Website : www.asthafoundation.in
Frontiers in Crop Improvement
Vol 10 (1) : 29-31 (January-2022) Print ISSN : 2393-8234 Online ISSN : 2454-6011
Astha Foundation, Meerut (U.P.) India

Studies on Genetic Variability, Heritability and Genetic Advance for Grain Yield and Yield Attributing Traits in Bread Wheat (*Triticum aestivum* L. em. Thell.)

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Abstract

An investigation was carried out at Agriculture Research Farm, BRD (PG) College (Campus), Deoria during *Rabi* 2019-20 to assess the variability and heritability along with genetic advance in 25 indigenous and exotic germplasm lines of wheat with one check variety under Randomized Block Design. The observation was recorded for 14 biometric traits of wheat *viz.*, days to 50% flowering, flag leaf area, days to maturity, number of effective tillers per plant, plant height, peduncle length, spike length, number of spikelets per spike, number of grains per spike, grain yield per plant, yield per spike, biological yield per plant, 1000 grains weight and harvest index. The result of analysis of variance in respect of germplasm evaluation revealed that the mean squares due to genotype (treatment) were highly significant for all the fourteen characters under study. The high magnitude of PCV along with high GCV was observed for biological yield, number of productive tillers and flag leaf area, Grain yield per plant and grain yield per spike had high PCV in combination with moderate GCV while moderate estimates of both parameters were recorded for number of grains per plant and harvest index. High estimates of heritability (>80%) were observed for biological yield per plant (94.03), flag leaf area (93.80), peduncle length (92.04), grain yield per plant (90.69), number of productive tillers (89.68), plant height (88.26), number of grain per spike (85.49), harvest index (83.16) and number of spikelets per spike (82.76) while high estimates of genetic advance in percent over mean was found for flag leaf area (33.58), biological yield (33.38), number of productive tillers (31.96), grain yield per plant (29.37) and harvest index (25.47).

Key words : *bread wheat, variability, heritability, GCV, PCV, genetic advance.*

Introduction

Wheat (*Triticum aestivum* L. em. Thell., 2n=42) is the most important staple food crop in the world, and emerged as the backbone of India's food security. It is grown all over the world for its wider adaptability and high nutritive value. It is an important winter cereal contributing about 38% of the total food grain production in India. Total food grain production is estimated to rise 3.74% to a new record 308.65 MT for 2020-21 crop year, higher than 297.5 MT last year. In addition, India is set to harvest a record wheat production of 108.75 MT in the 2020-21 crop year on the back of food grains, according to latest government of India. Wheat production is rising year-on-year and the previous record of 103.60 MT was achieved during the 2020-21 crop year (1).

Wheat is a self-pollinated C3 plant with cleistogamous condition. "The wheat is most successfully grown between the latitudes of 30° to 60°N and 27 to 40°S" (2), but beyond these limits it also be grown from arctic to high elevated equators. The optimum temperature for best growth and yield is 25°C with minimum 20°C and maximum 35°C growth temperatures.

Grain yield is a complex polygenic character with great genetic, physicmorphological, ecological and Pathological dependence. The hereditary potential of a cultivar/genotype depends upon stability and yielding. Genetically, yield contributing attributes i.e., yield components, (productive tiller, number of grains, 1000 grain weight etc.), there genetic nature and magnitude of association are responsible for realization of yield potential influenced by changing seraphic, agroclimatic condition (3).

Existence of large genetic variability is a prime pre-requisite for any breeding programme aimed at forming new varieties with high yield potential and yield stability. For genetic manipulation of grain yield as well as quality in cereals, there is need to examine the nature of genetic variability for the quality components and yield related attributes. Heritability offers an index of the transmissibility to quantify the genetic relationship of a trait in the population, is high it should be fairly easy to improve that trait. Genetic advance estimates give an idea of improvement in the mean performance of the selected clusters over the base populations in an experiment.

Materials and Methods

Field location : The field experiment under present investigation was conducted during *Rabi* 2019-20 at

Received : October-2021; Revised : Octoer-2021; Accepted : November-2021

Table-1 : Analysis of variance of randomized block design for 14 characters of wheat genotypes.

Source of variation	DF	Plant height (cm)	days of 50% flowering	days of maturity	Flag leaf area (cm^2)	Peduncle length (cm)	Spike length / plant (cm)	No. of productive tiller
Replication	2	1.59	14.44	0.25	0.71	0.99	0.22	0.09
Treatment	24	107.23**	40.13**	10.31**	125.21**	77.27**	2.94**	2.70**
Error	48	4.55	4.83	1.02	2.70	2.17	0.26	0.10

Table-1 : Contd.....

Source of variation	DF	Grain no. per spike	Grain weight (g)	Spikelets	Test weight (g)	Grain yield (g/plant)	Biological yield (g/plant)	Harvest index (%)
Replication	2	7.09	0.07	1.50	1.26	1.19	3.15	9.27
Treatment	24	158.25*	0.33**	8.75**	17.23**	9.52**	77.59**	91.23**
Error	48	8.47	0.03	0.57	1.36	0.32	1.61	5.77

*,** significant at 5% and 1% level, respectively.

Table-2 : Range, mean, genotypic and phenotypic coefficient variation, heritability and genetic advance in percent over mean for 14 characters of wheat genotypes.

