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Morphological and Agronomical Characterization in Bread Wheat (*Triticum aestivum* L.) Germplasm and Combined Study of Heritability, Genetic Variance, Genetic Advances and Association of Characters

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Authors' contributions

This work was carried out in collaboration among all authors. All authors read and approved the final manuscript.

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ABSTRACT

The present experiment was carried out during *Rabi* 2021-2022 at Crop Research Centre of Sardar Vallabhbhai Patel University of Agriculture & Technology, Meerut-250110 (U.P.). The material used in the present study comprised 103 germplasm accessions of Wheat (*Triticum aestivum* L.) having variability for various agronomic and morphological characters were obtained from the available germplasm in the Department of Genetics & Plant Breeding, SVPUA&T, Meerut. The number of genotypes are 103 including four check (DBW-71, DBW-222, DBW-173, HD-3226), the Plot size is10 row 2.5m length spaced at 0.25m and the date of sowing is 20 December, 2021 on Augmented experimental design. Twelve observations were recorded. In each plot, five plants from each genotype were arbitrarily selected and tagged to record the observations studied characteristics except days to 50 % flowering and days to maturity they were recorded on plot basis. The highest value of biological yield per plant was estimated in CSW-18 (45.16g), DBW-621 (51.45%) recorded a high value of harvest index and the maximum grain yield is from CSW-18 (15.94) g. High heritability coupled with high genetic advance observed for gluten content, grain yield per plant, biological yield per plant, harvest index and number of productive tillers per plant.

Keywords: Bread wheat; Heritability; Genetic advance; GCV; PCV etc.

1. INTRODUCTION

Wheat (*Triticum aestivum* L. 2n=6X=42) belongs to the Poaceae (Gramineae) family originally from the Near East and Ethiopian Highlands, but is now cultivated worldwide. The three species of wheat namely, *Triticum aestivum* (bread wheat), *Triticum durum* (macaroni wheat) and *Triticum dicoccum* (Emmer or Khapli wheat) are grown on a commercial basis in the Indian subcontinent. The pioneering cytogenetic studies of Sax, Kihara and including Riley (1965) and Sears (1944) have shown that the various species of Triticum form a polyploidy series (x=7) consisting of three different ploidy levels i.e. diploids (2x=2n=14), tetraploid (4x=2n=28) and hexaploid (6x=2n=42).

The evolutionary history of wheat has been most extensively investigated. Hexaploid wheat has three genomes, namely A, B, and D. The genome B is longest and the genome D is smallest. According to the current view, the source of B genome is unknown or possibly extinct species, while that of D and A genomes are from T. *tauschii* and T. *urartu* respectively. Morphologically, the wheat plant has a rhizomatous morphology, showing a relationship to the grass family, and the shoot bears several tiller-like leafy culms. The inflorescence, often known as the "ear" or "head," is an upward spike with florets (spikelets) placed on either side of a flat rachis. Each individual spikelet is a compressed reproductive stem made up of two sterile bracts (glumes) that each contain 3-5 florets. The lemma and the pale, two bract-like components that make up the florets and contain its reproductive organs. The wheat grain is an ovoid-shaped fruit called a caryopsis that has a crease that runs from end to end on the ventral side and the embryo at the base of the dorsal side. At the peak of the grain, there is a tuft of hair (brush). India wheat production has touched the landmark year in achieving the production of 107.59 million tonnes from 29.55 million hectares (13.43% of global area) of wheat and registering an all-time highest crop productivity of 3508 kg/ha [1]. 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. It is the second most important cereal staple food crop consumed nearly 35% of world population and provides 20% food calories. India is the second largest wheat growing country of the world after the China [2].

