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Agro-morphological Characterization of Wheat *(Triticum aestivum* L.) Genotypes

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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 study was conducted in field conditions that suitable to typical growth and all trait expression. A set of 30 wheat genotypes was evaluated for 10 agro-morphological traits in the *rabi* season 2022-2023. The experiment followed Randomized Complete Block Design (RCBD) with two replications and along with three different date of sowing. For the present study data was recorded on the basis of DUS (Distinctness, Uniformity and Stability) guidelines. Phenotypic assessment revealed variability in different morphological traits like Plant growth habit, Foliage colour, Flag leaf length, Flag leaf width, Ear time of emergence, Ear Shape, Ear Density, Ear colour, Grain colour and Grain

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shape. Most of the morphological traits found an adequate level of variability.These established descriptors serve as valuable markers for characterizing the wheat, facilitating genotypes utilization and conservation efforts.

Keywords: Wheat genotypes; DUS guidelines; phenotypic variability; agro-morphological traits.

1. INTRODUCTION

Wheat stands as a crucial annual cereal crop globally and holds a significant position in Indian agriculture, ranking just after rice. Among the 17 wheat species, only three are predominantly cultivated worldwide: *Triticum aestivum,Triticum durum* and *Triticum dicoccum.* Wheat is widely grown as a primary grain in the cereal category and contributes approximately 30% to the nation's food supply. There is a pressing need for substantial progress in wheat production, not only to meet the ever-growing domestic food demand but also to bolster exports and earn foreign currency.

Wheat stands out favorably in terms of its nutritional composition when compared to other cereals. It boasts an impressive nutritional profile, consisting of 12.1% protein, 1.8% lipids, 1.8% ash, 2.0% reducing sugars, 6.7% pentoses, and a substantial 59.2% starch content. Moreover, it is rich in carbohydrates, with a total carbohydrate content of 70%, providing a significant energy value of 314 kilocalories per 100 grams of food. Additionally, wheat serves as a valuable source of essential minerals and vitamins, including calcium at 37 milligrams per 100 grams, iron at 4.1 milligrams per 100 grams, thiamine at 0.45 milligrams per 100 grams, riboflavin at 0.13 milligrams per 100 grams, and nicotinic acid at 5.4 milligrams per 100 grams, as documented by Lorenz and Kulp in [1].

Wheat cultivation exhibits versatility, thriving in a range of environmental conditions, including mild, humid to arid, and cold climates. Its cultivation varies from irrigated to rainfed, encompassing regions with high rainfall. Globally, the production of wheat amounts to a staggering 779.1 million metric tonnes, covering an extensive area of 221.72 million hectares, with an average yield of 3.5 metric tonnes per hectare, as reported in FAOSTAT [2]. In the context of India, the country achieved a notable wheat production of 107.74 million metric tonnes in the 2021-2022 securing the second position in global wheat production, trailing only behind China. This substantial yield is cultivated across an expansive area of 30.58 million hectares, attaining an average productivity of 3440 kilograms per hectare, as indicated by Anonymous [3]. Delving specifically into the region of Madhya Pradesh, wheat cultivation flourishes over 6.69 million hectares, resulting in a remarkable production of 19.61 million tonnes and a productivity rate of 2627 kilograms per hectare, according to data from [3].

Wheat has evolved over countless ages, adapting to a diverse array of environmental niches. As a consequence, it displays a remarkable spectrum of adaptability. Throughout its evolutionary journey, both deliberate and inadvertent selection pressures have played a pivotal role in shaping specific genotypes tailored to distinct local environments. In the context of the present investigations, the primary objective was to Morphological characterization of wheat genotypes [4,5]. Morphological characteristics in wheat play a crucial role in assessing the significance of each trait in enhancing yield and are fundamental for identifying specific cultivars. Consequently, these traits have been incorporated into breeding programs, contributing to yield improvement and the introduction of commercially viable wheat varieties. Furthermore, the study sought to identify and remark certain genotypes that hold promise for integration into future genotype and breeding programs. This research contributes to our understanding of wheat genetic potential and offers valuable insights for the advancement of wheat breeding endeavors.