Genotypes	Range			Variance				
	Mean	Min	Max	Heritability (%)	GA	GA% mean	GCV (%)	PCV (%)
Plant height (cm)	96.22	88.03	109.9	88.26	11.32	11.77	6.08	6.47
days of 50% flowering	77.76	70.67	85.00	70.90	5.95	7.65	4.41	5.24
days of maturity	125.8	123.3	131.3	75.27	3.14	2.50	1.40	1.61
Flag leaf area (cm^2)	37.96	25.53	49.05	93.80	12.75	33.58	16.83	17.38
Peduncle length (cm)	48.46	42.60	66.50	92.04	9.89	20.40	10.32	10.76
Spike length / plant	11.99	10.37	14.08	77.65	1.72	14.33	7.89	8.96
No. of productive tiller	5.68	3.97	7.67	89.68	1.81	31.96	16.38	17.30
Grain no. per spike	58.40	45.80	69.70	85.49	13.46	23.05	12.10	13.09
Grain weight (g)	2.31	1.73	3.20	77.42	0.58	24.94	13.76	15.64
Spikelets	20.23	16.88	23.13	82.76	3.10	15.30	8.17	8.98
1000 grain weight (g)	38.62	33.10	42.33	79.50	4.22	10.94	5.95	6.68
Grain yield (g/plant)	11.70	9.00	16.07	90.69	3.44	29.37	14.97	15.72
Biological yield (g/plant)	30.12	21.87	45.03	94.03	10.05	33.38	16.71	17.23
Harvest index (%)	39.37	28.87	48.60	83.16	10.03	25.47	13.56	14.87

Agriculture Research farm of Baba Raghav Das Post Graduate College, Deoria (U.P.). Geographically, the College is located in the east part of Uttar Pradesh, India. The site of experiment is located at 26.5°N latitude, 83.79°E longitude and 68 meter (223 feet) above the mean sea level. The climate of district Deoria is semi-arid with hot summer and cold winter nearly 80% of total rain fall is received during the monsoon (only up to September) with a few showers in the winter.

Experimental details : The experiment was conducted to evaluate 25 wheat germplasm lines and one check (i.e., PBW-343) in normal soil under irrigated conditions following Randomized Block Design in three replications. Each variety consisted of three rows of 2.5 m length with spacing of 5 cm between plant to plant and 22.5 cm between row to row. All other recommended cultural practices were followed to raise good crops.

Generation of data : Observations on 5 randomly selected competitive plants from each of the advanced lines in each of the replication were recorded for 14 metric traits namely, days to 50% flowering, days to maturity, plant height (cm), number of effective tillers per plant (tillering), length of spike (cm), number of spikelets per spike, number of grains per spike, weight of 1000 grains (g), grain yield per plant (g), flag leaf area per plant (cm^2), peduncle length per plant (cm), grain yield per spike (g), biological yield per plant (g) and harvest index (%). The mean data after computing for each character was subjected to standard method of analysis of variance following (4), genotypic coefficient of variation (GCV) and phenotypic coefficient of variation (PCV) were estimated by the formula as suggested by Burton, 1952, heritability in broad sense (h^2) was estimated by the formula as suggested by (5) and genetic advance and genetic advance as per cent of mean by following (6).

Results and Discussion

The result of analysis of variance for Randomized complete design in respect of germplasm evaluation

experiment have been presented in Table-1. The mean squares due to genotype (treatment) were highly significant for all the characters while the variances due to replications were non-significant for all the fourteen traits under study.

The general mean, range, GCV, PCV, heritability and genetic advance in percent over mean for all the traits under studies are given in the Table-2. The magnitude of phenotypic coefficient of variation (PCV) was higher than the genotypic coefficient of variation (GCV) for all the characters. The high magnitude (>15%) of PCV along with high GCV was observed for biological yield (16.71), number of productive tillers (16.38) and flag leaf area (16.83), while grain yield per plant () and grain yield per spike had high PCV in combination with moderate GCV while moderate estimates of both parameters were recorded for number of grains per plant and harvest index. Moderate PCV with low GCV was exhibited by peduncle length whereas plant height, days to 50% flowering, days to maturity, number of spikelets, test weight and spike length showed low values for GCV as well as PCV. Such types of results for most of the characters under study were also noticed by (7, 8).

Heritability and genetic advance are important selection parameters. Heritability estimate along with genetic advance are normally more helpful in predicting the gain under selection than heritability estimates alone. The estimate of heritability can be utilized for the prediction of genetic gain, which indicates the genetic improvement that would result from the selection n of best individual. High estimates of heritability (>80%) were observed for biological yield per plant (94.03), flag leaf area (93.80), peduncle length (92.04), grain yield per plant (90.69), number of productive tillers (89.68), plant height (88.26), number of grain per spike (85.49), harvest index (83.16) and number of spikelets per spike (82.76) Moderate heritability (60-80%) was recorded for test weight (79.50), spike length per plant (77.65), grain yield per spike (77.42), days of maturity (75.27) and days of 50% flowering (70.90) indicating that a plant breeder can concentrate on these traits to exploit effective selection for genetic improvement. Most of the results are in agreement with the earlier reports of (9, 10).

Genetic advance is the improvement in the mean genotypic value of selected individual over the parental population. High heritability accompanied with high genetic advance indicates that the heritability is due to additive genetic effect and selection may be effective, while high heritability coupled with low genetic advance indicates the predominance of non-additive gene action, while low heritability is exhibited due to influence of environmental interactions rather than genotypic selection for such characters may not be rewarding.High estimates of genetic advance in percent over mean was found for flag leaf area (33.58), biological yield (33.38), number of productive tillers (31.96), grain yield per plant (29.37), harvest index (25.47) and the moderate genetic advance in per cent over mean were evaluated for grain yield per spike (24.94) and number of grains per spike (23.05). Rest of the characters showed low genetic advance in per cent over mean. Similar results were also observed by (10, 11). The estimates of broad sense heritability (h^2) and genetic advance in percent over mean (GA) for different characters are given in Table-2.

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