Research Article

Assessment of Genetic Variability in Late Sown Wheat (*Triticum Aestivum* L.) Germplasm

Nidhi Jain*, Shailesh Marker and Shakshi kanwar

Department of Genetics and Plant Breeding, Faculty of Agriculture, Sam Higginbottom Institute of Agriculture, Technology and Sciences (Deemed-to-be-University), Allahabad-211007, U.P., India

Abstract

The experiment was conducted to examine the genetic variability among 46 genotypes of wheat, during rabi season of year 2012-13 under Randomized Block Design with three replications. The data were recorded for fourteen quantitative characters to obtain estimates of variability, heritability, genetic advance and correlation co-efficient. Significant differences were observed among the genotypes for all the characters studied. A perusal of coefficient of variation showed that PCV was higher than GCV for all the characters studied indicating more effect of environment on the expression of these characters. The genotypic coefficient of variation (GCV) was observed high for grain yield followed by harvest index, canopy temperature, tillers per plant, grain weight per spike and spike length. The phenotypic coefficient of variation (PCV) was exhibited high by canopy temperature followed by tillers/plant, spike length and grain weight/spike. Heritability was observed high for plant height followed by harvest index, test weight and days to 50% flowering. Genetic advance was recorded moderate for plant height. Grain yield exhibited positive and significant correlation with grain weight per spike, spike length, grain filling period, harvest index, grains per spike, tillers per plant, test weight, days to maturity, biological yield, plant height and canopy temperature depression at genotypic level. Tillers per plant, spike length, grains per spike, grain filling period, grain weight per spike, harvest index, test weight, biological yield, days to maturity and plant height at phenotypic level.

Keywords: Wheat, genetic variability, GCV, PCV, Heritability, Correlation coefficient

***Correspondence**
Author: Nidhi Jain
Email: jain.nidhipatni@gmail.com

Introduction

Cereals form the most important source of human food and nutrition (protein, minerals and vitamins) in ordinary Indian diet. Wheat (*Triticum aestivum* L.) is the 2nd most important cereal in India after rice and its improvement in the productivity has played a key role in making the country self-sufficient in food production (Mahpara *et al*., 2008). Wheat is one of the nutritious cereals grown in India and finds a substantial share in food basket of Indians. In India, wheat is the second most important crop after rice occupying 31.00 million ha, with production of 88.90 million tones with an average productivity of 2872 kg per hectare (Economic survey of india, 2015-2016). Time of sowing is one of the most important aspects in obtaining good yield of wheat. In India, wheat is generally grown under three sowing conditions, i.e., normal (November sown), late (December sown), and very late sown (January sown) conditions. Nearly half of the area in UP and within the state, the wheat is largely concentrated in the eastern region to the extent that about 22 % of the total area is under rice - wheat cropping system in the country (Singh, 2001). Delay in wheat sowing in rice-wheat cropping system is perhaps the one of the major factors responsible for low crop yield. This reduction in yield is due to the sub-optimal temperature during the germination, stand establishment and supra-optimal during the reproductive growth. (Sattar *et al*., 2010). Late planting results in poor tillering, reduces the tillering period and more chances of winter injury (Byerlee *et al*., 1984 and Joshi *et al*., 1992). Generally wheat like other cool season crop is seeded early to take maximum period for growth and development toward maturity before the (possible) heat stress. However, mid-season seeding of winter wheat for any locality is usually most favorable, whereas late sown wheat suffers more winter injury, which produces fewer tillers and may ripen in lower grain weight and number of grains per plant (Razzaq *et al*., 1986). Late planted wheat, low temperature prevailing during germination substantially affects the germination and seedling emergence. Germination is a critical process, as temperature below 12°C result in poor and uneven emergence (Timmermans *et al*., 2007).

