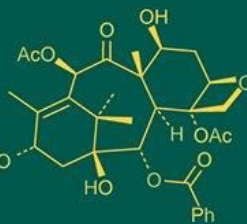
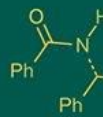
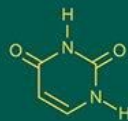
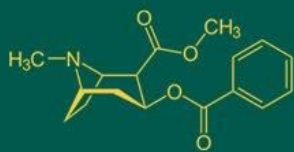


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Evaluation of physical grain characteristics in diverse wheat varieties/genotypes

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Abstract

This study aimed to evaluate the grain quality characteristics of 20 wheat genotypes/varieties (17 varieties and 3 genotypes) grown at the EBR section of rabi cereals at Chandra Shekhar Azad University of Agriculture and Technology, Kanpur. A varietal trial was conducted over two years, and grain quality traits such as test weight, moisture content, grain size, bulk density, and grain texture were analyzed using standard methods. The results revealed significant variations among the wheat genotypes/varieties for all the tested parameters. K-9533 recorded the highest 1000-grain weight and bulk density, while K-9006 exhibited the highest moisture content. K-68 and K-9107 had the largest grain size, and the varieties were classified into various texture categories, with K-9107 identified as hard wheat and K-9006 as soft wheat. The findings provide insights into the grain quality traits of wheat varieties, which are essential for their suitability in food processing industries. These results can serve as a basis for future breeding programs aimed at improving specific quality traits for various industrial applications.

Keywords: 1000 grain weight, moisture content, grain size and bulk density

Introduction

Wheat is one of the oldest and extensively grown crops. It has been a staple food grain for the people ever since they began to settle in permanent communities which go back to the Stone-Age era. Wheat is one of the world's most important grains, more so as a food; as the unique product making properties of its products can be utilized to advantage. It belongs to the family Gramineae, the grass family and is widely accepted to be first grown as a food crop about 10,000 - 8,000 B.C. With a good deal of evidence, origin of wheat is believed to be arid lands of Asia; where in, cultivated einkorn was developed from a grass type native to these countries. With natural hybridization over the centuries, by sharing of the chromosomes, different classes of wheat have evolved which profoundly influenced processing and agronomic adaptability of wheat. It is nowadays cultivated throughout the globe except the hottest tropical regions. The introduction of Mexican semi-dwarf wheat in the breeding programs lately has dramatically altered the yield of commercial varieties in most wheat producing countries. Production of wheat in India accounts to about 106 Million Metric Tonnes (MMT) annually. India ranks second in terms of the quantity of the grain produced accounting to 12% share in the total world wheat production. It is next only to China, which produces about 135.76 MMT of wheat and has 18% share in global wheat production. From being food-deficient with production of wheat standing at just 12 MMT during 1965,

India is now self-sufficient and even exports wheat due to adoption of modern science and technology that lead to "wheat revolution" (Nagarajan, 2005) [22]. With the advent of semi-dwarf varieties in mid 1960s, the chapatti making quality of traditional tall Indian wheat of the pre semi-dwarf era was eroded and no serious effort was made to recapture this trait in the new high yielding varieties. Other than C 306, Wheat varieties popular for good chapatti quality evolved in different eras/periods. Lok 1 released in 1982 and Raj 1482 released in 1983 for central zone have been preferred by consumers for their superior chapatti quality over the semi-dwarf wheat 1990's saw the release of wheats such as PBW 154, PBW 175, Raj 3765 and later the varieties HD 2733, GW 322 were released in 2001 and 2002

(Hemalatha *et al.*, 2007) ^[23].

Materials and Methods

Seed samples from 20 wheat genotypes/varieties (17 varieties and 3 genotypes) were sourced from the EBR section of rabi cereals at Chandra Shekhar Azad University of Agriculture and Technology, Kanpur. A varietal trial of wheat was conducted in three replications at the same location for this study. All experimental procedures followed standard methodologies outlined below.

