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Assessment of late sown wheat (*Triticum aestivum* L.) Genotypes for variability parameters under Mandsaur agro-climatic conditions

Rajesh Aggarwal, Niharika Gupta and Rahul Singh Rajput

Abstract
The present experiment entitled “Assessment of late sown wheat (*Triticum aestivum* L.) Genotypes for variability parameters under Mandsaur agro-climatic conditions”, was conducted in *Rabi* -2019-20 at the experimentation field, Department of Agriculture, Mandsaur University, Mandsaur. The experiment was carried out randomized block design with three replications. The 20 genotypes were used in the study which are well adopted for Central India on 10 quantitative characters i.e. Days to 50% flowering, Plant height, Flag leaf length, Flag leaf width, Number of tillers/plant, Spike length, Days to maturity, Grain yield/plant, Biological yield/plant and Harvest index. On the basis of *Per se* performance for grain yield per plant genotype JW-3288 followed by JW-1203 were found promising as they showed high value for grain yield and its components of wheat and genotype RVW-4106 was found earliest which is desirable. For direct selection parameters such as Plant Height, Flag leaf length, Flag leaf width, spike length and Harvest index can be improved by directional and restricted selection.

Keywords: Wheat, variability, heritability, genetic advance

Introduction
Wheat (*Triticum aestivum* L.) is the most important grain and is being used as a staple food for more than one third of the world belongs to Gramineae (Poaceae) family and having genus triticum, 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 (Food and Agriculture Organization, 2005) [8]. It has been recognized as the source of principal food of man for centuries. It occupies an inimitable position in human life as it is the major source of food and energy with a large number of end use products like chapathi, bread, biscuits, pasta and is also a good source of fodder for animals. Three species of wheat *viz*., *Triticum aestivum* L.(bread wheat), *Triticum durum* Desf. (Macaroni wheat) and *Triticum dicoccum* Schulb. (Emmer wheat) are grown commercially in India, covering 86, 12, and 2 per cent of the total area under wheat, respectively (Ukani *et al*., 2015) [23]. The centre of origin of wheat is known to be south west Asia. Hindukush area is the centre of origin of hexaploid wheat (Kundu and Nagarjan, 1996) [13]. Wheat is grown on 215.9 million hectares throughout the world, which produces 725.91 million tons of grain in 2015 (Foreign Agricultural Services, USDA, 2018) [9]. It provides, on an average, one fifth of total calorific input to the world population, Wheat in India is grown over an area of 29.86 million ha producing 95.85 million tons (FAO, 2008) [7]. Madhya Pradesh comes under Central zone for wheat cultivation other than M.P. states like Chhattisgarh, Gujarat, Kota and Udaipur district of Rajasthan and Jhansi district of Uttar Pradesh are also under Central zone. The central zone of wheat cultivation is known to be for very good quality of wheat throughout India. Madhya Pradesh produce the 18.41 million tons of wheat from area 5.91 million hectare with yield 3115 kg per hectare (Ministry of Agriculture and Farmers Welfare, Govt. of India, 2015-16) [15] while India produced 86.53 million metric tons from wheat area 31.47 million hectare with 2.75 metric tons per hectare in 2015-16 (Foreign agricultural service, USDA, 2018) [9].
Time of sowing is one of the important aspect in obtaining good yield, in India wheat is generally grown under three sowing conditions, that is, Normal (November sown), Late (December sown) and Very late sown (January sown). Delay in sowing due to Rice- Wheat cropping system very much responsible for low grain yield, this reduction is due to sub-optimal temperature during germination, stand establishment and supra-optimal temperature during reproductive growth (Sattar *et al.*, 2010) [18]. Late planting result in poor tillering, reduced tillering period and more chances of winter injury (Joshi *et al.*, 1992) [12].

Variability is the occurrence of differences among individuals due to differences in their genetic composition and/or the environment in which they are raised (Allard, 1960; Falconer and Mackay, 1996) [1, 6]. Variability is the presence of difference among the individuals of plant population and it is interaction genetic constitution and environment they have grown. Information on the nature and magnitude of genetic variability present in a crop species is important for developing effective crop improvement program. Heritability in broad sense refers to the portion of phenotypically expressed variation, within a given environment and it measures the degree to which a trait can be modified by selection (Christiansen and Lewis, 1982) [4].

Materials and Methods

The present study was carried out for assessment of direct selection parameters (variability, heritability, and genetic advance) at experimentation field, Department of Agriculture, Mandsaur University, Mandsaur by using 20 wheat genotypes in *Rabi* 2019-20; these genotypes exhibit a wide spectrum of variation for various agronomic and morphological characters. Sowing was done as late sowing on 15th December 2019 maintaining a spacing of 25 cm between two lines in Randomized Block Design in three replications as three lines of two meter for each genotype.