2. MATERIALS AND METHODS

The present experiment was carried out during *Rabi* 2021-2022 at Crop Research Centre of Sardar Vallabhbhai Patel University of Agriculture & Technology, Meerut-250110 (U.P.). Geographically, Meerut is situated at 29° 01 latitudes in the North and 77° 45 longitudes east and at altitude of 237m above MSL, representing the North Western Plain Zone (NWPZ). The soil of experimental field is fertile and sandy loam. The material used in present study comprised 103 germplasm accessions of Wheat (*Triticum aestivum* L.) having variability for various

agronomic and morphological characters were obtained from the available germplasm in the Department of Genetics & Plant Breeding, SVPUA&T, Meerut. Number of genotypes are 103 including four check (DBW-71, DBW-222, DBW-173, HD-3226), Plot size is10 row 2.5m length spaced at 0.25m and Date of sowing 20 December,2021 on Augumented experimental design. Twelve observation were recorded. In each plot, five plants from each genotype were arbitrarily selected and tagged to record the observations studied characteristics except days to 50 % flowering and days to maturity they were recorded on plot basis.

3. RESULTS AND DISCUSSION

Analysis of variance for augmented design was estimated for twelve characters to test the significance of differences among various genotypes, checks varieties and due to blocks is presented in Table 1. The variation due to genotypes was extremely significant for all characters under studies. The significant variation was recorded among the genotypes along with check varieties for the days to 50 % flowering, days to maturity, plant height, number of productive tillers per plant, spike length, total number of spikelets per spike, number of grains per spike, gluten content%, harvest index, biological yield per plant and grain yield/plant, remaining are significant. Variation due to blocks was significant for days to 50 % flowering, days to maturity, plant height, number of productive tillers per plant, number of grains per spike, total number of spikelets per spike, 1000 seed weight, harvest index, biological yield per plant and grain yield per plant except gluten content showed non-significant. Kumar et al. [3] Kumar and Mishra [4] and Lal et al. [5] observed wide range of variation for plant height, number of grains per spike and days to maturity.

3.1 Phenotypic Coefficient of Variance and Genotypic Coefficient of Variance

Days to 50% flowering (3.05), days to maturity (2.89), plant height (3.64),1000 seed weight (3.98) shown low phenotypic coefficient of variance (PCV) and number of productive per plant (10.15), gluten content (11.37), spike length (8.36), biological yield per plant (8.01), harvest index (9.23), total number spikelets per spike (7.21) revealed a moderate phenotypic coefficient of variance while grain yield per plant (12.32) shown highest phenotypic coefficient of variance .

The genotypic coefficient of variance (GCV) was low for the character days to 50% flowering (1.01), days to maturity (1.31), 1000 seed weight (1.62) , plant height (2.38), total number of spikelets per spike(2.69), spike length(3.11), number of grain per spike(3.04), and biological yield per plant (4.79) whereas, number of productive tiller per plant (5.62),gluten content (5.83),harvest index (7.71) While the grain yield per plant (10.36) revealed a high genotypic coefficients of variance. In the present study the phenotypic and genotypic coefficient of variation was found to be high for gluten content % and grain yield per plant. Similar observation was also reported by Kalimullah *et al.,* [6] Ranjana *et al*., [7] Dutamo et al., [8] Arya et al., [9] Kumar et al., [2] and Prasad et al., [10]. Moderate GCV and PCV were observed in biological yield per plant, harvest index, number of productive tillers per plant. Low GCV and PCV were obtained for total number of spikelets per spikes, plant height, spike length, number of grains per spikes, days to maturity, 1000 seeds weight, and days of 50% flowering.

3.2 Heritability (%)

The estimation of heritability in broad sense were estimated and laid out in Table 3 Heritability in broad sense were observed for all the characters low (<60%), Medium (60-80%) and High (>80%). In this investigation the heritability (%) in broad sense for twelve characters studied, which range from (10.69) to (69.73). Grain yield per plant (50.44), harvest index (69.73) exhibit high heritability while plant height (42.77), biological yield per plant (35.68), number of productive tiller per plant (30.66), days to maturity (20.60) and number of grain per spike (20.54) showed moderate heritability whereas days to 50% flowering (10.97), spike length (13.81), total number of spikelets per spike(13.96),1000 seed weight (16.49),gluten content (18.98) showed lowest heritability. The effective improvement in a particular trait for which the selection is undertaken will be based on quantum of genetic advance. high heritability was shown by gluten content, grain yield per plant, biological yield per plant, harvest index, number of productive tillers per plants, plant height, days to maturity, total number of spikelets per spikes, 1000 seeds weight, spike length, days of 50% flowering. High heritability values for these traits indicate that variation was mainly under genetic control and