2. MATERIALS AND METHODS

The Zonal Agricultural Research Station (ZARS) farm at College of Agriculture, Powarkheda, affiliated with Jawaharlal Nehru Krishi VishwaVidyalaya (JNKVV), Jabalpur, Madhya Pradesh, was the location for this research during the Rabi season of 2022-2023. The experiment consisted of thirty wheat genotypes, including three checks, obtained from the All India Coordinated Research Project on Wheat and Barley at the same college. To assess the impact of sowing time, a Randomized Complete Block Design (RCBD) with two replications was implemented, with sowing carried out on three different dates: 8th November 2022 (normal), 18th November 2022 (late), and 28th November 2023 (extra late). All genotypes were sown in a four-row pattern, maintaining a uniform 20 cm distance between rows. The study focused on ten morphological characteristics, specifically Plant growth pattern, Leaf colour, Flag leaf dimensions, Ear emergence time, Ear Shape, Ear Density, Ear colour, Grain colour, and Grain shape, following the guidelines of the DUS descriptor of the Protection of Plant Varieties & Farmers' Rights Authority [6]. The assessment of colour attributes was conducted using the Royal Horticultural Society (RHS) colour chart for accurate measurement.

3. RESULTS AND DISCUSSION

Thirty wheat genotypes were categorized based on various morphological characteristics as per DUS descriptors. As per DUS descriptors, 30 genotypes were categorized into various groups, and the distribution is presented in Table 1, and well as the frequency distributions of each trait in Figs. 1–10. Significant diversity was found in the wheat morphological traits. The study categorized wheat genotypes into four groups based on plant growth habits: erect, semi-erect, intermediate and semi-protrate. One genotype was erect (3%), twenty-one had semi-erect (70%), six had intermediate (20%), and two had semi-prostatate (7%) (Fig. 1). On the basis of foliage colour, genotypes were classified into three groups, viz., dark green, pale green, and green. Fourteen had dark green (47%), three genotypes had pale green (10%), and thirteen genotypes had green foliage colour (43%) (Fig. 2). Based on flag leaf length, genotypes were classified into three groups: long, medium and short. Eight had long (27%), twenty had medium (66%), and two had short (7%) flag leaf length (Fig. 3). Based on flag leaf width, genotypes were classified into three categories: narrow, medium, and broad. Out of thirty genotypes, twenty had a narrow (10%), twenty had a medium (67%) and seven had a broad (23%) flag leaf width (Fig. 4). Based on ear time of emergence, genotypes were classified into three categories: early, medium and late; three had early (10%), twenty-six had medium (87%) and one had late (3%) ear emergence (Fig. 5). On the basis of ear shapes in profile, genotypes were classified into three groups: tapering, parallel and fusiform. Twenty-three genotypes had tapering (79%) six had parallel (18%), and one had fusiform ear shape (3%) (Fig. 6). Based on ear density, genotypes were classified into five categories: very lax, lax, medium, dense and very dense. Twenty-eight genotypes had dense (93%) and two had medium (7%) ear density (Fig. 7). On the basis of ear colour, genotypes were classified into three categories: white, light brown and dark brown. Three had white (10%), while twenty-seven had light brown (90%) in ear colour (Fig. 8). On the basis of grain colour, genotypes were classified into three categories: white, amber and red. Twenty-four genotypes had amber (80%), four had white (13%), and two had red (7%) grain colour (Fig. 9). Based on grain shape, genotypes were classified into four categories: round, ovate, oblong and elliptical. Five had ovates (17%), while twenty-five had oblong (83%) grain shapes (Fig. 10). These distinctive traits serve as valuable identification keys for different wheat genotypes resources.Similar to our result Khaliq et al. [7], Mebatsion et al. [8], Goyal, et al. [9] and Raza, et al. [10] found the morphological characters.

