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Characterization of wheat varieties (*Triticum* spp.) through seed morphology

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Abstract: An experiment was carried out at the Department of Seed Science and Technology, Junagadh Agricultural University, Junagadh, to characterize 28 wheat varieties of different species [17 varieties (MP 4010, HI 1500, HI 1531, HI 1544, GW 1, GW 503, DL 788-2, HD 2932, GW 11, GW 173, GW 190, GW 273, LOK 1, GW 322, MP 3288, GW 366 and GW 496) of *Triticum aestivum*, 9 varieties (HI 8381, HI 8498, HI 8627, HI 8713, A 28, A 206, GDW 1255, GW 1139 and RAJ 1555) of *Triticum durum* and 2 varieties (DDK 1025, DDK 1029) of *Triticum dicoccum*)] released for general cultivation in Gujarat at state level as well as at the National level in Central India based on the seed morphological characters. Based on the seed colour, the varieties were grouped into amber (25), white (1) and red (2). On the basis of seed shape, wheat varieties were separated in to round (2) ovate (7), oblong (12) and elliptical (7). On the basis of seed size, varieties were grouped into medium seed size (5), bold seed size (15) and very bold seed size (8). On the basis of seed hardness, varieties were grouped into soft (1), semi-hard (7) and hard (20). Based on the seed germ width, varieties were grouped into medium (15), wide (9) and narrow (4) seed germ width types. The varieties were grouped based on the seed crease into three groups, as medium (11), shallow (12) and deep (5) grain crease types. Based on the brush hair length, wheat varieties were grouped as short (17), medium (7) and long (4) brush hair length types.

Keywords: Characterization, Morphology, Seed, *T. aestivum, T. dicoccum, T. durum,* Wheat

INTRODUCTION

Wheat is one of the most important and widely cultivated crops in the world, used mainly for human consumption and support nearly 35% of the world population (Mohammadi-joo *et al.*, 2015) and providing 20 per cent of the total food calories (Anonymous, 2014). It is the most widely cultivated food crop of the world. It is known for its remarkable adoption to a wide range of environments and its role in world economy. The main wheat growing countries are European Union, China, India, USA, Russian Federation, Canada, Australia, Pakistan, Turkey, Ukraine, Iran, (Anonymous, 2015).

Wheat (*Triticum spp*. L.) is an annual plant that belongs to the grass family *Poaceae*, tribe *Triticeae*, and subtribe *Triticineae*. It is thought to have originated on the Eurasian continent, a starting point from which man spread it throughout the world, including China and central Europe (Haider, 2012). Wheat is one of the earliest domesticated crop plants in the Pre-Pottery Neolithic Near East (Lev-Yadun *et al.*, 2000). The center of its domestication is widely accepted to be somewhere in the Middle East (Anikster and Wahl, 1979). It is the world's most widely cultivated food crop, followed by rice and maize (Gulbitti-Onarici *et al.*, 2009), and one of the oldest and most important of the cereal crops (Harlan, 1992), producing the highest global grain production of any crop (Lamoureux *et al.*, 2005).

In India, wheat is mainly grown in the states of Uttar Pradesh, Madhya Pradesh, Punjab, Rajasthan, Haryana, Bihar, Maharashtra, Karnataka and Gujarat. During 2013-14, India accounts an area, production and productivity of 31.34 million ha, 95.91 million metric tonnes and 3061 kg/ha, respectively (Anonymous, 2013). In Gujarat, wheat is grown during 2013-14 in about 13.51 lac ha with total production of 36.50 lac metric tonnes and productivity of 2074 kg/ha (Anonymous, 2013). Globally, demand for wheat by the year 2020 is forecast at around 950 million tonnes per year. This target will be achieved only, if global wheat production is increased approximately by 2.5 per cent per annum.

Maintenance of genetic purity of varieties is of primary importance for preventing varietal deterioration during successive regeneration cycles and for ensuring varietal performance at an expected level. The aspects of Distinctness, Uniformity and Stability (DUS) are fundamental for characterization of varieties. In countries having Plant Breeder's Right (PBR) in operation, a new variety is registered only, if it is distinct from other varieties, uniform in its characteristics and genetically stable. In the light of the above facts, the present study on documentation of characters

for wheat varieties was planned with the objective to identify stable diagnostic characteristics of seed morphology of wheat varieties.

