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Morphological Evaluation and Screening of Indian Wheat (*Triticum aestivum* L.) Cultivars for Yield

Sandeep Kumar[1*], Naresh Pratap Singh[2] and Vaishali[1]

[1]Department of Agricultural Biotechnology, [2]Department of Commercial Biotechnology, College of Biotechnology, SVPUA&T, Meerut, U.P., India

**Corresponding author*

A B S T R A C T

World population is increasing at alarming rate which will increasing the concern of breeders to identify the high yielding varieties to feed. In the present research, sixty Indian wheat genotypes were taken for morphological evaluation for yield. The pre harvest and post harvest characters of two years mean were recorded for this study. The plant height varied from 66.4cm in PBW502 to 108.2 cm in SL 1. The no. of productive tillers per plant were varied from 2.8 in RAJ3765 to 8.7 in Kharchia65. The length of spike, number of spikelet per spike, grains per spike and 1000 grain weight is directly contributed to yield component. The length of spike varied from 12.62cm in NW1076 to 19.07cm in Kharchia65 genotype. The number of spikelet is found to be varied from 11.9 in RAJ3765 to 20.6 in Kharchia65. The actual yield of the genotype is measured by thousand grain weight as the yield of plant depends upon size as well as weight of seeds of genotype. Test Weight of the grain varies from 22.3gm in K7903 to 48.9gm in Kharchia65 genotypes.

Keywords

Wheat, Genotypes, Morphological characters, Yield, Test weight

Introduction

Today, increasing population pressure of the world, urges food security for human feed. Wheat (*Triticum aestivum* L.) is the most important grain crop cultivated all over the world, and providing major nutritional requirement for human diet. Due to its importance, many plant breeders are engaged in its improvement throughout the world. Because of its significance it is growing on a large scale (Fassil, 2000). It provides 21% of the total food calories with 20% of the protein, in developing countries (Braun *et al.,* 2010; Tewari, 2015). It was expected that global wheat grain production must increase by 2% annually till 2050 to feed the population (Rosegrant and Agcoili, 2010; FAO, 2015; Singh and Vaishali, 2017). India is second largest producer of wheat in the world. The production of wheat in 2018-19 is million tonnes in India. It is grown almost in all states of the country namely Uttar Pradesh, Punjab, Haryana, Madhya Pradesh, Rajasthan, Bihar, Maharashtra, Gujarat, West Bengal, Uttarakhand and Himachal Pradesh.

All together contribute about 98% to the total wheat production of the country.

Wheat is an annual crop belongs to family *Poaceae* and *Triticum* genus in plant systematics. *Poaceae* family includes major cereal crops such as sorghum, maize, rice, millet and barely (Briggle and Reitz, 1963). Wheat farming had spread to Asia, Europe and North Africa after about 4,000 B.C. *Triticum aestivum* known as bread wheat are composed of different types of winter and spring cultivars.

Many plant breeders required to identify the specific characters to be incorporated into the wheat genotypes to maximize the yields. Donald (1968) had described those morphological characteristics of wheat crop that theoretically results in better yield. Hucl and baker, (1987); Cox *et al.,* (1988); Major *et al.,* (1992) in their studies observed above ground and whole plant biomass, tillers and growth rates for yield. Now a day an extensive research on various morphological traits that could responsible for higher yield are going on (Fida *et al.,* 2011). Zaheer (1991) suggested that the yield could be increased through selection of plants with taller plant height and more spikelets per spike, spike length and harvest index.

In this scenario, indirect selection which targets the morpho-physiological traits directly contribute to the crop yield can be more efficient than direct selection for higher yield (Reynolds *et al.,* 2005, 2012; Reynolds and Trethowan, 2007). Advances in precision phenotyping, along with combining genetic and molecular approaches in the breeding process are expected to improve the efficiency of breeding programs (Mir *et al.,* 2012; Kosová *et al.,* 2014; Choudhary *et al.,* 2018). Therefore, morpho-physiological trait-based breeding is the only hope to identify the traits which can affect yield or yield attributing traits (Nigam *et al.,* 2005). This approach may increase the possibility of making more successful crosses in a breeding program by exploiting the potential for additive gene action (Reynolds *et al.,* 2009a; Ataei *et al.,* 2017; Dolferus *et al.,* 2019; José *et al.,* 2019; Singh and Vaishali, 2016, 2017; Naresh *et al.,* 2015).

