

Original Research Article

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Estimation of Genetic Variability, Heritability and Genetic Advance in Wheat (*Triticum* SP.)

Madhu Yadav*, Sita Ram Kumhar, Rupaldhoot and Govind Goyal

Department of Genetics and Plant Breeding, College of Agriculture,
Mandor, Jodhpur, Rajasthan, India

*Corresponding author

ABSTRACT

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Estimation of the genetic variability, heritability and genetic advance in the wheat genotypes (*Triticum* sp.) is most important in the plant breeding because, with the help of this study the plant breeder developed an improved variety of wheat. The present investigation has been carried out at Agricultural Research Station, Mandor, Jodhpur during *rabi* 2016-17 to evaluate thirty one genotypes of wheat to assess extent of genetic variability, heritability and genetic advance for grain yield and contributing character. The material was planted in randomized block design with three replications and observations were recorded on individual plant basis. Analysis of variance had shown highly significant variances among the genotypes for all the characters under study, indicated availability of wide spectrum of variability among the genotypes. The maximum percentage of coefficient of variation (GCV and PCV) were observed for number of tillers per plant followed by grain yield per plant, flag leaf area, harvest index, spike length, days to heading, plant height, 1000 grain weight, protein content and peduncle length. High heritability estimates were obtained for days to heading, harvest index, grain yield and number of tillers per plant. Expected genetic advance (GA) was observed to be high for number of tillers per plant, grain yield, harvest index, flag leaf area and days to heading.

Introduction

Wheat (*Triticum* sp.), a crop of poaceae family, is a major staple food crop of the world. Wheat is originally, the most cold and drought tolerant crop among the major cereals, but also sensitive to high temperature during day or night. Wheat is grown mainly in two seasons in the world viz., winter and spring. Winter wheat is grown in cold countries like- Europe, U.S.A., Australia, Russian Federation etc., while spring wheat is

grown in Asia and parts of U.S.A. Bread wheat (*Triticum aestivum* L.) is an allohexaploid ($2n = 6x = 42 = AABBDD$). Genome A assumed to be donated from *Triticum monococcum* (AA, $2n=14$) the source of cytoplasm and B genome is from *Aegilops speltoides* (unknown species of diploid wheat BB, $2n=14$). The D genome is donated by *Triticum tauschii* (DD, $2n=14$). A successful selection depends upon the information on the genetic variability and association of morpho-agronomic traits with

grain yield. The quantitative measurement of individual character provides the basis for an interpretation of analysis of variance. The available variability in a population can be partitioned into heritable and non-heritable components with the aid of genetic parameters such as genetic coefficient of variation, heritability and genetic advance. Heritability specifies the proportion of the genotypic variance to the total phenotypic variance. It is a good index for transmission of characters from parents to the offsprings (Falconer, 1960). Genetic advance is the difference between mean genotypic value of selected lines and mean genotypic value of parental population (original population before selection). Heritability and genetic advance are important selection parameters for improvement of specific traits or yield. The study of genetic advance is also important as it measures the genetic gain based on selection in a particular character. High genetic advancement coupled with high heritability estimates offer the most suitable condition for selection (Johnson *et al.*, 1955). Therefore, for any crop improvement programme through selection, the study of genetic variability and heritability together with genetic advance will be more useful.

Materials and Methods

The field experiment entitled “Estimation of Genetic Variability, Heritability and Genetic advance in Wheat (*Triticum* sp.)” was conducted during *Rabi* season of 2016-17 at Agricultural Research Station, Mandor-Jodhpur. In this experiment, 31 wheat cultivars *viz.*, WH1105, GW 11, GW 366, GDW 1255, PBW 644, WH 1080, HD 3043, JW 3269, MP 3288, MP 1201, MP 3336, DBW 71, DBW 88, DBW 90, DBW 107, DBW 110, Bilara selection, HD 2967, HD 2985, HD 2987, WHD 948, WH 1124, HD 3059, HD 3086, HD 3090, HD 3118, HI 8713, HI 8737, HI 1563, RAJ 4083 and RAJ

3765 were grown in randomized block design with three replications during *Rabi*, 2016-17 under irrigated conditions at experimental field of ARS mandor, Jodhpur. Each entry was grown in 30 m row spacing. Each genotype was planted in an experimental plot size of (4m×3m). The recommended package of practices will be adopted to raise a healthy crop. The observations were recorded on individual plant basis on ten randomly selected plants from each replication for 11 characters *viz.*, Days to heading, days to maturity, plant height (cm), number of tillers per plant, peduncle length (cm), spike length (cm), flag leaf area (cm²), grain yield per plant (g), harvest index (%), protein content (%) and 1000-grain weight (g) were recorded.