MATERIALS AND METHODS

The experiment was conducted in the seed testing laboratory of Department of Seed Science and Technology, Junagadh Agricultural University, Junagadh, during *rabi* 2014 to study the varietal characterization in 28 wheat varieties [17 varieties (MP 4010, HI 1500, HI 1531, HI 1544, GW 1, GW 503, DL 788-2, HD 2932, GW 11, GW 173, GW 190, GW 273, LOK 1, GW 322, MP 3288, GW 366 and GW 496) of *Triticum aestivum*, 9 varieties (HI 8381, HI 8498, HI 8627, HI 8713, A 28, A 206, GDW 1255, GW 1139 and RAJ 1555) of *Triticum durum* and 2 varieties (DDK 1025, DDK 1029) of *Triticum dicoccum*)] released for general cultivation in Gujarat at state level as well as at the national level in central India based on the seed morphological characters. Seed morphological characters *viz.,* seed colour, seed shape, seed size (test weight) (g), seed hardness, seed germ width, seed crease and brush hair length were measured as per the guidelines of DUS testing (http://plantauthority.gov.in/pdf/GBread%20 Wheat.pdf). Of all the seed morphological characters, seed size (test weight) was the only quantitative character, which was analyzed following analysis of variance for Completely Randomized Design as per the method of Cochran and Cox (1957)

RESULTS AND DISCUSSION

Based on the variation in seed morphological characteristics, the varieties were grouped in to different categories (Table 1 and 2). Based on the seed colour, the varieties were grouped into amber (25 varieties), white (1 variety) and red (2 varieties). On the basis of seed shape, wheat varieties were separated in to round (2 varieties) ovate (7 varieties), oblong (12 varieties) and elliptical (7 varieties). On the basis of seed size, five varieties were grouped into medium seed size (35-40 g), fifteen in bold seed size (40-45 g) and eight in very bold seed size (> 45 g). The seed size ranged from 35.78 g (GW 190) to 54.62 g (LOK 1) with a mean of 43.66 g. On the basis of seed hardness, one genotype was grouped as soft, seven varieties as semi-hard and twenty varieties as hard. Based on the seed germ width, fifteen varieties were grouped as medium, nine varieties as wide and four varieties as narrow seed germ width types. The varieties were grouped based on the seed crease into three groups, as medium (11 varieties), shallow (12 varieties) and deep (5e varieties) seed crease types. Based on the brush hair length, seventeen varieties were grouped as short, seven varieties as medium and four varieties as long brush hair length types.

The seed morphological characteristics helped in identifying and grouping of the varieties. Based on the variation in seed morphological characteristics, wheat varieties identification keys are presented in Fig. 1. The varieties *viz.,* MP 4010 and GW 503 were having similar seed morphology *viz*., amber seed colour, oblong seed shape, bold seed size, hard seed, medium seed germ width, shallow seed crease and medium brush hair length. The varieties, HI-1500 and DL-788-2 were differing from the above varieties (MP 4010 and GW 503) with respect to brush hair length having short brush hair length, while GW 173 with respect to seed size having medium size seed. The variety, A 28 was having amber seed colour, oblong seed shape, bold seed size, hard seed, wide seed germ width, deep seed crease and medium brush hair length and was varied with A 206 with respect to medium seed crease. The varieties, LOK 1, HI 8498, GW 1139 and RAJ

Table 1. Identification and grouping of wheat varieties based on seed colour, seed shape and seed size (test weight).