Materials and Methods

This investigation was carried out at the experimental field station of the Department of Biotechnology, SVPUA&T, Meerut, to analyse the morphological characters (pre and post harvest) of sixty Indian wheat genotypes viz. K-9423 (UNNATHALNA), AAI-12,SL-1, LN-26P, LN-15B,UP-2425, LN-15C, K-9644, K-9162, W-7, HUW-533, SL-2,UP-2565, DBW-835, WCW-953,K-710, K-9397, K-616, NW-1076, SL-7, W-3,K-617,LN-16B, SL-4, W-4, K-424, WCW-984, AAI-2, HUW-516,SL-5, K-8962, HUW-846, HUW-825, K-7903(HALNA), NW-2036, HUW-637, K-9533(NAINA), NW-1014, HUW-638,HUW-234, HUW-213, AAI-336, SL-15,K-712, DBW-17, DBW-16, KRL-213, RAJ-3765, KHARCHIA-65, KRL1-4, KRL-19, HD-2009, WH-1021, PBW-226, PBW-343, PBW 373, PBW-502, PBW-550, WH-711, KRL-210. All varieties were grown and maintained in the field under normal condition.

Morphological evaluation of wheat varieties

The data was observed by randomly selecting five plants from each variety. The data was observed for pre-harvest characters like Plant height (total height of plant) and Number of productive tiller. For post-harvest characters the data was recorded for Length of Spike (Ear length is measured in cm.), Number of spikelets per Spike (mean of 5 spikes per genotypes is considered for analysis), Seeds per Spike (Mean of seeds counted from 5 randomly sampled spikes at maturity is recorded for analysis), thousand Grain Weight (in gm.) were recorded of two years and there mean was considered for the final results.

Statistical analysis

The experimental data were compiled by taking mean values over randomly selected plant from both replications and subjected to the statistical analysis. The analysis of variance for the design of the experiment was carried out according to the procedure outlined by Panse and Sukhatme (1978).

Results and Discussion

Pre-harvest characters

Plant height is an important parameter for the development of plant. Plant height was recorded in cm in all the genotypes at the time of maturity. Variation in plant height was observed in different wheat genotypes and varied from 66.4cm in PBW502 to 108.2 cm in SL 1.

In studied genotypes the SL 15, AAI 336, HUW638, NW1014, K616 and K9423 shows the plant height more than 100 cm. whereas the genotypes RAJ3765, PBW343, WH711, PBW373, UP2425, UP2565, WCW953, K7903, Kharchia65 and KRL213 shows the plant height less than 85cm. The plant height is negatively correlated with yield (Table, Figure).

The numbers of productive tillers per plants were noted at the time of maturity. The no. of productive tillers per plant was varied from 2.8 in RAJ3765 to 8.7 in Kharchia65 (Table, Figure). The genotypes WH1021, PBW343, PBW373, PBW502, SL2, Kharchia65, KRL14, KRL210 and KRL213 are the better genotypes showing the number of tillers more than 7 in each of them. On the other hand the genotypes RAJ3765, WH711, SL1, LN15B, UP2565, SL5, K9533 and SL15 showing less than 4 numbers of productive tillers. This parameter is directly linked to the yield of plant. The results are in accordance with Rashidi, (2011) as they also observed the plant height and number of tillers of various wheat genotypes ranged from 50.05cm to110.5cm and 3.02 to 6.40.

Masood *et al.,* (2014) also recorded the similar range of plant height and number of tillers in studied wheat genotypes. The short plant height with in a very narrow range 70.8 to 79.05cm was also reported by Fetahu *et al.,* 2008. Singh and Vaishali, 2016, 2017; Naresh *et al.,* 2015; Fida *et al.,* 2011 supports the above observed data in his study on wheat varieties.

Post-harvest characters

The length of spike, number of spikelet per spike, grains per spike and 1000 grain weight is directly contributed to yield component. The result showed that the length of spike varied from 12.62cm in NW1076 to 19.07cm in Kharchia65 genotype (Table 1). However the genotypes PBW343 PBW502, K9423, SL4, Kharchis65, KRL14, KRL19, KRL210 and KRL213 also shows the significant length of spike ie. More than 17cm.