Each day delay in sowing of wheat after 20 November onward in decreases grain yield at the rate of 36 kg ha^{-1} day^{-1} (Hussain *et al*., 1998). Delayed sowing from normal to late and very late increased the canopy temperature depression significantly, whereas other parameters such as anthesis, maturity, spike length, and grain-filling period were reduced as sowing was delayed (Tripathi *et al.,* 2005). Assessment of variability for the yield and its components becomes absolutely essential before planning for an appropriate breeding strategy for genetic improvement. Parameters such as genotypic and phenotypic coefficient of variability are useful in detecting the amount of variability present in the germplasm. Heritability and genetic advance help in determining the influence of environment on the expression of the genotype and the reliability of characters. Being highly influenced by environmental changes direct selection for grain yield is often not effective. The estimation of correlation coefficient among yield and its components has been useful to the breeders in selecting suitable plant type. However, simple association does not provide the exact basis of simultaneous improvement of the different traits. Thus, the present study was carried out to evaluate the genetic variability and inheritance of yield and some related plant traits to develop desirable wheat genotypes for the late sown condition.

Materials and Method

The experimental material comprising of forty six genotypes of wheat were grown in randomized block design with three replications at the research farm of Department of Genetics and Plant Breeding, Allahabad Agricultural institute-Deemed University, Allahabad during *Rabi* season of year 2012-13. Each plot consisted of four rows of 2 meter row length spaced at 5 cm plant and within a row at 22.5 cm. All the standard practices for wheat was followed to raise a healthy crop. Data were recorded on five randomly and competitive plants of each genotype from each replication for fourteen quantitative and physiological characters *viz*. plant height (cm), number of tillers per plant, spike length (cm), chlorophyll content (%), canopy temperature (^{o}c), grain filling period, number of grains per spike, grain weight per spike (g), biological yield (g), harvest index (%), 1000 grain weight (g), grain yield per plant (g), except days to 50% flowering and days to maturity, The variability was estimated as per procedure for analysis of variance suggested by Panse and Sukhatme (1967), Phenotypic and genotypic coefficients of variation (Burton, 1952), heritability in broad sense (Burton & Devane, 1953), genetic advance (Johnson *et al*., 1955) and genotypic and phenotypic correlation coefficients were calculated following the formula suggested by Al- Jibouri *et al*., 1958.

Results and Discussion

A wide range of phenotypic variability was observed for all the characters studied. The analysis of variance (ANOVA) for fourteen characters indicated highly significant differences among the genotypes (**Table 1**).

Table 1 ANOVA and genetic parameters for 14 quantitative and physiological characters in wheat genotypes

S.No	Characters	ANOVA	GCV	PCV	h^2(bs)	GA	GA as % of Mean
1.	Days to 50% flowering	10.02**	2.12	2.71	61	2.68	3.42
2.	Plant height	212.15**	9.64	9.84	96	16.86	19.47
3.	Grains/spike	23.62**	3.78	6.49	34	2.62	4.54
4.	Tillers/plant	7.30**	13.65	22.10	38	1.59	17.37
5.	Spike length	6.66**	12.40	21.32	34	1.39	14.85
6.	Days to maturity	7.24**	1.09	1.96	31	1.34	1.24
7.	Grain filling period	7.66**	4.29	7.08	37	1.59	5.35
8.	Grain weight/spike	0.21**	12.42	21.10	35	0.25	15.06
9.	Chlorophyll content	0.27**	7.00	13.49	27	0.23	7.49
10	Canopy temperature depression	1.70**	14.17	24.17	34	0.71	17.11
11.	Test weight	6.26**	3.68	4.46	68	2.28	6.26
12.	Biological yield	24.13**	6.43	10.90	34	2.70	7.81
13.	Harvest index	64.52**	15.31	16.26	89	8.81	29.71
14.	Grain yield/plant	10.15**	15.99	21.06	58	2.58	25.00