Varieties	Seed Colour	Seed Shape	Seed Size (Test Weight(g)	Groups (Seed Size)
Triticum aestivum L.				
MP 4010	Amber	Oblong	43.31	Bold
HI 1500	Amber	Oblong	44.21	Bold
HI 1531	Amber	Round	38.62	Medium
HI 1544	Amber	Round	40.71	Bold
GW 1	Amber	Elliptical	42.82	Bold
GW 503	Amber	Oblong	42.51	Bold
DL 788-2	Amber	Oblong	42.06	Bold
HD 2932	Amber	Elliptical	41.43	Bold
GW 11	Amber	Ovate	47.37	Very bold
GW 173	Amber	Oblong	39.30	Medium
GW 190	Amber	Ovate	35.78	Medium
GW 273	Amber	Ovate	40.18	Bold
LOK 1	Amber	Oblong	54.62	Very bold
GW 322	Amber	Ovate	38.32	Medium
MP 3288	White	Oblong	39.81	Medium
GW 366	Amber	Ovate	48.59	Very bold
GW 496	Amber	Ovate	42.58	Bold
Triticum durum Desf				
HI 8381	Amber	Elliptical	44.45	Bold
HI 8498	Amber	Oblong	51.91	Very bold
HI 8627	Amber	Elliptical	42.03	Bold
HI 8713	Amber	Ovate	43.97	Bold
A 28	Amber	Oblong	41.81	Bold
A 206	Amber	Oblong	44.51	Bold
GDW 1255	Amber	Elliptical	46.21	Very bold
GW 1139	Amber	Oblong	47.13	Very bold
RAJ 1555	Amber	Oblong	48.94	Very bold
Triticum dicoccum Schrank				
DDK 1025	Red	Elliptical	44.20	Bold
DDK 1029	Red	Elliptical	45.12	Very bold
Mean			43.66	
S.Em ±			0.37	
C.D. at 5 %			1.05	
CV %			1.46	

Note: Seed Size (Test weight) g; Low < 35 g; Medium 35 to 40 g; Bold 40 to 45 g; Very bold > 45 g.

Table 2. Identification and grouping of wheat varieties based on seed hardness, seed germ width, seed crease and brush hair length.

Varieties	Seed Hardness	Seed Germ Width	Seed Crease	Brush Hair Length
***Triticum aestivum* L.**				
MP 4010	Hard	Medium	Shallow	Medium
HI 1500	Hard	Medium	Shallow	Short
HI 1531	Semi hard	Narrow	Shallow	Short
HI 1544	Semi hard	Wide	Shallow	Short
GW 1	Hard	Wide	Deep crease	Medium
GW 503	Hard	Medium	Shallow	Medium
DL 788-2	Hard	Medium	Shallow	Short
HD 2932	Hard	Medium	Medium	Short
GW 11	Semi hard	Medium	Medium	Short
GW 173	Hard	Medium	Shallow	Short
GW 190	Semi hard	Medium	Deep crease	Long
GW 273	Hard	Narrow	Medium	Short
LOK 1	Hard	Medium	Medium	Medium
GW 322	Semi hard	Wide	Shallow	Long
MP 3288	Hard	Medium	Medium	Short
GW 366	Hard	Medium	Medium	Short
GW 496	Semi hard	Medium	Shallow	Medium
***Triticum durum* Desf**				
HI 8381	Hard	Medium	Medium	Short
HI 8498	Hard	Wide	Shallow	Short
HI 8627	Hard	Wide	Shallow	Short
HI 8713	Hard	Wide	Medium	Short
A 28	Hard	Wide	Medium	Medium
A 206	Hard	Wide	Deep crease	Medium
GDW 1255	Hard	Medium	Deep crease	Short
GW 1139	Hard	Medium	Medium	Short
RAJ 1555	Hard	Wide	Medium	Short
***Triticum dicoccum* Schrank**				
DDK 1025	Soft	Narrow	Deep crease	Long
DDK 1029	Semi hard	Narrow	Shallow	Long