Table 1. Analysis of variance (ANOVA) for twelve characters of 103 genotypes in Bread wheat (*Triticum aestivum*.L)

Source of variation	DF	Days of 50% flowering	Days to maturity	Plant Height (cm)	Number of Productive Tillers/ plant	Spike Length (cm)	Total number of spikelets/ spike	No of grains/ spike	1000 Seed weight (g)	Gluten content %	Harvest index %	Biological Yield/ Plant (g)	Grain yield/ Plant (g)
Block	9	46.93**	49.38**	186.05**	6.17**	2.86**	10.81**	46.97**	18.53**	1.21	57.75**	48.85**	6.78**
GENOTYPES	102	13.78**	39.19**	49.64**	3.12**	1.29**	3.96**	24.68**	7.23**	3.05**	66.74**	30.03**	2.93**
CHECKS	3	30.60**	113.63**	13.46**	6.04**	2.96**	8.42**	48.64**	4.79*	2.80**	29.03**	29.93**	6.92**
TEST ENTRY	98	17.14**	39.15**	64.58**	3.43**	1.12**	3.78**	18.02**	7.36**	3.12**	36.48**	31.99**	3.29**
ERROR	27	6.17	10.90	5.86	0.57	0.50	1.51	5.35	2.43	0.91	2.78	4.59	1.63
Total	138	14.45	34.32	49.97	2.82	1.24	3.92	22.35	7.03	2.51	53.64	26.28	2.93

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

Table 2. Mean performance for twelve characters of 103 genotypes in Bread wheat (*Triticum aestivum*.L)

S. No	Genotypes	Days of 50% flowering	Days to maturity	Plant Height (cm)	No of Productive Tillers/ plant	Spike Length (cm)	Total number of spikelets/ spike	No of grains/ spike	1000 Seed weight (g)	Gluten content %	Harvest index %	Biological Yield/ Plant (g)	Grain yield/Plant (g)
1	C-306	90.00	135.00	110.67	7.52	9.17	19.67	44.50	46.50	9.30	30.97	40.10	12.42
2	WR-544	92.00	120.00	95.33	8.32	10.23	18.50	42.62	47.60	10.37	31.49	37.47	11.80
3	CBW-38	90.00	125.00	93.33	8.74	8.57	17.67	43.50	39.80	9.72	33.07	32.17	10.64
4	DT-46	91.00	130.00	94.32	10.54	9.00	21.52	50.10	45.50	9.51	32.72	42.17	13.80
5	K-1504	85.00	124.00	95.20	8.67	9.00	19.67	47.21	39.30	10.32	31.91	29.93	9.55
6	KUNDAN	87.00	127.00	99.33	8.33	9.70	21.67	43.24	37.20	10.12	21.76	38.70	8.42
7	WL-711	88.00	120.00	101.33	10.33	8.90	18.33	45.33	38.40	4.84	28.17	38.20	10.76
8	CSW-18	83.00	125.00	96.33	11.42	10.00	22.50	54.50	40.80	6.49	35.30	45.16	15.94
9	HI-8498	82.00	127.00	100.67	9.26	11.83	19.67	45.32	42.60	5.57	30.77	37.51	11.54
10	HI-1563	85.00	135.00	85.33	11.66	9.50	22.50	51.62	44.54	5.82	29.74	44.15	13.13
11	HI-1544	82.00	130.00	107.22	7.12	8.07	17.33	44.33	44.70	4.85	28.57	25.27	7.22
12	HI-1531	81.00	126.00	99.78	8.33	6.93	17.33	47.32	42.80	6.60	36.59	29.24	10.70
13	HI-1500	80.00	128.00	78.98	10.24	10.00	20.00	42.32	41.40	10.09	26.76	34.57	9.25