The number of spikelet is found to be varied from 11.9 in RAJ3765 to 20.6 in Kharchia65 (Table 2). The genotypes PBW343, DBW16, PBW502, K9423, SL4, SL15, Kharchia65, KRL14, KRL19, KRL210 and KRL 213 genotypes also seems to good in terms of number of spikelet per spike as they have more than 16 spikelets per spike. Grain per spike is direct measure of yield/plant and also economically important. It varies from variety to variety as shown in result.

Table.1 Pre- harvest morphological characters of studied wheat genotypes

S.N.	Variety	Plant ht. (cm)	S.D.	No. of Tiller/ Plant	S.D
1	RAJ-3765	74.9	±0.42	2.8	±0.28
2	WH-1021	95.2	±0.00	7.3	±0.14
3	PBW-343	84.9	±0.71	7.8	±0.14
4	WH-711	81.0	±1.98	4.0	±0.28
5	HD-2009	90.7	±0.14	5.1	±0.14
6	PBW-226	94.1	±0.71	4.1	±0.14
7	PBW-373	76.2	±0.28	7.8	±0.14
8	PBW-550	87.1	±0.14	6.1	±0.99
9	DBW-17	87.9	±0.42	6.0	±0.28
10	DBW-16	92.5	±0.42	5.3	±0.14
11	PBW-502	66.4	±0.57	7.7	±0.14
12	K-9423	100.2	±0.28	4.8	±0.28
13	AAI-12	86.4	±0.00	6.1	±0.99
14	SL-1	108.2	±0.57	3.9	±0.14
15	LN-26P	90.2	±0.28	3.9	±0.14
16	LN-15B	74.5	±0.71	3.5	±0.99
17	UP-2425	69.3	±0.42	4.0	±0.28
18	LN-15C	90.8	±0.57	5.0	±0.85
19	K-9162	88.9	±0.42	4.3	±0.14
20	K-9644	91.2	±1.98	4.1	±0.14
21	W-7	90.6	±1.98	4.0	±0.57
22	HUW-533	93.6	±0.28	6.0	±0.28
23	SL-2	94.6	±0.28	7.7	±0.14
24	UP-2565	83.8	±0.28	3.8	±0.28
25	DBW-835	95.8	±0.57	5.1	±0.14
26	WCW-953	84.9	±0.71	4.9	±0.14
27	WCW-984	94.3	±1.46	4.9	±0.14
28	K-710	89.9	±0.99	5.0	±0.28
29	K-9397	87.3	±0.42	4.3	±0.14
30	K-616	101.0	±0.57	4.4	±0.28

31	NW-1076	92.9	±0.71	4.4	±0.28
32	SL-7	93.1	±0.71	4.7	±0.14
33	W-3	92.8	±0.57	4.1	±0.14
34	K-617	90.15	±0.35	4.3	±0.14
35	LN-16B	91.5	±0.42	4.6	±0.00
36	SL-4	85.7	±0.14	4.7	±0.14
37	W-4	91.4	±0.28	4.1	±0.14
38	K-424	89.2	±0.28	4.5	±0.14
39	AAI-2	87.9	±0.14	4.3	±0.14
40	HUW-516	90.0	±0.28	4.3	±0.14
41	SL-5	86.3	±0.42	3.5	±0.42
42	K-8962	86.4	±0.57	4.9	±0.14
43	HUW-846	96.2	±0.28	4.2	±0.28
44	HUW-825	96.3	±0.42	5.5	±1.56
45	K-7903	83.1	±0.42	6.1	±0.99
46	NW-2036	85.2	±0.57	4.7	±0.71
47	HUW-637	87.1	±0.42	4.5	±0.14
48	K-712	88.2	±0.57	4.9	±0.14
49	K-9533	94.5	±0.99	3.9	±0.14
50	NW-1014	106.1	±0.42	4.7	±0.14
51	HUW-638	108.1	±0.42	5.1	±0.14
52	HUW-234	95.5	±0.42	4.9	±0.14
53	HUW-213	85.8	±13.16	5.7	±0.42
54	AAI-336	101.2	±0.28	5.7	±0.14
55	SL-15	108.1	±0.71	3.3	±0.14
56	KHARCHIA-65	80.6	±0.99	8.7	±0.49
57	KRL-1-4	92.55	±0.78	7.8	±0.14
58	KRL-19	87.45	±1.06	6.9	±0.28
59	KRL-210	91.7	±0.00	7.4	±0.14
60	KRL-213	82.1	±7.35	8.6	±0.07

