

GCP/AFG/045/EC Field Document

National Catalogue of Wheat Varieties in Afghanistan

Ministry of Agriculture, Irrigation and Livestock
Food and Agriculture Organization of the United Nations
International Center for Agricultural Research in the Dry Areas

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Contents

Foreword	v
Acknowledgments	v
Introduction	1
National plant variety catalogue	1
Explanation of characters	4
Characterization of wheat varieties	
Pamir-94	8
Solh-02	10
Gul-96	12
Ghazna-97	14
Bakhtawar-92	16
Ghori-96	18
HD-2285	20
Inqlab-91	22
Balkh-66	24
Nangarhar-64	26
PBW-154	28
Takhar-96	30
Snb ^{”s”}	32
HUW-234	34
Dayma-96	36
MH-97	38
Rana-96	40
Irena/Weaver	42
Lalmi-3	44
Sheshambagh-08	46
Amu-99	48
Kabul-2000	50
Darulaman-07	52
Roshan-96	54
Mazar-99	56
Herat-99	58
Croc-1	60
Drokhshan-08	62
Parva-2	64
Lalmi-2	66
Lalmi-1	68
Ariana-07	70
Additional data	
Table 2. Wheat varieties tested, sources and pedigrees	74
Table 3. Summary of data from Jalalabad, Mazar and Herat locations	75
Table 4. Glutenin subunits banding patterns	77
Table 5. Quick reference table for winter wheat varieties	78
Table 6. Quick reference table for spring wheat varieties	78
Table 7. Quick reference table for facultative and alternative wheat varieties	79
Table 8. Quick reference table for wheat varieties	80
Figure 10. Glutenin subunits banding patterns of wheat varieties	82

Foreword

This publication, Afghanistan's first national variety catalogue for commercial wheat varieties, resulted from collaborative work by the Food and Agriculture Organization of the United Nations (FAO), the Ministry of Agriculture, Irrigation and Livestock (MAIL) in Afghanistan, and the International Center for Agricultural Research in the Dry Areas (ICARDA). This FAO-MAIL-ICARDA collaboration is part of a project on variety and seed industry development, funded by the European Union.

Development of a strong, sustainable seed sector requires well established procedures for evaluating and registering new varieties. Accurate, comprehensive national variety catalogues for the main crops, are an important first step.

The collaborative seed project involves several components. For example, the three institutions are working together to establish a mechanism for conducting DUS and VCU¹ trials for different crops with a focus on wheat, the country's most important food security crop. As part of this effort, teams of national experts working with the project at different locations are being trained by FAO technical experts in close collaboration with ICARDA seed specialists. Adequate capacity now exists within Afghanistan to establish and manage national variety registration trials. Results from these trials were used to produce this variety catalogue. The variety registration trials will continue, and the data will be used to regularly update the catalogue as new varieties are released and older ones withdrawn from commercial seed production.

It is hoped that the system established and manpower trained through this collaborative effort will lay the foundation for further efforts in agricultural research and seed sector development in Afghanistan.



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Acknowledgments

To develop the Afghanistan national variety catalogue, it was necessary to establish DUS trials at multiple locations, and to analyze and report the data collected. Trials were conducted at three locations for two seasons. The contributions by national experts from MAIL and FAO in Mazar-e-Sharif, Nangarhar, Herat and Kabul Agricultural Research Centers were crucial in the preparation of this catalogue. Mr Fuad Jabi-El-Haramain, Head of ICARDA's Grain Quality Laboratory, was responsible for all the grain quality analysis reported here. ICARDA's Afghanistan Office provided valuable information on the varieties tested, contributed to the training, and helped arrange the logistics for technical visits by a number of experts.

¹ DUS = Distinctness, uniformity and stability. VCU = Value for cultivation and use

Introduction

The development of new crop varieties is a crucial first step in agricultural development; but this must be supported by an effective system for the evaluation and release of appropriate new varieties. In countries with developed seed programs, new varieties are released for cultivation through an efficient, effective and transparent system implemented by an independent agency, whether public or associated with the seed industry. This agency conducts variety registration (DUS) and/or performance (VCU) testing. Registration testing is a descriptive assessment to establish the identity of a new variety using morphological, chemical and other characters, and to assess whether it is sufficiently uniform and stable. Registration testing usually runs for two growing seasons or years; the new variety is compared with a number of existing varieties to establish its identity. Performance testing focuses on the merits of the new variety offers to producers and consumers through multi-location, multi-year trials in different agro-ecological zones. This helps identify the best performing varieties, suited to specific environments, or even widely adapted to a range of environments.

Plant variety

A plant variety is a population of plants developed by breeders. For a plant population to be recognized as a variety, it must satisfy at least three criteria. It must be distinct, uniform and genetically stable (DUS). Distinctness refers to significant differences between varieties in at least one important character recorded at one testing site for one season. Uniformity refers to similarity in the genetic makeup of individual plants belonging to a particular plant population (variety). If a plant population maintains its characteristics in successive generations, it is considered stable. Lack of uniformity within a population indicates lack of stability.

Importance of DUS testing

New crop varieties need to have a clear identity, based on which they can be maintained, multiplied, certified and used. Variety identification is essential for variety maintenance (purification), seed production (rogueing), seed certification (field inspection), breeder's rights (protection) and above all commercialization (promotion). DUS testing is the method by which the identity of a new variety is described and the national plant variety catalogue is prepared, maintained and updated.

National plant variety catalogue

The national variety catalogue is an official document in which all commercialized crop varieties in the country are registered and their major varietal characteristics listed. It is a valuable reference for public- and private-sector plant breeders, seed producers and crop producers, as well as seed certification agencies, extension services and plant variety protection offices.

DUS testing procedures

In preparing this catalogue, DUS plots were planted with the varieties grouped by crop, seasonal type, plant height, maturity, etc. The methods, time of observations and scoring of characters followed the guidelines of the International Union for Protection of New Varieties of Plants (UPOV). However, visual observations and measured characters were recorded from 30 plants, rather than the 20 plants specified in the UPOV guidelines. Data were recorded for two seasons at three test sites: Mazar-e-Sharif, Jalalabad and Herat. All plots were replicated twice. Thirty-two wheat varieties (31 bread wheat, one durum wheat) were tested. Of the 31 bread wheat varieties, 15 are facultative, 11 are spring, 4 are winter and 1 is an alternative adapted type.

Data measurements and scoring method

For qualitative characteristics, the level of expression in different varieties was visually rated on a 1-9 scale. There were some differences in scores for the same character at different sites, probably due to human error or genotype by environment (GxE) interactions. For qualitative characteristics, GxE affects the degree to which a character is expressed but not the character itself. For example, a wheat variety with reddish seed color may be darker or lighter red in different environments, but never white. The description given in this catalogue for each character is the most frequent score over the three testing sites. For example if a character is scored as 5, 5, and 7 at the three sites, the description is “medium” (5).

Table 1 lists the characters assessed, and the method of scoring. Table 2 (page 74) lists the 32 varieties, and their sources and pedigrees. Table 3 (page 75) summarizes the results from DUS testing (two years, three sites). Tables 5-8 (page 78-81) provide quick references for prominent characteristics: plant height, beak length, straw color, earliness, grain weight, grain color and seasonal type.

In addition to DUS field plots, all varieties were tested for grain quality and finger print (electrophoresis glutenin subsets). The results are presented in Table 4 (page 77) and Figure 10 (page 82).



Figure 1. Field staff in Afghanistan recording varietal data

Table 1. Characters and scoring method

Character	Time of scoring	Scoring scale
Growth habit	5-tiller stage	Erect, intermediate, prostrate
Earliness	1st spikelet visible	Early, medium, late
Auricle color	Flowering	Present, absent
Flag leaf attitude	Flowering	Erect, semi-drooping, drooping
Flag leaf sheet glaucosity	Flowering	Weak, medium, strong
Flag leaf width	Flowering	Narrow, medium, broad
Last node hairiness	Flowering	Weak, medium, strong
Susceptibility to yellow rust	Flowering	Susceptible, tolerant, resistant
Glume hairiness	Physiological maturity	Present, absent
Cross section of neck	Physiological maturity	Thin, medium, thick
Plant height	Physiological maturity	Short, medium, tall
Beak length	Physiological maturity	Very short, short, medium, long
Shoulder width	Physiological maturity	Narrow, medium, broad
Shoulder shape	Physiological maturity	Sloping, rounded, elevated, straight
Neck zigzagness	Physiological maturity	Weak, medium, strong
Ear shape	Physiological maturity	Tapering, fusiform, parallel
Ear density	Physiological maturity	Lax, medium, dense
Straw color	Full maturity	White, colored
Thousand kernel weight (g)	Full maturity	Low, medium, high
Grain color	Full maturity	White, amber, red
Yield potential	Full maturity	kilograms per hectare
Kernel hardness or Particle Size Index	Full maturity	Soft, medium, hard, very hard
Wheat protein as is moisture basis (%)	Full maturity	Actual protein content (10.9–13.6%)
High molecular weight 1A	Full maturity	Actual score
High molecular weight 1B	Full maturity	Actual score
High molecular weight 1D	Full maturity	Actual score
Farinograph measurements		
Water absorption (%)	Full maturity	Low (desirable), medium, high
Development time (min)	Full maturity	Very weak, weak, medium, balanced (desirable)
Stability time (min)	Full maturity	Very weak, weak, medium, balanced, very strong, over stable
Dough softening (BU)	Full maturity	V. weak, weak, medium, balanced, strong, v. strong, over stable
Alveograph measurements		
Tenacity, P (mm)	Full maturity	Actual score
Extensibility, L (mm)	Full maturity	Actual score
Dough strength	Full maturity	Actual score
P/L configuration ratio	Full maturity	Actual score

Explanation of characters

Plant height. There are differences between varieties in plant height at full maturity. Varieties may be classified as short, medium or high.

Grain color. The natural color of matured wheat grains ranges from light (white) to slightly reddish (amber) to dark red (red) (Fig 2).

Thousand kernel weight (g). The weight of 1000 wheat kernels for different varieties ranges from low (20-30g), medium (30-40g) to high (>40g) in different varieties.

Earliness. The period between germination and heading varies significantly between varieties, from short (Takhar-96) to medium (Lalmi-3) and late (Ghazna-97). See Fig3.

Auricle color. The natural color of flag leaf auricles can be white or pink (Fig 4).

Growth habit. This is described in terms of the angle between the auxiliary tillers and the actual or imaginary upright main stem (Fig 5). It is best scored when there are about five tillers. Growth habit may be erect, semi-erect, intermediate, semi-prostrate or prostrate.

Flag leaf attitude. The angle between the flag leaf and the stem when the first spikelet is visible. This varies between varieties: erect, semi-drooping or drooping.

Flag leaf width. The width of the flag leaf sheet, measured at the base. It may be narrow, medium or broad.

Glumes. Each individual spikelet of a spike is enclosed by two structures known as glumes. Wheat varieties can be grouped, after anthesis, based on characteristics of different parts of the glumes including the beak, the shoulder and the internal imprints. For standardization purposes, all observations are made on the lower glume which can be identified by its lower point of attachment to the rachis branch, compared to the upper glume.

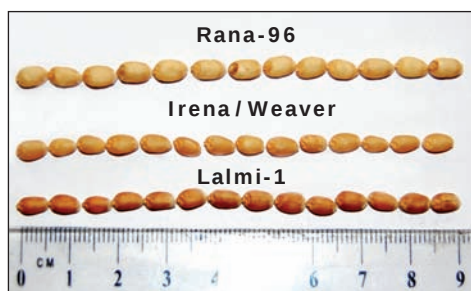


Figure 2. Grain color and size



Figure 3. Earliness and other varietal differences

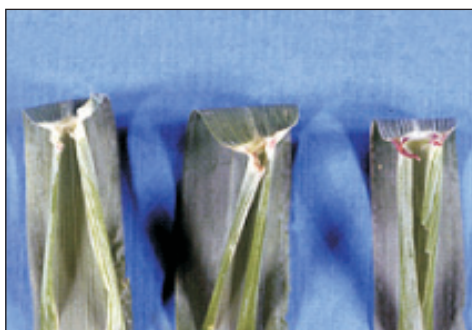


Figure 4. Auricle color

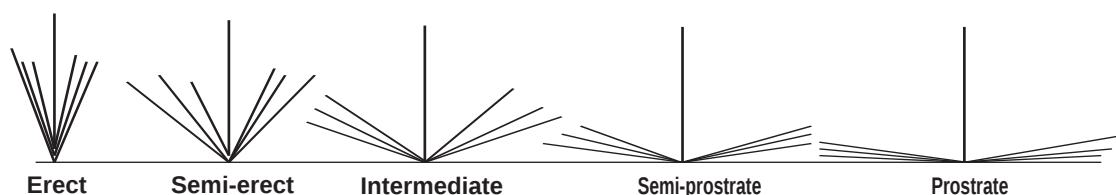


Figure 5. Growth habit

Flag leaf sheet glaucosity. The intensity of waxiness on the flag leaf (Fig 6). It may be weak, medium or strong.

Beak length of glume. Varies from very short to very long (Fig 7). This can be used to classify varieties between the time of anthesis and full maturity.

Shoulder width of glume. Varies from very narrow to very broad. This can be used to classify varieties between the time of anthesis and full maturity.

Shoulder shape of glume. The glume shoulder may be straight, rounded, sloping or elevated. Varieties can be classified on this character between anthesis and full maturity.

Straw color. The natural straw color of mature wheat varies from light or white (Lal-mi-3) to red (PBW-154). See Fig 8.

Ear shape. This refers to the general view of the ear and the position at which the broadest part of the ear is located. It is best scored from completion of heading to complete maturity. The shape may be tapering (Dayma-96), parallel (Lal-mi-3) or fusiform (PBW-154).

Ear density. The spike is composed of several spikelets attached to the main rachis. A dense spike is one with closely spaced spikelets. It is best scored from completion of heading to complete maturity; ear density may be very lax, lax, medium, dense or very dense.

Hairiness of last node. This refers to the presence of hairs on the uppermost node of the stem. Variety differences exist in both bread and durum wheat. It is best scored between heading and anthesis as strong, medium, weak, very weak or absent.

Glume hairiness. Varieties can be classified as glabrous or hairy.

Thickness of parenchyma wall. This refers to the thickness of the parenchyma wall in a horizontal section made at the middle of the spike neck. Variety differences exist in both bread and durum wheat. It is best scored from heading to complete maturity as thick, medium or thin (Fig 9).

Neck zigzagness. Neck zigzagness may be weak, medium and strong.