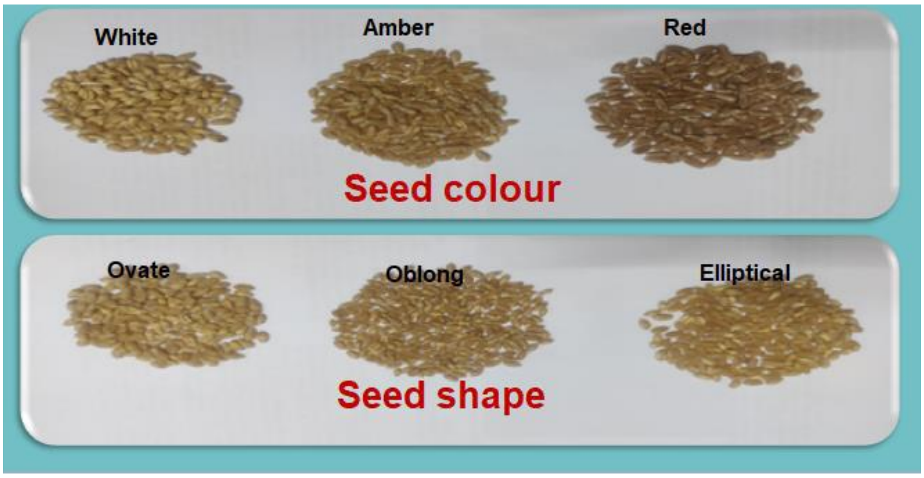

Plate 1. Grain characterization

Table 1. Morphological description of wheat genotypes

Genotypes	Plant growth habit	Foliage colour	Flag leaf length	Flag leaf width	Time of ear emergence	Ear shape	Ear density	Ear colour	Grain shape	Grain colour
GW 432	Semi-erect	Dark green	long	medium	medium	Tapering	Dense	Light brown	Oblong	Amber
PBW 760	Semi-serect	Pale green	long	narrow	medium	Tapering	Dense	Light brown	Oblong	White
HD 3317	Intermediate	Dark green	medium	long	late	Tapering	Dense	Light brown	Ovate	Amber
IC 296769	Semi-erect	pale green	medium	medium	medium	Tapering	Dense	Light brown	Oblong	Amber
MP 3336	Semi-spreading	pale green	medium	medium	medium	Tapering	Medium	Light brown	Oblong	Amber
HS 661	Semi-erect	Green	long	medium	medium	Tapering	Dense	White	Oblong	Amber
HI 1624	Semi-erect	Dark green	long	medium	medium	Tapering	Dense	Light brown	Ovate	Amber
PBW 820	Semi-erect	Green	medium	medium	medium	Tapering	Dense	Light brown	Oblong	Amber
HD 2967	Semi-erect	Green	medium	narrow	medium	Parallel	Dense	Light brown	Oblong	White
GW 328	Semi-erect	Dark green	medium	broad	medium	Parallel	Dense	Light brown	Oblong	Amber
DBW 107	Semi-erect	Dark green	medium	medium	medium	Tapering	Dense	Light brown	Oblong	White
MP 4010	Semi-erect	Dark green	short	medium	medium	Tapering	Dense	Light brown	Oblong	Amber
GW 190	Erect	Dark green	medium	medium	medium	Tapering	Dense	Light brown	Ovate	Amber
K 1317	Semi-erect	Green	medium	medium	medium	Tapering	Dense	Light brown	Oblong	Amber
HI 1634	Semi-erect	Dark green	medium	medium	medium	Tapering	Dense	Light brown	Oblong	Amber
USA NG 326	Semi-erect	Dark green	long	medium	medium	Tapering	Dense	Light brown	Oblong	Amber
HI1628	Semi-spreading	Green	medium	medium	medium	fusiform	Dense	Light brown	Oblong	Amber
WAPD 1505	Semi-spreading	Dark green	medium	broad	medium	Tapering	Dense	Light brown	Oblong	Amber
HD 3237	Intermediate	Green	long	broad	medium	Tapering	Medium	Light brown	Oblong	Amber
WGW 2014 596	Semi-erect	Green	medium	narrow	medium	Tapering	Dense	Light brown	Oblong	Red
CG 1029	Semi-erect	Dark green	medium	broad	medium	Tapering	Dense	Light brown	Ovate	Amber
GW 3211	Semi-erect	Pale green	short	medium	medium	Tapering	Dense	Light brown	Oblong	Amber
JW 17	Intermediate	Dark green	medium	medium	medium	Tapering	Dense	White	Oblong	White
PBW 797	Intermediate	Dark green	medium	medium	medium	Parallel	Dense	Light brown	Oblong	Amber
GW 499	Semi-erect	Green	long	medium	medium	Parallel	Dense	Light brown	Oblong	Amber
DBW 110	Intermediate	Green	long	medium	medium	Tapering	Medium	Light brown	Oblong	Amber
DBW 71	Semi-erect	Green	medium	medium	medium	Tapering	Dense	Light brown	Oblong	Red
GW 322	Semi-erect	Dark green	medium	medium	Early	Tapering	Dense	White	Oblong	Amber
JW 3382	Semi-erect	Green	medium	medium	Early	Tapering	Dense	Light brown	Ovate	Amber
Lok 1	Semi-erect	Dark green	long	medium	Early	Tapering	Dense	Light brown	Oblong	Amber