Test weight: To observe the extent of grain filling 1000 seed of each replication were weight out. The result were however, reported as 1000 grains weight by multiplying 10 times.

Moisture content: Weight accurately 20 g of wheat in an aluminium box having a close fitting lid. Place the box with its lid in an oven maintained at 70 °C for 24 hours, cool the box with the lid to room temperature in a desiccator and weight again put in oven at 70 °C for one hour and weight. Repeat the process till a constant weight is obtained. Calculate loss in weight due to moisture and express as percentage.

Grain size: Grain size of wheat measured by Caliper Method

Bulk density: Bulk density of grain is the ratio of mass of grain to its bulk volume the bulk volume (including pore spaces between grains). Actual volume between grains of grain is smaller than that are true density. The bulk density of wheat is determined by measuring the mass of grain sample of non bloom the great grain sample was placed in a cylindrical container of volume 500 cm cube. Packaging of grain in the cylinder Thar density was at 10 by gently

typing the cylinder vertically down to a table 30 times in the same manner in all measurements. The axis grain of the top of cylinder was removed by sliding a string along the top edge of the cylinder. After the access had been removed. The mass of the grains sample was measured by an electronic balance.

Grain texture: After the preliminary screening of chapattis of different tried variants by a semi-trained panel of 5 judges, a consumer panel was recruited for expanded sensory evaluation, which was done using a 9-point hedonic scale. Chapattis were placed in room temperature in silver micro foil plates and labeled as 1, 2, 3, 4, 5, 6, 7, 8, 9, 10, 11, 12, 13, 14, 15, 16, 17, 18, 19, and 20 random codes. Panelists were provided with distilled water to clean their mouths between samples. The chapatti samples were presented in random order and panelists were asked to rate their assessment of palatability texture, chewiness characteristics, Pliability, mouth feel, after taste and overall acceptability on a 1–9 point hedonic scale.

Results and Discussion

Wheat Grain Quality

Test weight: The data regarding 1000-grain weight of different wheat variety are depicted in (table 1). It was clear from the data that 1000-grain weight of all tested varieties of wheat varied significantly ranged from 39.90 to 44.82 g in first year and in second year it was ranged from 39.44 to 43.25 g. Based on pooled analysis of both years the maximum value of K-9533 (44.04 g) being followed by Genotype K-424 (42.80 g), Genotype K-1711 (42.63 g) appeared to be superior and minimum value of HD-3392 (39.67 g) as compared to other wheat varieties/Genotypes. Similar results of varietal differences were also reported by Kala and Singh (2011) ^[12], Abaye *et al.* (2004) ^[13], Dziki *et al.* (2000) ^[14].

Table 1: 1000 grain weight (g) in various varieties/ genotypes of wheat grain

S. No.	Varieties/genotypes	1000 grain weight (g)		
		Mean		Pooled Mean
		2022-2023	2023-2024	
1	K-1711	43.16	42.10	42.63
2	K-906	42.74	40.17	41.46
3	K-424	42.32	43.28	42.80
4	HD 3392	39.90	39.44	39.67
5	HD 3086	42.56	41.22	41.89
6	PBW 222	43.09	39.97	41.53
7	K-8027	40.24	40.40	40.32
8	K -607	40.20	39.51	39.85
9	K-7903	40.90	40.07	40.98
10	K-9423	42.01	40.22	41.11
11	PBW 826	40.69	40.50	40.59
12	K-9162	43.44	41.07	42.25
13	DBW 350	43.14	40.27	41.71
14	K-9533	44.82	43.27	44.04
15	K-68	41.56	41.56	41.36
16	K-9006	43.19	40.36	41.77
17	k-402	43.97	40.37	42.17
18	K - 9351	40.87	40.80	40.83
19	K -9644	43.25	39.97	41.61
20	K -9107	42.84	40.16	41.50
Mean		42.19	40.62	41.40
S.E.(d) ±		0.56	0.18	0.37
C.D. (5%)		1.14	0.36	0.75

Moisture content: The data pertaining maximum moisture content (15.32%) recorded in varieties K-68 while minimum moisture content (12.30%) recorded in K-9644 as compared to other tested varieties/Genotypes during first years of study. During second year maximum moisture content (14.60%) recorded in variety K-8027 while minimum moisture content (11.95%) recorded in DBW-350. Based on pooled analysis it was observed that wheat K-9006 (14.67%) emerged as significantly superior varieties/Genotypes and while, lowest moisture content wheat variety K-906 (12.09%).