Figure 6. Flag leaf glaucosity

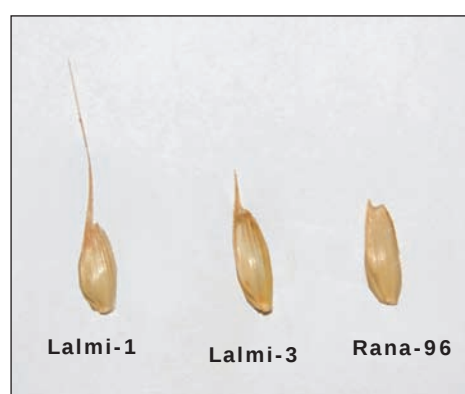


Figure 7. Beak length of glume



Figure 8. Straw color



Figure 9. Thickness of parenchyma wall

Characterization of wheat varieties

Pamir-94

Crop: Wheat
Common name: Bread wheat
Scientific name: *Triticum aestivum*
Pedigree: YMH/TOB/3/LIRA
SWM16#
Seasonal type: Winter
Origin: CIMMYT/ICARDA



Grain characteristics

Grain color	Red
Thousand kernel weight	39 g

Juvenile plant characteristics

Growth habit	Prostrate
--------------	-----------

Flowering plant characteristics

Days from emergence to flowering	Medium
Auricle color	Absent
Flag leaf attitude	Erect
Flag leaf sheet glaucosity	Very weak
Flag leaf width	Narrow
Glume hairiness	Absent
Cross section of neck	Medium

Mature plant characteristics

Last node hairiness	Weak
Plant height	Medium
Beak length of lower glume	Very short
Shoulder width of lower glume	Broad
Shoulder shape of lower glume	Rounded
Neck zigzagness	Medium
Ear shape	Parallel
Ear density	Dense
Straw color	White

Agronomic characteristics

Disease reaction	Resistant to yellow rust
Yield potential	4.2 t/ha

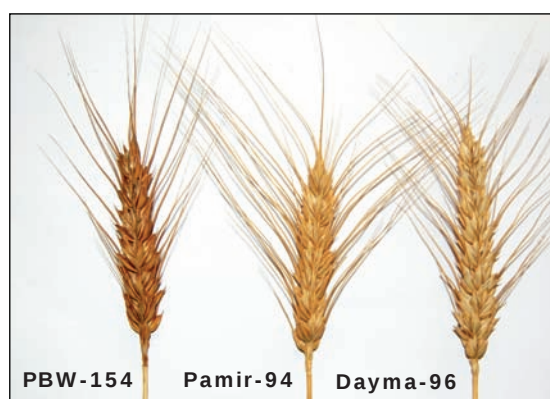
Grain quality characteristics

Parameters	Classification
Particle size index (%)	Soft (62)
Protein (%)	12.1
Farinograph measurements	
Water absorption (%)	57.0
Development time (min)	Weak (2.5)
Stability time (min)	Weak (3.5)
Dough softening (Brabender Unit)	Weak (150)
Alveograph measurements	
P (mm) tenacity	31
L (mm) extensibility	179
W dough strength	0.17
P/L configuration ratio	97
High molecular weight 1A	1
High molecular weight 1B	7+8
High molecular weight 1D	5+10

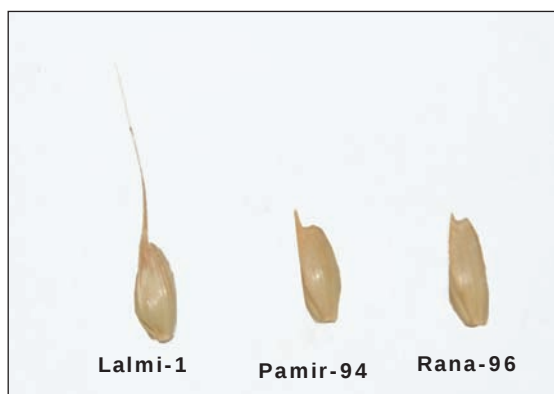
Earliness



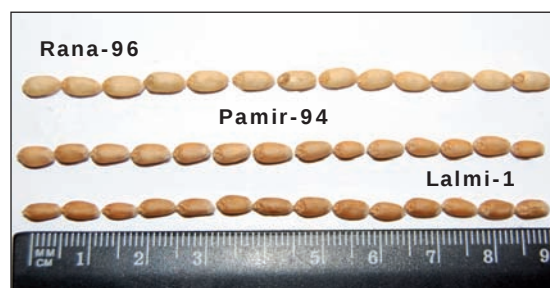
Spikes



Lower glumes



Grain sample



Solh-02

Crop: Wheat
Common name: Bread wheat
Scientific name: *Triticum aestivum*
Pedigree: OK82282//BOW//NKT/F4/
Seasonal type: Winter
Origin: CIMMYT



Grain characteristics

Grain color	Amber
Thousand kernel weight	40 g

Juvenile plant characteristics

Growth habit	Prostrate
--------------	-----------

Flowering plant characteristics

Days from emergence to flowering	Early
Auricle color	Weak
Flag leaf attitude	Erect
Flag leaf sheet glaucosity	Weak
Flag leaf width	Narrow
Glume hairiness	Absent
Cross section of neck	Thin

Maturing plant characteristics

Last node hairiness	Medium
Plant height	Medium
Beak length	Very short
Shoulder width	Broad
Shoulder shape	Slopping
Neck zigzagness	Very weak
Ear shape	Parallel
Ear density	Medium
Straw color	White

Agronomic characteristics

Disease reaction	Resistant to yellow rust
Yield potential	5.7 t/ha

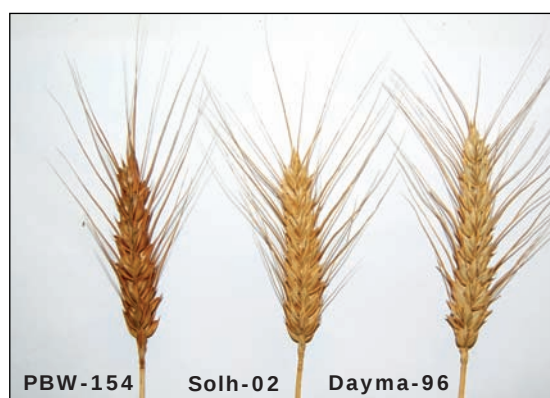
Grain quality characteristics

Parameters	Classification
Particle size index (%)	Medium (50)
Protein (%)	11.8
Farinograph measurements	
Water absorption (%)	59.5
Development time (min)	Weak (3.0)
Stability time (min)	Medium (6.2)
Dough softening (Brabender Unit)	Well-balanced to strong (95)
Alveograph measurements	
P (mm) tenacity	39
L (mm) extensibility	173
W dough strength	0.23
P/L configuration ratio	142
High molecular weight 1A	2*
High molecular weight 1B	13+16
High molecular weight 1D	5+10

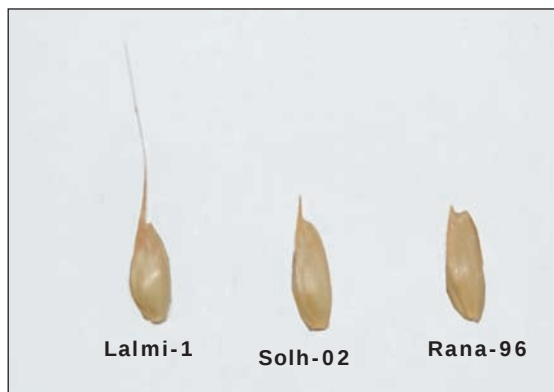
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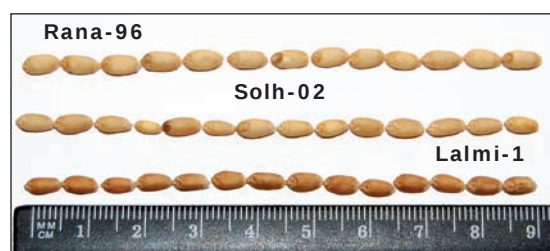
Spikes



Lower glumes



Grain sample



Gul-96

Crop:	Wheat
Common name:	Bread wheat
Scientific name:	<i>Triticum aestivum</i>
Pedigree:	ID8009994.W./VEE 2WM- OWM-OSE-1YC-OYC
Seasonal type:	Winter
Origin:	CIMMYT/ICARDA



Grain characteristics

Grain color	Amber
Thousand kernel weight	45 g

Juvenile plant characteristics

Growth habit	Prostrate
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Flowering plant characteristics

Days from emergence to flowering	Late
Auricle color	Absent
Flag leaf attitude	Erect
Flag leaf sheet glaucosity	Medium
Flag leaf width	Medium
Glume hairiness	Absent
Cross section of neck	Thin

Maturing plant characteristics

Last node hairiness	Weak
Plant height	Medium
Beak length	Short
Shoulder width	Medium
Shoulder shape	Rounded
Neck zigzagness	Weak
Ear shape	Parallel
Ear density	Dense
Straw color	White

Agronomic characteristics

Disease reaction	Resistant to yellow rust
Yield potential	4.3 t/ha

Grain quality characteristics

Parameters	Classification
Particle size index (%)	Medium (44)
Protein (%)	11.4
Farinograph measurements	
Water absorption (%)	Good (62.5)
Development time (min)	Weak (3.5)
Stability time (min)	Weak (2.6)
Dough softening (Brabender Unit)	Weak (160)
Alveograph measurements	
P (mm) tenacity	58
L (mm) extensibility	80
W dough strength	0.73
P/L configuration ratio	124
High molecular weight 1A	1
High molecular weight 1B	7+9
High molecular weight 1D	5+10

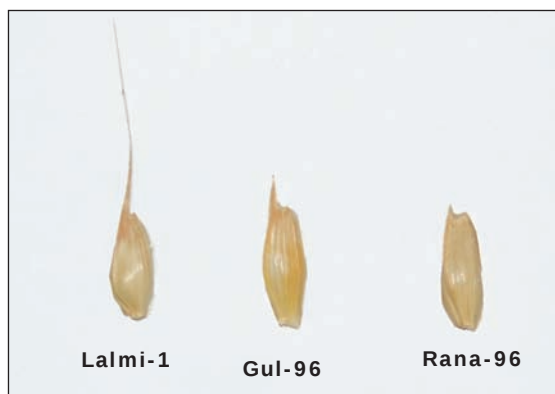
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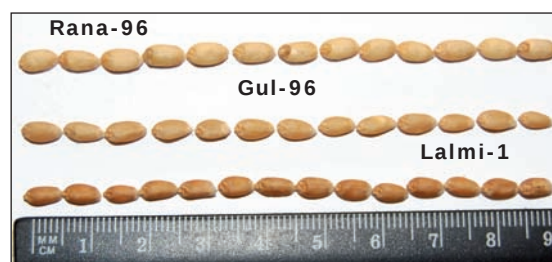
Spikes



Lower glumes



Grain sample



Ghazna-97

Crop:	Wheat
Common name:	Bread wheat
Scientific name:	<i>Triticum aestivum</i>
Pedigree:	AGRI/NAC
Seasonal type:	Winter
Origin:	CIMMYT/ICARDA



Grain characteristics

Grain color	White
Thousand kernel weight	23 g

Juvenile plant characteristics

Growth habit	Prostrate
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Flowering plant characteristics

Days from emergence to flowering	Late
Auricle color	Medium
Flag leaf attitude	Semi-dropping
Flag leaf sheet glaucosity	Weak
Flag leaf width	Broad
Glume hairiness	Absent
Cross section of neck	Medium

Maturing plant characteristics

Last node hairiness	Strong
Plant height	Tall
Beak length	Long
Shoulder width	Narrow
Shoulder shape	Sloping
Neck zigzagness	Very weak
Ear shape	Fusiform
Ear density	Lax
Straw color	White

Agronomic characteristics

Disease reaction	Resistant to yellow rust
Yield potential	3.9 t/ha

Grain quality characteristics

Parameters	Classification
Particle size index (%)	Soft (61)
Protein (%)	13.6
Farinograph measurements	
Water absorption (%)	55.5
Development time (min)	Weak (3.5)
Stability time (min)	well-balanced to strong (9.2)
Dough softening (Brabender Unit)	well-balanced to strong (50)
Alveograph measurements	
P (mm) tenacity	45
L (mm) extensibility	151
W dough strength	0.30
P/L configuration ratio	186
High molecular weight 1A	2*
High molecular weight 1B	7
High molecular weight 1D	5+10

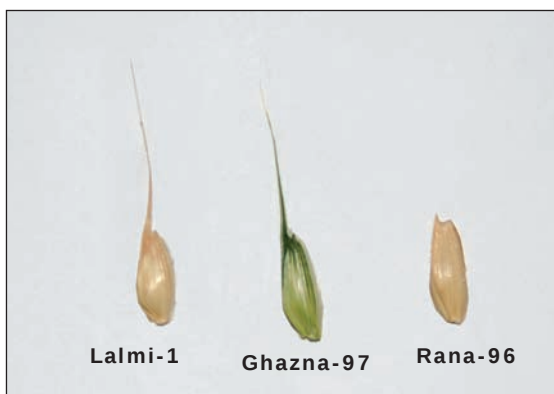
Earliness



Spikes



Lower glumes



Grain sample



Bakhtawar-92

Crop:	Wheat
Common name:	Bread wheat
Scientific name:	<i>Triticum aestivum</i>
Pedigree:	JUP/BJY/URES CM7458-4Y- 1M-3Y-08-OSY
Seasonal type:	Spring
Origin:	CIMMYT/ICARDA



Grain characteristics

Grain color	Amber
Thousand kernel weight	36 g

Juvenile plant characteristics

Growth habit	Semi-erect
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Flowering plant characteristics

Days from emergence to flowering	Early
Auricle color	Absent
Flag leaf attitude	Semi-dropping
Flag leaf sheet glaucosity	Strong
Flag leaf width	Narrow
Glume hairiness	Absent
Cross section of neck	Thin

Maturing plant characteristics

Last node hairiness	Medium
Plant height	Short
Beak length	Short
Shoulder width	Medium
Shoulder shape	Elevated
Neck zigzagness	Weak
Ear shape	Parallel
Ear density	Dense
Straw color	White

Agronomic characteristics

Disease reaction	Resistant to yellow rust
Yield potential	5 t/ha

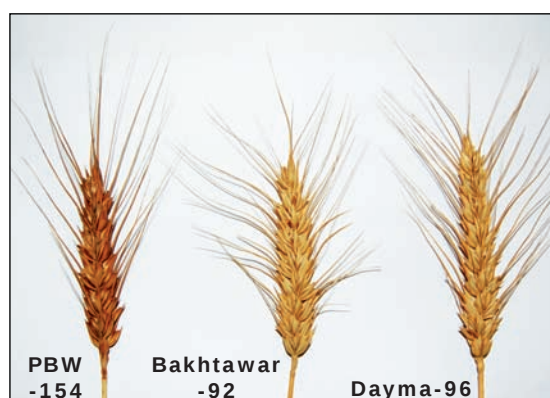
Grain quality characteristics

Parameters	Classification
Particle size index (%)	Medium (38)
Protein (%)	11.4
Farinograph measurements	
Water absorption (%)	63 good
Development time (min)	Weak (3.2)
Stability time (min)	Weak (2)
Dough softening (Brabender Unit)	Weak (160)
Alveograph measurements	
P (mm) tenacity	56
L (mm) extensibility	61
W dough strength	0.92
P/L configuration ratio	96
High molecular weight 1A	2*
High molecular weight 1B	7+9
High molecular weight 1D	5+10

Earliness



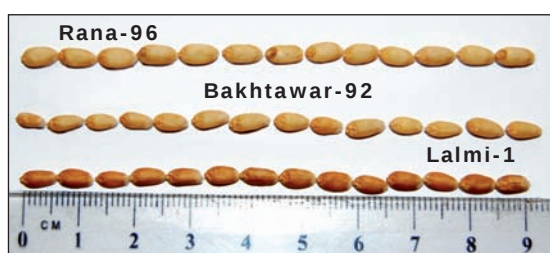
Spikes



Lower glumes



Grain sample



Ghori-96

Crop:	Wheat
Common name:	Bread wheat
Scientific name:	<i>Triticum aestivum</i>
Pedigree:	PRL''S''/PEW CM59377- 3AP-1AP-3AP-2AP-1AP-OAP
Seasonal type:	Spring
Origin:	CIMMYT/ICARDA



Grain characteristics

Grain color	Amber
Thousand kernel weight	49 g

Juvenile plant characteristics

Growth habit	Intermediate
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Flowering plant characteristics

Days from emergence to flowering	Early
Auricle color	Weak
Flag leaf attitude	Semi-dropping
Flag leaf sheet glaucosity	Medium
Flag leaf width	Medium
Glume hairiness	Absent
Cross section of neck	Thin

Maturing plant characteristics

Last node hairiness	Weak
Plant height	Tall
Beak length	Short
Shoulder width	Broad
Shoulder shape	Rounded
Neck zigzagness	Weak
Ear shape	Parallel
Ear density	Medium
Straw color	White

Agronomic characteristics

Disease reaction	Resistant to yellow rust
Yield potential	5.9 t/ha

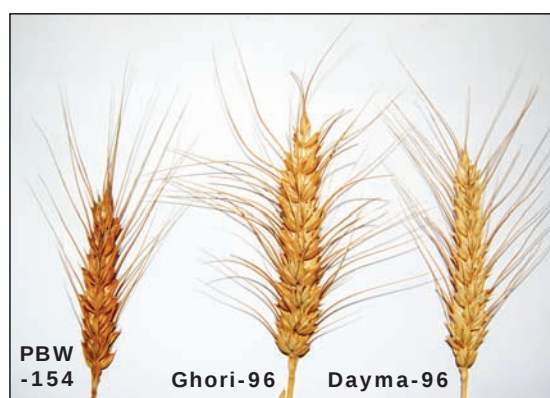
Grain quality characteristics

Parameters	Classification
Particle size index (%)	Hard (43)
Protein (%)	11.6
Farinograph measurements	
Water absorption (%)	Good (60.5)
Development time (min)	Weak (3.0)
Stability time (min)	Weak (2.6)
Dough softening (Brabender Unit)	Weak (150)
Alveograph measurements	
P (mm) tenacity	42
L (mm) extensibility	159
W dough strength	0.26
P/L configuration ratio	109
High molecular weight 1A	2*
High molecular weight 1B	12 + 16
High molecular weight 1D	2+12

Earliness



Spikes



Lower glumes



Grain sample



HD-2285

Crop:	Wheat
Common name:	Bread wheat
Scientific name:	<i>Triticum aestivum</i>
Pedigree:	HD1912-1592/hd1962E4870-K65XHD2160/HD2186
Seasonal type:	Spring
Origin:	India



Grain characteristics

Grain color	Amber
Thousand kernel weight	45 g

Juvenile plant characteristics

Growth habit	Erect
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Flowering plant characteristics