Significant genetic variation in various traits exhibited by the genotypes indicated that selection for these characters might be effective however, absolute variability in different characters cannot be the criteria for deciding as to which character is showing the highest degree of variability. For this, computation of heritability, genetic advance and coefficient of variability was done. The estimates of both phenotypic (PCV) and genotypic coefficients of variation (GCV) for the fourteen characters were worked out (Table 1). In general, the estimates of PCV were greater than the GCV for all the traits which suggested the role of environment in the expression of the characters. Highest GCV was obtained for grain yield (15.99 per cent) followed by harvest index (15.31%), canopy temperature depression (14.17%), tillers per plant (13.65%), grain weight per spike (12.42%) and spike length (12.40%). The canopy temperature depression showed the higher estimate of PCV (24.17%) in comparison to GCV (14.17%) suggesting environmental influence on this character, which was confirmed by its heritability. The least difference between PCV and GCV for days to maturity suggested that this character is least affected by environment. In such a situation, selection can be effective on the basis of phenotype alone with equal probability of success. On the basis of GCV, it is possible to determine the amount of heritable variation. It can be found out with greater degree of accuracy when heritability in conjunction with genetic advance is studied. Hence both heritability and genetic advance were determined to study the scope of improvement in various characters through selection. The heritability estimates ranged from 27.0% for chlorophyll content to 96.0% for plant height. High estimates of heritability were observed for plant height, harvest index, test weight and days to 50% flowering. Moderate for grain yield, tillers per plant, grain filling period, grain weight per spike, number of grains per spike, spike length, canopy temperature depression, biological yield, days to maturity except chlorophyll content (27 percent) indicated that environmental effects constitute a sufficient portion of the total phenotypic variation and hence, selection for these characters will be less effective Expected genetic advance and its estimated per cent mean for various characters revealed that plant height exhibited the moderate genetic advance. This confirms the findings of (Singh and Sharma. 2007), that GCV together with heritability estimate would give a better picture of genetic advance to be expected from selection. Therefore the characters like plant height, grain yield and harvest index possessing high GCV, heritability and genetic advance as per cent of mean could be effectively used in selection, as it had been suggested that characters with high heritability coupled with high GA as per cent of mean would respond to selection better than those with high heritability and low genetic advance. According to Panse (1957) such characters are governed predominantly by non-additive gene action and could be improved through individual plant selection. However, Kaul and Kumar (1982); Mehertre *et al.*, (1996) and Sarma *et al*. (1996*)* registered high estimates of heritability for plant height. Degewione *et al*., (2013) found high heritability coupled with moderate genetic advance for plant height. High heritability coupled with low genetic advance for days to 50 % flowering, test weight and harvest index. Similar findings were earlier reported by Waqar-ul-haq *et al*. (2008) for test weight. The magnitude of genetic inheritance and expected genetic advance are important for the prediction of response to selection in diverse environment and provide the basis for planning and evaluating breeding programs (Ahmed *et al*. 2007).

Character association reveals the mutual relationship between two characters, and it is an important parameter for taking a decision regarding the nature of selection to be followed for improvement in the crop under study. In the present investigation, the estimates of the phenotypic and genotypic correlations for quantitative traits are presented in **Table 2**. Grain yield per plant had highly significant and positive genotypic and phenotypic correlations with grains per spike, tillers per plant and grain filling period, grain weight per spike and spike length , harvest index , test weight, days to maturity, harvest index, biological yield and plant height, canopy temperature. Canopy temperature showed positive but non significant phenotypic correlations with grain yield per plant. These results were in agreement with those of Subhashchandra *et al*. (2007) for spike length and days to maturity and Inamullah *et al*. (2006) for tillers per plant and grains per spike and mondal *et al.* (1997) for test weight, Kumar *et al.* (1986) and Buller *et al*. (1985) for grain weight per spike and plant height. Similar findings were also found by Khan *et al.* (2010 a, b) and Zahid Akaram *et al.* (2008) reported that plant height was positively correlated with grain yield at genotypic level. The yield components exhibited varying trends of association among themselves. This indicates that improving these characters is positively associated with grain yield and these characters improve the grain yield.

Table 2 Genotypic co-efficient of correlation for different quantitative characters in bread wheat genotypes

Characters	Days to 50% flowering	Plant height	Grains / spike	Tillers/ plant	Spike length	Days to maturity	Grain filling period	Grain weight/ spike	Chlorophyll content	Canopy temperature depression	Test weight	Biological yield	Harvest index	Grain yield per plant
Days to 50% flowering	1.00	0.25**	-0.59**	-0.49**	-0.53**	0.52**	-0.63**	-0.49**	0.36**	0.25**	-0.19*	-0.29**	-0.44**	-0.53**
Plant height		1.00	0.33**	0.38**	0.42**	0.03**	0.30**	0.39**	0.30**	0.38**	0.32**	0.14	0.30**	0.33**
Grains/ spike			1.00	0.98**	0.96**	0.35**	0.99**	0.94**	-0.05	0.19*	0.72**	0.33**	0.99**	0.90**
Tillers/ plant				1.00	0.99**	0.44**	0.9664**	0.91**	0.07	0.28**	0.79**	0.31**	0.96**	0.80**
Spike length					1.00	0.41**	0.93**	0.94**	0.10	0.29**	0.83**	0.27**	1.00**	0.98**

