

# Agro-morphological and Seed Trait Characterization of DUS-Tested Wheat Varieties for Central India

DK VERMA AND RAVINDRA PANWAR\*

ICAR-Indian Agriculture Research Institute, Regional Station, Daly College Road,  
Indore, Madhya Pradesh-452001, India

\*mailmedilipverma@rediffmail.com, ravindrapanwar447@gmail.com

(Received August 2025; Revised September 2025; Accepted October 2025)

**ABSTRACT:** Agro-morphological and seed trait characterization of wheat genotypes is a prerequisite for varietal identification, DUS testing, and maintenance of genetic purity in seed production systems. The present investigation was carried out at ICAR-IARI Regional Station, Indore, Madhya Pradesh, during the rabi seasons of 2022–23 and 2023–24 to characterize eight promising wheat genotypes along with two check varieties (DBW-187 and HD-2967). The experiment was laid out in a randomized complete block design with three replications. Significant variation was observed among genotypes for major quantitative traits, including plant height, days to heading, peduncle length, ear length, awn length, and thousand grain weight, while most qualitative seed and plant descriptors remained stable across years. Absence of coleoptile anthocyanin coloration, uniform amber grain colour, and consistent awn presence contributed to varietal distinctness and seed identity. Early heading and maturity were recorded in genotypes 22BRHI3304 and 22BRHI3305, whereas 2889/2139 and 22BRDP5001 were late maturing. The stability of qualitative traits coupled with significant differences in yield-related seed traits highlights the suitability of these genotypes for DUS testing and seed certification. The study underscores the importance of integrating agro-morphological and seed characters for varietal registration, seed purity maintenance, and wheat improvement under Central Indian conditions.

**Keywords:** DUS testing, Seed traits, Wheat genotypes, Morphological characterization, Grain weight

## INTRODUCTION

Wheat is the second most important cereal crop of India after rice, occupying a substantial area and contributing significantly to national food security. During 2018–19, wheat was cultivated over 7.40 million hectares with an average productivity of 3.36 t ha<sup>-1</sup> (MOAD, 2018/19). India possesses a wide range of wheat landraces and breeding lines adapted to diverse agro-ecological conditions; however, limited utilization of this diversity in breeding programmes has resulted in gradual genetic erosion [1].

Morphological and seed trait characterization forms the foundation of genetic diversity assessment and germplasm management. For wheat, agro-morphological descriptors—particularly those related to seed, ear, and plant architecture—are essential for varietal identification, maintenance of genetic purity, and seed certification. Characterization of accessions based on multiple traits facilitates effective utilization of germplasm collections by breeders and seed producers, while also supporting varietal regeneration and validation [2].

Under the Protection of Plant Varieties and Farmers' Rights Act (PPVFRA), DUS (Distinctness, Uniformity, and

Stability) testing is mandatory for variety registration and grant of Plant Breeders' Rights. Qualitative traits, largely governed by mono- or oligogenic inheritance, are highly stable and serve as reliable markers for varietal identity, seed purity testing, and certification [3]. Quantitative traits, although influenced by the environment, are crucial for assessing agronomic performance and yield potential [4].

Seed traits such as grain colour, grain size, thousand grain weight, and awn characteristics are particularly important in wheat, as they directly influence seed quality, market acceptability, and processing suitability [5]. Therefore, integrating agro-morphological descriptors with seed-related quantitative traits provides a comprehensive framework for varietal characterization and selection.

Keeping these aspects in view, the present study was undertaken to characterize DUS-tested wheat genotypes using agro-morphological and seed traits and to identify promising lines with stable seed characteristics and desirable agronomic performance under Central Indian conditions.

## MATERIALS AND METHODS

The experiment was conducted at ICAR–IARI Regional Station, Indore, Madhya Pradesh, during the rabi seasons of 2022–23 and 2023–24. The experimental site is located at 22.7196° N latitude and 75.8577° E longitude, at an altitude of 553 m above mean sea level, with black cotton soil typical of the Malwa plateau.