Table.2 Post harvest morphological characters of studied wheat genotypes

S.N.	Variety	Spike length (cm)	S.D	No. of Spikelet/ Spike	S.D.	No. of Grain/ Spike	S.D	Test Wt. (gm)	S.D
1	RAJ-3765	13.73	±0.10	**11.9**	±0.42	31.2	±0.28	38.9	±0.42
2	WH-1021	15.50	±0.08	14.5	±0.14	44.7	±0.71	31.5	±0.42
3	PBW-343	17.41	±0.13	16.4	±0.28	46.0	±0.00	46.2	±0.49
4	WH-711	16.30	±0.25	15.7	±0.14	39.6	±0.47	45.4	±0.57
5	HD-2009	13.43	±0.24	12.6	±0.28	51.6	±0.47	43.3	±0.28
6	PBW-226	15.87	±0.10	13.8	±0.28	48.3	±0.47	42.9	±0.21
7	PBW-373	14.06	±0.08	13.1	±0.14	44.0	±0.35	47.2	±0.35
8	PBW-550	15.45	±0.47	14.4	±0.28	58.8	±1.17	43.6	±0.64
9	DBW-17	13.98	±0.06	12.7	±0.14	51.8	±0.71	38.0	±0.28
10	DBW-16	16.30	±0.25	16.2	±0.28	41.2	±4.28	43.8	±0.35
11	PBW-502	17.41	±0.13	16.0	±0.28	45.3	±0.21	39.7	±0.28
12	K-9423	17.22	±0.31	16.8	±0.28	44.3	±0.71	46.5	±0.42
13	AAI-12	13.83	±0.27	12.1	±0.14	45.7	±0.71	38.6	±0.64
14	SL-1	14.08	±0.31	13.7	±2.12	31.8	±1.41	40.8	±0.49
15	LN-26P	13.58	±0.31	12.8	±1.70	44.2	±0.57	32.8	±0.64
16	LN-15B	14.53	±0.04	13.7	±0.21	43.8	±0.49	32.0	±0.21
17	UP-2425	13.58	±0.31	13.5	±0.28	42.5	±0.35	30.0	±0.71
18	LN-15C	15.15	±0.49	14.5	±0.14	34.2	±1.41	38.5	±0.54
19	K-9162	14.50	±0.08	12.4	±0.28	42.5	±1.06	30.9	±0.42
20	K-9644	15.83	±0.38	14.0	±0.28	41.7	±0.71	28.9	±0.27
21	W-7	15.84	±0.48	14.9	±0.14	40.6	±1.41	31.0	±0.25
22	HUW-533	14.47	±0.24	13.9	±0.14	37.4	±1.13	35.3	±0.81
23	SL-2	13.65	±0.25	12.7	±0.14	37.4	±5.66	34.8	±0.38
24	UP-2565	15.94	±0.03	14.3	±0.14	42.1	±1.27	34.9	±0.42
25	DBW-835	14.53	±0.47	12.4	±0.28	39.2	±1.77	40.6	±0.65
26	WCW-953	13.80	±0.13	12.1	±0.14	42.1	±0.71	37.8	±0.48
27	WCW-984	15.30	±0.00	14.1	±0.14	38.1	±0.71	41.8	±0.52
28	K-710	15.28	±0.31	14.9	±0.14	42.4	±1.41	33.0	±0.21
29	K-9397	15.85	±0.89	14.9	±0.14	41.5	±2.12	39.8	±0.54
30	K-616	14.44	±0.31	13.4	±0.28	47.9	±1.27	36.9	±0.51
31	NW-1076	12.62	±0.00	12.2	±0.28	**23.7**	±0.71	36.7	±0.34
32	SL-7	14.56	±0.76	13.3	±0.14	44.2	±0.85	29.9	±0.62
33	W-3	14.15	±0.16	13.2	±0.28	37.0	±1.41	33.1	±0.29
34	K-617	13.29	±0.13	12.6	±0.28	38.4	±1.13	28.5	±0.42

