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Original Research Article

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

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A B S T R A C T

The field experiment under present investigation was conducted at Agriculture Research Farm of B.R.D. Post Graduate College (Campus), Deoria (U.P.) during *rabi* 2014-15 in normal soil, timely sown and irrigated conditions. Total 81 genotypes excluding 3 checks were evaluated for 14 quantitative traits under Augmented Block Design. Genetic variability, heritability and genetic advance were studied in 81 genotypes of bread Wheat (*Triticum aestivum* L. em. Thell) in Uttar Pradesh to estimate variability parameters for high yield and their attributing traits in 81 germplasm lines of wheat. The highest heritability per cent in broad sense 0.9890 was recorded for days to maturity followed by biological yield per plant (g) (0.8316). The highest genetic advance 7.461 was evaluated for harvest index (%) followed by biological yield per plant (g) (7.0720).The highest genetic advance as per cent over mean was recorded for biological yield per plant (g) (58.6302) followed by grain yield per plant (g) (56.0032). The results indicate that these traits were governed by additive with epistatic effects for the phenotypic expression of the characters. It indicates that these traits were governed by additive genetic effect which is fixable type and consequently desirable selection will reward for improvement for these traits.

Keywords

Genetic advance, Heritability, Variability, Germplasm, Yield, Bread wheat

Introduction

Wheat (*Triticum aestivum* L. em Thell, 2n=42) is the most important staple food crop in the world. It is currently grown on approximately 225 mha Area globally, with an average productivity of 3 t/ha. It exhibits considerable variation between different agro-ecological zones (Singh *et al.*, 2008). It supplies about 25% of protein and 20% of the calories consumed by human beings from the daily diet. According to FAOSTAT, India is the second largest wheat producer in the world after China. Total food grain production is pegged at a record 291.95 MT for 2019-20 crop year, higher than 285.21MT last year. In addition, India is set to harvest a record wheat production of 106.21 MT in the 2019-20 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 2018-19 crop year (Source: m.economicstimes.com, April, 2020).

Wheat (*Triticum aestivum* L.); a self-pollinating annual plant in the true grass

family *Gramineae* (Poaceae) and genus *Triticum*, is the world's most famous energy rich cereal crop. It has been described as the "*King of the cereals*" because of the acreage it occupies, high productivity and the prominent position it holds in the international food grain trade. It is a C_3 plant grown from temperate , irrigated to dry, high rain fall areas and from warm, humid to dry, cold environments. Undoubtedly, this wide adaptation has been possible due to the complex nature of the plants genome which provides great plasticity to the crop.

Materials and Methods

The field experiment under present investigation was conducted during *Rabi* 2014-15 at Agriculture Research form of B.R.D.P.G College (Campus), Deoria UP). Geographically, Baba Raghav Das Post Graduate College, Deoria is located in the east part of up India. The site of experiment is located at 26.5°N latitude, 83.79°E longitude and 68 meter (223feet) above the 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 show in the winter. The experimental materials of studies comprised of 81 wheat genotypes form exotic and indigenous with 3 check varieties. These genotypes were procured from Genetic stock available in wheat section, Department of Genetics and Plant Breeding, I.A.Sc., B.H.U., Varanasi (UP) India. The experiment was conducted to evaluate 81 wheat germplasm lines in normal soil under timely soon and irrigated conditions following augmented block design the entire experiment field was divided in 9 blocks of equal size and each the 3 checks, namely, PUSHA-2733, PBW-154 and PBW-502 were randomly allocated each block. The remaining a plots of a block were used for accommodating the test genotypes which were not replicated. A test genotype was present only one block while the three checks were replicated in all the 9 blocks. Each plot consisted of two rows 2.5 meters length with spacing of five cm in the row and 23 cm between the rows. Recommended cultural practices were followed to raise good crops. The data on days to 50% flowering, days to maturity, number of effective tillers per plant, flag leaf area, plant height, spike length, number of spikelets per spike, peduncle length, biological yield per plant, grain yield per spike, number of grains per spike, grain yield per plant, 1000 grains weight and harvest index were recorded to estimate genetic variability parameters. Genetic variability was measured and subjected to statistical analysis as: Analysis of variance, Heritability (Broad sense), Genetic advance and Genetic advance as per cent over mean; suggested by (1, 2 and 3) respectively.

Results and Discussions

Availability of variability is the most important characteristic feature of any population. Estimation of genetic variability is an important prerequisite for realizing response to selection, as the progress in breeding depends upon its amount, nature and magnitude. The analysis of variance revealed that the variance due to blocks was highly significant for the characters days to 50% flowering (23.564), flag leaf area (cm^2) (42.525), plant height (cm) (85.978), days to maturity (10.190), biological yield/Plant (g) (80.278), grain yield/plant (g) (9.016) and grain yield/Spike (g) (0.535).

The variance due to checks was significant for most of the characters except no. of effective fillers/plants (3.029) and harvest index (2.579); which were non-significant at given probability level (Table 1).