S. No	Genotypes	Days of 50% flowering	Days to maturity	Plant Height (cm)	No of Productive Tillers/ plant	Spike Length (cm)	Total number of spikelets/ spike	No of grains/ spike	1000 Seed weight (g)	Gluten content %	Harvest index %	Biological Yield/ Plant (g)	Grain yield/Plant (g)
14	HI-588	89.00	130.00	85.33	9.67	10.40	14.67	38.90	49.65	4.70	35.98	23.54	8.47
15	HS-590	85.00	127.00	92.67	11.51	8.67	21.50	52.51	45.40	9.73	32.26	41.41	13.36
16	HS-487	83.00	130.00	98.98	10.49	9.83	19.00	45.32	41.40	8.87	34.41	33.51	11.53
17	HS-485	84.00	137.00	96.67	10.33	11.33	17.67	48.76	44.60	9.10	41.03	24.42	10.02
18	HS-490	85.00	129.00	78.33	6.65	7.17	16.00	40.50	43.40	10.50	25.27	28.14	7.11
19	PBW-746	90.00	135.00	90.67	7.67	10.33	17.67	41.50	39.80	4.24	25.75	31.50	8.11
20	HD3136	89.00	131.00	90.61	8.89	10.11	16.89	39.50	40.65	7.79	27.59	32.22	8.89
21	HD-3171	88.00	121.00	86.67	7.33	10.33	17.00	44.50	45.90	8.76	24.91	35.45	8.83
22	PBW-745	80.00	121.00	85.65	9.45	7.83	20.50	46.33	40.20	4.37	33.44	38.40	12.84
23	PBW-744	84.00	119.00	82.33	7.67	9.33	18.67	38.65	40.90	9.38	37.66	26.21	9.87
24	PBW-730	81.00	120.00	81.33	11.33	8.33	16.67	43.68	42.40	10.38	33.15	30.50	10.11
25	DBW-14	82.00	130.00	84.54	10.61	9.07	20.00	45.23	36.50	6.46	34.73	39.10	13.58
26	DBW-16	83.00	124.00	74.33	11.41	8.50	16.00	42.43	38.40	9.25	34.52	32.50	11.22
27	DBW-18	81.00	128.00	85.45	11.52	9.50	21.33	52.66	39.90	10.22	34.16	35.30	12.06
28	DBW-32	82.00	125.00	80.33	13.33	9.77	18.67	49.54	40.90	10.36	32.44	40.14	13.02
29	DBW-39	80.00	122.00	83.55	11.52	8.00	16.33	42.43	42.40	7.10	34.10	30.12	10.27
30	DBW-187	90.00	134.00	86.67	5.67	9.83	18.33	40.96	42.87	9.98	46.11	21.32	9.83
31	HD-4502	86.00	129.00	85.33	12.50	9.63	17.33	52.54	42.40	5.43	32.06	41.45	13.29
32	DBW-195	81.00	120.00	85.67	13.41	10.00	21.67	54.50	42.40	8.57	31.73	42.95	13.63
33	HDCSW18	82.00	123.00	86.67	7.33	10.50	17.33	44.43	43.40	8.70	49.93	21.89	10.93
34	DBW-621	83.00	128.00	95.32	7.33	10.07	19.00	47.65	44.20	6.02	51.45	24.80	12.76
35	DBW-303	80.00	130.00	85.22	7.33	10.07	18.33	40.50	45.60	7.73	45.06	20.33	9.16
36	DBW332	88.00	125.00	99.67	8.97	10.17	15.00	50.54	46.60	6.51	33.79	35.40	11.96
37	PBW-175	86.00	129.00	86.67	7.67	5.67	18.33	46.50	45.40	8.40	34.74	27.46	9.54
38	PBW-373	87.00	119.00	91.33	9.42	9.83	18.33	44.50	39.80	9.42	31.53	33.02	10.41
39	PBW-502	85.00	138.00	100.33	13.12	9.33	21.50	43.32	40.40	8.28	35.46	38.41	13.62
40	PBW-509	84.00	127.00	83.33	12.51	7.80	21.50	47.32	41.30	8.28	32.52	42.50	13.82
41	PBW-566	89.00	129.00	75.67	8.33	9.57	15.67	50.43	42.50	10.80	31.83	34.43	10.96
42	PBW-590	88.00	124.00	82.33	6.48	7.50	18.00	50.48	42.40	8.00	39.00	32.33	12.61
43	PBW-592	86.00	122.00	81.33	10.67	9.40	17.00	47.67	41.20	4.00	28.44	37.62	10.70