Days from emergence to flowering	Early
Auricle color	Weak
Flag leaf attitude	Semi-dropping
Flag leaf sheet glaucosity	Medium
Flag leaf width	Medium
Glume hairiness	Absent
Cross section of neck	Thin

Maturing plant characteristics

Last node hairiness	Medium
Plant height	Medium
Beak length	Very short
Shoulder width	Medium
Shoulder shape	Straight
Neck zigzagness	Weak
Ear shape	Parallel
Ear density	Lax
Straw color	White

Agronomic characteristics

Disease reaction	Resistant to yellow rust
Yield potential	5.1 t/ha

Grain quality characteristics

Parameters	Classification
Particle size index (%)	Hard (43)
Protein (%)	11.1
Farinograph measurements	
Water absorption (%)	Good (61)
Development time (min)	Weak (2.0)
Stability time (min)	Weak (2.6)
Dough softening (Brabender Unit)	Weak (155)
Alveograph measurements	
P (mm) tenacity	42
L (mm) extensibility	118
W dough strength	0.36
P/L configuration ratio	94
High molecular weight 1A	2*
High molecular weight 1B	7+8
High molecular weight 1D	2+12

Earliness



Spikes



Lower glumes



Grain sample



Inqlab-91

Crop:	Wheat
Common name:	Bread wheat
Scientific name:	<i>Triticum aestivum</i>
Pedigree:	PB19545-9A-0A-OPAK
Seasonal type:	Spring
Origin:	Pakistan



Grain characteristics

Grain color	Amber
Thousand kernel weight	44 g

Juvenile plant characteristics

Growth habit	Semi erect
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Flowering plant characteristics

Days from emergence to flowering	Early
Auricle color	Absent, 2
Flag leaf attitude	Semi-dropping
Flag leaf sheet glaucosity	Medium
Flag leaf width	Medium
Glume hairiness	Absent
Cross section of neck	Thin

Maturing plant characteristics

Last node hairiness	Medium
Plant height	Medium
Beak length	Short
Shoulder width	Medium
Shoulder shape	Straight
Neck zigzagness	Medium
Ear shape	Tapering
Ear density	Lax
Straw color	Red

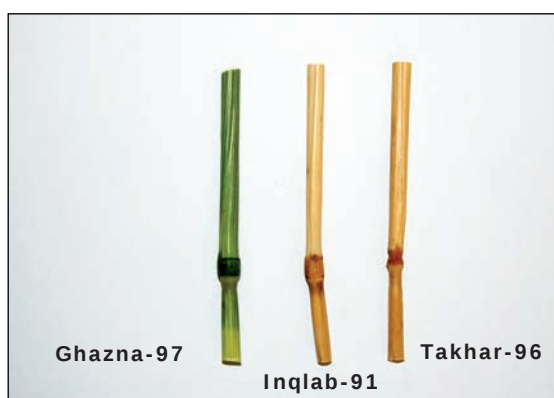
Agronomic characteristics

Disease reaction	Resistant to yellow rust
Yield potential	3.8 t/ha

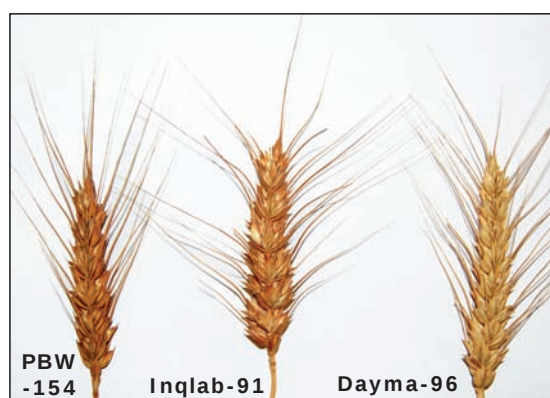
Grain quality characteristics

Parameters	Classification
Particle size index (%)	Very hard (39)
Protein (%)	12.2
Farinograph measurements	
Water absorption (%)	Good (65)
Development time (min)	Weak (3.0)
Stability time (min)	Weak (3.6)
Dough softening (Brabender Unit)	Medium (115)
Alveograph measurements	
P (mm) tenacity	58
L (mm) extensibility	140
W dough strength	0.41
P/L configuration ratio	156
High molecular weight 1A	2*
High molecular weight 1B	17+18
High molecular weight 1D	2+12

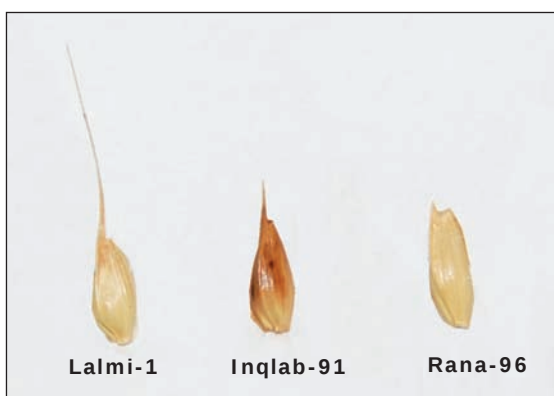
Earliness



Spikes



Lower glumes



Grain sample



Balkh-66

Crop: Wheat
Common name: Bread wheat
Scientific name: *Triticum aestivum*
Pedigree: HD-2232
Seasonal type: Spring
Origin: India



Grain characteristics

Grain color	Amber
Thousand kernel weight	39 g

Juvenile plant characteristics

Growth habit	Semi erect
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Flowering plant characteristics

Days from emergence to flowering	Early
Auricle color	Absent
Flag leaf attitude	Dropping
Flag leaf sheet glaucosity	Weak
Flag leaf width	Medium
Glume hairiness	Absent
Cross section of neck	Thin

Maturing plant characteristics

Last node hairiness	Strong
Plant height	Medium
Beak length	Medium
Shoulder width	Medium
Shoulder shape	Elevated
Neck zigzagness	Strong
Ear shape	Tapering
Ear density	Lax
Straw color	White

Agronomic characteristics

Disease reaction	Resistant to yellow rust
Yield potential	6.3 t/ha

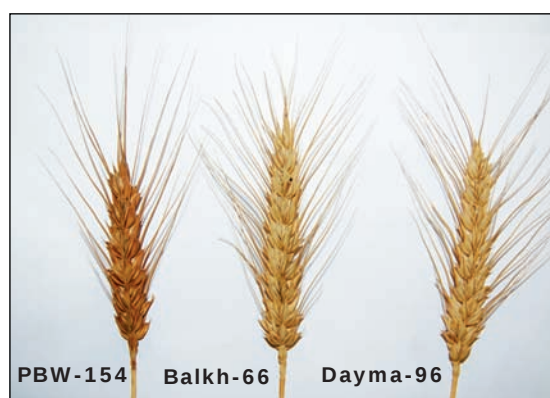
Grain quality characteristics

Parameters	Classification
Particle size index (%)	Very hard (39)
Protein (%)	11.6
Farinograph measurements	
Water absorption (%)	Good 63
Development time (min)	Weak (2.0)
Stability time (min)	Very weak(1.9)
Dough softening (Brabender Unit)	Very weak (230)
Alveograph measurements	
P (mm) tenacity	50
L (mm) extensibility	55
W dough strength	0.91
P/L configuration ratio	72
High molecular weight 1A	2*
High molecular weight 1B	7+8
High molecular weight 1D	2+12

Earliness



Spikes



Lower glumes



Grain sample



Nangarhar-64

Crop:	Wheat
Common name:	Bread wheat
Scientific name:	<i>Triticum aestivum</i>
Pedigree:	WL-711
Seasonal type:	Spring
Origin:	ARIA



Grain characteristics

Grain color	Amber
Thousand kernel weight	43 g

Juvenile plant characteristics

Growth habit	Erect
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Flowering plant characteristics

Days from emergence to flowering	Early
Auricle color	Strong
Flag leaf attitude	Semi-dropping
Flag leaf sheet glaucosity	Medium
Flag leaf width	Medium
Glume hairiness	Absent
Cross section of neck	Thin

Maturing plant characteristics

Last node hairiness	Strong
Plant height	Tall
Beak length	Short
Shoulder width	Broad
Shoulder shape	Straight
Neck zigzagness	Weak
Ear shape	Fusiform
Ear density	Lax
Straw color	White

Agronomic characteristics

Disease reaction	Susceptible to yellow rust
Yield potential	4.6 t/ha

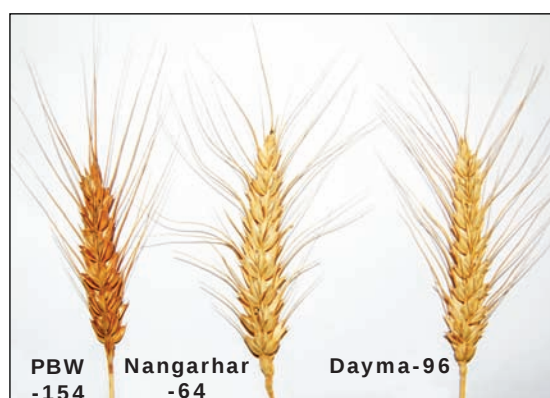
Grain quality characteristics

Parameters	Classification
Particle size index (%)	Hard (41)
Protein (%)	12.2
Farinograph measurements	
Water absorption (%)	Good (62.5)
Development time (min)	Weak (2.0)
Stability time (min)	Weak (2.2)
Dough softening (Brabender Unit)	Weak (180)
Alveograph measurements	
P (mm) tenacity	42
L (mm) extensibility	103
W dough strength	0.41
P/L configuration ratio	80
High molecular weight 1A	2*
High molecular weight 1B	7+8/17 +18
High molecular weight 1D	2+12

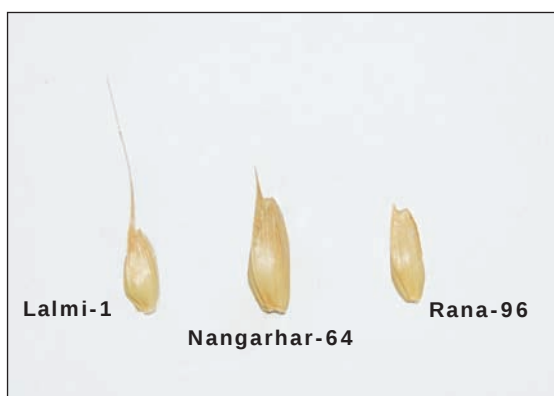
Earliness



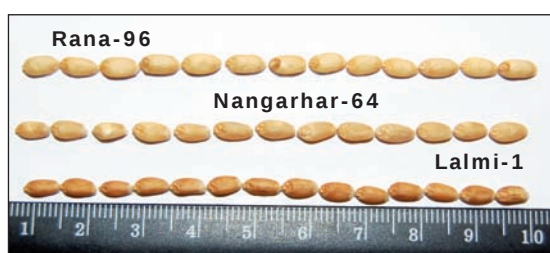
Spikes



Lower glumes



Grain sample



PBW-154

Crop:	Wheat
Common name:	Bread wheat
Scientific name:	<i>Triticum aestivum</i>
Pedigree:	HD2177/HD2160
Seasonal type:	Spring
Origin:	India



Grain characteristics

Grain color	Amber
Thousand kernel weight	44 g

Juvenile plant characteristics

Growth habit	Erect
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Flowering plant characteristics

Days from emergence to flowering	Early
Auricle color	Absent
Flag leaf attitude	Dropping
Flag leaf sheet glaucosity	Weak
Flag leaf width	Narrow
Glume hairiness	Absent
Cross section of neck	Thin

Maturing plant characteristics

Last node hairiness	Strong
Plant height	Medium
Beak length	Short
Shoulder width	Broad
Shoulder shape	Straight
Neck zigzagness	Weak
Ear shape	Fusiform
Ear density	Medium
Straw color	Red

Agronomic characteristics

Disease reaction	Moderately susceptible to yellow rust
Yield potential	4.6 t/ha

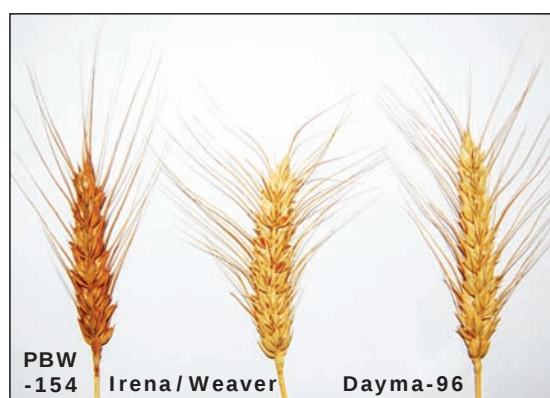
Grain quality characteristics

Parameters	Classification
Particle size index (%)	Very hard (38)
Protein (%)	11.4
Farinograph measurements	
Water absorption (%)	Good 62
Development time (min)	Weak (2.6)
Stability time (min)	Weak (3.3)
Dough softening (Brabender Unit)	Medium (120)
Alveograph measurements	
P (mm) tenacity	62
L (mm) extensibility	120
W dough strength	0.52
P/L configuration ratio	168
High molecular weight 1A	2*
High molecular weight 1B	7+8
High molecular weight 1D	2+12

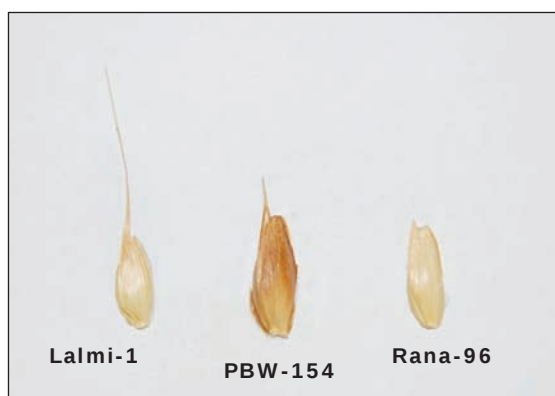
Earliness



Spikes



Lower glumes



Grain sample



Takhar-96

Crop: Wheat
Common name: Bread wheat
Scientific name: *Triticum aestivum*
Pedigree: VEE#7/OPATA
Seasonal type: Spring
Origin: CIMMYT



Grain characteristics

Grain color	Dark amber
Thousand kernel weight	36 g

Juvenile plant characteristics

Growth habit	Intermediate
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Flowering plant characteristics

Days from emergence to flowering	Early
Auricle color	Absent
Flag leaf attitude	Semi-dropping
Flag leaf sheet glaucosity	Medium
Flag leaf width	Narrow
Glume hairiness	Absent
Cross section of neck	Thin

Maturing plant characteristics

Last node hairiness	Medium
Plant height	Medium
Beak length	Very short
Shoulder width	Broad
Shoulder shape	Rounded
Neck zigzagness	Weak
Ear shape	Parallel
Ear density	Lax
Straw color	White

Agronomic characteristics

Disease reaction	Susceptible to yellow rust
Yield potential	4.2 t/ha

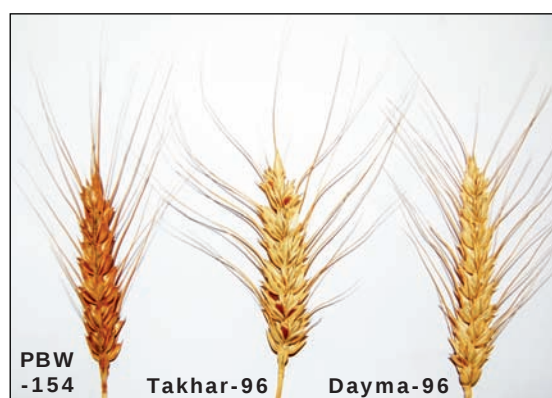
Grain quality characteristics

Parameters	Classification
Particle size index (%)	Hard (44)
Protein (%)	13.1
Farinograph measurements	
Water absorption (%)	Good 63.5
Development time (min)	Weak (3.3)
Stability time (min)	Weak (2.3)
Dough softening (Brabender Unit)	Medium (130)
Alveograph measurements	
P (mm) tenacity	53
L (mm) extensibility	115
W dough strength	0.46
P/L configuration ratio	121
High molecular weight 1A	1
High molecular weight 1B	7+9
High molecular weight 1D	2+12