Data was noted down by selecting 5 plants randomly from each plant genotypes and ten characters i.e. Days to 50% flowering, Plant height, Flag leaf length, Flag leaf width, Number of tillers/plant, Spike length, Days to maturity, Grain yield/plant, Biological yield/plant and Harvest index and Average mean of data was worked out from 5 plants and subjected to statistical analysis. To determine the significance of data, the variance analysis for all the characters was carried out according to the technique given by Steel et al. (1997) [22]. The variance was partitioned into phenotypic and genotypic components. The heritability determination in broad sense was estimated as ratio between genotypic and phenotypic variance (Burton and Devan 1953) [2]. The expected genetic advance under selection (GA) and heritability were estimated as per the formula described by Allard (1960) [1]. The genetic advance expressed as percentage of mean was computed by method suggested by Johnson *et al.*, (1955) [11].

Results and Discussion

The mean sum of square due to genotype were significant for all the 10 characters studied suggesting that the genotypes were genetically divergent from each other. This indicates that there is ample scope for selection of promising lines from the present gene pool for yield and its components the findings were also found by Singh and Dwivedi (2002) [21] and Lad *et al.* (2002) [14]. Who also observed significant variability for yield and its components in wheat.

On the basis of mean values (*per-se*) for all the 10 characters taken, Genotype RVS-4106 was found to be earliest which is desirable. Character number of tillers per plant contributes very significantly in the overall yield, Genotype MP-1255 having highest number of tillers that is 14.69. The spike of genotype PBW-226 which was largest also contributes significantly in yield. Number of grains per plant holds importance as it the major contributor to seed yield as the genotype showing more number of grains per spike are potentially high yielder, Genotype HD-2285 having maximum number of grains that is 54.16. For grain yield per plant Genotype JW-3288 was found to be highest yielder that is 13.18 g, These findings for grain yield are in accordance with the studies of Dwivedi and Pawar (2004) [5] and Rajput (2018) [17]. The mean value of different quanitative characters is as follows, the mean value of Days to 50% flowering (85.80 days), Plant height (95.34 cm), Flag leaf length (25.16 cm), Flag leaf width (1.32 cm), Number of tillers/plant (9.02), Spike length (15.88 cm), Days to maturity (116.63 days), Grain yield/plant (16.19 g), Biological yield/plant (182.34 g) and Harvest index (38.16).

One of the important considerations in any crop improvement is the detailed study of genetic variability. Variability is a measure of estimation of mean genotypic and phenotypic coefficient of variation, heritability, genetic advance and genetic gain. The estimates of variance, coefficient of variation, heritability and genetic advance for all 10 characters studied have been given in Table 1.

Less difference in estimates of genotypic and phenotypic variance and higher phenotypic variance values compared to genotypic variance for all the characters suggested the influence of environment among the genotypes studied (Fig.1), these findings are in accordance with the findings of Singh *et al.* (2001) [20], Sharma and Garg (2002) [19] and Rajput (2018) [17]. GCV and PCV are found moderate to low which gave us idea that scope for selection for these characters is limited and PCV is found greater than GCV for all the 10 Characters depicts the influence of environment and phenotypic selection can be effective.

Table 1: Estimate of genetic parameters for 10 quantitative characters in wheat genotypes

S. No.	Character	VG	VP	GCV%	PCV%	Heritability (BS %)	GA	GA as % of mean
1	Days to 50% flowering	5.85	15.73	2.89	4.92	37.90	2.98	3.47
2	Plant height	62.02	76.30	8.26	9.20	81.28	14.49	15.19
3	Flag leaf length	7.22	9.28	12.60	13.97	97.80	5.01	19.91
4	Flag leaf width	0.12	0.18	9.87	13.42	66.67	0.21	15.90
5	Number of tillers/plant	3.72	6.32	18.05	23.65	58.86	2.97	32.92
6	Spike length	1.66	2.52	11.72	14.56	65.87	2.20	13.85
7	Days to maturity	9.07	10.02	2.47	4.19	90.51	3.44	2.94
8	Grain yield/plant	2.34	2.67	16.47	17.57	87.64	3.03	18.71
9	Biological yield/plant	44.23	50.02	18.01	19.42	88.42	13.01	7.13
10	Harvest index	12.04	17.61	13.61	16.52	68.37	5.98	15.67

VG = Genotypic variance, VP = Phenotypic variance, GCV = Genotypic coefficient of variation, PCV = Phenotypic coefficient of variation, h^2 (BS) = Heritability (Broad sense), GA = Genetic advance.