Statistical analysis

The overall mean values of different characters were subjected to statistical analysis according to the method as following:

Analysis of variance

Analysis of variance was done by subjecting the data to the statistical method on randomized block design (RBD) as described by Panse and Sukhatme (1978). The genotypic coefficient of variation (GCV) and phenotypic coefficient of variation (PCV) was calculated as per formula suggested by Burton (1952) and Johnson *et al.*, (1955).

Genotypic coefficient of variation: GCV (%) = $\frac{\sqrt{\sigma_g^2}}{\bar{X}} \times 100$

Phenotypic coefficient of variation: $PCV (\%) = \frac{\sqrt{\sigma_p^2}}{\bar{X}} \times 100$

Where, \bar{X} = General Mean, σ_g^2 and σ_p^2 = Genotypic and phenotypic variances, respectively.

Heritability (Broad sense): Heritability was estimated by the formula as suggested by

$$h^2 \% = \frac{\sigma_g^2}{\sigma_p^2} \times 100$$

Johnson *et al.*, (1955).

Genetic advance (G A): The expected genetic advance (GA) expressed in percentage of mean were calculated by using the method suggested by Johnson *et al.*, (1955)

$$G.A. = K.h^2b.\sigma_p$$

$$\text{Genetic advance as percent of mean} = \frac{GA}{\bar{X}} \times 100$$

K = Selection intensity (constant 2.06 at 5%),
 σ_p = Phenotypic standard deviation, h^2b = Heritability in broad sense, \bar{X} = General mean of the character concerned

Results and Discussion

The results of analysis of variance for eleven traits were carried out to partition the total variation into the variation due to genotypes and other sources. The analysis of variance revealed highly significant differences amongst the genotypes for all the traits studied. The analysis of variance for grain yield and its component traits is presented in Table 1. All eleven characters studied were showed significant mean sum of square due to genotype, *viz.*, days to heading, days to maturity, plant height, number of tillers per plant, peduncle length, spike length, flag leaf area, grain yield per plant, harvest index, protein content and 1000 grain weight.

It indicates that there was considerable variability present for these characters under study. Similar kind of results were also substantiated by Kumar and Mishra (2004), Chaitali and Bini (2007), Shankarrao *et al.*, (2010) and Maan and Yadav (2010) on yield and its component traits in wheat.

Mean performance of genotypes

The variation in different traits under study revealed the measure of free variability in the population of different genotypes which would reflect the unforeseen impact of potential variability on yield.

On the basis of mean performance the WH 1105 and MP 3336 were earliest in heading (50 days). The mean value of this character was 59 days and 26 genotypes were significantly varied from mean for days to heading and it ranged about 22 days. Days to maturity ranged from 114 to 121 days with general mean value of 117 days and about 16 genotypes significantly deviated from general mean.

The average grain yield per hectare ranged from 6.13 to 11.0 g per plant with general mean of 9.29 g. Maximum grain yield per plant was depicted by the genotype HI 8713 (11.0 g). The mean value of protein content was 13.2 with the range of 10.9 to 15.7% and 15 genotypes were significantly deviated toward higher side of mean. Maximum Protein content was observed for the genotype GDW 1255 (15.7%).

Estimation of variability, heritability and expected genetic advance

Moderate GCV (10.65) and PCV (10.82) were for days to heading although, high heritability (97.02%) along with high genetic advance (21.63%) were recorded for this character. (Singh *et al.*, 2014) Low heritability (58.02%) and low genetic advance (2.23%) along with low estimates of GCV (1.42) and PCV (1.86) were observed for days to maturity. The estimates of GCV (8.66) was on lower side of PCV (10.22) indicating considerable influence of environment on this character expression.