S. No	Genotypes	Days of 50% flowering	Days to maturity	Plant Height (cm)	No of Productive Tillers/ plant	Spike Length (cm)	Total number of spikelets/ spike	No of grains/ spike	1000 Seed weight (g)	Gluten content %	Harvest index %	Biological Yield/ Plant (g)	Grain yield/Plant (g)
44	PBW-692	87.00	129.00	79.42	5.76	8.43	20.67	45.00	40.50	7.50	30.95	38.22	11.83
45	PBW-697	94.00	143.00	84.32	5.67	8.57	18.67	42.45	43.21	6.40	32.51	32.42	10.54
46	PBW-698	80.00	125.00	105.67	11.53	11.40	20.67	47.33	39.90	9.52	33.48	30.32	10.15
47	PBW-725	81.00	123.00	86.32	12.33	8.93	19.33	44.64	40.60	10.24	40.83	27.80	11.35
48	PBW-707	82.00	119.00	85.33	8.33	9.27	17.33	46.00	42.40	9.33	42.25	23.36	9.87
49	RAJ-1482	87.00	132.00	85.34	8.33	8.70	17.33	44.00	44.40	8.32	30.80	34.67	10.68
50	RAJ-3077	90.00	138.00	82.33	7.67	7.40	14.67	46.33	42.40	8.79	28.81	36.24	10.44
51	HD-4503	81.00	134.00	93.33	7.22	8.77	19.00	45.00	41.50	7.65	32.66	38.49	12.57
52	RAJ-3765	91.00	132.00	93.21	6.65	8.77	17.33	47.33	44.40	6.54	34.52	32.33	11.16
53	RAJ-4077	87.00	126.00	92.33	9.33	8.93	12.33	46.00	43.20	6.60	28.70	36.24	10.40
54	RAJ-4121	86.00	129.00	87.67	7.67	8.73	17.67	41.33	46.40	5.46	30.16	32.33	9.75
55	RAJ-4124	85.00	136.00	91.67	6.33	9.47	18.33	40.00	44.20	7.89	25.37	30.75	7.80
56	RAJ-4201	84.00	123.00	93.67	5.00	10.03	20.67	44.43	41.80	9.79	20.59	41.34	8.51
57	RAJ-4419	83.00	129.00	89.33	6.33	9.10	19.67	40.21	42.90	8.76	32.65	32.34	10.56
58	RAJ-4421	89.00	122.00	96.33	9.67	9.63	18.67	46.21	47.80	6.65	31.53	29.02	9.15
59	RAJ-4465	88.00	140.00	99.67	10.33	9.17	19.33	46.00	49.60	8.54	33.79	30.66	10.36
60	UP-2903	89.00	132.00	92.34	8.45	7.64	18.33	42.32	44.50	8.88	32.99	28.92	9.54
61	UP-2906	80.00	130.00	87.73	8.33	9.40	15.44	43.00	39.80	9.54	31.37	34.30	10.76
62	UP-2907	81.00	127.00	81.33	9.33	7.33	19.33	42.43	40.90	10.24	37.43	29.55	11.06
63	HD-2380	82.00	121.00	85.33	10.17	9.50	17.33	40.23	42.40	7.89	32.29	30.44	9.83
64	HD-2385	90.00	129.00	86.67	8.33	11.17	15.67	42.21	44.40	6.54	39.68	32.33	12.83
65	HD-2402	89.00	125.00	88.32	7.67	9.27	19.67	37.67	42.80	7.89	22.68	35.54	8.06
66	HD-2501	88.00	131.00	85.67	9.33	7.57	17.33	42.43	45.60	9.87	28.00	26.50	7.42
67	HD-2733	86.00	126.00	89.33	9.67	8.60	19.00	42.32	47.80	7.54	33.25	35.67	11.86
68	HD-2781	85.00	124.00	88.32	10.67	8.73	17.67	43.48	46.50	4.32	32.54	42.50	13.83
69	HD-2819	92.00	137.00	82.33	11.33	10.00	18.33	45.43	42.20	6.74	36.68	30.40	11.15
70	HD-2824	87.00	135.00	68.67	9.32	7.50	19.67	42.32	43.20	7.54	31.69	31.65	10.03
71	HD-2851	81.00	128.00	78.67	10.64	9.67	16.00	46.33	44.20	8.98	42.54	29.24	12.44
72	HD-2864	83.00	126.00	84.33	7.54	9.50	17.67	47.00	39.70	10.54	34.89	27.26	9.51
73	HD-2888	82.00	124.00	94.67	7.72	9.00	17.00	45.67	38.90	8.66	42.70	25.60	10.93

