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Study of genetic variability parameters in advance breeding lines of bread wheat (*Triticum aestivum* L.)

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Abstract
A field study was carried out under irrigated conditions during *Rabi* 2018-20 to study the genetic variability, heritability and expected genetic advance for eleven traits in 20 advance breeding lines in bread wheat. The genotypes exhibited wide range of variation for all the traits except for days to maturity, 1000-seed weight, Biological yield per plant indicating the presence of enough genetic variability in the study material. Phenotypic coefficients of variation were higher than the genotypic ones, for all the characters. High phenotypic and genotypic coefficient of variation was observed for effective tillers per plant and grin yield per plant. Days to maturity has lowest phenotypic and genotypic coefficient of variation. Peduncle length exhibited high heritability coupled with high genetic advance reveled that character is governed by additive gene action and selection may be effective for improvement of this character. Traits like plant height, effective tillers per plant, ear length, spike weight, grains per spike, 1000-seed weight, biological yield per plant, and harvest index are those character which have high x medium or medium x high heritability and genetic advance, respectively, indicates that these character can also be improved through selection.

Keywords: *Triticum aestivum*, PCV, GCV, heritability, genetic advance

Introduction
Wheat (*Triticum aestivum* L.) is the world's most staple food crop as well as most consumed cereal. It is known as “*king of cereals*” as its cultivation is easier, ecologically suitable and contain high amount of nutrients. It is the most extensively grown cereal crop in the world, engaging 17% of crop acreage world over, giving food about 40% of world population and supplying 20% of the total food calories and protein in human diet (Gupta *et al.*, 2005) [1]. Wheat grain yield varies widely as a consequence of its interaction with a variety of environmental factors since it is a complex quantitative genetic parameter and is the result of numerous contributing factors affecting grain yield directly or indirectly. Wheat grain production can be improved through the development of productive varieties which better adjust in diverse agro-climatic conditions and also resist all types of biotic and abiotic stresses. Selection and improvement in respect to grain yield can only be efficient if adequate genetic variability is exit in the breeding materials (Ali *et al.*, 2008) [2]. Correlation coefficient is an important statistical technique which can assist wheat breeders in selection crop plants for higher yields. Therefore, knowledge of interrelationships between grain yield and its contributing factors will improve the effectiveness of breeding programs through the use of suitable selection indices (Mohammadi *et al.*, 2003) [3]. The creation and selection of genetic variation for crop improvement is one of the key integral tasks for plant breeders. The selection depends not only on the estimation of genetic variation among genotypes, but also upon a proportion of heritable variation and expected genetic gain that could be obtained (Falconer and Mackay, 1996; Singh, 2000) [3, 5]. An attempt was made in the present research study to assess the heritability of some quantitative traits and understand the relationship between these traits and their contribution to yield in a set of advance cultivars.

Materials and Methods
The experimental material consisted of 20 strains of wheat *(Triticum astivum* L.) for the study of genetic variability and divergence. These genotypes belong to different states of India and abroad (Table 1) which exhibited wide spectrum of variability for various agronomic and morphological characters. All the 20 lines/varieties were sown on 5th Nov 2019-20 in first year following Randomized Complete Block Design with three replications.

Each treatment was grown in 3 m long single row, spaced 30 cm apart. Distance of plant to plant within row was maintained at about 15 cm by thinning and all the recommended agronomic practices and plant protection measures were adopted for raising a good crop.

Observations were recorded on five competitive plants selected randomly and tagged well in advance in each entry, for eleven quantitative characters. Five plants were selected randomly from each genotype per replication for recording agronomic data and observations on days to heading and days to maturity were recorded on plot basis. The data obtained were subjected to the biometrical analysis that included analysis of variance, heritability and genetic advance. Genotypic coefficient of variation (GCV%), phenotypic coefficient of variation (PCV%), broad sense

heritability (h^2(bs)%) and genetic advance in percent mean (GAPM) were estimated by the formula suggested by Singh and Chaudhary, (1985) [6]. The estimate of GCV and PCV were classified as low, medium and high (Sivasubramanian and Madhavamenon, 1973) [7]. The heritability was categorized as suggested by Robinson *et al*. (1949) [8]. Again, genetic advance was classified by adopting the method of Johnson *et al*. (1955) [9].