Ten wheat genotypes comprising eight advanced breeding lines (2889/2139, 22BRDP5001, 22BRWH2402, 22BRDB1003, 22BRHI3304, 22BRHI3405, 22BRHI0006, and 22BRHI4407) and two check varieties (DBW-187 and HD-2967) were evaluated in a randomized complete block design with three replications.

Each plot consisted of six rows of 6 m length. Seeds were sown at a rate of 100 kg ha<sup>-1</sup> with a row spacing of 30 cm and plant spacing of 10 cm. Fertilizer was applied at 120:60:40 kg ha<sup>-1</sup> of N:P<sub>2</sub>O<sub>5</sub>:K<sub>2</sub>O. Half of the nitrogen and full doses of phosphorus and potassium were applied as basal, while the remaining nitrogen was applied in two equal splits at tillering and heading stages. All recommended agronomic practices were uniformly followed.

Observations on qualitative traits were recorded as per DUS guidelines, including coleoptile anthocyanin coloration, plant growth habit, foliage colour, auricle characteristics, flag leaf attitude, waxiness, ear shape,

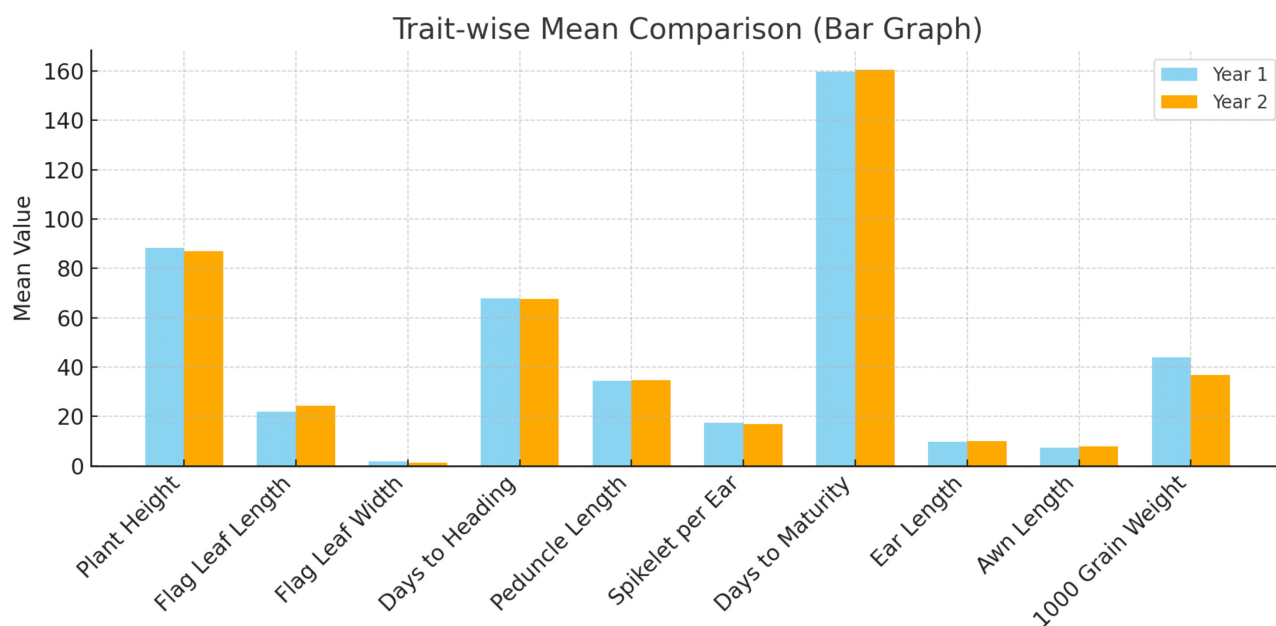
ear density, awn presence, spike attitude, and grain colour. Quantitative traits recorded included plant height, days to heading, peduncle length, ear length, awn length, flag leaf width, number of spikelets, grains per spike, and thousand grain weight (Table 2 and Table 4).

Data were subjected to analysis of variance using R-STAT statistical software. Mean comparisons were performed using the least significant difference (LSD) test at the 5% probability level.