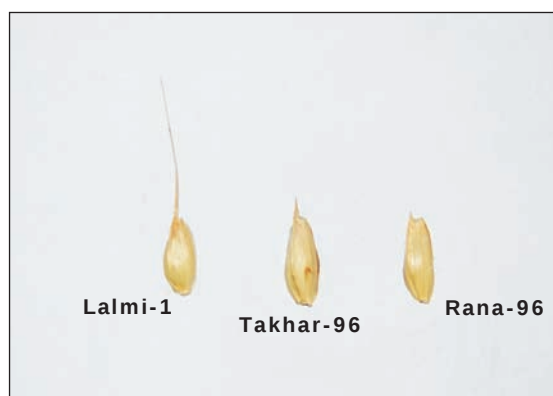
Earliness



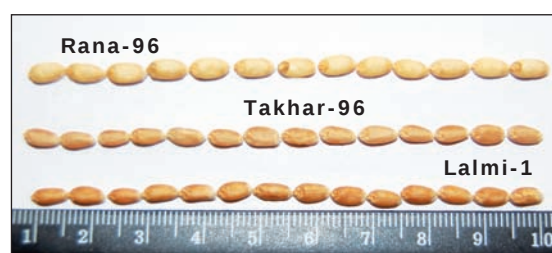
Spikes



Lower glumes



Grain sample



Snb"s"

Crop: Wheat
Common name: Bread wheat
Scientific name: *Triticum aestivum*
Pedigree: Snb's'/5/Maya74's'/On//
II60.147/3/Bb/GII/4/
Chat's'
Seasonal type: Spring
Origin: CIMMYT/ICARDA



Grain characteristics

Grain color	Amber
Thousand kernel weight	38 g

Juvenile plant characteristics

Growth habit	Intermediate
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Flowering plant characteristics

Days from emergence to flowering	Early
Auricle color	Weak
Flag leaf attitude	Dropping
Flag leaf sheet glaucosity	Weak
Flag leaf width	Narrow
Glume hairiness	Absent
Cross section of neck	Thin

Maturing plant characteristics

Last node hairiness	Strong
Plant height	Short
Beak length	Very short
Shoulder width	Broad
Shoulder shape	Elevated
Neck zigzagness	Very weak
Ear shape	Parallel
Ear density	Medium
Straw color	White

Agronomic characteristics

Disease reaction	Resistant to yellow rust
Yield potential	5 t/ha

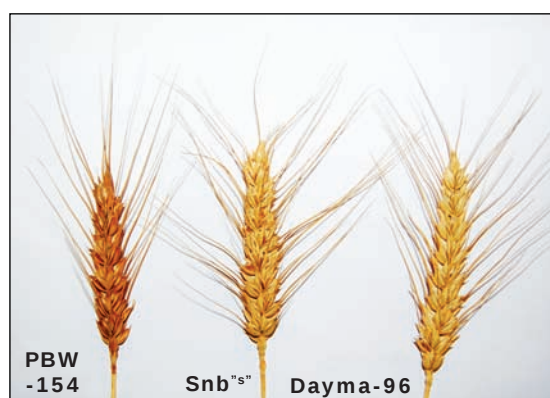
Grain quality characteristics

Parameters	Classification
Particle size index (%)	Hard (47)
Protein (%)	12.4
Farinograph measurements	
Water absorption (%)	Good (61.0)
Development time (min)	Weak (4.0)
Stability time (min)	Weak (3.5)
Dough softening (Brabender Unit)	Weak (160)
Alveograph measurements	
P (mm) tenacity	46
L (mm) extensibility	138
W dough strength	0.33
P/L configuration ratio	142
High molecular weight 1A	1
High molecular weight 1B	7+9
High molecular weight 1D	5+10

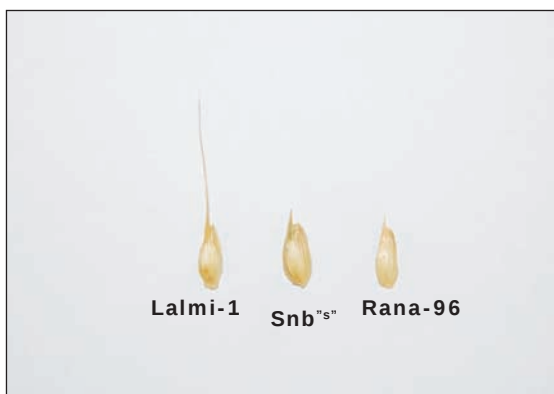
Earliness



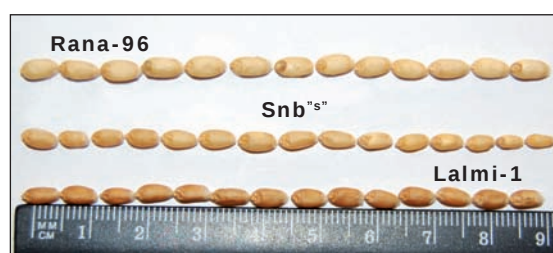
Spikes



Lower glumes



Grain sample



HUW-234

Crop: Wheat
Common name: Bread wheat
Scientific name: *Triticum aestivum*
Pedigree: HUW12/Sparrow/HUW12
Seasonal type: Spring
Origin: India



Grain characteristics

Grain color	Amber
Thousand kernel weight	44 g

Juvenile plant characteristics

Growth habit	Erect
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Flowering plant characteristics

Days from emergence to flowering	Early
Auricle color	Absent
Flag leaf attitude	Semi-dropping
Flag leaf sheet glaucosity	Medium
Flag leaf width	Medium
Glume hairiness	Absent
Cross section of neck	Thin

Maturing plant characteristics

Last node hairiness	Strong
Plant height	Tall
Beak length	Very short
Shoulder width	Very broad
Shoulder shape	Rounded
Neck zigzagness	Weak
Ear shape	Parallel
Ear density	Lax
Straw color	White

Agronomic characteristics

Disease reaction	Moderately susceptible to yellow rust
Yield potential	5.6 t/ha

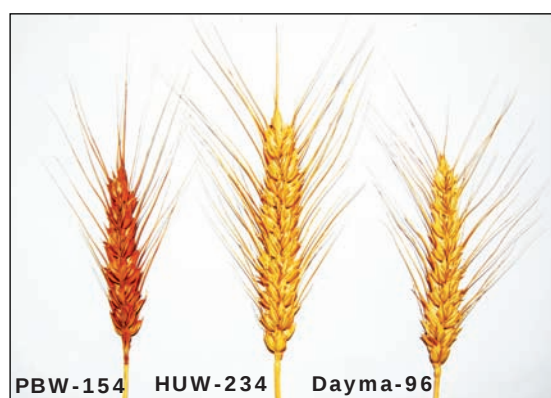
Grain quality characteristics

Parameters	Classification
Particle size index (%)	Hard (44)
Protein (%)	11.1
Farinograph measurements	
Water absorption (%)	60.0
Development time (min)	Weak (2.6)
Stability time (min)	Weak (3.0)
Dough softening (Brabender Unit)	Weak (150)
Alveograph measurements	
P (mm) tenacity	40
L (mm) extensibility	128
W dough strength	0.31
P/L configuration ratio	99
High molecular weight 1A	2*
High molecular weight 1B	7+8
High molecular weight 1D	2+12

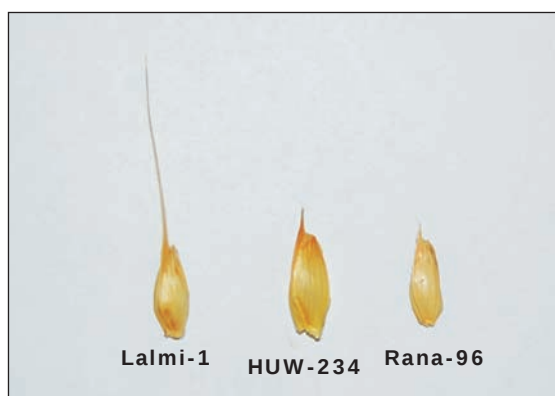
Earliness



Spikes



Lower glumes



Grain sample



Dayma-96

Crop:	Wheat
Common name:	Bread wheat
Scientific name:	<i>Triticum aestivum</i>
Pedigree:	HD2206/HORK//BUC/BUL
Seasonal type:	Spring
Origin:	CIMMYT/ICARDA



Grain characteristics

Grain color	Amber
Thousand kernel weight	37 g

Juvenile plant characteristics

Growth habit	Semi erect
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Flowering plant characteristics

Days from emergence to flowering	Early
Auricle color	Weak
Flag leaf attitude	Semi-dropping
Flag leaf sheet glaucosity	Medium
Flag leaf width	Narrow
Glume hairiness	Absent
Cross section of neck	Thin

Maturing plant characteristics

Last node hairiness	Medium
Plant height	Tall
Beak length	Short
Shoulder width	Narrow
Shoulder shape	Sloping
Neck zigzagness	Very weak
Ear shape	Parallel
Ear density	Lax
Straw color	White

Agronomic characteristics

Disease reaction	Moderately resistant to yellow rust
Yield potential	5.2 t/ha

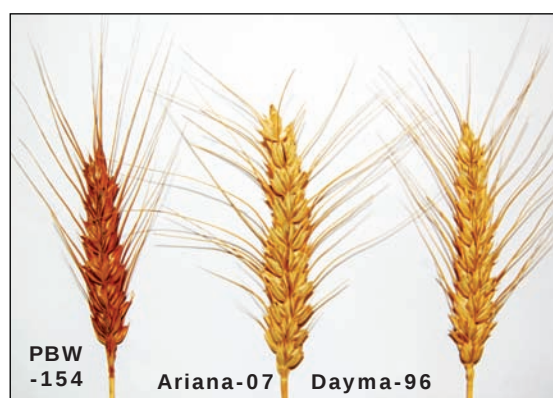
Grain quality characteristics

Parameters	Classification
Particle size index (%)	Hard (40)
Protein (%)	11.2
Farinograph measurements	
Water absorption (%)	Good (61.0)
Development time (min)	Weak (3.0)
Stability time (min)	Weak (3.0)
Dough softening (Brabender Unit)	Weak (155)
Alveograph measurements	
P (mm) tenacity	49
L (mm) extensibility	104
W dough strength	0.47
P/L configuration ratio	110
High molecular weight 1A	2*
High molecular weight 1B	7+9
High molecular weight 1D	5+10

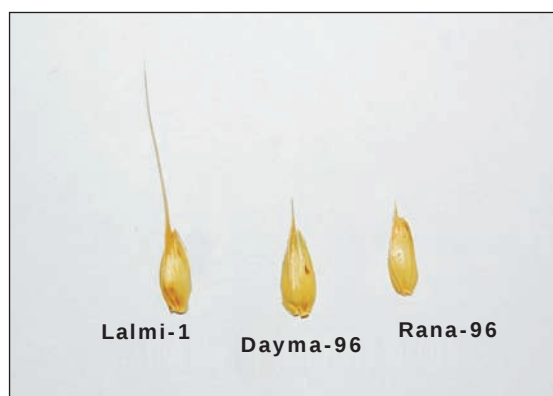
Earliness



Spikes



Lower glumes



Grain sample



MH-97

Crop:	Wheat
Common name:	Bread wheat
Scientific name:	<i>Triticum aestivum</i>
Pedigree:	Attila CM8583-504-OM- OY-OSY-OAP
Seasonal type:	Facultative/spring type
Origin:	Pakistan



Grain characteristics

Grain color	White
Thousand kernel weight	43 g

Juvenile plant characteristics

Growth habit	Semi-erect
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Flowering plant characteristics

Days from emergence to flowering	Early
Auricle color	Absent
Flag leaf attitude	Erect
Flag leaf sheet glaucosity	Weak
Flag leaf width	Medium
Glume hairiness	Absent
Cross section of neck	Thick

Maturing plant characteristics

Last node hairiness	Medium
Plant height	Medium
Beak length	Medium
Shoulder width	Narrow
Shoulder shape	Rounded
Neck zigzagness	Weak
Ear shape	Tapering
Ear density	Lax
Straw color	White

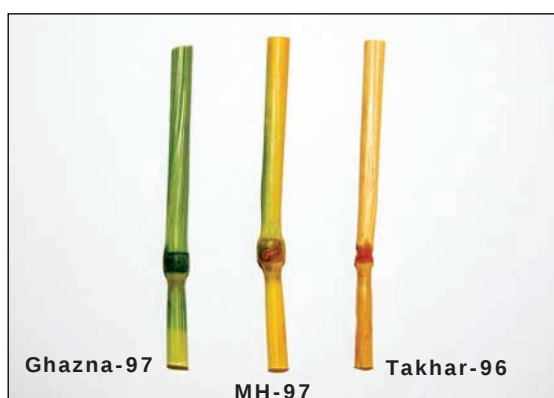
Agronomic characteristics

Disease reaction	Susceptible to yellow rust
Yield potential	5.6 t/ha

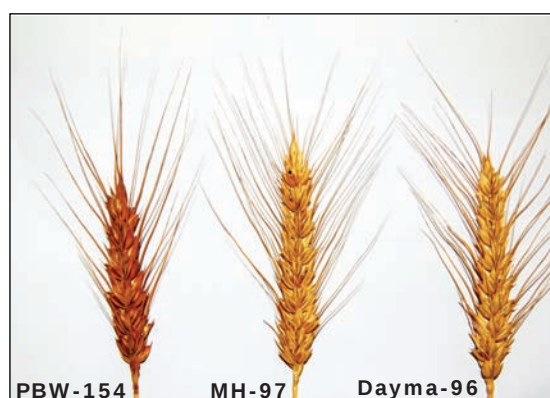
Grain quality characteristics

Parameters	Classification
Particle size index (%)	Medium (43)
Protein (%)	11.4
Farinograph measurements	
Water absorption (%)	60
Development time (min)	Weak (2.2)
Stability time (min)	Weak (3.2)
Dough softening (Brabender Unit)	Medium (125)
Alveograph measurements	
P (mm) tenacity	45
L (mm) extensibility	133
W dough strength	0.34
P/L configuration ratio	103
High molecular weight 1A	2*
High molecular weight 1B	7+8
High molecular weight 1D	5+10/ 2 + 12

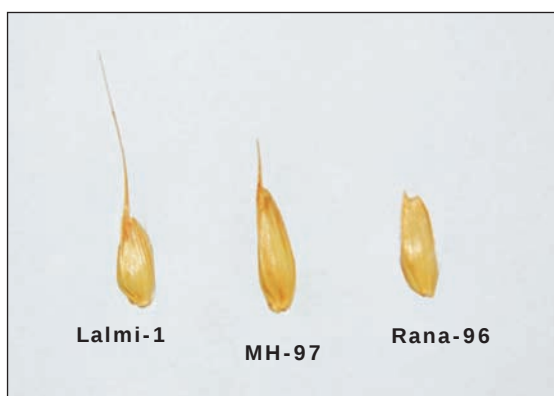
Earliness



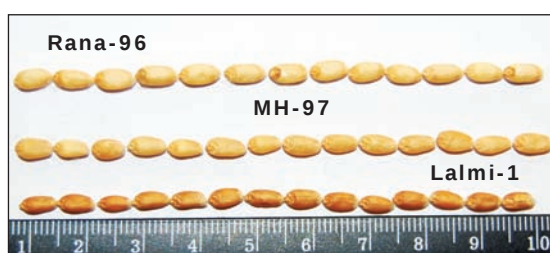
Spikes



Lower glumes



Grain sample



Rana-96

Crop: Wheat
Common name: Bread wheat
Scientific name: *Triticum aestivum*
Pedigree: CA8055/6/PATOR/CAL/
3/76//BB/CN015/CAL//
CNO SN64/4/CNO//NAD/
CH2AP-2AP-2AP-1AP-OAP
Seasonal type: Facultative,
Origin: CIMMYT/ICARDA



Grain characteristics

Grain color	White
Thousand kernel weight	39 g

Juvenile plant characteristics

Growth habit	Prostrate
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Flowering plant characteristics

Days from emergence to flowering	Early
Auricle color	Absent
Flag leaf attitude	Semi-dropping
Flag leaf sheet glaucosity	Very weak
Flag leaf width	Narrow
Glume hairiness	Absent
Cross section of neck	Thick

Maturing plant characteristics

Last node hairiness	Medium
Plant height	Tall
Beak length	Very short
Shoulder width	Broad
Shoulder shape	Sloping
Neck zigzagness	Very weak
Ear shape	Fusiform
Ear density	Dense
Straw color	White

Agronomic characteristics

Disease reaction	Susceptible to yellow rust
Yield potential	5.3 t/ha

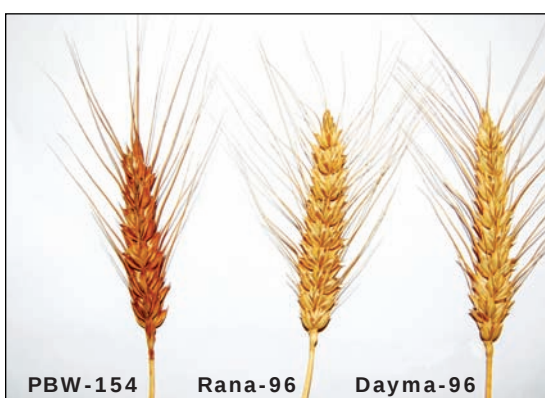
Grain quality characteristics

Parameters	Classification
Particle size index (%)	Medium (62)
Protein (%)	11.6
Farinograph measurements	
Water absorption (%)	59
Development time (min)	Very weak (2.0)
Stability time (min)	Very weak (1.7)
Dough softening (Brabender Unit)	Weak (160)
Alveograph measurements	
P (mm) tenacity	39
L (mm) extensibility	102
W dough strength	0.38
P/L configuration ratio	67
High molecular weight 1A	1
High molecular weight 1B	20
High molecular weight 1D	2+12