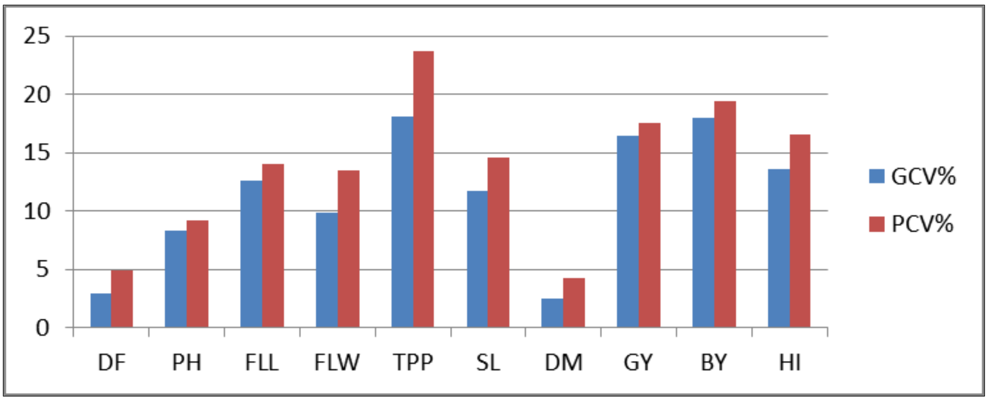

Fig 1: Histogram depicting GCV and PCV

Heritability alone provides no. of indications of amount of genetic improvement that would result from selection of individual genotypes hence knowledge about genetic advance coupled with heritability is most useful. All the characters except Days to 50% flowering and Tillers per plant showed high heritability but high heritability alone is not enough to make sufficient improvement through selection unless accompanied by a substantial amount of genetic advance, Johnson *et al*. (1955) [11] showed that high heritability should be accompanied by high genetic advance to arrive at more reliable conclusion.

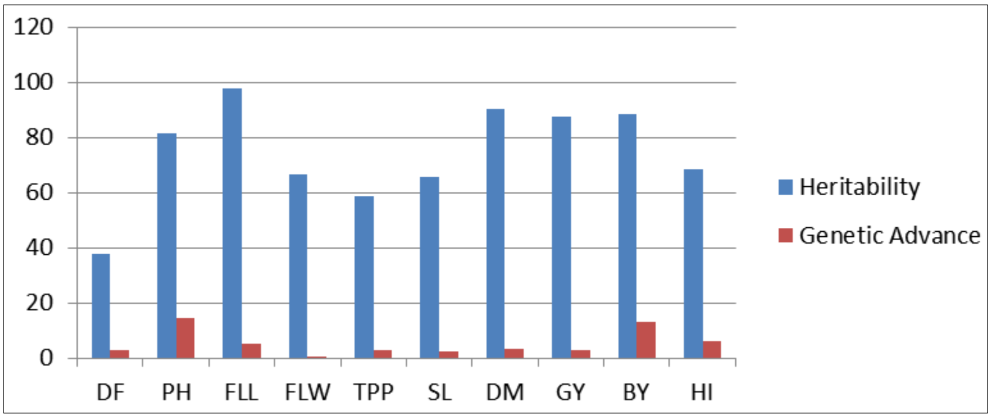

Fig 2: Histogram depicting Heritability and Genetic Advance

High heritability with moderate genetic advance was registered for Plant Height (81.28, 15.19), Flag leaf length (97.80, 19.91), Flag leaf width (66.67, 15.90), spike length (65.87, 13.85) and Harvest index (68.37, 15.67) suggesting predominance of additive and non additive gene actions in expression of these traits (Fig.2), it makes these characters less amenable for selection hence improvement can be done by careful directional and restricted selection and other breeding methods based on progeny testing. Similar results found by Gupta and verma (2000) [10], Chandersekher and kerketta (2004) [3] and Rajput (2018) [17] for different characters, However characters such as Days to maturity (90.51, 2.91) and Biological yield (88.42, 7.13) possessed high heritability with low genetic advance suggesting non additive gene action which reveals the importance of dominance and epistatic efforts in inheritance, high heritability is due to favorable influence of environment and selection may not be rewarding except individual plant selection, similar results reported by Pawar *et al.* (2005) [16]. Genetic advance as percent of mean indicate mode of gene action in expression of a trait and helps in choosing appropriate breeding programme.

Conclusion
From this whole experiment it can be concluded that on the basis of variability parameters that Phenotypic variance is greater for all the characters which depicts the affect of environment. Moderate to low GCV and PCV depicts that the scope for selection for these characters is limited and selection in the basis of phenotype can be made. In this study due to High heritability and moderate genetic advance selection for Plant Height, Flag leaf length, Flag leaf width, spike length and Harvest index may be useful among these genotypes. It is also concluded that on the basis of *per se* performance genotype JW-3288 followed by JW-1203 found best genotype under Mandsaur conditions for highest grain yield along with tillers per plant test weight. On the basis of mean performance no. of grain per spike, harvest index, biological yield per plant and other character taken into consideration RVW-4106 found promising follower by MP-4010 which are suitable for late sown conditions.

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