## RESULTS

Qualitative characterization revealed a high degree of uniformity and stability across years. All genotypes exhibited absence of coleoptile anthocyanin coloration, similar to the check varieties. Amber grain colour and awn presence were consistent across all entries, reinforcing varietal identity and seed uniformity. Variations were observed in auricle hairiness, flag leaf attitude, waxiness, ear shape, and spike attitude, which contributed to distinctness among genotypes (Table 1 and Table 3).

Significant differences were observed among genotypes for quantitative traits. Plant height ranged from 82.3 to 95.8 cm, with genotype 2889/2139 recording the maximum height. Days to heading varied significantly, with 22BRHI3304 and 22BRHI3305 being the earliest



**Trait-wise Mean Comparison (Year 1 vs Year 2)**

This bar graph compares the mean values of key agronomic traits across two years of wheat genotype evaluation.

Sky Blue = Year 1, Orange = Year 2

**Table 1.** Qualitative Traits of Wheat Genotypes at ICAR-IARI RS Indore during crop period 2022-2023

Genotypes	Coleoptile: Antho- cyanin colour- ation	Plant: growth habit	Foliage colour	Flag leaf: Antho- cyanin colour- ation of auricles	Flag leaf: Hairson auricle	Flag leaf: attitude	Flag leaf: Wax. on leaf sheath	Flag leaf: Wax. on leaf blade	Ear : Waxi- ness of neck Peduncle	Ear shape in profile	Ear density	Peduncle: Attitude (at maturity)	Awn: attitude	Awns orscurs presence	Grain colour	Season Type
2889/2139	Absent	Semi- erect	Green	Absent	Absent	Drooping	Strong	Strong	Absent	Tapering	Medium	Straight	Medium	Present	Amber	Spring
22BRDP5001	Absent	Semi- erect	Dark Green	Absent	Strong	Erect	Strong	Strong	Absent	Tapering	Medium	Bent	Spreading	Present	Amber	Spring
22BRWH2402	Absent	Semi- erect	Green	Absent	Absent	Drooping	Strong	Weak	Absent	Parallel Sided	Medium	Bent	Spreading	Present	Amber	Spring
22BRDB1003	Absent	Inter- mediate	Green	Absent	Absent	Drooping	Medium	Medium	Absent	Parallel Sided	Medium	Bent	Medium	Present	Amber	Spring
22BRHI3304	Absent	Semi- erect	Green	Absent	Absent	Drooping	Medium	Absent	Weak	Parallel Sided	Medium	Bent	Medium	Present	Amber	Spring
22BRHI3405	Absent	Semi- erect	Green	Absent	Absent	Drooping	Strong	Strong	Weak	Tapering	Lax	Straight	Medium	Present	Amber	Spring
22BRHI0006	Absent	Semi- erect	Green	Absent	Strong	Drooping	Absent	Absent	Absent	Parallel Sided	Medium	Straight	Medium	Present	Amber	Spring
22BRHI4407	Absent	Semi- erect	Green	Absent	Absent	Drooping	Medium	Medium	Absent	Parallel Sided	Medium	Bent	Medium	Present	Amber	Spring
DBW-187	Absent	Erect	Green	Absent	Strong	Drooping	Medium	Weak	Absent	Tapering	Dense	Bent	Medium	Present	Amber	Spring
HD-2967	Absent	Erect	Green	Absent	Absent	Erect	Very Strong	Medium	Absent	Tapering	Medium	Straight	Medium	Present	Amber	Spring