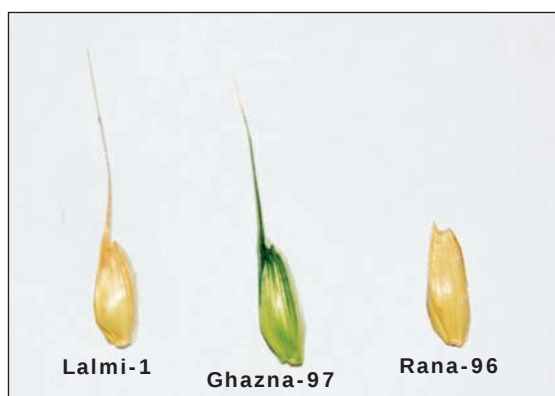
Earliness



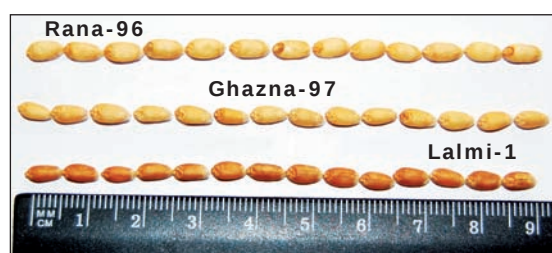
Spikes



Lower glumes



Grain sample



Irena / Weaver

Crop:	Wheat
Common name:	Bread wheat
Scientific name:	<i>Triticum aestivum</i>
Pedigree:	IRENA/Weaver CMBW90M294.1-1M-020Y- 010M-010Y- 6M-015Y-0Y
Seasonal type:	Facultative
Origin:	CIMMYT



Grain characteristics

Grain color	Amber
Thousand kernel weight	38 g

Juvenile plant characteristics

Growth habit	Erect
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Flowering plant characteristics

Days from emergence to flowering	Medium
Auricle color	Very strong
Flag leaf attitude	Semi-dropping
Flag leaf sheet glaucosity	Very weak
Flag leaf width	Narrow
Glume hairiness	Absent
Cross section of neck	Thin

Maturing plant characteristics

Last node hairiness	Weak
Plant height	Medium
Beak length	Short
Shoulder width	Broad
Shoulder shape	Elevated
Neck zigzagness	Very weak
Ear shape	Fusiform
Ear density	Lax
Straw color	White

Agronomic characteristics

Disease reaction	Resistant to yellow rust
Yield potential	4.9 t/ha

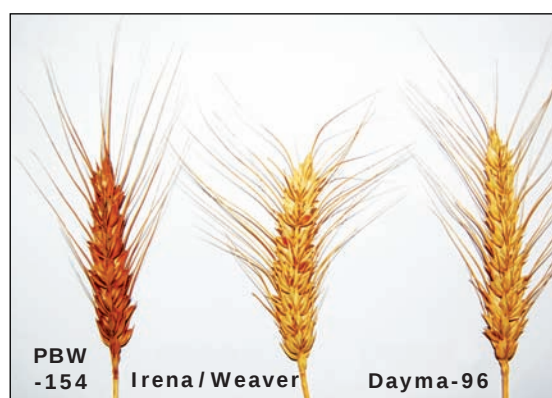
Grain quality characteristics

Parameters	Classification
Particle size index (%)	Very hard (39)
Protein (%)	11.5
Farinograph measurements	
Water absorption (%)	Good 63.5
Development time (min)	Weak (3.5)
Stability time (min)	Weak (3.3)
Dough softening (Brabender Unit)	Medium (130)
Alveograph measurements	
P (mm) tenacity	61
L (mm) extensibility	107
W dough strength	0.57
P/L configuration ratio	158
High molecular weight 1A	2*
High molecular weight 1B	7+8
High molecular weight 1D	2 + 12

Earliness



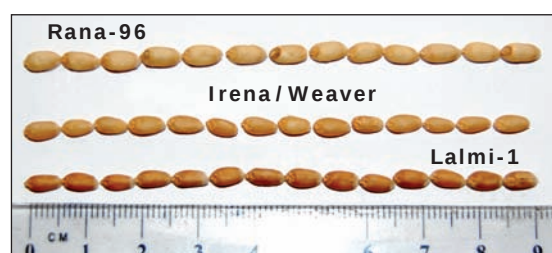
Spikes



Lower glumes



Grain sample



Lalmi-3

Crop:	Wheat
Common name:	Bread wheat
Scientific name:	<i>Triticum aestivum</i>
Pedigree:	FLORKWA-3 IC84-0074-02AP-3002-1AP-OL-OAP
Seasonal type:	Facultative
Origin:	CIMMYT/ICARDA



Grain characteristics

Grain color	Amber
Thousand kernel weight	40 g

Juvenile plant characteristics

Growth habit	Semi-erect
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Flowering plant characteristics

Days from emergence to flowering	Early
Auricle color	Strong
Flag leaf attitude	Semi-dropping
Flag leaf sheet glaucosity	Weak
Flag leaf width	Medium
Glume hairiness	Absent
Cross section of neck	Thin

Maturing plant characteristics

Last node hairiness	Weak
Plant height	Medium
Beak length	Short
Shoulder width	Narrow
Shoulder shape	Slopping
Neck zigzagness	Weak
Ear shape	Parallel
Ear density	Medium
Straw color	White, 1

Agronomic characteristics

Disease reaction	Resistant to yellow rust
Yield potential	5.1 t/ha

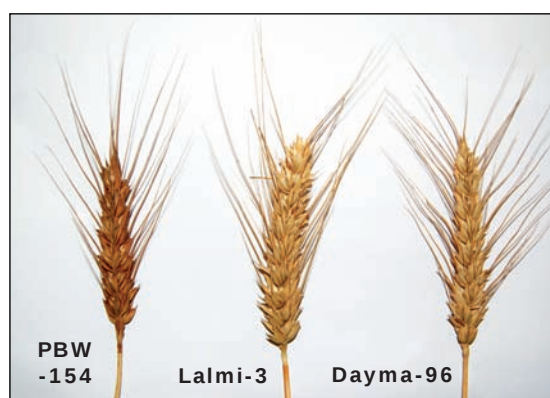
Grain quality characteristics

Parameters	Classification
Particle size index (%)	Medium (43)
Protein (%)	11.6
Farinograph measurements	
Water absorption (%)	Good 62.5
Development time (min)	Weak (3.1)
Stability time (min)	Medium (2)
Dough softening (Brabender Unit)	Weak (160)
Alveograph measurements	
P (mm) tenacity	47
L (mm) extensibility	98
W dough strength	0.48
P/L configuration ratio	101
High molecular weight 1A	2*
High molecular weight 1B	7+ 8
High molecular weight 1D	2 + 12/5+10

Earliness



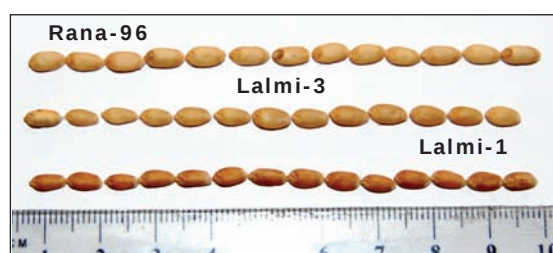
Spikes



Lower glumes



Grain sample



Sheshambagh-08

Crop:	Wheat
Common name:	Bread wheat
Scientific name:	<i>Triticum aestivum</i>
Pedigree:	SW89.5181/KAUZ
Seasonal type:	Facultative
Origin:	CIMMYT



Grain characteristics

Grain color	Amber
Thousand kernel weight	43 g

Juvenile plant characteristics

Growth habit	Intermediate
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Flowering plant characteristics

Days from emergence to flowering	Early
Auricle color	Weak
Flag leaf attitude	Erect
Flag leaf sheet glaucosity	Medium
Flag leaf width	Medium
Glume hairiness	Absent
Cross section of neck	Thin

Maturing plant characteristics

Last node hairiness	Weak
Plant height	Medium
Beak length	Short
Shoulder width	Medium
Shoulder shape	Sloping
Neck zigzagness	Very weak
Ear shape	Parallel
Ear density	Medium
Straw color	White

Agronomic characteristics

Disease reaction	Resistant to yellow rust
Yield potential	5.4 t/ha

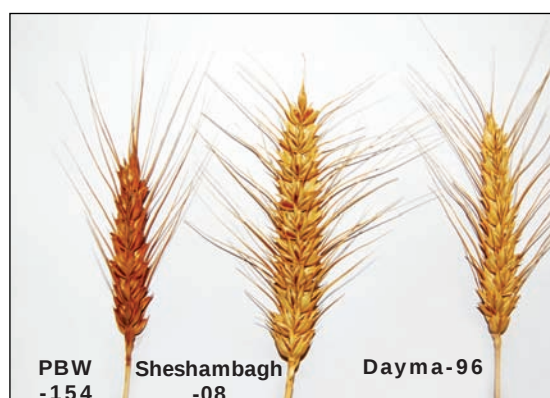
Grain quality characteristics

Parameters	Classification
Particle size index (%)	Medium (39)
Protein (%)	11.1
Farinograph measurements	
Water absorption (%)	Good 61.5
Development time (min)	Weak (2.2)
Stability time (min)	Very weak (1.2)
Dough softening (Brabender Unit)	Weak (170)
Alveograph measurements	
P (mm) tenacity	35
L (mm) extensibility	69
W dough strength	0.51
P/L configuration ratio	135
High molecular weight 1A	0
High molecular weight 1B	7+9
High molecular weight 1D	2+12

Earliness



Spikes



Lower glumes



Grain sample



Amu-99

Crop:	Wheat
Common name:	Bread wheat
Scientific name:	<i>Triticum aestivum</i>
Pedigree:	Bloyka ICW84-0008-013AP-300L-OAP
Seasonal type:	Facultative
Origin:	CIMMYT/ICARDA



Grain characteristics

Grain color	Amber
Thousand kernel weight	39 g

Juvenile plant characteristics

Growth habit	Intermediate
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Flowering plant characteristics

Days from emergence to flowering	Medium
Auricle color	Absent
Flag leaf attitude	Semi-dropping
Flag leaf sheet glaucosity	Very weak
Flag leaf width	Medium
Glume hairiness	Absent
Cross section of neck	Thin

Maturing plant characteristics

Last node hairiness	Strong
Plant height	Tall
Beak length	Short
Shoulder width	Medium
Shoulder shape	Straight
Neck zigzagness	Strong
Ear shape	Parallel
Ear density	Medium
Straw color	White

Agronomic characteristics

Disease reaction	Susceptible to yellow rust
Yield potential	6.4 t/ha

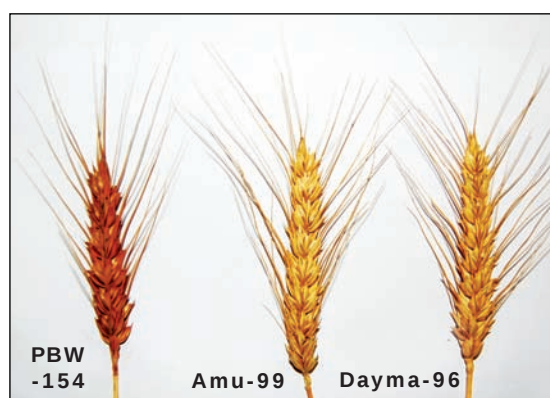
Grain quality characteristics

Parameters	Classification
Particle size index (%)	Hard (47)
Protein (%)	11.5
Farinograph measurements	
Water absorption (%)	58.5
Development time (min)	Weak (2.6)
Stability time (min)	Weak (2.7)
Dough softening (Brabender Unit)	Weak (150)
Alveograph measurements	
P (mm) tenacity	44
L (mm) extensibility	128
W dough strength	0.34
P/L configuration ratio	98
High molecular weight 1A	2*
High molecular weight 1B	7+8
High molecular weight 1D	2+12

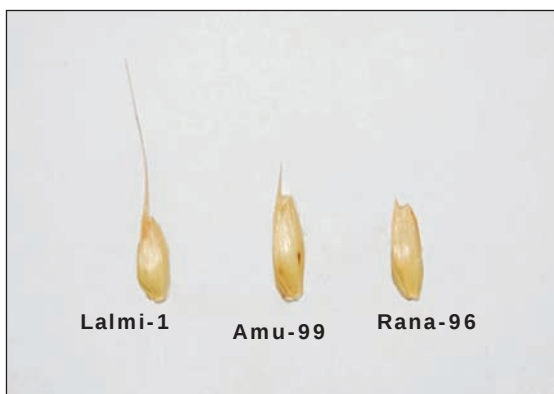
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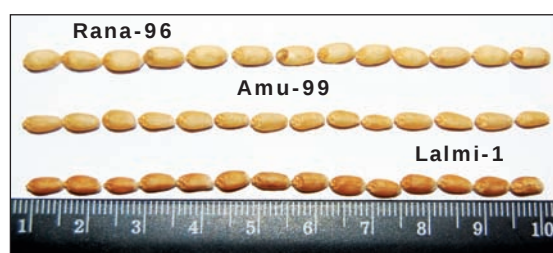
Spikes



Lower glumes



Grain sample



Kabul-2000

Crop:	Wheat
Common name:	Bread wheat
Scientific name:	<i>Triticum aestivum</i>
Pedigree:	HD-3280
Seasonal type:	Facultative
Origin:	India



Grain characteristics

Grain color	Amber
Thousand kernel weight	38 g

Juvenile plant characteristics

Growth habit	Prostrate
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Flowering plant characteristics

Days from emergence to flowering	Late
Auricle color	Weak
Flag leaf attitude	Dropping
Flag leaf sheet glaucosity	Medium
Flag leaf width	Narrow
Glume hairiness	Absent
Cross section of neck	Medium

Maturing plant characteristics

Last node hairiness	Strong
Plant height	Short
Beak length	Short
Shoulder width	Broad
Shoulder shape	Rounded
Neck zigzagness	Very weak
Ear shape	Parallel
Ear density	Lax
Straw color	White

Agronomic characteristics

Disease reaction	Resistant to yellow rust
Yield potential	5.4 t/ha

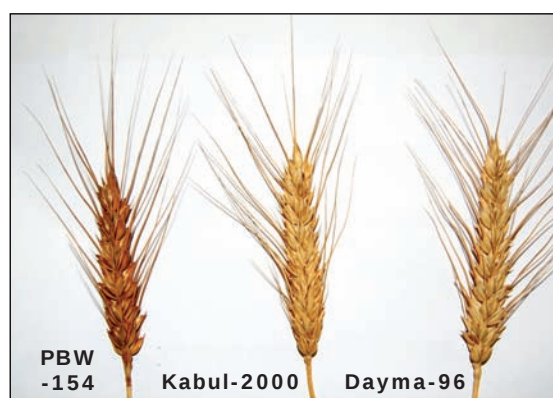
Grain quality characteristics

Parameters	Classification
Particle size index (%)	Hard (45)
Protein (%)	11.5
Farinograph measurements	
Water absorption (%)	59.5
Development time (min)	Weak (3.0)
Stability time (min)	Medium (4.2)
Dough softening (Brabender Unit)	Medium (130)
Alveograph measurements	
P (mm) tenacity	42
L (mm) extensibility	137
W dough strength	0.31
P/L configuration ratio	117
High molecular weight 1A	2*
High molecular weight 1B	13+16 / 7+18
High molecular weight 1D	5+10/2+12

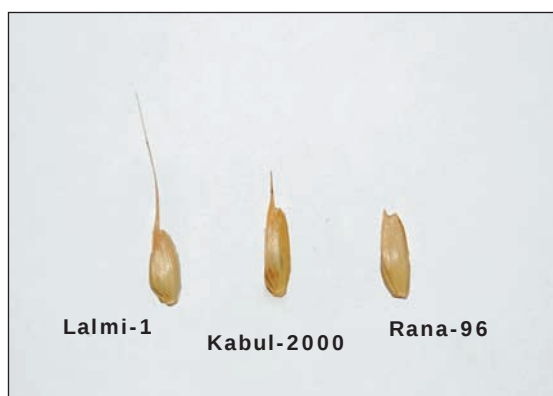
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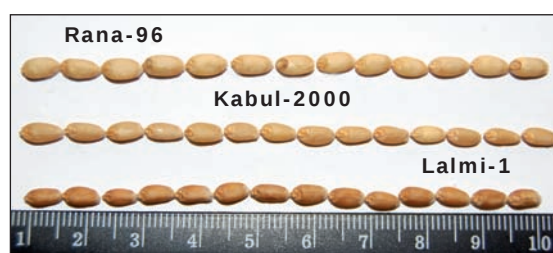
Spikes