1555 were having amber seed colour, oblong seed shape, very bold seed size and hard seed, but were distinct to each other with respect to germ width, seed crease and brush hair length. The LOK 1 was medium in seed germ width, seed crease and brush hair length, while HI 8498 having wide seed germ width, shallow seed crease and short brush hair length, GW 1139 having medium seed germ width, medium seed crease and short brush hair length and RAJ 1555 having wide seed germ width, medium seed crease and short brush hair length. MP 3288 is the only variety under study having white seed colour with oblong seed shape, medium seed size, hard seed, medium seed germ width, medium seed crease, short brush hair length. GW 11 and GW 366 were having amber seed colour, ovate seed shape, very bold seed size, medium seed germ width, medium seed crease and short brush hair length, but differing in seed hardness (GW 11 had semi hard seed, while GW 366 had hard seed). GW 273, GW 496 and HI 8713 were having amber seed colour, ovate seed shape, bold seed size and hard seed, but differing to each other with respect to seed germ width, seed crease and brush hair length. GW 273 was having narrow seed germ width, medium seed crease and short brush hair length, while GW 496 was having medium seed germ width, shallow seed crease, medium brush hair length and HI 8713 having wide seed germ width, medium seed crease, short brush hair length. GW 322 was having amber seed colour, ovate seed shape, medium seed size, semi hard seed, wide seed germ width, shallow seed crease and long brush hair length. HI 1531 and HI 1544 were having amber seed colour, round seed shape, semi hard seed, shallow seed crease and short brush hair length, but differing in seed size and seed germ width. HI 1531 had medium size seed with narrow seed germ width, while HI 1544 had bold seed with wide seed germ width.

HI 2932 and HI 8381 were having amber seed colour, elliptical seed shape, bold seed size, hard seed, medium seed germ width, medium seed crease and short brush hair length. Two varieties, GW 1 and HI 8627 were differing from the HI 2932 and HI 8381 with respect to seed germ width, seed crease and brush hair length. GW1 having wide seed germ width, deep seed crease and medium brush hair length, while HI 8627 having wide seed germ width, shallow seed crease and short brush hair length.

GDW 1255 was having amber seed colour, elliptical seed shape, very bold seed size, hard seed, medium seed germ width, deep seed crease and short brush hair length, whereas GW 190 was having amber seed colour, ovate seed shape, very bold seed size, semi hard seed, medium seed germ width, deep seed crease and long brush hair length. Similarly, variety DDK-1025 was having red seed colour, elliptical seed shape, bold seed size, soft seed, narrow seed germ width, deep seed crease and long brush hair length, while DDK 1029 having red seed colour, elliptical seed shape, very bold seed size, semi hard seed, narrow seed germ width, shallow seed crease and long brush hair length.

In nut shell, MP 4010 and GW 503, HI 1500 and DL 788-2 and HD 2932 and HI 8381 possessed the similar seed morphology and cannot be differentiated from each other on the basis of seed characteristics. All the remaining 22 varieties were differed from other varieties under study at least for one seed character and could be helpful for the identification of variety from the seed lot.

Similar observations and grouping of varieties based on seed morphological characters were made by various scientists in past in wheat. Naseem *et al*. (2007) characterized 12 buckwheat varieties/genotypes using seed parameters *viz*., seed coat colour, seed shape and seed weight. Among these, seed shape was found to be the most effective parameter for characterization of buckwheat cultivars. The cultivar Shimla B1 had