S. No	Genotypes	Days of 50% flowering	Days to maturity	Plant Height (cm)	No of Productive Tillers/ plant	Spike Length (cm)	Total number of spikelets/ spike	No of grains/ spike	1000 Seed weight (g)	Gluten content %	Harvest index %	Biological Yield/ Plant (g)	Grain yield/Plant (g)
74	HD-2906	86.00	132.00	81.32	7.67	9.50	21.00	44.32	40.54	6.54	38.99	24.24	9.45
75	HD-2952	81.00	127.00	75.33	8.67	9.57	19.00	47.34	42.40	8.54	37.82	28.90	10.93
76	HD-2937	83.00	120.00	95.32	8.67	8.63	18.00	46.43	44.40	9.73	38.47	30.67	11.80
77	HD-2939	84.00	143.00	108.67	10.00	9.70	18.00	44.32	43.40	8.45	24.42	37.80	9.23
78	HD-2944	85.00	140.00	84.67	9.33	10.07	18.00	42.32	42.40	7.98	26.70	33.45	8.93
79	HD-2946	88.00	139.00	88.33	10.33	9.57	16.00	43.43	41.40	5.54	45.75	27.98	12.80
80	HD-2948	90.00	127.00	79.48	9.33	7.60	17.33	42.54	39.80	6.44	43.49	26.65	11.59
81	HD-2953	92.00	124.00	81.43	8.33	7.73	15.00	38.54	37.80	7.87	36.03	30.06	10.83
82	HD-2960	94.00	129.00	90.33	8.00	7.93	17.67	47.76	42.40	6.54	32.59	42.50	13.85
83	HD-2962	92.00	138.00	87.67	7.67	9.20	19.00	51.33	44.80	7.34	36.71	32.50	11.93
84	HD-2964	84.00	140.00	75.33	8.33	7.87	18.67	54.67	42.90	9.34	25.70	37.86	9.73
85	HD-2985	94.00	141.00	77.33	7.67	9.27	16.00	46.20	45.60	8.76	30.73	36.68	11.27
86	HD-2987	98.00	147.00	75.33	6.33	8.87	19.33	44.50	43.20	6.65	20.83	32.74	6.82
87	HD-3016	96.00	124.00	94.67	6.33	9.77	17.67	59.21	44.50	7.53	23.00	31.43	7.23
88	HD-3043	89.00	131.00	80.33	8.00	10.33	20.67	43.20	42.23	6.66	24.87	31.24	7.77
89	HD-3077	90.00	120.00	82.67	8.67	7.33	17.67	42.21	38.40	7.65	31.01	32.44	10.06
90	HD-3080	92.00	128.00	84.67	7.67	9.83	18.67	42.50	39.70	8.34	34.87	32.72	11.41
91	HD-3090	84.00	128.00	85.33	11.51	9.17	16.67	53.50	42.20	7.84	30.79	44.50	13.70
92	HD-3091	86.00	121.00	87.67	7.67	9.23	18.67	46.30	44.30	5.42	26.86	36.34	9.76
93	HD-3093	90.00	132.00	96.67	9.00	9.60	18.00	51.33	42.40	6.43	35.29	29.78	10.51
94	HD-3096	86.00	123.00	83.33	8.00	8.37	21.33	44.42	46.55	10.14	36.10	26.43	9.54
95	HD-3107	92.00	126.00	77.00	9.00	8.67	22.67	42.50	41.80	9.74	38.58	31.65	12.21
96	HD-3117	94.00	125.00	84.33	8.33	8.00	17.00	48.67	48.90	4.65	28.08	35.76	10.04
97	HD-3128	89.00	123.00	91.33	6.33	7.17	16.00	53.00	45.50	6.21	31.81	36.87	11.73
98	HD-3129	87.00	122.00	84.33	8.00	9.17	18.67	55.67	44.90	9.65	22.13	40.94	9.06
99	HD-3136	85.00	119.00	77.33	10.00	8.00	20.67	52.33	46.90	5.76	24.96	39.67	9.90
1	DBW-71	85.10	122.60	84.54	9.57	9.03	17.77	47.93	41.96	8.93	30.21	34.79	10.51
2	DBW-222	85.10	123.80	84.30	9.16	8.77	17.41	47.68	42.27	8.21	30.79	34.91	10.75
3	DBW-173	86.60	126.50	85.61	8.61	8.23	18.31	48.17	42.74	7.64	29.11	36.00	10.48
4	HD-3226	88.80	130.20	86.84	10.45	9.54	19.51	52.32	43.55	8.38	31.75	38.52	12.23