Table.1 Analysis of variance (ANOVA) for 11 characters in wheat genotype

Sources of variation	D.F	Mean sum of squares										
		Days to heading	Days to maturity	Plant height (cm)	Number of tillers per plant	Peduncle length (cm)	Spike length (cm)	Flag leaf area (cm ²)	Grain yield (g per plant)	Harvest index (%)	Protein content (%)	1000-grain weight (g)
Replication	2	2.78	0.98	19.69	0.73	5.76	0.44	2.57	0.018	0.98	1.005	0.49
Treatment	30	122.28*	10.41*	146.38*	4.60*	22.34*	1.92*	16.05*	0.56*	34.52*	3.53*	36.58*
Error	60	1.24	2.02	16.98	0.33	2.96	0.17	1.47	0.038	1.51	0.55	3.12

Table.2 Range of mean, PCV, GCV, Heritability (broad sense) and Genetic Advance in percent of mean for eleven characters in wheat

S. No.	Characters	Mean Range		PCV (%)	GCV (%)	Heritability (%) in broad sense	GA as percentage of mean
		Min.	Max.				
1	Days to heading	50	72	10.82	10.65	97.02	21.63
2	Days to maturity	114	121	1.86	1.42	58.02	2.23
3	Plant height (cm)	64.3	91.8	10.22	8.66	71.75	15.11
4	Number of tillers per plant	5.5	10.8	16.40	14.79	81.30	28.45
5	Peduncle length (cm)	28.3	41.9	8.89	7.36	68.55	12.55
6	Spike length (cm)	5.0	8.6	12.29	10.81	77.37	19.35
7	Flag leaf area (cm ²)	12.57	22.44	14.85	13.00	76.74	23.47
8	Grain yield (g per plant))	6.13	11.0	14.89	13.46	81.78	25.08
9	Harvest index (%)	19.8	33.5	13.09	12.27	87.92	23.70
10	Protein content (%)	10.9	15.7	9.45	7.57	64.06	12.48
11	Test weight (g)	35.8	50.3	8.81	7.79	78.12	14.18

It was further recorded that moderate GCV and PCV along with moderate estimates of genetic advance (15.11%) and heritability (71.75%) were studied for the character. GCV (14.79) and PCV (16.40) were moderate along with high heritability (81.30%) and high genetic advance (28.45%) for number of tillers per plant. Similar finding were also reported by Chandrashekhar and Kerketta (2004), Shankarrao *et al.*, (2010), Binod *et al.*, (2013) and Salahuddin *et al.*, (2016) (Table 2).

It was observed that moderate heritability (68.55%) and genetic advance (12.55%) along with low estimates of GCV (7.36) and PCV (8.89) were present for peduncle length. GCV and PCV were moderate for spike length. The estimates for GCV (10.81) was observed to be lower than PCV (12.29). Although, moderate heritability (77.37%) and genetic advance (19.35%) were recorded for this character. For 1000 grain weight GCV (7.79) and PCV (8.81) were along with moderate heritability (78.12%) and genetic advance (14.18%). The estimates of GCV(13.46) were on lower side of PCV (14.89) indicating considerable influence of environment on character expression. This was further recorded that moderate GCV and PCV along with moderate estimates of genetic advance (25.08%) and high heritability (81.78%) were observed for grain yield per plant. GCV and PCV were moderate for harvest index. The estimates for GCV (12.27) was observed to be lower than PCV (13.09). Although, high heritability (87.92%) and genetic advance (23.70%) were recorded for this character. It was observed that moderate heritability (64.06%) and genetic advance (12.48%) along with low estimates of GCV (7.57) and PCV (9.45) were present for protein content. The estimates of GCV (13.0) were on lower side of PCV (14.85) indicating considerable influence of environment on character expression. This was further recorded that moderate GCV and

PCV along with high estimates of genetic advance (25.08%) and moderate heritability (76.74%) for flag leaf area. Similar finding were reported by Khumkar *et al.*, (2001), Chandrashekhar and Kerketta (2004) and Meles *et al.*, (2017).