Days to maturity						1.00	0.32**	0.36**	0.38**	0.48**	0.46**	0.02	0.50**	0.47**
Grain filling period							1.00	0.85**	-0.10	0.12	0.59**	0.38**	0.95**	0.96**
Grain weight/ spike								1.00	0.03	0.37**	0.88**	0.14	0.98**	0.99**
Chlorophyll content									1.00	0.41**	0.31**	-0.16	0.02	-0.03
Canopy temperature depression										1.00	0.54**	-0.11	0.30**	0.23**
Test weight											1.00	0.15	0.74**	0.75**
Biological yield												1.00	0.0056	0.39**
Harvest index													1.00	0.92**
Grain yield per plant														1.00

*** significant at 5% and 1% level of significance

Table 3 Phenotypic Co-efficient of Correlation for different quantitative characters in bread wheat genotypes

characters	Days to 50% flowering	Plant height	Grains/ spike	Tillers/ plant	Spike length	Days to maturity	Grain filling period	Grain weight/ spike	Chlorophyll content	Canopy temperature depression	Test weight	Biological yield	Harvest index	Grain yield per plant
Days to 50% flowering	1.00	-0.21*	-0.39**	-0.33**	-0.34**	0.43**	-0.43**	-0.35**	0.15	0.05	-0.15	-0.22**	-0.35**	-0.37**
Plant height		1.00	0.18*	0.23**	0.23**	-0.01	0.17*	0.22**	0.17*	0.21*	0.25**	0.08	0.27**	0.24**
Grains/ spike			1.00	0.94**	0.94**	0.54**	0.97**	0.90**	-0.06	-0.02	0.69**	0.64**	0.78**	0.91**
Tillers/ plant				1.00	0.97**	0.58**	0.94**	0.88**	-0.01	0.02	0.71**	0.65**	0.79**	0.93**
Spike length					1.00	0.56**	0.94**	0.89**	-0.05	0.009	0.73**	0.64**	0.79**	0.92**
Days to maturity						1.00	0.54**	0.52**	0.09	0.04	0.49**	0.38**	0.43**	0.51**
Grain filling period							1.00	0.88**	-0.08	-0.01	0.64**	0.65**	0.76**	0.90**
Grain weight/ spike								1.00	-0.006	0.03	0.73**	0.55**	0.77**	0.86**
Chlorophyll content									1.00	0.11	0.14	-0.07	-0.001	-0.03
Canopy temperature depression										1.00	0.15	-0.11	0.11	0.019
Test weight											1.00	0.32**	0.69**	0.68**
Biological yield												1.00	0.23**	0.68**
Harvest index													1.00	0.86**
Grain yield per plant														1.00

*,** significant at 5% and 1% level of significancez

References

[1] Ahmed, N., Chowdhry, M.A., Khaliq, I. and Maekawa, M., (2007) The inheritance of yield and yield components of five wheat hybrid population under drought conditions. Indonesian Journal Agriculture Science 53-59.

[2] Al-Jibouri, Miller, R.A. and Robinson, H.P. (1958). Genotypic and environmental variance and covariance in upland cotton crosses of inter-specific origin. Agronomy journal, 50:133.

[3] B. subhashchandra , H. C. lohithaswa , S. A. Desai, R. R. hanchinal, I. K. kalappanavar, K. K. math and P. M. salimath (2007). Assessment of genetic variability and relationship between genetic diversity and transgressive segregation in tetraploid wheat. Karnataka Journal of Agriculture Science, 22(1): 36-38

[4] Burton, F.W. and Devane E. H. (1952). Estimating heritability in tall fescues (Tevisia araundica) from replicated clonal natural materials. Agronomy Journal, 45: 171-181.

[5] Burton, G.W. (1952). Quantitative inheritance in grasses. Proc. IV Institute Grassland Congress. 1: 155-157.