Lower glumes



Grain sample



Darulaman-07

Crop: Wheat
Common name: Bread wheat
Scientific name: *Triticum aestivum*
Pedigree: Weaver/4/Nac/
Th.ac//3*PVN/3/mirlo/buc
CID/SID: 133428/10₄
Seasonal type: Facultative
Origin: CIMMYT



Grain characteristics

Grain color	Amber
Thousand kernel weight	43 g

Juvenile plant characteristics

Growth habit	Semi erect
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Flowering plant characteristics

Days from emergence to flowering	Medium
Auricle color	Absent
Flag leaf attitude	Erect
Flag leaf sheet glaucosity	Medium
Flag leaf width	Narrow
Glume hairiness	Present
Cross section of neck	Thin

Maturing plant characteristics

Last node hairiness	Medium
Plant height	Medium
Beak length	Medium
Shoulder width	Medium
Shoulder shape	Straight
Neck zigzagness	Weak
Ear shape	Parallel
Ear density	Lax
Straw color	White

Agronomic characteristics

Disease reaction	Resistant to yellow rust
Yield potential	4 t/ha

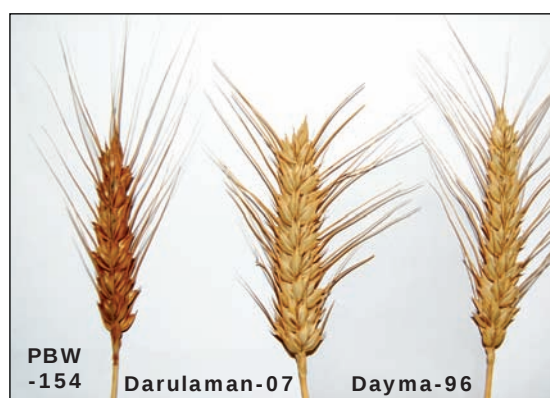
Grain quality characteristics

Parameters	Classification
Particle size index (%)	Hard (40)
Protein (%)	12.4
Farinograph measurements	
Water absorption (%)	Good (62)
Development time (min)	Weak (2.5)
Stability time (min)	Very weak (1.6)
Dough softening (Brabender Unit)	Weak (190)
Alveograph measurements	
P (mm) tenacity	41
L (mm) extensibility	100
W dough strength	0.41
P/L configuration ratio	76
High molecular weight 1A	2*
High molecular weight 1B	17+18
High molecular weight 1D	2+12

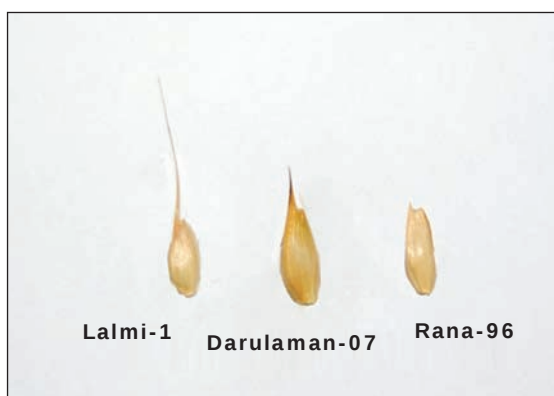
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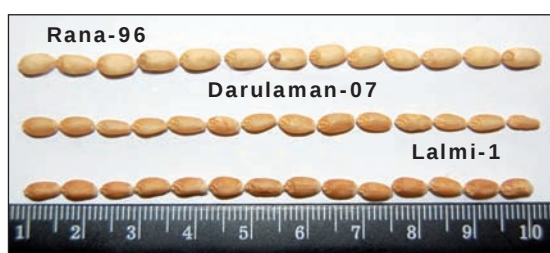
Spikes



Lower glumes



Grain sample



Roshan-96

Crop:	Wheat
Common name:	Bread wheat
Scientific name:	<i>Triticum aestivum</i>
Pedigree:	BLOUNDANL/3/Bb/7C*2// Y50E/KAL*3
Seasonal type:	Facultative
Origin:	CIMMYT/ICARDA



Grain characteristics

Grain color	Amber
Thousand kernel weight	35 g

Juvenile plant characteristics

Growth habit	Intermediate
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Flowering plant characteristics

Days from emergence to flowering	Medium
Auricle color	Absent
Flag leaf attitude	Erect
Flag leaf sheet glaucosity	Very weak
Flag leaf width	Broad
Glume hairiness	Present
Cross section of neck	Medium

Maturing plant characteristics

Last node hairiness	Medium
Plant height	Tall
Beak length	Medium
Shoulder width	Medium
Shoulder shape	Rounded
Neck zigzagness	Weak
Ear shape	Tapering
Ear density	Medium
Straw color	White

Agronomic characteristics

Disease reaction	Susceptible to yellow rust
Yield potential	6.5 t/ha

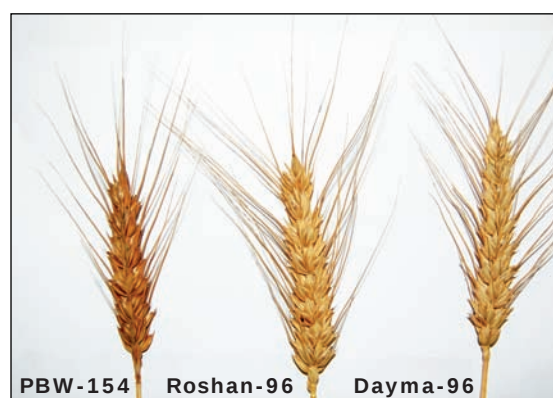
Grain quality characteristics

Parameters	Classification
Particle size index (%)	Hard (43)
Protein (%)	12
Farinograph measurements	
Water absorption (%)	59.5
Development time (min)	Weak (2.5)
Stability time (min)	Weak (3.5)
Dough softening (Brabender Unit)	Medium (100)
Alveograph measurements	
P (mm) tenacity	46
L (mm) extensibility	158
W dough strength	0.29
P/L configuration ratio	127
High molecular weight 1A	2*
High molecular weight 1B	7+8
High molecular weight 1D	2+12

Earliness



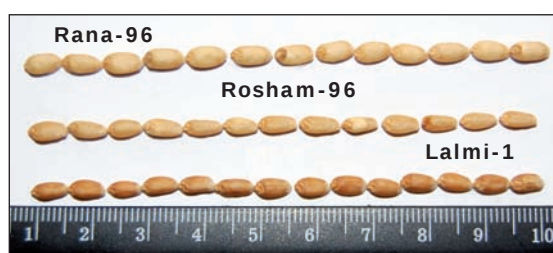
Spikes



Lower glumes



Grain sample



Mazar-99

Crop:	Wheat
Common name:	Bread wheat
Scientific name:	<i>Triticum aestivum</i>
Pedigree:	PASTURE CM85295-0101TO PY-2M-OY-OM-3Y- OM
Seasonal type:	Facultative
Origin:	CIMMYT/ICARDA



Grain characteristics

Grain color	Amber
Thousand kernel weight	39 g

Juvenile plant characteristics

Growth habit	Intermediate
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Flowering plant characteristics

Days from emergence to flowering	Medium
Auricle color	Weak
Flag leaf attitude	Dropping
Flag leaf sheet glaucosity	Strong
Flag leaf width	Narrow
Glume hairiness	Absent
Cross section of neck	Thick

Maturing plant characteristics

Last node hairiness	Medium
Plant height	Medium
Beak length	Short
Shoulder width	Narrow
Shoulder shape	Slopping
Neck zigzagness	Medium
Ear shape	Fusiform
Ear density	Medium
Straw color	White

Agronomic characteristics

Disease reaction	Resistant to yellow rust
Yield potential	5.9 t/ha

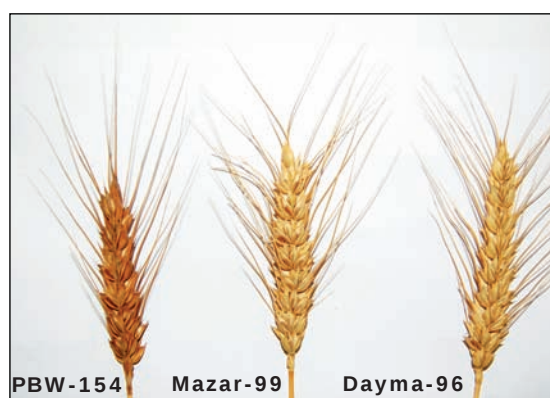
Grain quality characteristics

Parameters	Classification
Particle size index (%)	Hard (41)
Protein (%)	11.7
Farinograph measurements	
Water absorption (%)	Good 61
Development time (min)	Weak (3.3)
Stability time (min)	Medium (4.3)
Dough softening (Brabender Unit)	Medium (130)
Alveograph measurements	
P (mm) tenacity	48
L (mm) extensibility	143
W dough strength	0.34
P/L configuration ratio	133
High molecular weight 1A	1
High molecular weight 1B	17+18
High molecular weight 1D	5+10

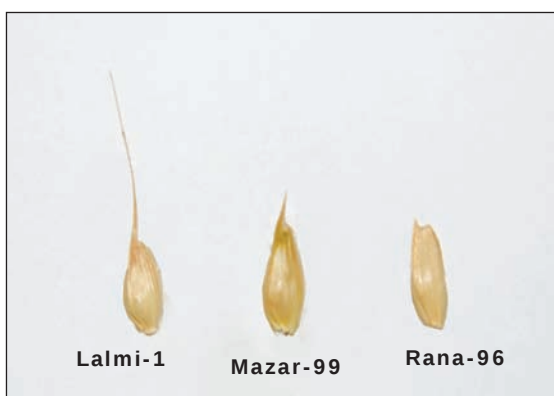
Earliness



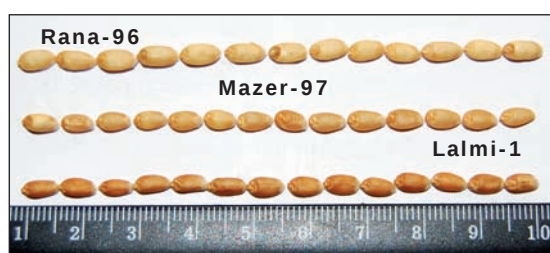
Spikes



Lower glumes



Grain sample



Herat-99

Crop:	Wheat
Common name:	Bread wheat
Scientific name:	<i>Triticum aestivum</i>
Pedigree:	MYNA/VUL//PRL CM97958-OM-7Y-030M-030M-84-OM
Seasonal type:	Facultative
Origin:	CIMMYT/ICARDA



Grain characteristics

Grain color	Amber
Thousand kernel weight	39 g

Juvenile plant characteristics

Growth habit	Semi erect
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Flowering plant characteristics

Days from emergence to flowering	Early
Auricle color	Absent
Flag leaf attitude	Dropping
Flag leaf sheet glaucosity	Medium
Flag leaf width	Narrow
Glume hairiness	Absent
Cross section of neck	Thin

Maturing plant characteristics

Last node hairiness	Medium
Plant height	Tall
Beak length	Short
Shoulder width	Narrow
Shoulder shape	Rounded
Neck zigzagness	Weak
Ear shape	Tapering
Ear density	Medium
Straw color	Red

Agronomic characteristics

Disease reaction	Resistant to yellow rust
Yield potential	5.4 t/ha

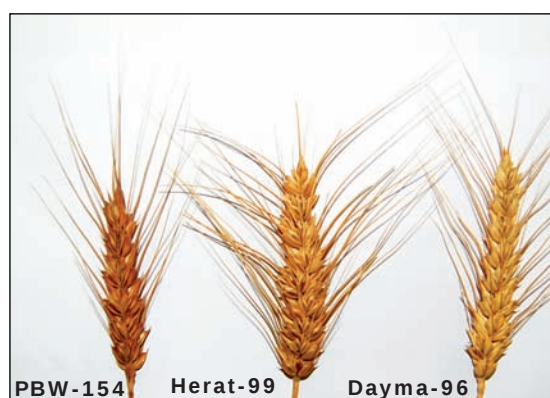
Grain quality characteristics

Parameters	Classification
Particle size index (%)	Hard (42)
Protein (%)	11.7
Farinograph measurements	
Water absorption (%)	Good 61.5
Development time (min)	Weak (3.5)
Stability time (min)	Weak (3.7)
Dough softening (Brabender Unit)	Weak (150)
Alveograph measurements	
P (mm) tenacity	43
L (mm) extensibility	129
W dough strength	0.33
P/L configuration ratio	102
High molecular weight 1A	2*
High molecular weight 1B	7+9
High molecular weight 1D	5+10

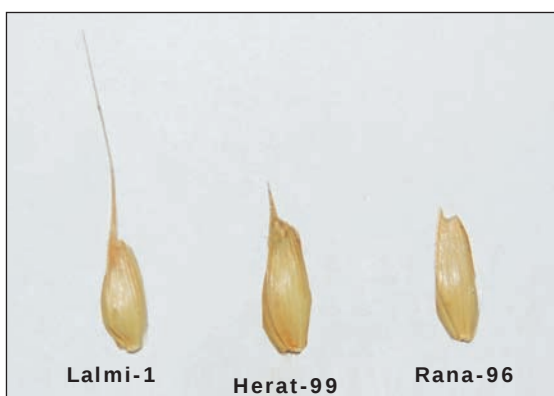
Earliness



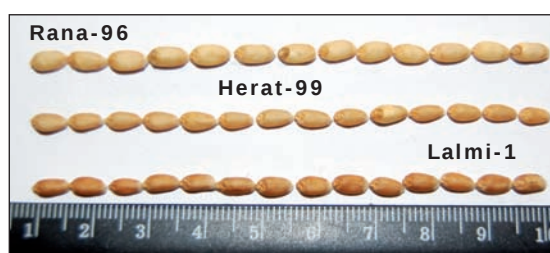
Spikes



Lower glumes



Grain sample



Croc-1

Crop:	Wheat
Common name:	Bread wheat
Scientific name:	<i>Triticum aestivum</i>
Pedigree:	CROC_1/AE.SQ (205) KAUZ/3/PASTOR
Seasonal type:	Facultative
Origin:	CIMMYT



Grain characteristics

Grain color	Amber
Thousand kernel weight	40 g

Juvenile plant characteristics

Growth habit	Semi erect
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Flowering plant characteristics

Days from emergence to flowering	Medium
Auricle color	Absent
Flag leaf attitude	Dropping
Flag leaf sheet glaucosity	Medium
Flag leaf width	Narrow
Glume hairiness	Absent
Cross section of neck	Thin

Maturing plant characteristics

Last node hairiness	Strong
Plant height	Medium
Beak length	Very short
Shoulder width	Broad
Shoulder shape	Rounded
Neck zigzagness	Weak
Ear shape	Tapering
Ear density	Medium
Straw color	White

Agronomic characteristics

Disease reaction	Resistant to yellow rust
Yield potential	5.4 t/ha

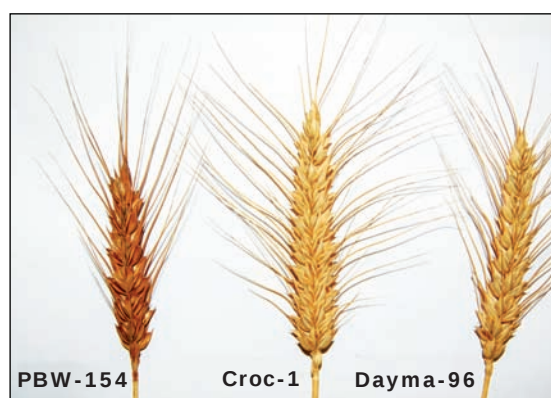
Grain quality characteristics

Parameters	Classification
Particle size index (%)	Hard (41)
Protein (%)	10.9
Farinograph measurements	
Water absorption (%)	Good 61
Development time (min)	Weak (2.2)
Stability time (min)	Very weak (1.4)
Dough softening (Brabender Unit)	Very weak (230)
Alveograph measurements	
P (mm) tenacity	35
L (mm) extensibility	73
W dough strength	0.48
P/L configuration ratio	52
High molecular weight 1A	2*
High molecular weight 1B	7+9
High molecular weight 1D	2 + 12/ 5+10