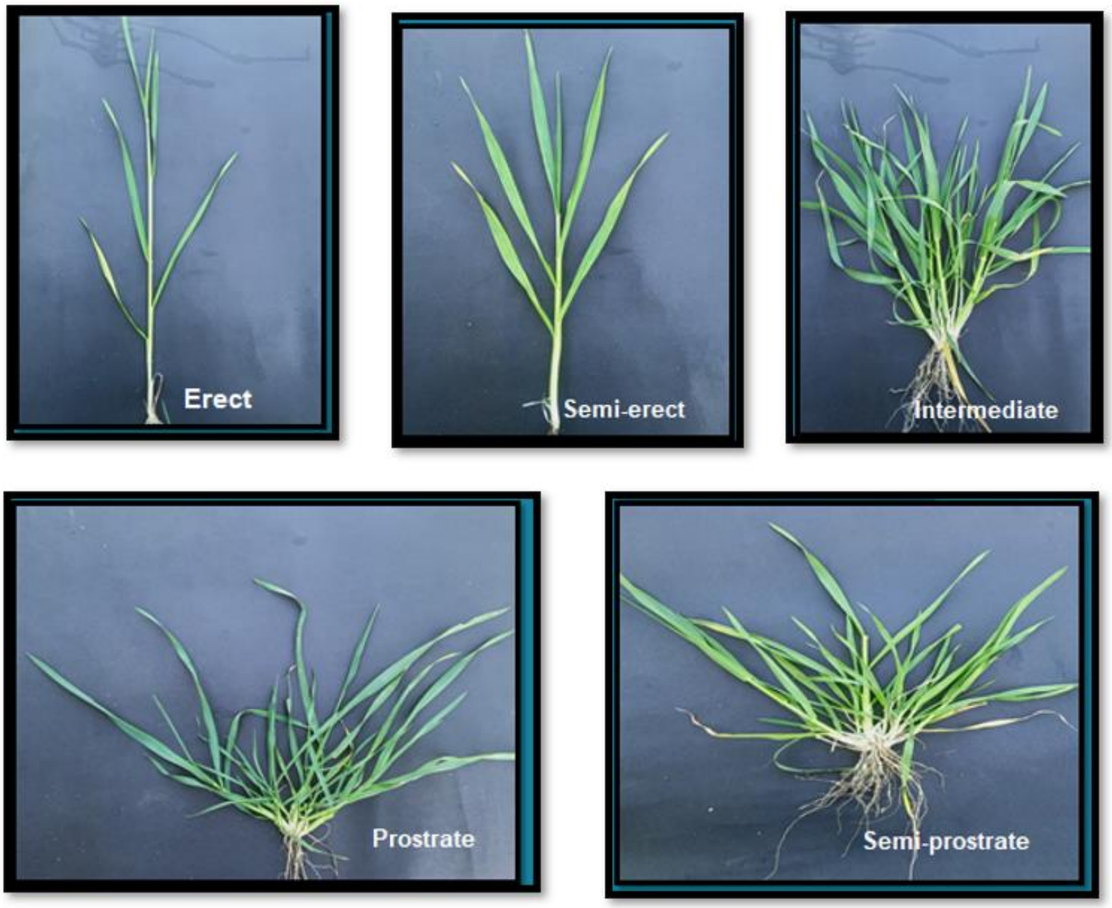

Plate 2. Plant growth habits

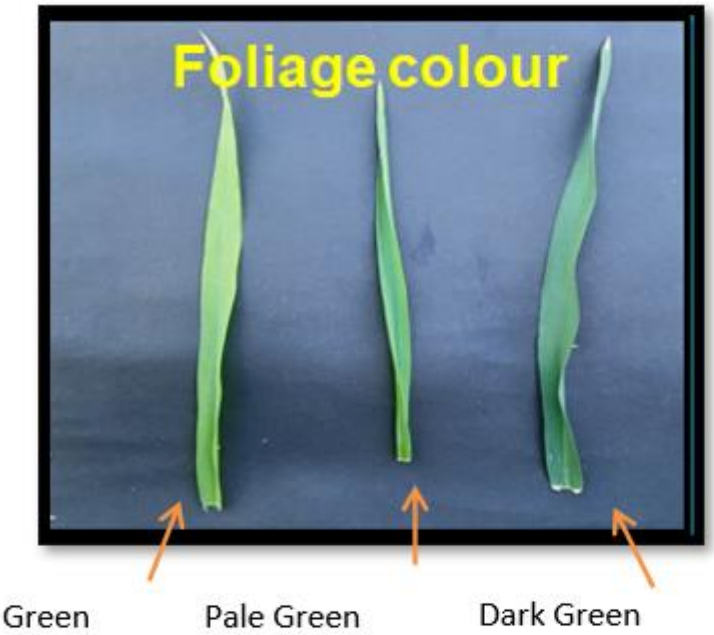

Plate 3. Morphological characterization

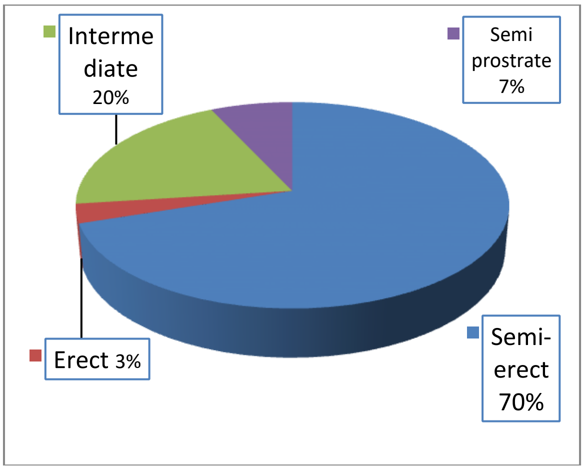

Fig. 1. Plant Growth Habit

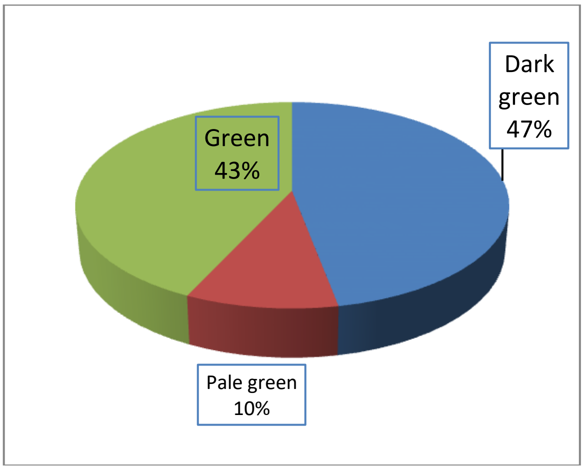

Fig. 2. Foliage colour

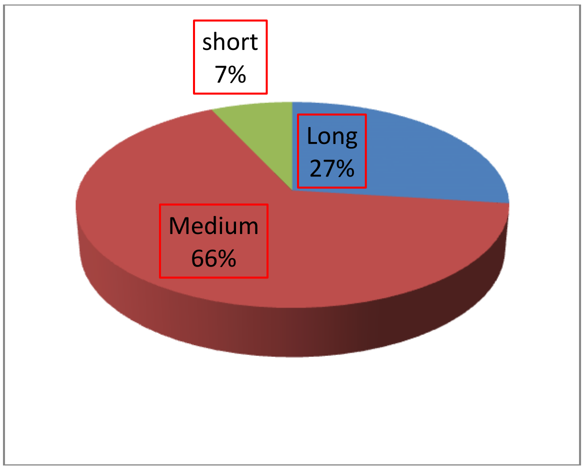

Fig. 3. Flag Leaf Length

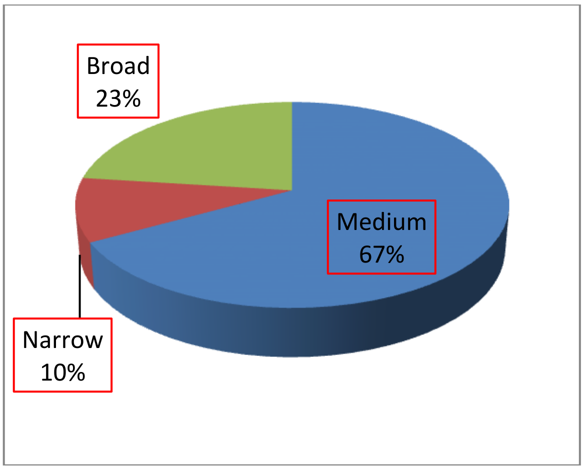