S. No	Genotypes	Days of 50% flowering	Days to maturity	Plant Height (cm)	No of Productive Tillers/ plant	Spike Length (cm)	Total number of spikelets/ spike	No of grains/ spike	1000 Seed weight (g)	Gluten content %	Harvest index %	Biological Yield/ Plant (g)	Grain yield/Plant (g)
	Gen Mean	**86.25**	**128.20**	**87.88**	**8.97**	**9.07**	**18.38**	**45.78**	**42.83**	**7.93**	**32.81**	**33.33**	**10.76**
	Test mean	86.24	128.30	87.99	8.95	9.08	18.38	45.65	42.84	7.92	32.91	33.22	10.75
	Check mean	86.40	125.78	85.32	9.45	8.89	18.25	49.03	42.63	8.29	30.47	36.06	10.99
	Min	80.00	119.00	68.67	5.00	5.67	12.33	37.67	36.50	4.00	20.59	20.33	6.82
	Max	98.00	147.00	110.67	13.41	11.83	22.67	59.21	49.65	10.80	51.45	45.16	15.94
	Std. Error	0.438	0.546	0.842	0.609	0.345	0.446	0.625	0.407	0.616	1.037	0.966	0.544

Table 3. Estimates of GCV (%), PCV (%), heritability h^2 % (BS), genetic advance and genetic advance percentage of mean for twelve characters in Bread wheat (*Triticum aestivum* L.)

Characters	Mean	Range		PCV (%)	GCV (%)	ECV (%)	GA	GA mean (%)	var (g)	var (p)	Heritability h^2(%)
		Min	Max								
Days of 50% flowering	86.25	80.00	98.00	3.05	1.01	2.88	0.76	0.88	0.76	6.93	10.97
Days to maturity	128.20	119.00	147.00	2.89	1.31	2.58	2.02	1.57	2.83	13.73	20.60
Plant Height (cm)	87.88	68.67	110.67	3.64	2.38	2.75	3.61	4.11	4.38	10.24	42.77
No of Productive Tillers/plant	8.97	5.00	13.41	10.15	5.62	8.45	0.74	8.22	0.25	0.83	30.66
Spike Length (cm)	9.07	5.67	11.83	8.36	3.11	7.76	0.28	3.05	0.08	0.58	13.81
Total number of spikelets /spike	18.38	12.33	22.67	7.21	2.69	6.68	0.49	2.66	0.24	1.75	13.96
No of grains/ spike	45.78	37.67	59.21	5.90	3.04	5.05	1.89	4.13	1.93	7.28	26.54
1000 Seed weight (g)	42.83	36.50	49.65	3.98	1.62	3.64	0.74	1.73	0.48	2.91	16.49
Gluten content %	7.93	4.00	10.80	11.37	5.83	12.04	0.53	6.70	0.21	1.13	18.98
Harvest index %	32.81	20.59	51.45	9.23	7.71	5.08	5.58	16.99	6.40	9.17	69.73
Biological Yield/ Plant (g)	33.33	20.33	45.16	8.01	4.79	6.43	2.52	7.55	2.54	7.13	35.68
Grain yield/Plant (g)	10.76	6.82	15.94	12.32	10.36	11.85	2.26	12.42	0.13	1.76	50.44