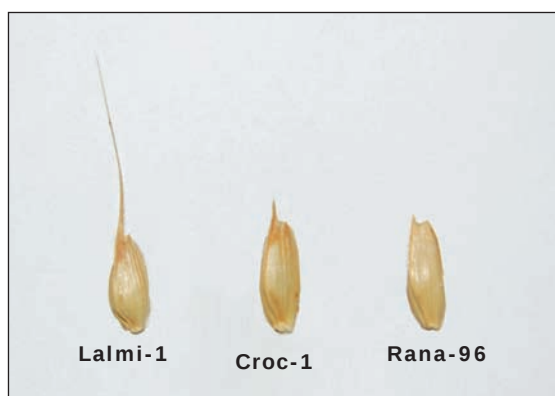
Earliness



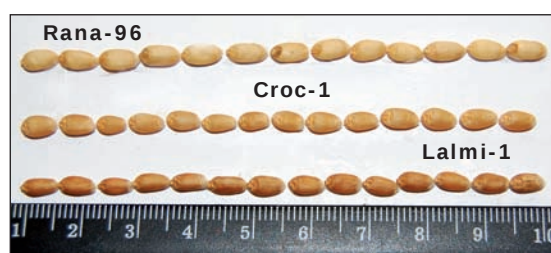
Spikes



Lower glumes



Grain sample



Drokhshan-08

Crop: Wheat
Common name: Bread wheat
Scientific name: *Triticum aestivum*
Pedigree: CNDO/R143/ENTE/
MEXI_2/3/...
Seasonal type: Facultative
Origin: CIMMYT



Grain characteristics

Grain color	Amber
Thousand kernel weight	39 g

Juvenile plant characteristics

Growth habit	Intermediate
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Flowering plant characteristics

Days from emergence to flowering	Early
Auricle color	Weak
Flag leaf attitude	Semi-dropping
Flag leaf sheet glaucosity	Medium
Flag leaf width	Narrow
Glume hairiness	Present
Cross section of neck	Thin

Maturing plant characteristics

Last node hairiness	Weak
Plant height	Medium
Beak length	Medium
Shoulder width	Medium
Shoulder shape	Elevated
Neck zigzagness	Medium
Ear shape	Parallel
Ear density	Medium
Straw color	White

Agronomic characteristics

Disease reaction	Resistant to yellow rust
Yield potential	5 t/ha

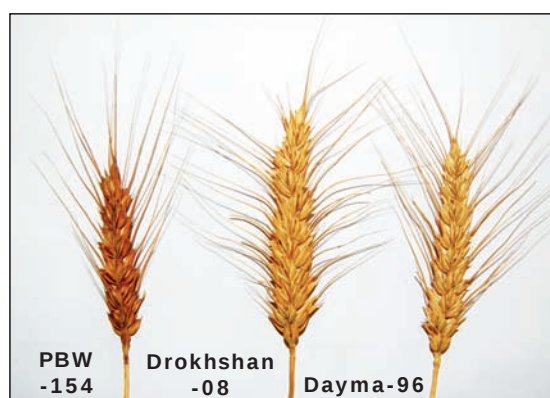
Grain quality characteristics

Parameters	Classification
Particle size index (%)	Hard (42)
Protein (%)	11.7
Farinograph measurements	
Water absorption (%)	Good 63.5
Development time (min)	Very weak (1.8)
Stability time (min)	Very weak (1.0)
Dough softening (Brabender Unit)	Very weak (210)
Alveograph measurements	
P (mm) tenacity	43
L (mm) extensibility	44
W dough strength	0.98
P/L configuration ratio	54
High molecular weight 1A	0
High molecular weight 1B	7+9
High molecular weight 1D	2+12

Earliness



Spikes



Lower glumes



Grain sample



Parva-2

Crop:	Wheat
Common name:	Bread wheat
Scientific name:	<i>Triticum aestivum</i>
Pedigree:	CHTO/ARDEA//SRN_2 CD74825-C-5M-1Y-040M- 2YRC-2M-0YRC
Seasonal type:	Facultative
Origin:	CIMMYT
Other names:	Sia Dasa



Grain characteristics

Grain color	Amber
Thousand kernel weight	50 g

Juvenile plant characteristics

Growth habit	Intermediate
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Flowering plant characteristics

Days from emergence to flowering	Medium
Auricle color	Strong
Flag leaf attitude	Erect
Flag leaf sheet glaucosity	Strong
Flag leaf width	Narrow
Glume hairiness	Present
Cross section of neck	Thick

Maturing plant characteristics

Last node hairiness	Very strong
Plant height	Short
Beak length	Very short
Shoulder width	Very narrow
Shoulder shape	Sloping
Neck zigzagness	Very strong
Ear shape	Parallel
Ear density	Very dense
Straw color	White

Agronomic characteristics

Disease reaction	Resistant to yellow rust
Yield potential	4.6 t/ha

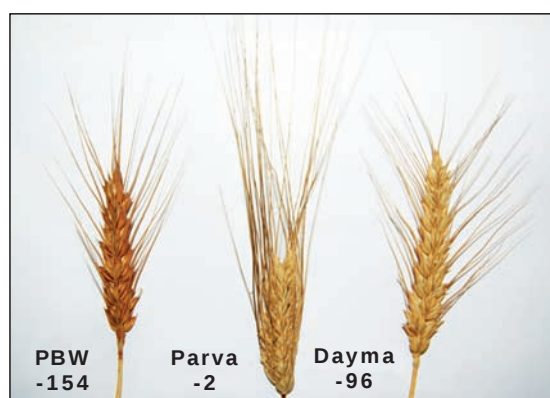
Grain quality characteristics

Parameters	Classification
Particle size index (%)	Very hard (28)
Protein (%)	12.3
Farinograph measurements	
Water absorption (%)	Good 69.0
Development time (min)	Very weak (1.8)
Stability time (min)	Weak (2.2)
Dough softening (Brabender Unit)	Weak (150)
Alveograph measurements	
P (mm) tenacity	49
L (mm) extensibility	94
W dough strength	0.52
P/L configuration ratio	90
High molecular weight 1A	0
High molecular weight 1B	20
High molecular weight 1D	0

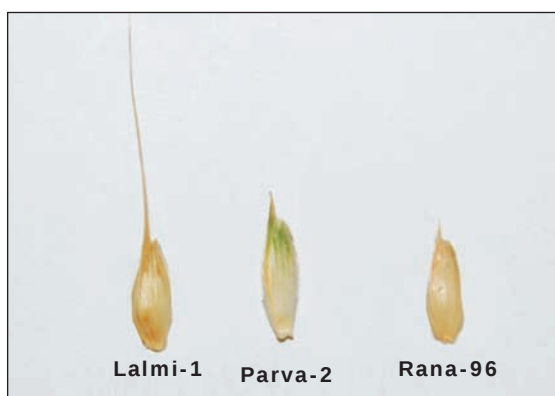
Earliness



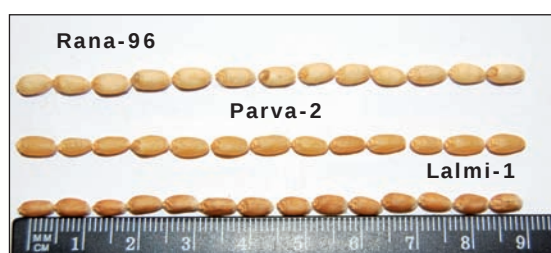
Spikes



Lower glumes



Grain sample



Lalmi-2

Crop:	Wheat
Common name:	Bread wheat
Scientific name:	<i>Triticum aestivum</i>
Pedigree:	BOBWHITE/MN... IC88-063-1AP-OL-1AP-2AP-OTS-AP
Seasonal type:	Facultative
Origin:	CIMMYT/ICARDA



Grain characteristics

Grain color	Amber
Thousand kernel weight	41 g

Juvenile plant characteristics

Growth habit	Intermediate
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Flowering plant characteristics

Days from emergence to flowering	Early
Auricle color	Medium
Flag leaf attitude	Erect
Flag leaf sheet glaucosity	Medium
Flag leaf width	Narrow
Glume hairiness	Present
Cross section of neck	Thin

Maturing plant characteristics

Last node hairiness	Weak
Plant height	Medium
Beak length	Medium
Shoulder width	Narrow
Shoulder shape	Sloping
Neck zigzagness	Very weak
Ear shape	Parallel
Ear density	Dense
Straw color	White

Agronomic characteristics

Disease reaction	Resistant to yellow rust
Yield potential	5.8 t/ha

Grain quality characteristics

Parameters	Classification
Particle size index (%)	Hard (40)
Protein (%)	11.9
Farinograph measurements	
Water absorption (%)	Good 63
Development time (min)	Weak (2.5)
Stability time (min)	Very weak (1.5)
Dough softening (Brabender Unit)	Very weak (210)
Alveograph measurements	
P (mm) tenacity	46
L (mm) extensibility	57
W dough strength	0.81
P/L configuration ratio	67
High molecular weight 1A	2*
High molecular weight 1B	7+9
High molecular weight 1D	2+12/ 5+10

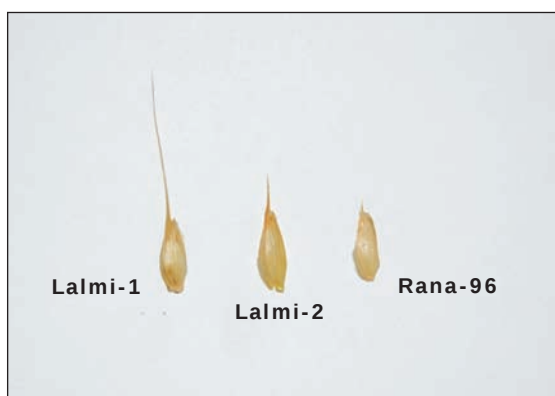
Earliness



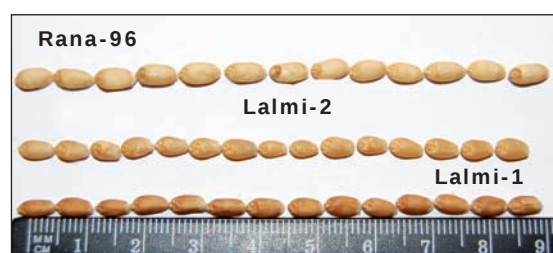
Spikes



Lower glumes



Grain sample



Lalmi-1

Crop:	Wheat
Common name:	Bread wheat
Scientific name:	<i>Triticum aestivum</i>
Pedigree:	FOW-1 SWM11147-1AP-2AP-1AP-1AP-OAP
Seasonal type:	Facultative
Origin:	CIMMYT/ICARDA



Grain characteristics

Grain color	Red
Thousand kernel weight	42 g

Juvenile plant characteristics

Growth habit	Semi erect
--------------	------------

Flowering plant characteristics

Days from emergence to flowering	Medium
Auricle color	Absent
Flag leaf attitude	Erect
Flag leaf sheet glaucosity	Weak
Flag leaf width	Narrow
Glume hairiness	Absent
Cross section of neck	Thin

Maturing plant characteristics

Last node hairiness	Weak
Plant height	Medium
Beak length	Very long
Shoulder width	Narrow
Shoulder shape	Rounded
Neck zigzagness	Very weak
Ear shape	Parallel
Ear density	Medium
Straw color	White

Agronomic characteristics

Disease reaction	Resistant to yellow rust
Yield potential	5.6 t/ha

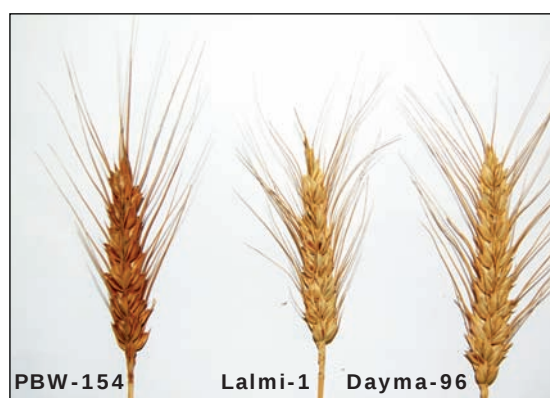
Grain quality characteristics

Parameters	Classification
Particle size index (%)	Medium (58)
Protein (%)	12.3
Farinograph measurements	
Water absorption (%)	58.0
Development time (min)	Weak (2.5)
Stability time (min)	Medium (5.5)
Dough softening (Brabender Unit)	Medium (100)
Alveograph measurements	
P (mm) tenacity	41
L (mm) extensibility	184
W dough strength	0.22
P/L configuration ratio	169
High molecular weight 1A	2*
High molecular weight 1B	7+9
High molecular weight 1D	5+10

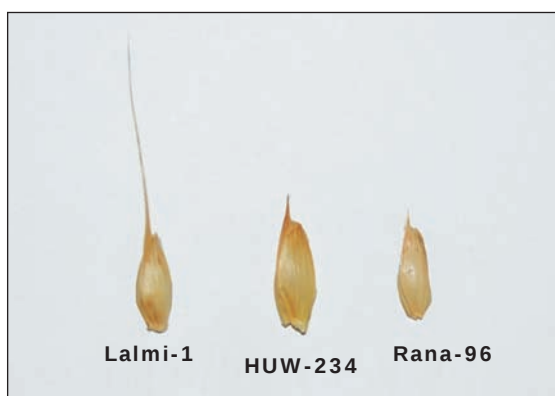
Earliness



Spikes



Lower glumes



Grain sample



Ariana-07

Crop:	Wheat
Common name:	Bread wheat
Scientific name:	<i>Triticum aestivum</i>
Pedigree:	Pastor/3/kauz*2/Opata// Kauz/CID/SID:133513/256
Seasonal type:	Facultative
Origin:	CIMMYT



Grain characteristics

Grain color	Amber
Thousand kernel weight	48 g

Juvenile plant characteristics

Growth habit	Intermediate
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Flowering plant characteristics

Days from emergence to flowering	Medium
Auricle color	Absent
Flag leaf attitude	Erect
Flag leaf sheet glaucosity	Very strong
Flag leaf width	Narrow
Glume hairiness	Absent
Cross section of neck	Thin

Maturing plant characteristics

Last node hairiness	Strong
Plant height	Medium
Beak length	Short
Shoulder width	Medium
Shoulder shape	Sloping
Neck zigzagness	Very weak
Ear shape	Parallel
Ear density	Medium
Straw color	White

Agronomic characteristics

Disease reaction	Resistant to yellow rust
Yield potential	6.3 t/ha

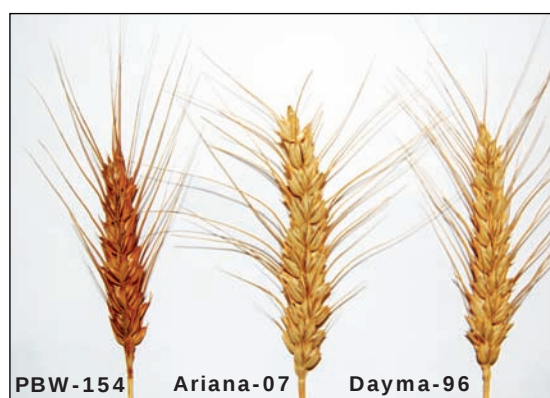
Grain quality characteristics

Parameters	Classification
Particle size index (%)	Hard (41)
Protein (%)	11.3
Farinograph measurements	
Water absorption (%)	Good 61.0
Development time (min)	Weak (3.5)
Stability time (min)	Weak (3.2)
Dough softening (Brabender Unit)	Medium (130)
Alveograph measurements	
P (mm) tenacity	56
L (mm) extensibility	82
W dough strength	0.68
P/L configuration ratio	115
High molecular weight 1A	1
High molecular weight 1B	7+9
High molecular weight 1D	5+10