Grain size: It was clear from the data that grain size of wheat grain of all tested varieties of wheat varied significantly ranged from 6.33 to 7.16 mm in first year and in second year it was ranged from 6.33 to 7.17 mm. Based on pooled analysis of both years the maximum value of K-68 (7.10 mm), K-9107 (7.0 mm) appeared to be superior and minimum value of HD-3086 (6.50 mm) as compared to other wheat varieties/Genotypes.

Bulk density (g/m³).

Bulk density of grain is showed quality character of grain it also influences the market value. The data regarding bulk density weight of different wheat variety are depicted. It was clear from the data that bulk density of all tested varieties/Genotypes of wheat varied significantly ranged from 351.85 to 395.48 in first year and in second year it was ranged from 345.43 to 391.41. Based on pooled analysis of both years the maximum value of bulk density K-9533 (393.43) being followed by HD -3086 (388.69), K-9162 (385.81) appeared to be superior and minimum value of Genotype K-906 (329.72) as compared to other wheat varieties/Genotypes. Similar results of varietal differences were also reported by Hemalatha, M.S (2007)^[23].

Table 2: Moisture content (%) in various varieties/ genotypes of wheat flour

S. No.	Varieties/genotypes	Moisture content (%)		
		Mean		Pooled Mean
		2022-2023	2023-2024	
1	K-1711	12.55	14.10	13.32
2	K-906	13.24	12.95	12.09
3	K-424	14.20	13.45	13.82
4	HD 3392	12.75	13.40	13.07
5	HD 3086	13.25	14.10	13.67
6	PBW 222	14.16	12.80	13.48
7	K-8027	12.45	14.60	13.52
8	K -607	13.30	12.10	12.70
9	K-7903	12.95	14.18	13.56
10	K-9423	14.20	12.18	13.19
11	PBW 826	12.50	13.70	13.10
12	K-9162	14.23	12.85	13.54
13	DBW 350	13.22	11.95	12.08
14	K-9533	12.58	13.10	12.84
15	K-68	15.32	13.40	14.36
16	K-9006	15.25	14.10	14.67
17	k-402	13.52	12.20	12.86
18	K - 9351	14.12	12.80	13.46
19	K -9644	12.30	13.42	12.86
20	K -9107	15.20	13.85	14.52
Mean		16.81	16.81	16.50
S.E.(d) ±		0.42	0.42	0.24
C.D. (5%)		0.86	0.86	0.49

Table 3: Grain size (mm) in various varieties/ genotypes of wheat

S. No.	Varieties/genotypes	Grain size (mm)		
		Mean		Pooled Mean
		2022-2023	2023-2024	
1	K-1711	6.83	6.83	6.83
2	K-906	6.67	6.83	6.75
3	K-424	6.80	6.50	6.65
4	HD 3392	6.50	6.67	6.58
5	HD 3086	6.67	6.33	6.50
6	PBW 222	6.83	6.83	6.83
7	K-8027	6.33	7.00	6.67
8	K -607	7.00	6.67	6.83
9	K-7903	7.00	6.83	6.91
10	K-9423	6.83	6.17	6.50
11	PBW 826	6.50	6.67	6.58
12	K-9162	6.50	6.67	6.58
13	DBW 350	7.16	6.83	7.00
14	K-9533	6.50	7.33	6.92
15	K-68	7.10	7.0	7.10
16	K-9006	6.50	6.67	6.58
17	k-402	6.67	6.33	6.50
18	K - 9351	6.33	6.83	6.58
19	K -9644	6.83	6.17	6.50
20	K -9107	6.83	7.17	7.0
Mean		6.62	6.67	6.64
S.E.(d) ±		0.31	0.29	0.30
C.D. (5%)		0.63	0.59	0.61