35	LN-16B	14.48	±0.14	13.5	±0.14	30.0	±1.13	28.8	±0.31
36	SL-4	18.21	±0.44	17.2	±0.28	35.6	±0.85	31.2	±0.40
37	W-4	13.42	±2.12	12.3	±0.14	28.4	±0.57	24.2	±0.76
38	K-424	13.57	±0.27	12.7	±0.14	45.9	±0.71	30.3	±0.22
39	AAI-2	14.34	±0.00	13.3	±0.14	40.1	±1.27	37.8	±0.91
40	HUW-516	14.80	±0.25	13.7	±0.14	45.5	±0.42	35.7	±0.59
41	SL-5	13.82	±0.20	12.1	±0.14	34.8	±1.41	34.8	±0.62
42	K-8962	14.76	±0.00	13.8	±0.28	37.6	±4.03	31.9	±0.34
43	HUW-846	**13.25**	±0.21	12.9	±0.14	47.8	±0.28	33.7	±0.73
44	HUW-825	14.93	±0.16	13.9	±0.14	38.5	±0.42	29.9	±0.56
45	K-7903	15.15	±0.13	14.0	±0.28	36.1	±0.99	**22.3**	±0.66
46	NW-2036	13.55	±0.07	12.4	±0.21	42.8	±0.42	39.9	±0.57
47	HUW-637	16.75	±0.21	14.2	±0.28	41.1	±0.71	38.7	±0.77
48	K-712	14.96	±0.28	12.6	±0.28	44.2	±1.41	35.8	±0.62
49	K-9533	15.68	±0.03	14.4	±0.28	40.1	±0.99	41.0	±0.88
50	NW-1014	14.24	±0.25	12.7	±0.14	38.5	±0.42	43.1	±0.78
51	HUW-638	13.82	±0.20	12.9	±0.14	36.1	±0.99	33.6	±0.74
52	HUW-234	15.54	±0.00	14.8	±0.28	43.4	±0.57	41.2	±0.37
53	HUW-213	15.04	±0.20	14.9	±0.14	43.8	±1.13	46.5	±0.33
54	AAI-336	14.58	±0.17	13.2	±0.28	38.4	±1.13	36.8	±0.57
55	SL-15	17.69	±0.69	16.9	±0.14	36.7	±0.42	31.3	±0.71
56	KHARCHIA-65	**19.07**	±0.16	**20.6**	±0.28	**58.1**	±1.27	**48.9**	±0.42
57	KRL-1-4	17.45	±0.92	18.7	±2.12	47.8	±0.57	47.1	±0.49
58	KRL-19	17.00	±0.00	18.2	±0.64	47.7	±0.74	46.8	±0.78
59	KRL-210	17.40	±0.00	18.6	±0.49	49.8	±0.85	40.0	±0.92
60	KRL-213	17.10	±0.14	18.3	±0.35	55.1	±1.56	42.7	±0.99

The minimum seeds/spike was observed 23.7 in NW1076 whereas the maximum number of seeds per spike was observed 58.1 in Kharchia65 followed by 55.1 in KRL213, 52.8 in PBW550, 51.8 in PBW17 and 51.6 in HD2009 (Table 2). The results of the present study are in accordance with result of Masood *et al.,* (2014) as they also reported the number of spiklet per spike ranged from 22.27 to 18.40 in lines 9595 and 9546 respectively. Safi *et al.,* (2017) observed highest number of spiklet per spike i.e 18.9 in Raj1972 wheat genotype respectively. Our results are in accordance with the result observed by Masood *et al.,* 2014; Fetahu and Aliu, 2010; Fetahu *et al.,* 2008. Singh and Vaishali, 2016, 2017; Naresh *et al.,* 2015, Fida et. al., 2011 supports the above observed data in his study on wheat varieties.

The actual yield of the genotype is measured by thousand grain weight as the yield of plant depends upon size as well as weight of seeds of genotype. Test Weight of the grain varies from 22.3gm in K7903 to 48.9gm in Kharchia65 (Table 2). In addition to this the genotypes PBW343, WH711, K9423, HUW213, KRL14, KRL19, KRL210 and

KRL213 also perform better under filed condition in terms of thousand grain weight as they show more than 45gm test weight. Similarly, Masood *et al.,* (2014) observed the test weight ranged from 58.48gm to 43.23gm. Rashidi, (2011) also reported the similar range of test weight varies from 32.09 to 47.70gm. Singh and Vaishali, 2016, 2017; Naresh *et al.*, 2015; Fida et. al., 2011 supports the above observed data in their study done on wheat varieties.

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