Earliness



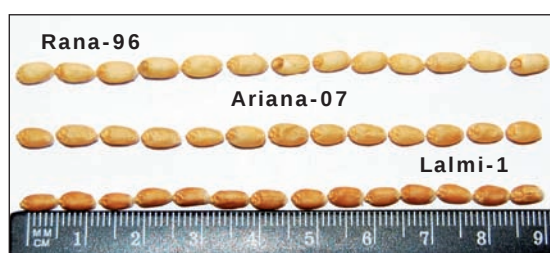
Spikes



Lower glumes



Grain sample



Additional data

Table 2. Wheat varieties tested, sources and pedigrees

Varieties	Type	Source	Pedigree
Pamir-94	Winter	CIMMYT/ICARDA	YMH/TOB/3/LIRA SWM16#...
Solh-02	Winter	CIMMYT	OK82282//BOW//NKT/F4/
Gul-96	Winter	CIMMYT/ICARDA	ID8009994.W./VEE 2WM-OWM-OSE-1YC-OYC
Ghazna-97	Winter	CIMMYT/ICARDA	AGRI/NAC
Bakhtawar-92	Spring	CIMMYT/ICARDA	JUP/BJY/URES CM7458-4Y-1M-3Y-08-OSY
Ghori-96	Spring	CIMMYT/ICARDA	PRL"S"/PEW CM59377-3AP-1AP-3AP-2AP-1AP-OAP
HD-2285	Spring	India	HD1912-1592/hd1962E4870-K65X-HD2160/HD2186
Inqlab-91	Spring	Pakistan	PB19545-9A-0A-OPAK
Balkh-66	Spring	India	HD-2232
Nangarhar-64	Spring	ARIA	WL-711
PBW-154	Spring	India	HD2177/HD2160
Takhar-96	Spring	CIMMYT	VEE#7/OPATA
Snb ^{ts}	Spring	CIMMYT/ICARDA	Snb's'/5/Maya74's'/On//II60.147/3/Bb/GII/4/Chat's'
HUW-234	Spring	India	HUW12/Sparrow/HUW12
Dayma-96	Spring	CIMMYT/ICARDA	HD2206/HORK//BUC/BUL
MH-97	Alternative	Pakistan	Attila CM8583-504-OM-OY-OSY-OAP
Rana-96	Facultative	CIMMYT/ICARDA	CA8055/6/PATOR/CAL/3/76//BB/CN015/CAL//CNOSN64/4/CNO//NAD/CH 2AP-2AP-2AP-1AP-OAP
Irena/Weaver	Facultative	CIMMYT	IRENA/Weaver/CMBW90M294.1-1M-020Y-010M-010Y- 6M-015Y-0Y
Lalmi-3	Facultative	CIMMYT/ICARDA	FLORKWA-3 IC84-0074-02AP-3002-1AP-OL-OAP
Sheshambagh-08	Facultative	CIMMYT	SW89.5181/KAUZ
Amu-99	Facultative	CIMMYT/ICARDA	Bloyka-ICW84-0008-013AP-300L-OAP
Kabul-2000	Facultative	India	HD-3280
Darulaman-07	Facultative	CIMMYT	Weaver/4/Nac/Th.ac//3*PVN/3/mirlo/bucCID/SID:133428/104
Roshan-96	Facultative	CIMMYT/ICARDA	BLOUNDAN/3/Bb/7C*2//Y50E/KAL*3
Mazar-99	Facultative	CIMMYT/ICARDA	PASTURE CM85295-0101TOPY-2M-OY-OM-3Y-OM
Herat-99	Facultative	CIMMYT/ICARDA	MYNA/VUL//PRL CM97958-OM-7Y-030M-030M-84-OM
Croc-1	Facultative	CIMMYT	CROC_1/AE.SQ (205) KAUZ/3/PASTOR
Drokhshan-08	Facultative	CIMMYT	CNDO/R143/ENTE/MEXI_2/3/
Parva-2	Facultative	CIMMYT	CHTO/ARDEA//SRN_2 CD74825-C-5M-1Y-040M-2YRC-2M-0YRC
Lalmi-2	Facultative	CIMMYT/ICARDA	BOBWHITE/MN IC88-063-1AP-OL-1AP-2AP-OTS-OAP
Lalmi-1	Facultative	CIMMYT/ICARDA	FOW-1 SWM11147-1AP-2AP-1AP-1AP-OAP
Ariana-07	Facultative	CIMMYT	Pastor/3/kauz*2/Opata//Kauz/CID/SID:133513/256

Table 3. Summary of qualitative and quantitative data scored in two consecutive seasons at Jalalabad, Mazar and Herat locations (converted into 1-9 scale)

Variety	ST	GC	GW	GH	DTF	AC	FLA	FLG	FLW	GLH	CSN	LNH	PH	BL	SW	SS	NZ	ES	ED	SC
Pamir-94	1	2	5	7	5	1	3	1	1	1	5	3	5	1	7	2	5	1	7	1
Solh-02	1	3	5	7	3	3	3	3	1	1	3	5	5	1	7	1	1	1	5	1
Gul-96	1	3	7	7	7	1	3	5	5	1	3	3	5	3	5	2	3	1	7	1
Ghazna-97	1	1	3	7	7	5	5	3	7	1	5	7	7	7	1	1	1	3	3	1
Bakhtawar-92	2	3	5	3	3	1	5	7	1	1	3	5	3	3	5	3	3	1	7	1
Ghori-96	2	3	7	5	3	3	5	5	5	1	3	3	7	3	7	2	3	1	5	1
HD-2285	2	3	7	3	3	3	5	5	5	1	3	5	5	1	5	4	3	1	3	1
Inqlab-91	2	3	7	3	3	1	5	5	5	1	3	5	5	3	5	4	5	2	3	2
Balkh-66	2	3	5	3	3	1	7	3	5	1	3	7	5	5	5	3	7	2	3	1
Nangarhar-64	2	3	7	3	3	7	5	5	5	1	3	7	7	3	7	4	3	3	3	1
PBW-154	2	3	7	3	3	1	7	3	1	1	3	7	5	3	7	4	3	3	5	2
Takhar-96	2	2	5	5	3	1	5	5	1	1	3	5	5	1	7	2	3	1	3	1
Snb ^s	2	3	5	5	3	3	7	3	1	1	3	7	3	1	7	3	1	1	5	1
HUW-234	2	3	7	3	3	1	5	5	5	1	3	7	7	1	9	2	3	1	3	1
Dayma-96	2	3	5	3	3	3	5	5	1	1	3	5	7	3	1	1	1	1	3	1
MH-97	4	1	7	5	3	1	3	3	5	1	7	5	5	5	1	2	3	2	3	1
Rana-96	3	1	5	7	3	1	5	1	1	1	7	5	7	1	7	1	1	3	7	1
Irena/Weaver	3	3	5	3	5	7	5	1	1	1	3	3	5	3	7	2	1	3	3	1
Lalmi-3	3	3	5	3	3	7	5	3	5	1	3	3	5	3	1	1	3	1	3	1
Sheshambagh-08	3	3	7	5	3	3	3	7	5	1	3	3	5	3	5	1	1	1	5	1
Amu-99	3	3	5	5	5	1	5	1	5	1	3	7	7	3	5	4	7	1	5	1
Kabul-2000	3	3	5	7	7	3	7	5	1	1	5	7	3	3	7	2	1	1	3	1
Darulaman-07	3	3	7	3	5	1	3	5	1	9	3	5	5	5	5	4	3	1	3	1
Roshan-96	3	3	5	5	5	1	3	1	7	9	5	5	7	5	5	2	3	2	5	1

Table 3. Continued

Variety	ST	GC	GW	GH	DTF	AC	FLA	FLG	FLW	GLH	CSN	LNH	PH	BL	SW	SS	NZ	ES	ED	SC
Mazar-99	3	3	5	5	5	3	7	7	1	1	7	5	5	3	1	1	5	3	5	1
Herat-99	3	3	5	3	3	1	7	5	1	1	3	5	7	3	1	2	3	2	5	2
Croc-1	3	3	5	3	5	1	7	5	1	1	3	7	5	1	7	2	3	2	5	1
Drokhshan-08	3	3	5	5	3	3	5	7	1	9	3	3	5	5	5	3	5	1	5	1
Parva-2	3	3	7	5	5	5	3	5	1	9	7	7	3	1	1	1	7	1	9	1
Lalmi-2	3	3	5	5	3	5	3	5	1	9	3	3	5	5	1	1	1	1	7	1
Lalmi-1	3	2	7	3	5	1	3	3	1	1	3	3	5	9	1	2	1	1	5	1
Ariana-07	3	3	7	5	5	1	3	9	1	1	3	7	5	3	5	1	1	1	5	1

Seasonal type (ST), Grain color (GC), Growth habit (GH), Grain weight (GW), Days to flowering (DF), Auricle color (AC), Flag leaf attitude (FLA), Flag leaf sheet glaucosity (FLG), Flag leaf width (FLW), Glume hairiness (GH), Cross section of neck (CSN), Last node hairiness (LNH), Plant height (PH), Beak length of lower glume (BL), Shoulder width of lower glume (SW), Shoulder shape of lower glume (SS), Neck zigzagness (NZ), Ear Shape (ES), Ear density (ED), Straw color (SC)

Table 4. Glutenin subunits banding patterns in wheat varieties in Afghanistan

Cultivar	HMW1A	HMW1B	HMW1D	Remarks
Pamir-94	1	7+8	5+10	
Solh-02	2*	13+16	5+10	
Gul-96	1	7+9	5+10	
Ghazna-97	2*	7	5+10	
Bakhtawar-92	2*	7+9	5+10	
Ghori-96	2*	13+16	2+12	
HD-2285	2*	7+8	2+12	
Inqlab-91	2*	17+18	2+12	
Balkh-66	2*	7+8	2+12	
Nangarhar-64	2*	7+8 / 17+18	2+12	
PBW-154	2*	7+8	2+12	
Takhar-96	1	7+9	2+12	
Snb ^{'s'}	1	7+9	5+10	
HUW-234	2*	7+8	2+12	
Dayma-96	2*	7+9	5+10	
MH-97	2*	7+8	5+10 / 2+12	Mixture
Rana-96	1	20	2+12	
IRENA/Weaver	2*	7+8	2+12	
Lalmi-3	2*	7+8	2+12 / 5+10	Mixture
Sheshambagh-08	0	7+9	2+12	
Amu-99	2*	7+8	2+12	
Kabul-2000	2*	13+16 / 7+18	5+10 / 2+12	Mixture
Darulaman-07	2*	17+18	2+12	
Roshan-96	2*	7+8	2+12	
Mazar-99	1	17+18	5+10	
Herat-99	2*	7+9	5+10	
CROC-1	2*	7+9	2+12 / 5+10	Mixture
Drokhshan-08	0	7+9	2+12	
Parva-2	0	20	0	
Lalmi-2	2*	7+9	2+12 / 5+10	Mixture
Lalmi-1	2*	7+9	5+10	
Ariana-07	1	7+9	5+10	

HMW1A, 1B and 1D: High molecular weight located at chromosome A1 and 1D respectively

Table 5. Quick reference table for winter wheat varieties in Afghanistan

1	White	Red	Amber
2	Low	Medium	Medium
3	Late	Medium	Early
4			Late
5			
Medium	Short	Pamir-94	Solh-02
Medium	Medium		
Tall	Long	Ghazna-97	Gul-96

Grain color (1), Grain weight (2), Earliness (3), Beak length (4) and Plant height (5)

	Lax						Medium	Dense
	1	2	3	4	5	6		
Short	Very short	Short	White	White	Medium	High	Medium	Dense
Medium	Short	Medium	White	White	Medium	High	Medium	Amber
	Medium	Medium	White	White	Medium	High	Medium	Medium
Tall	Short	Medium	White	White	Medium	High	Medium	Medium

Ear density (1), Grain color (2), Grain weight (3), Straw color (4), Beak length (5) and Plant height (6)

Table 7. Quick reference table for facultative and alternative wheat varieties in Afghanistan

1			Short			Medium			Tall				
6	2		Short		3	Very long		Very short	Short		Medium		
	4		White			White							
	5		White			White							
	5		White			White							
	5		White			White							
	5		White			White							
White	Medium	Early							Rana-96				
High	Early							MH-97					
Early								Lalmi-3					
Medium	Medium							Mazar-99					
Late								Lalmi-2					
Amber	High							Shesambagh-08					
Early								Ariana-07					
Medium	Parva-2							Darulaman-07					
Late								Irena/Weaver					
Medium								Lalmi-1					

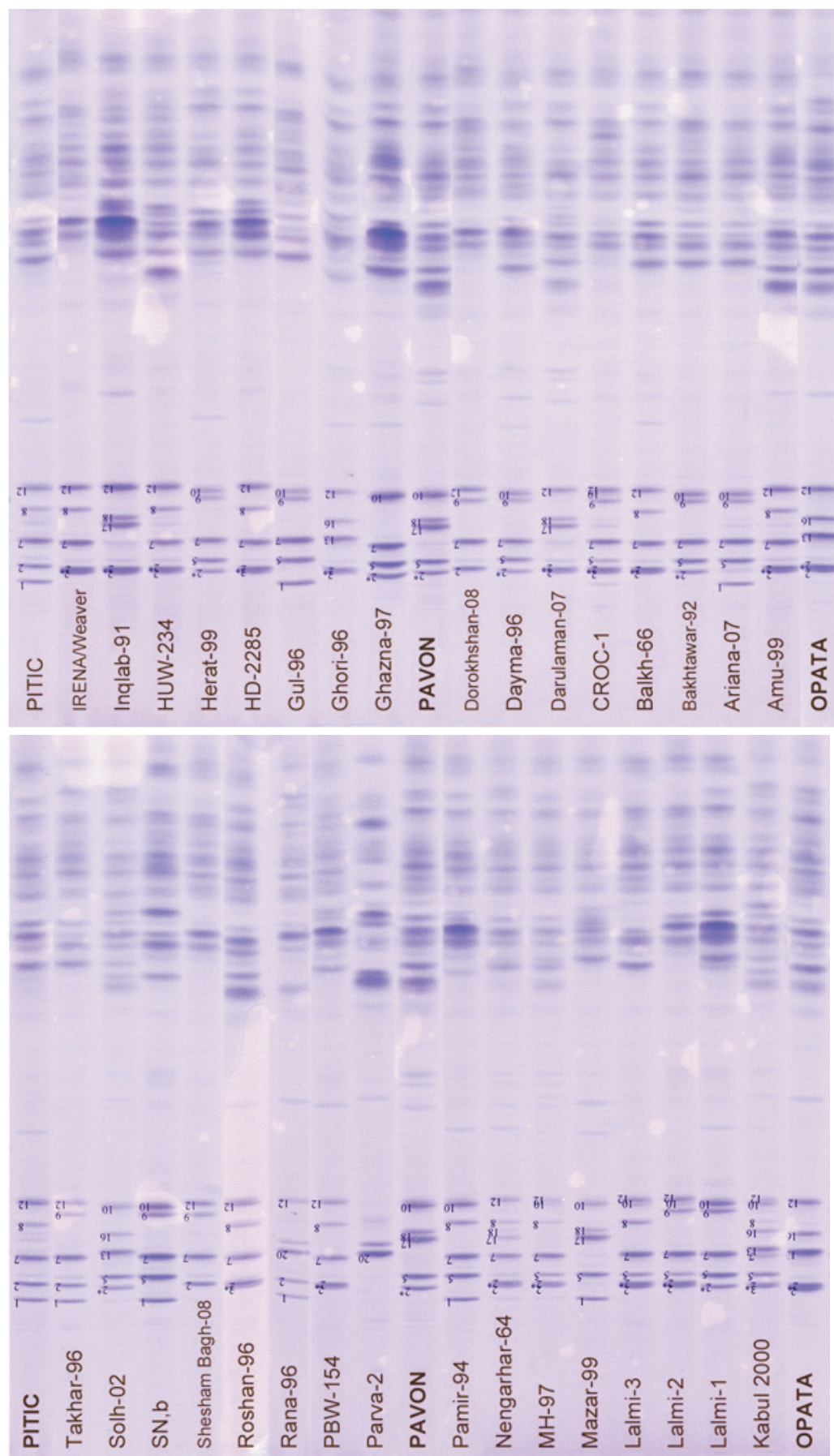
Table 8. Quick reference table for wheat varieties in Afghanistan

7	6	5	4	1	Short			Medium	
				2	Very short	Short		Very long	Short
				3					
					White	White	Red	White	White
Spring	White	Medium	Early						
		High	Early					HD-2285	
	Amber	Medium	Early	Snb ^{s'}	Bakhtavar-92				
		High	Early			PBW-154			Inqelab-91
	Red	Medium	Early					Takhar-96	
Facultative	White	Medium	Early						
			Medium						
		High	Early						
	Amber	Medium	Early						Lalmi-3
			Medium						Mazar-99
			Late		Kabul-2000				
		High	Medium						Ariana-07
			Late						
	Red	High	Early						Shesambagh-08
			Medium					Lalmi-1	
Winter	White	Low	Late						
	Red	Medium	Medium						Pamir-94
	Amber	Medium	Early						Solh-02
			Late						

Plant height (1), Beak length (2), Straw color (3), Earliness (4), Grain weight (5), Grain color (6) and seasonal type (7)

		Tall				
	Medium	Very short	Short		Medium	Long
	White	White	White	Brown	White	White
			Dayma-96			
		HUW-234	Ghori-96			
	Balkh-66					
			Nangarhar-64			
	MH-97					
	Lalmi-2	Croc-1	Amu-99	Herat-99	Drokhshan-08	
					Roshan-96	
	Darulaman-07	Parva-2				
	Irena/Weaver					
						Ghazna-97
	Gul-96					

Figure 10. Glutenin subunits banding patterns of wheat varieties in Afghanistan





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