Table 4: Bulk density (kg/m³) in various varieties/ genotypes of wheat

S. No.	Varieties/genotypes	Bulk density (kg/m ³)		
		Mean		Pooled Mean
		2022-2023	2023-2024	
1	K-1711	351.85	365.80	358.83
2	K-906	347.29	355.48	351.39
3	K-424	370.15	364.97	367.56
4	HD 3392	350.15	365.27	357.71
5	HD 3086	392.50	377.88	385.19
6	PBW 222	373.89	360.56	367.23
7	K-8027	351.82	340.43	346.13
8	K -607	375.50	390.37	382.94
9	K-7903	383.16	370.10	376.63
10	K-9423	361.91	375.99	368.95
11	PBW 826	372.19	385.89	379.04
12	K-9162	382.52	394.10	388.31
13	DBW 350	371.12	385.62	378.37
14	K-9533	375.48	390.41	382.95
15	K-68	365.59	380.46	373.03
16	K-9006	380.57	362.60	371.59
17	k-402	375.26	360.70	367.98
18	K – 9351	386.17	381.14	383.66
19	K -9644	361.65	365.55	363.6
20	K -9107	361.81	350.29	356.05
Mean		369.53	371.18	370.35
S.E.(d) ±		1.44	1.51	1.47
C.D. (5%)		2.93	0.57	1.75
C.V.		3.86	3.52	3.69

Grain texture

Grain texture is important factor which affected the quality of chapatti, bread, pastis and biscuits. The grain texture did not show any marked change with during both the years. Grain texture was found soft wheat, velvety wheat, silky wheat and hard wheat in this experiment. Wheat variety K-9107 (hard wheat), K-68 (silky wheat), K-9006 (soft wheat) and K-9423 (velvety wheat) respectively.

Table 5: Grain texture in various varieties/ genotypes of wheat grain

S. No.	Varieties/genotypes	Grain texture	
		2022-2023	2023-2024
1	K-1711	Silky wheat	Silky wheat
2	K-906	Hard wheat	Hard wheat
3	K-424	Silky wheat	Silky wheat
4	HD 3392	Hard wheat	Hard wheat
5	HD 3086	Soft wheat	Soft wheat
6	PBW 222	Hard wheat	Hard wheat
7	K-8027	Silky wheat	Silky wheat
8	K -607	Hard wheat	Hard wheat
9	K-7903	Silky wheat	Silky wheat
10	K-9423	Velvety wheat	Velvety wheat
11	PBW 826	Soft wheat	Soft wheat
12	K-9162	Soft wheat	Soft wheat
13	DBW 350	Soft wheat	Soft wheat
14	K-9533	Hard wheat	Hard wheat
15	K-68	Silky wheat	Silky wheat
16	K-9006	Soft wheat	Soft wheat
17	k-402	Hard wheat	Hard wheat
18	K - 9351	Soft wheat	Soft wheat
19	K -9644	Silky wheat	Silky wheat
20	K -9107	Hard wheat	Hard wheat

Conclusion

The variety K-9533 emerged as superior in terms of 1000-grain weight and bulk density, while K-9006 showed the highest moisture content. In terms of grain size K-9107 exhibited the largest grain dimensions. Grain texture analysis categorized the wheat varieties into different texture types, with K-9107 classified as hard wheat and K-9006 as soft wheat, which has implications for end-use processing.

These results provide valuable insights into the performance of wheat varieties, particularly in relation to grain quality traits important for food processing industries such as flour production, bread making, and chapatti preparation. The varietal differences identified could guide future breeding programs aimed at improving specific quality traits to meet diverse market demands.

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Conflict of Interest Statement

The authors declare that there are no conflicts of interest regarding the publication of this paper.

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