[6] Degewione A., Takele Dejene and Mohammed Sharif (2013). Genetic variability and traits association in bread wheat (Triticum aestivum L.) genotypes. International Research Journal of Agricultural Sciences, 1(2): 19-29.

[7] Dewey, D. R. and Lu, K.H. (1959). A correlation and path coefficient analysis of components of crested wheat grass seed production. Agronomy Journal, 51: 515-518.

[8] Economic survey of india(2015), ministry of finance,Government of india http://indiabudget.nic.in/ES2015-16

[9] Hussain, A., Maqsood M., Ahmad A., Aftab S. and Ahmad, Z. (1998). Effect of irrigation during various development stages on yield, component of yield and harvest index of different wheat cultivars. Pakistan Journal of Agricultural Sciences, 34: 104–107.

[10] Inamullah, H., Ahmad, Muhammad F., Sirajuddin, Hassan G. and Gul, R. (2006). Diallel analysis of the inheritance pattern of agronomic traits of bread wheat. Pakistan Journal Botany, 38(4): 1169-1175.

[11] Johnson, H.W., Robison, H.F. and Comstock, R.E. (1955). Estimates of genetic and environmental variability in soybean. Agronomy Journal, 47: 314-318.

[12] Kaul, M.L.H. and Kumar, V., 1982. Variability in the rice. Genetic Agrarian, 36 : 257-268

[13] Khan, A. A., Iqbal, A., Awan F. S. and Khan I. A. (2010a). Genetic diversity in wheat germplasm collections from Balochistan province of Pakistan. Pakistan Journal of Botany, 42(1): 89-96.

[14] Khan, A. S., Sami U and Sadique S. (2010 b). Genetic variability and correlation among seedling traits of wheat (Triticum aestivum) under water stress. International Journal of Agriculture Biology, 12(2): 247- 250.

[15] Kumar D, Sharma S.C. and Gupta S.C. (1986). Correlation and path studies in wheat under normal and saline condition. Wheat Information Ser. 61/62: 64-67.

[16] Mahpara, S., Ali, Z. and Ahsan,M. (2008) Combining ability analysis for yield and yield related traits among wheat varieties and their Fi hybrids. International Journal of Agriculture Biology, 10: 599-604

[17] Panse, V.S. and Sukhatame, P.V. (1957) Statistical method for agricultural workers I.C.A.R. New Delhi.

[18] Razzaq, A., Zada K. and Shah, P. (1986). Effect of sowing dates and varieties on yield and yield components ofwheat in Peshawar valley. Sarhad Journal of Agriculture. 2: 29–40.

[19] Sattar, A., Cheema, M.A., Farooq, M., Wahid, M.A., Wahid A. and Babar, B.H. (2010). Evaluating the performance of wheat varieties under late sown conditions. International Journal of Agriculture and Biology, 12: 561–565

[20] Sharma S. 1996. Applied multivariate techniques, John Wiley and Sons, New York. 493.

[21] Singh, M. (2001). Sustainability of rice-wheat system in eastern Uttar Pradesh: An economic perspective. Ph. D. dissertation, Indian Agricultural Research Institute, New Delhi

[22] Singh, T. and Sharma, R. K. (2007). Genetic variability, character association and path analysis of yield and itscomponent characters in duram wheat. Prograssive Agriculture, 7(1/2): 15-18.

[23] Timmermans, B.G.H., Vos, J., Nieuwburg, J.V., Stomph, T.J., Putten P.E.L. and Molendijk, L.P.G. (2007). Field performance of Solanum sisymbriifolium, a trap crop for potato cyst nematodes. I. Dry matter accumulation in relation to sowing time, location, season and plant density. Annual of Appllied Biology, 150: 89–97

[24] Waqar-ul-haq, Malik, M.F., Rashid, M., Munir M. and Akram. Z. (2008). Evalution and estimation of heritability and genetic advancement for yield related attributes in wheat lines. Pakistan Journal of Botany, 40(4): 1699-1702.

[25] Zahid Akram, Saif U. A. and Muhammad Munir (2008). Estimation of correlation coefficient among some yield parameters of wheat under rainfed conditions. Pakistan Journal of Botany, 40(4): 1777-1781.

Publication History

Received	08th May 2017
Revised	26th May 2017
Accepted	09th June 2017
Online	30th June 2017