The character days to maturity (118.925-128.925) showed highest range, while the minimum range was observed in case of 1000 Grains Weight (g) (3.226-5.786). The other parameters with high range of variation were days to 50% flowering (71.00-95.80), plant height (54.951-97.885) and harvest index (24.22-84.692). Hence, a breeder can concentrate more of these traits which can provide him ample scope for selection (Table 2).

The highest variance due to genotypes with highest variance due to phenotypes was observed for harvest index i.e. 35.74 and 97.41 respectively followed by plant height (20.36 and 37.69 respectively). Phenotypic and genotypic variance and phenotypic and genotypic coefficient of variation were computed for 14 characters. The phenotypic and genotypic variances are influenced by unit of measurement of different traits. Therefore, these parameters were made unit free by estimating phenotypic coefficient of variation (PCV) and genotypic coefficient of variation (GCV). Relatively the higher values of GCV were recorded for Biological Yield/ plant (g) (31.21) followed by Grain yield/ Plant (g) (29.83) while higher values of PCV were noticed for Biological Yield/ plant (g) (34.22), Grain yield/ Plant (g) (32.74), Productive Tillers/ Plant (22.78) and harvest index (%) (22.04) (Table 2).

Table.1 Analysis of variance of augmented block design for 14 characters of wheat germplasm

S.N	Character	Source of variation		
		Blocks	Checks	Error
		d. f (8)	d. f (2)	d. f (16)
1.	Days to 50% flowering	23.564**	157.000***	4.750
2.	Flag leaf area (cm^2)	42.525*	512.275***	14.114
3.	Plant height (cm)	85.978**	1926.766***	17.331
4.	Days to maturity	10.190***	88.481***	0.064
5.	Spike length (cm)	3.392	109.917***	3.882
6.	No. of spikelet's per spike	5.945	101.503***	3.588
7.	No. of effective fillers/Plants	1.388	3.029	1.014
8.	Peduncle length	33.381	1336.459***	28.291
9.	Grains/Spike	156.341	545.024**	66.547
10.	1000 Grain weight (g)	0.516	9.023**	1.399
11.	Biological yield/Plant (g)	80.278***	121.428***	2.871
12.	Grain yield/Plant (g)	9.016***	21.908***	0.497
13.	Grain yield/Spike (g)	0.535**	5.162***	0.110
14.	Harvest Index (%)	134.450	2.579	61.668

**Significant at 5% Probability level, *Sign at1% Probability level.

Table.2 Estimates of Heritability and Genetic Advance in 81 germplasm lines of wheat

Characters	Range			Variance						
	Min.	Max.	Mean	$\sigma^2 g$	$\sigma^2 p$	GCV	PCV	h^2 (BS) (%)	GA (%)	GAM
Days to 50% Flowering	71.000	95.800	83.109	14.25	19.00	4.53	5.23	0.7501	6.7357	8.0946
Plant Height (cm)	54.951	97.885	80.418	20.36	37.69	5.60	7.63	0.5402	6.2320	8.4917
Peduncle Length (cm)	36.931	63.065	46.144	-6.60	21.68	-5.56	10.09	-0.3046	-2.9218	-6.3307
Flag Leaf Area (cm^2)	18.941	51.361	30.360	17.59	31.70	13.92	18.69	0.5549	6.4363	21.3651
Ear Length (cm)	6.197	15.237	10.275	-2.07	1.80	-14.08	13.10	-1.1540	-3.1912	-31.1626
Productive Tillers/ Plant	2.314	9.114	4.814	0.19	1.20	9.13	22.78	0.1607	0.3638	7.5431
Spikelet's/ Spike	11.411	23.033	18.076	-0.11	3.46	-1.90	10.32	-0.0340	-0.1303	-0.7224
Days to Maturity	118.925	128.925	123.21	5.77	5.83	1.95	1.96	0.9890	4.9230	3.9960
Biological Yield/ plant (g)	4.592	29.992	12.142	14.17	17.04	31.21	34.22	0.8316	7.0720	58.6302
Yield/ Spike (g)	1.534	3.7044	2.312	0.05	0.16	9.78	17.47	0.3133	0.2584	11.2813
No of Grains/ Spike	23.207	64.807	46.255	1.76	68.31	2.88	17.90	0.0259	0.4407	0.9546
Grain yield/ Plant (g)	2.433	13.466	5.251	2.43	2.92	29.83	32.74	0.8304	2.9266	56.0032
1000 Grains Weight (g)	3.226	5.786	4.358	-1.06	0.33	-23.73	13.27	-3.197	-3.802	-87.437
Harvest Index %	24.22	84.692	44.550	35.74	97.41	13.35	22.04	0.367	7.461	16.666

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 of best individual. High estimates of heritability were observed for days to maturity (0.9890), Biological Yield/ plant (g) (0.8316), Grain yield/ Plant (g) (0.8304) and Days to 50% flowering (0.7501). Rest of the characters showed very low to low heritability.

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 recorded for the trait Biological Yield/ plant (g) (58.6302) followed by Grain yield/ Plant (g) (56.0032). Remaining traits showed low to moderate genetic advance in per cent of mean (Table 2).

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