**Table 2.** Variation in Quantitative Traits of Wheat Genotypes at ICAR-IARI RS Indore during crop period 2022-2023

Genotypes	Plant ht (cm)	Flag leaf length (cm)	Flag leaf width (cm)	Days to 75% heading	Peduncle length (cm)	Spikelet par Ear	Days to 75% maturity	Ear length (cm)	Awn Length (cm)	1000 gr wt. (gm)
2889/2139	95.8	28.6	1.5	75	34	17.9	170	11	8.6	39.6
22BRDP5001	95.3	19.35	2.9	74	32.3	18	168	9.6	7.4	42.0
22BRWH2402	81.6	20	1.5	69	32.6	17.6	160	9.5	7.5	42.3
22BRDB1003	85.4	21.6	1.3	78	32.8	15	164	9.4	7.4	47.3
22BRHI3304	82.7	23.5	1.3	62	34.8	17.2	150	10.7	7.5	43.4
22BRHI3405	78.9	22.7	1.3	63	36.5	16.8	156	10.4	8.4	43.4
22BRHI0006	83.6	26.2	1.7	65	35.4	16.1	157	9.7	8.4	43.2
22BRHI4407	94	23.5	1.5	64	39	16.4	155	8.4	7.4	47.8
DBW-187	97	23	2	64	34.5	20	158	12.3	7.6	42.0
HD-2967	88.8	18	1.9	65	33.4	20	160	9.8	7.4	48.5
Grand mean	88.31	21.98	1.69	67.9	34.53	17.5	159.8	9.8	7.4	44.0
P-value	0.012	0.089	0.145	0.004	0.031	0.065	0.210	0.027	0.097	0.001
LSD	6.22	3.17	0.38	2.85	5.90	1.35	3.01	1.12	2.31	3.34
CV%	7.04	14.12	23.64	7.02	6.24	8.59	1.84	11.11	4.07	7.53

(60–62 days), while 2889/2139 and 22BRDP5001 were late heading. Thousand grain weight showed significant variation, with the highest values recorded in 22BRHI4407 and 22BRDB1003, comparable to check varieties.

Combined analysis across years indicated significant genotype effects for plant height, peduncle length, ear length, awn length, and thousand grain weight, while year and genotype × year interactions were significant for certain traits such as flag leaf width and grain number.

## DISCUSSION

The observed variation among wheat genotypes for agro-morphological and seed traits reflects substantial genetic diversity and highlights the effectiveness of DUS descriptors in varietal differentiation. Stability of qualitative traits such as grain colour, awn presence, and coleoptile pigmentation across years confirms their reliability for seed identity, varietal purity, and certification purposes [7].

Quantitative seed traits, particularly thousand grain weight, exhibited significant and consistent variation, underscoring their importance as key yield determinants and selection criteria in wheat breeding programmes [11,12]. Genotypes with higher grain weight and stable expression across environments are desirable for both productivity and seed quality.

Early heading and maturity observed in certain genotypes offer advantages for escaping terminal heat stress, a

major constraint in Central India [10]. Peduncle length, which showed significant variation, is also relevant for disease escape and spike health, thereby indirectly contributing to seed quality [8].

The integration of agro-morphological descriptors with seed-related quantitative traits strengthens the DUS evaluation process and supports informed decisions in variety release, seed multiplication, and genetic improvement.

## CONCLUSION

The present study demonstrated that agro-morphological and seed trait characterization is a robust approach for DUS testing and varietal identification in wheat. Significant genotypic variation was recorded for key agronomic and seed-related traits, particularly plant height, days to heading, ear length, and thousand grain weight. The stability of qualitative seed traits such as grain colour and awn presence reinforces their utility in maintaining seed purity and varietal identity. Promising genotypes, especially 2889/2139 and selected 22BRHI4407 lines, exhibited distinct and stable traits comparable to national check varieties, indicating their suitability for varietal release and registration. These findings provide valuable information for breeders, seed producers, and regulatory authorities involved in wheat improvement and seed system strengthening under Central Indian agro-climatic conditions.