References

- Ali, Y., Atta, B. M., Akhter, J., Monneveux, P. and Lateef, Z. 2008. Association studies in wheat (*Triticum aestivum* L.) germplasm. *Pakistan Journal of Botany*, 40(5): 2087-2097.
- Binod K, Singh C M and Jaiswal K. 2013. Genetic variability, association and diversity studies in bread wheat. *The Bioscan*. 8(1): 143–7.
- Burton, G.W. 1952. Quantitative inheritance in grasses. Proceeding 6th International Grassland Congress; 1: 227-283.
- Chaitali, S. and Bini, T. 2007. Variability, character association and component analysis in wheat (*T. aestivum* L.). *Crop Research (Hisar)*. 34(1-3): 166-170.
- Chandrashekhar, Mahto and Kerketta, V. 2004. Estimation of some genetic parameters under normal and late sown conditions in wheat (*Triticum aestivum* L.). *Journal-of-Research, Birsa-Agricultural-University*. 16(1): 119-121.
- Falconer, D. S. 1960. The inheritance of liability to certain diseases, estimated from the incidence among relatives. *Annals of human genetic, London*. 29, 61.
- Johnson H. W., Robinson H. F. and Comstock R. L. 1955. Estimates of genetic and environmental variability in soyabean. *Agronomy Journal*. 47:314-318.
- Khumkar, M. S., Chaudhary, H. B. and Deshmukh, P. S. 2001. Genetic variability and association of morpho-physiological characters with grain yield in late sown wheat (*Triticum aestivum* L.). *Annals of Agricultural Research*.

- 22(2): 217-220.
- Kumar, A., Gaurav, S. S., bahuguna, D. K., Sharma, P., Singh, T. and Chand, P. 2017. Analysis of variability, heritability and genetic advance for yield and yield related traits in wheat (*Triticum aestivum* L.) genotype. *International Journal of Agriculture Science and Research*.7: 583-590.
- Kumar, P. and Mishra, Y. 2004. Genetic variability in wheat (*Triticum aestivum* L.). Biodiversity and sustainable utilization of biological resources. 16(18): 144-149.
- Kumar, P. and Shukla, R. S. 2002. Genetic analysis for yield and its attributed traits in bread wheat under varieties situation. JNKW. *Journal of Research*. 36(1-2): 95-97.
- Maan, R. K. and Yadav, A. K. 2010. Variability for quantitative characters in hexaploid wheat (*Triticum aestivum* L.). *Progressive Agriculture*. 10(2): 355-357.
- Meles, B., Mohammed, W. and Tsehaye, Y. 2017. Genetic variability correlation and path analysis of yield and grain quality traits in bread wheat (*Triticum aestivum* L.) genotype at Axum, Northern Ethiopia. *Journal of Plant Breeding and Crop Science*. 9(10), pp. 175-185.
- Panase, V. G. and Sukhatme, P. V. 1978. Statistical Methods for Agricultural Workers. I.C.A.R., New Delhi. 3rd Rev. Ed.
- Prasad, J., Kerketta, V., Prasad, K. D. and Verma, A. K. 2006. Study of genetic parameters under different environment conditions in wheat (*Triticum aestivum* L.). *Journal-of-Research,-Birsa-Agricultural-University*. 18(1): 135-140.
- Salahuddin, W., Suresh, B. G., Lavanya, G. R. 2016. Genetic variability, correlation and path analysis in wheat germplasm (*Triticum aestivum* L.). *International Journal of Multidisciplinary Research and Development*. 3(7): 24-27.
- Shankarrao, B. S., Mukherjee, S., Pal, A. K. and De, D. K. 2010. Estimation of variability for yield parameters in bread wheat (*Triticum aestivum* L.) grown in gangetic West Bengal. *Electronic Journal Plant Breeding*. 1(4): 764-768.
- Singh, J., Prasad, L. C., Madakemohekar, A. H. and Bornare S. S. 2014. Genetic variability and character association in diverse genotypes of barley (*Hordeum vulgare* L.). *Thebioscan*. 9(2): 759-761.

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