was less influenced by environment. It is in confirmation with the results of earlier workers Saktipada et al., [11] Ajmal et al., [12] Kumar et al., [13] Kumar et al., [14] Fellahin et al., [15] , Bhushan et al., [16] Desheva and Kyosev et al., [17] Dutamo et al., [8], Fikre et al., [18] Arya et al., [9] Ashish et al., (2020), Prasad et al., [10] Moderate heritability was observed in number of grains per spikes which is according to the previous report by Desheva and Kyosev et al., [17].

3.3 Genetic Advance as Percent of Mean

The high estimates of genetic advance in per cent of mean (>20%) were not recorded for any character, the moderate estimate for genetic advance (10-20%) in per cent of mean was shown by harvest index (16.99), grain yield per plant (12.42), while number of productive tiller per plant (8.22) , biological yield per plant (7.55), gluten content (6.70), plant height (4.11), number of spikelet per spike (2.66), days to maturity (1.57),days to 50% flowering (0.88), spike length (3.05), number of grain per spike (4.13) ,1000 seed weight(1.73), showed low estimate of (<10%) genetic advance in per cent of mean. genetic advance as per cent of mean was found high for gluten content, biological yield per plant, grain yield per plant, harvest index, number of productive tillers per plants. These results were confirmed by earlier findings of Saktipada *et al.,* [11] Ajmal *et al.,* [12] Kumar *et al.,* [13] Kumar *et al.,* [14] Bhushan *et al.,* [16] Desheva and Kyosev *et al.,* [17] Fikre *et al.,* [18] Arya *et al.,* [9] Ashish *et al.,* (2020). High heritability coupled with moderate genetic advance recorded for spike length suggesting further improvement of genotypes for these characters for further selection and subsequent use in breeding programme. Similar findings were obtained by Bhushan *et al*. [16].

4. SUMMARY AND CONCLUSION

Considerable variability existed in the genotypes for all the characters studied. The genotype HI-1500 (80.00) with high mean values in desirable direction showed early in flowering, the earliest maturity was shown by PBW-707(119) and HD-2824(68.67 cm) is the short statured variety. High number of productive tillers per plants DBW-195 (13.41), the spike length is more in CSW-18(11.83 cm), total number of spikelets per spikes is more in HD-3107(22.67), highest number of grains per spikes is were present in HD-3016 (59.21), the highest 1000 seed weight is for HI-1500(49.65 g), the highest gluten content is present in PBW-566 (10.80%). The highest value of biological yield per plant was estimated in CSW-18 (45.16g), DBW-621 (51.45%) recorded high value of harvest index and the maximum grain yield is from CSW-18 (15.94) g. High heritability coupled with high genetic advance observed for gluten content, grain yield per plant, biological yield per plant, harvest index and number of productive tillers per plants. Hence, direct selection of genotypes can be done through these characters for further improvement of genotypes of wheat while High heritability coupled with moderate genetic advance recorded for 1000 seed weight, total number of spikelets per spikes, spike length, number of productive tillers per plants ,gluten content days to maturity, days to 50% flowering suggesting further improvement of genotypes for these characters for further selection and subsequent use in wheat breeding programmed.

COMPETING INTERESTS

Authors have declared that no competing interests exist.

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