Fig. 4. Flag Leaf Width

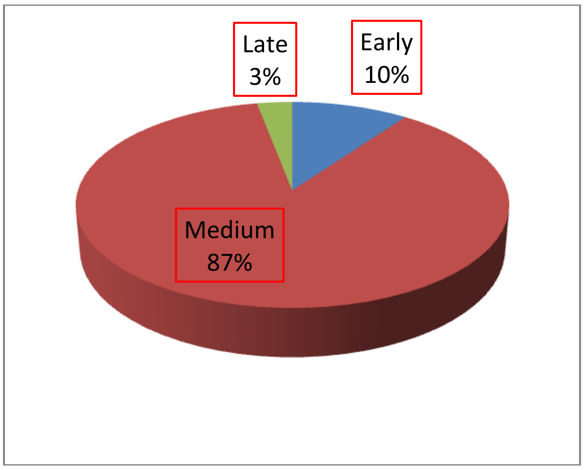

Fig. 5. Time of Ear Emergence

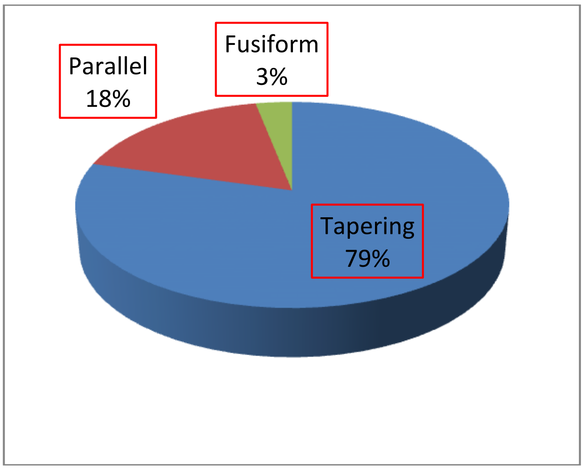

Fig. 6. Ear Shape

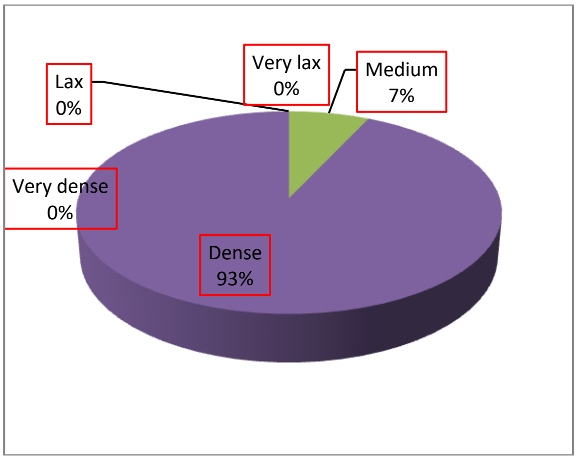

Fig. 7. Ear Density

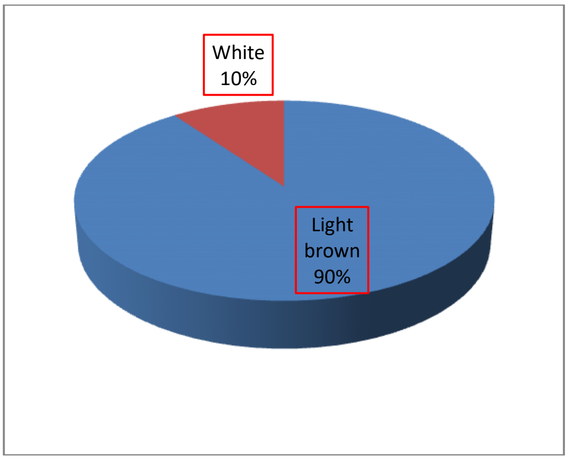

Fig. 8. Ear Colour

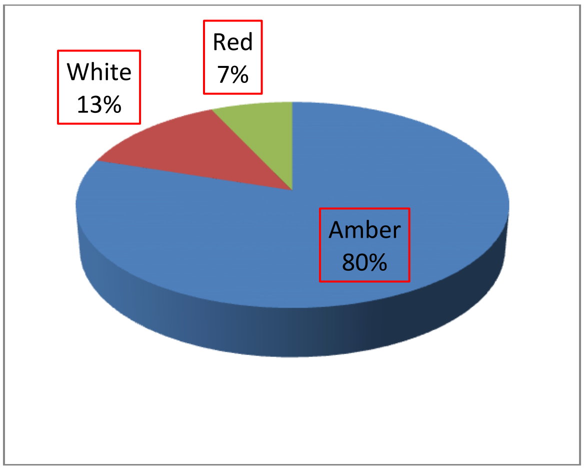

Fig. 9. Grain Colour