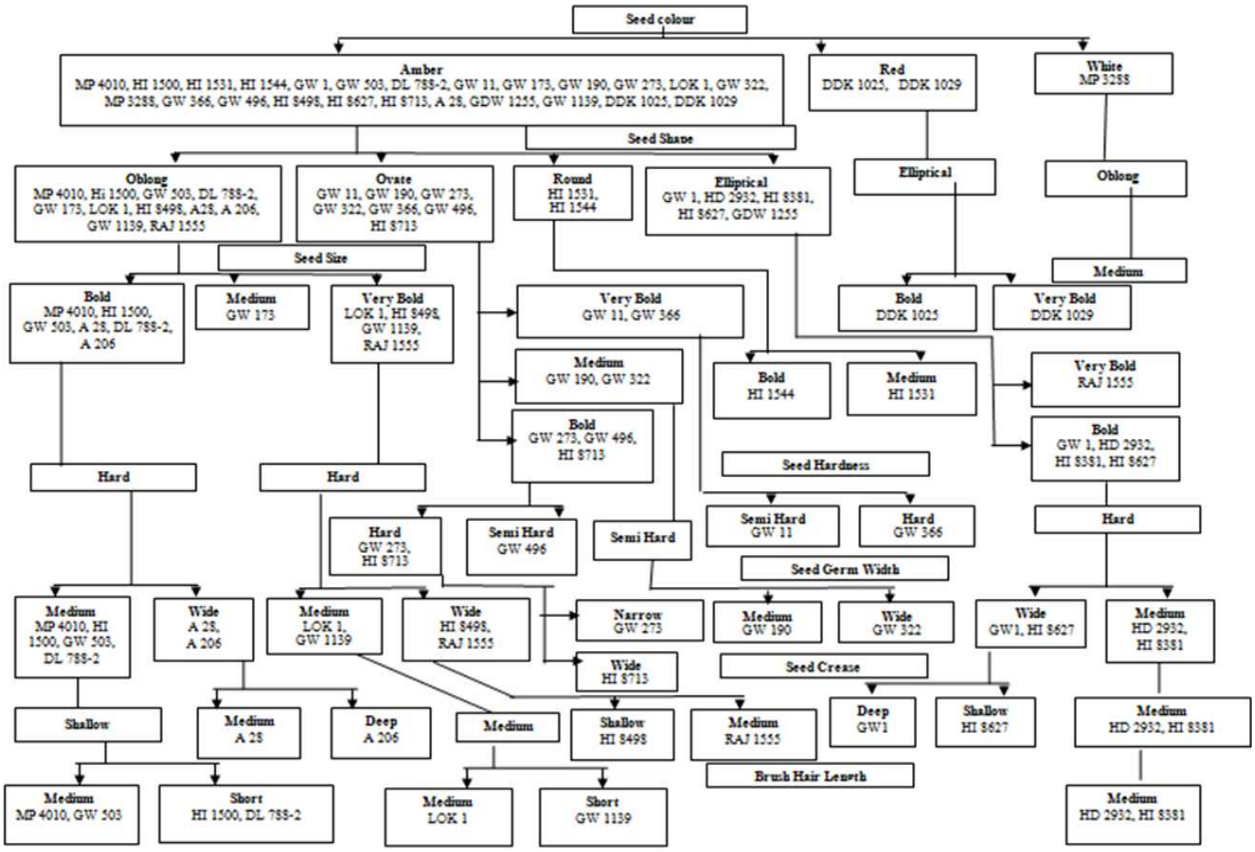

Fig. 1. *Wheat varieties identification keys on the basis of seed morphological characters.*

slightly ovate seed shape and differed from all other cultivars that had conical or triangular seed shape. The cultivar Sangla B2 and Shimla B2 had black seed coat colour, VL 7 and PRB l had mottled and the rest showed grey seed colour. Khan *et al.* (2009) observed significantly, the highest test weight in grains of wheat variety C 273 (78.00 kg/hl) followed by Iqbal 2000 (76.90 kg/ hl). The grains of Kohinoor 83 yielded significantly the lowest test weight (66.47 kg/hl). Mansing (2010) grouped the wheat genotypes based on seed morphology and reported that the seed morphological characteristics helped in identifying and grouping of the genotypes. The genotypes *viz.*, DWR 162 and DWR 225 were having amber colour, ovate type seed shape, semi-hard in nature, low test weight, medium germ width and long brush hair length, while the genotype NI 5439 was distinct to above mentioned genotypes by having medium brush hair length. Similarly, the genotypes *viz.*, DWR 185, MACS 2846 and NIDW 295 showed distinctness in seed characters by having oblong shape, hard in nature, very bold in test weight, wide in germ width and lacking in brush hair length. The genotypes *viz.*, UAS 304 and UAS 305 showed similarity in characters by having amber coloured, oblong shaped, semi-hard in nature, bold in test weight, wide in germ width, but distinct only in brush hair length. Brush hair was absent in UAS 305. Whereas, the genotypes DDK 1001 and DDK 1009 were red in colour, elliptical in shape, hard in nature, medium in test weight, wide in germ width and long in brush hair length.

However, seed colour is genetically controlled characteristics, and it is influenced by the environment (Pascual-Villalobos *et al.*, 1993) and thus, leading to difficulty in classifying the genotypes on the basis of seed colour.

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