Results and Discussion

Phenotypic coefficient of variation was higher than the respective genotypic coefficient of variation for all the traits indicating that attribute is considerably influenced by environment (Table 1). However, sufficient amount of genotypic and phenotypic variability has been observed for effective tillers per plant and grain yield per plant. High estimates of phenotypic and genotypic coefficient of variability for these characters were also reported by Kumar *et al.* (2014) and Desheva and Kyosev (2015) [10, 11]. For characters such as days to maturity the chance of improvement through selection may be limited due to low genotypic and phenotypic coefficient of variability.

It is apparent from the above results that sufficient magnitude of variability is present in all the characters except days to maturity, 1000-seed weight, biological yield per plant showed exploitable amount of genetic variability in improvement of crop through eye ball selection.

In the present study the estimate of heritability in broad sence was computed, which includes both additive and non-additive gene effects. Therefore, heritability estimates should be used in conjugation with genetic advance (Burton and de Vane, 1953). The results showed wide variation in heritability estimates which varied from 35.0 (grain yield per plant) to 92.0 per cent (biological yield per plant).

High to moderate estimates of genetic advance were recorded for all the characters except days to maturity. Whereas traits like plant height, year length, grains per spike, 1000-seed weight, biological yield per plant, grain yield per plant and harvest index showed moderate genetic advance. Low genetic advance was exhibited by days to maturity whereas high genetic advance was shown by effective tillers per plant, peduncle length, and spike weight.

Table 1: Estimates of mean, range, coefficient of variation, heritability and genetic advance in Wheat

Characters	Grand Mean	Range		Coefficient of variation (%)		Heritability in broad sense (%)	Genetic advance (% of mean)
		Minimum	Maximum	Genotypic	Phenotypic		
Days to maturity	129	110	135	4.9	5.8	92	9.5
Plant height (cm)	84.62	61.10	97.80	13.2	14.6	85	25
Effective tillers plant^{-1}	24.61	8.45	29.46	28.4	30.2	73	26
Ear length (cm)	17.36	8.92	18.53	14.6	16.3	71	22
Peduncle length (cm)	84.82	45.62	112.43	18.3	20.7	82	29
Spike weight (g):	3.10	2.84	4.12	13.9	14.5	64	34
Grains spike^{-1}	52.76	28.6	82.9	14.6	15.2	52	17
1000-seed weight (g)	48.31	42.3	63.8	8.9	10.3	83	18
Biological Yield plant^{-1} (g):	15.1	13.6	16.9	9.2	18.6	92	15
Grain Yield Plant^{-1} (g)	14.11	11.8	22.3	17.2	22.1	35	25
Harvest Index (%)	38.28	26.3	46.9	11.4	18.3	81	19

Johnson *et al.* (1955) [12] stated that in predicting the resultant effects of selection, the genetic advance should be given weightage along with heritability. According to this yardstick, characters such as plant height, peduncle length and 1000-seed weight could be favourably selected because they exhibited moderate to high heritability and high genetic advance. The observed inter-relationship between heritability and genetic advance indicted the existence of additive genetic control in the inheritance of these traits and simple selection could be profitably applied for improvement of these characters. High heritability coupled with high genetic advance was also reported by Patel (2006), Kemelew (2011) [14, 15] for these traits.

Grain yield per plant has low heritability accompanied with medium genetic advance also revealed that the character is governed by additive gene effects and selection may not be effective for improvement of this character. Peduncle length exhibited high heritability coupled with high genetic advance reveled that character is governed by additive gene action and selection may be effective for improvement of this character. Traits like plant height, effective tillers per plant, ear length, spike weight, grains per spike, 1000-seed weight, biological yield per plant, and harvest index are those character which have high x medium or medium x high heritability and genetic advance, respectively, indicates that these characters can also be improved through selection. These observations are in consonance with earlier findings of Ahmad I (2004); Bhushan *et al.* (2013); Breiman A and Graur D (1995) [16, 17, 18].

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