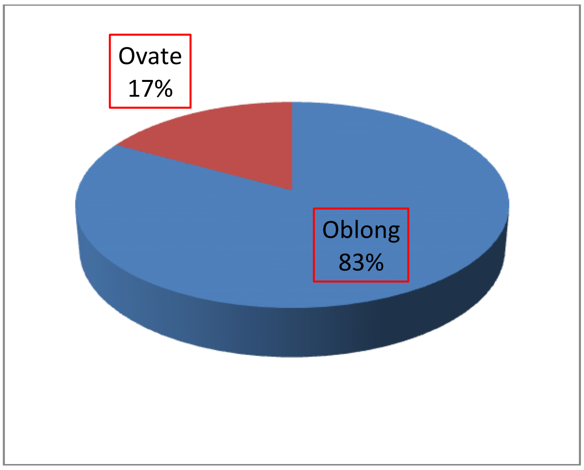

Fig. 10. Grain Shape

Figs. 1- 10. Frequency distribution pie chart for different morphological traits

4. CONCLUSION

There was significant variability among wheat genotypes in terms of distribution as well as extent of variation for ten morphological traits. Across all examined morphological characteristics, this substantial divergence was consistently observed. They provide a solid foundation for their potential application as morphological markers in future varietal development programs, highlighting their value for wheat breeding.

ACKNOWLEDGEMENTS

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COMPETING INTERESTS

Authors have declared that no competing interests exist.

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