**Table 3.** Variation in Quantitative Traits of Wheat Genotypes at ICAR-IARI RS Indore during crop period 2023-2024

Genotypes	Coleoptile: Antho-cyanin colour-ation	Plant: growth habit	Foliage colour	Flag leaf: Antho-cyanin colour-ation of auricles	Flag leaf: Hairson auricle	Flag leaf: attitude	Flag leaf: Wax. on leaf sheath	Flag leaf: Wax. on leaf blade	Ear: Waxiness of neck	Culm: waxiness of neck	Ear shape in profile	Ear density	Peduncle: Attitude (at maturity)	Awn: attitude	Awns orscurs presence	Grain colour	Season Type
2889/2139	Absent	Semi-erect	Green	Absent	Absent	Drooping	Strong	Strong	Weak	Medium	Tapering	Medium	Straight	Medium	Present	Amber	Spring
22BRDP5001	Absent	Semi-erect	Dark Green	Absent	Strong	Erect	Strong	Medium	Weak	Strong	Tapering	Medium	Bent	Spreading	present	Amber	Spring
22BRWH2402	Absent	Semi-erect	Green	Absent	Absent	Drooping	Strong	Weak	Weak	Strong	Tapering	Medium	Bent	Spreading	present	Amber	Spring
22BRDB1003	Absent	Inter-mediat	Green	Absent	Absent	Drooping	Medium	Weak	Weak	Weak	Tapering	Medium	Bent	Medium	present	Amber	Spring
22BRHI3304	Absent	Semi-erect	Green	Absent	Absent	Drooping	Medium	Weak	Medium	Weak	Tapering	Medium	Bent	Medium	present	Amber	Spring
22BRHI3405	Absent	Semi-erect	Green	Absent	Absent	Drooping	Strong	Weak	Weak	Strong	Tapering	Lax	Straight	Medium	present	Amber	Spring
22BRHI0006	Absent	Semi-erect	Green	Absent	Absent	Drooping	Absent	Absent	Weak	Absent	Tapering	Medium	Bent	Medium	Both present	Amber	Spring
22BRHI4407	Absent	Semi-erect	Green	Absent	Absent	Drooping	Medium	Absent	Absent	Absent	Parallel Sided	Lax	Straight	Medium	Both present	Amber	Spring
DBW-187	Absent	Erect	Green	Absent	Strong	Drooping	Medium	Absent	Absent	Medium	Tapering	Dense	Bent	Medium	Both present	Amber	Spring
HD-2967	Absent	Erect	Green	Absent	Absent	Erect	Very Strong	Strong	Medium	Strong	Tapering	Medium	Bent	Medium	Both present	Amber	Spring

**Table 4.** Variation in quantitative traits of wheat genotypes at ICAR-IARI RS Indore during crop period 2023-2024

Genotypes	Plant ht (cm)	Flag leaf length (cm)	Flag leaf width (cm)	Days to 75% heading	Peduncle length (cm)	Spikelet par Ear	Days to 75% maturity	Ear length (cm)	Awn Length (cm)	1000 gr wt. (gm)
2889/2139	92.5	25.3	1.5	72	31.3	20	167	10.7	8.6	31.3
22BRDP5001	90.6	18.2	1.9	73	32.7	18	165	9.8	7.5	36.9
22BRWH2402	88.9	27.5	1.3	68	35.5	16	159	9.4	7.4	30.5
22BRDB1003	88.3	22.3	1.2	76	34	14.2	165	9.7	6.4	36.3
22BRHI3304	80.3	22	1.6	63	37.6	18.5	154	9.6	8.5	34.6
22BRHI3405	82.2	25.7	1.3	64	37.4	16.2	155	10.2	8.6	39.8
22BRHI0006	83.6	26.2	1.7	66	35.4	16.1	160	9.7	8.4	35.6
22BRHI4407	84.9	27.7	1.5	64	38	15.2	158	9.9	7.9	42.5
DBW-187	95	25.7	1.4	66	34	19.2	162	10.7	8.4	41.4
HD-2967	85	22.7	1.3	64	32.4	20	161	9.6	7.6	39.5
Grand mean	87.13	24.33	1.4	67.6	34.83	17.04	160.6	9.93	7.93	36.8
P-value	0.026	0.073	0.112	0.009	0.041	0.058	0.183	0.019	0.081	0.003
LSD	6.05	3.18	0.49	2.65	5.62	1.41	3.15	1.04	2.05	4.58
CV%	7.63	13.98	29.05	8.98	5.95	9.12	2.03	10.63	6.38	8.68

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