**	443.44**	14.14**	1740.50**	1.58
2.	Days to maturity	1.27	45.36**	221.61**	16.14**	1591.42**	2.31
3.	Plant height(cm)	9.86	37.16**	143.20**	33.08**	8.57	3.90
4.	No. of effective tillers per plant	0.51	0.98	1.38	0.97	0.45	0.59
5.	Length of main spike	3.35*	1.87*	8.57**	1.62	0.01	0.82
6.	No. of spikelets per spike	3.48	3.23	24.86**	2.29	4.91	1.62
7.	No. of grains per spike	20.23	39.61	181.74**	34.08	5.89	20.20
8.	Grain weight per spike (g)	0.11	0.21	1.08**	0.17	0.27	0.13
9.	1000-grain weight(g)	4.66	8.12**	10.81*	8.09**	1.95	2.08
10.	biological yield per plant (g)	15.14	51.16*	100.23**	49.81*	0.05	17.44
11.	grain yieldper plant (g)	1.51	10.83**	40.57**	9.71**	1.48	2.67
12.	Harvest index	6.43	17.97*	50.97**	16.77*	4.02	6.95
13.	sedimentation value (ml)	1.20	36.50**	200.00**	30.08**	1.92	0.67
14.	Protein content (%)	0.46*	0.47**	1.60**	0.41*	1.42**	0.15

*Significant at P=0.05, **Significant at P=0.01, [ ] Degree of freedom

Table 2: Genetic Variability Parameters for different Characters in bread wheat

S N	Character	Range		Mean	GCV (%)	PCV (%)	H^2 (%)	GA (%)	GG (%)
		Min.	Max.						
1	Days to 50% heading	65.17	92.00	83.2	4.14	4.39	88.84	6.88	8.03
2	Days to maturity	113.00	137.00	126.9	2.88	3.11	85.68	7.09	5.48
3	Plant height(cm)	98.12	123.12	106.28	5.07	5.40	88.20	10.45	9.82
4	No. of effective tillers per plant	4.80	9.60	6.66	9.34	14.88	39.46	0.80	12.09
5	Length of main spike	6.08	12.88	10.17	8.75	12.50	48.97	1.28	12.61
6	No. of spikelets per spike	15.80	23.80	20.31	4.00	7.41	29.22	0.91	4.46
7	No. of grains per spike	53.60	79.80	68.59	5.42	8.49	40.71	4.90	7.12
8	Grain weight per spike (g)	2.41	4.30	3.64	5.75	11.32	25.78	0.22	6.01
9	1000-grain weight(g)	37.54	48.72	45.05	5.45	6.33	74.26	4.35	9.68
10	biological yield per plant (g)	30.40	56.70	47.73	11.92	14.79	65.00	9.45	19.80
11	grain yield per plant (g)	11.13	20.99	16.75	15.91	18.68	72.52	4.65	27.91
12	Harvest index	30.08	42.96	35.07	8.97	11.72	58.55	4.94	14.13
13	sedimentation value (ml)	30.00	58.00	44.76	12.14	12.28	97.78	11.05	24.73
14	Protein content (%)	9.90	13	11.44	4.42	5.55	63.42	0.83	7.25

GCV- Genotypic Coefficient of Variance, PCV- Phenotypic Coefficient of Variance, h^2- Heritability, GA- Genetic Advance, GG- Genetic Gain

In the present investigation, wide range of variation was observed for sedimentation value (30-58 ml), days to heading (65.17-92 days), biological yield per plant (30.40 -56.70 g), number of grains per spike (53.60-79.80), plant height (98.12-123.12 cm) and days to maturity (113-137 days). Similar finding was observed by Baye *et al.*, 2020. A better idea can be gained by comparing the relative amount of coefficient of phenotypic and genotypic variance for the actual strength of variability.

The estimates of PCV were higher than their respective GCV for all the traits. Among all the traits studied, number of effective tillers per plant, length of main spike, number of spikelets per spike, number of grains per spike and grain weight per spike (g) had difference between their respective estimates of phenotypic and genotypic coefficient of variation. This may be either due to interaction of genotypes × environments or environmental factors influencing the expression of these five traits. The characters *viz*., days to

50% heading, days to maturity, plant height, 1000-grain weight, sedimentation value and protein content were least influenced by environmental factors indicated availability of more chances of improvement through selection breeding programme. This result is in agreement of findings of Bhushan *et al.*, 2013 and Kumar *et al.*, 2017 [3].

Present study revealed that maximum genotypic coefficient of variation was recorded by grain yield per plant (15.91 %) followed by sedimentation value (12.14 %) and biological yield per plant (11.92 %) while high phenotypic coefficient of variation was observed for grain yield per plant (18.68 %) followed by number of effective tillers per plant (14.88%), biological yield per plant (14.79 %), length of main spike (12.50 %) and sedimentation value (12.28 %). High degree of phenotypic coefficient of variation providing sufficient scope for improvement of these characters. Genotypic coefficient of variation is more important than that of phenotypic coefficient of variation because higher amount of genotypic variation helps in formulation of effective breeding program for crop improvement. Low value of GCV and PCV was observed for days to maturity, days to 50% heading and protein content (Table 2). Similar results were reported by Bhushan *et al*., (2013), Kumar *et al*. (2019) [9] and Nagar *et al*. (2018) [11].

With the help of PCV and GCV alone it is not possible to determine the amount of variation which is heritable. The heritability indicates only the effectiveness of phenotypic performance of a character. The heritability estimates help the breeders in selection based on the phenotypic performance. High heritability was observed for most of the characters under study indicating the strong genetic base. In the present study, high values of heritability were observed for sedimentation value followed by days to 50% heading, plant height, days to maturity and 1000-grain weight which indicated that the selection was effective.

The genetic advance expressed as *per cent* of mean was the highest for grain yield per plant followed by sedimentation value and biological yield per plant while the plant height followed by number of effective tillers per plant had moderate values of genetic advance expressed as percentage of mean. High values of genetic advance expressed as percentage of mean have been reported in wheat for grain yield per plant Prasad *et al.*, 2020.

Heritability in broad sense and genetic advance as *per cent* of mean are direct selection parameters that provide index of transmissibility of traits which gives indication about the effectiveness of selection in improving the characters. The genetic advance is the further estimation of expected gain resulting from selection pressure in breeding material. High heritability associated with high genetic advance for different yield components have a better scope for selecting high yielding genotypes (Yadawad *et al.*, 2015) [14].

The high heritability combined with high genetic advance as *per cent* of mean was observed for sedimentation value followed by grain yield per plant and biological yield per plant indicated that selection will be effective for these characters (Panse, 1957) [12]. Therefore, grain yield per plant can be better exploited through simple selection (Subhashchandra *et al.*, 2009) [13]. On the other hand, high heritability with moderate genetic gain was observed for plant height and 1000-grain weight. This revealed that selection would be less effective for these traits. These observations are in agreement with earlier reports of Bhusan *et al.*, (2013), Kumar *et al.*, (2017) [3] and Jaiswal *et al*, (2020) [7].

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