Investigation of Physical Quality Characteristics of Dry Land and Wet Land Wheat Varieties

Saghir Ahmed Sheikh[1,*], Benish Nawaz Merani[1], Aijaz Hussain Somro[1], Liaquat Jamali[2] and Aasia Akbar Panhwar[1]

[1]*Institute of food Sciences and Technology, Sindh Agriculture University Tandojam, Pakistan*

[2]*Department of Farm Structure and Machinery, Sindh Agriculture University Tandojam, Pakistan*

Abstract: The aim of this research study was to determine the physical characteristics of some commercial wheat varieties of dry land and wet land grown in Sindh province. Four irrigated land (Inqulab, TD-1, Kherman, and Sarsabz) wheat varieties and four drought tolerant (TK-3, Marvi, PK-85, Sassi) wheat varieties were collected from their respective areas and subjected to physical analysis.

The physical characteristics of dry land and wet land wheat varieties differed significantly. It was observed that dry land wheat varieties higher in length (7.29mm) as compared to wet land wheat varieties (7.05mm). Whereas, wet land wheat varieties higher in breadth (4.97mm), thickness(3.86mm), volume (59.7mm^3), geometric mean (10.66mm) and sphericity (1.72%) than those of dry land wheat varieties with breadth (4.15mm), thickness (3.25mm), volume (45.3mm^3), geometric mean (9.34mm) and sphericity (1.35%). It is also observed that TKW (47g) of wet land wheat varieties were higher than those of dry land wheat varieties TKW (40.2g). Moreover, falling number (419sec) were recorded higher in wet land wheat varieties than those of dry land wheat varieties falling number (387sec). While, dry land wheat varieties increased in its hardness (55.3%) than those of wet land wheat varieties hardness (51.3%). This study reveals that availability of water and environmental factors are directly related with the nutritional characteristics of wheat varieties. This study revealed that due to more moisture content in wet land wheat varieties TKW, breadth, thickness, volume, geometric mean, falling number and sphericity were recorded as higher than dry land wheat varieties. However, Length and hardness were observed higher in dry land wheat varieties which resulted in better yield of flour as compared with wet land wheat varieties.

Keywords: Dry land, wet land, wheat varieties, physical characteristics.

INTRODUCTION

Wheat (*Tritium aestivum* L.) belongs to family "Gramineae" and genus Triticum [1]. Wheat is the largest grain crop and staple food of Pakistan. It occupies a central position in agriculture and economy of Pakistan [2]. Besides being a rich source of carbohydrate, wheat contains protein, essential amino acids except lysine, minerals such as phosphorus, magnesium, iron, copper and zinc and thiamine, riboflavin, niacin and vitamin E [3]. In Pakistan about 80% of the total wheat produced is used for the production of unleavened flat bread locally known as "chapatti" and its culinary variations like "tandoori roti", "naans", "Parathas" and "Poories". However, 20% of the rest is used for other bakery products such as breads, cookies, cakes and pastries etc [4].

During the year 2010-11, the area under wheat cultivation was 1144.4 thousand hectares with the production of 4287.9 thousand tons. The average yield was 3747 kg/ hectare [5]. Area of wheat crop for the year 2010-11 shows a decrease of 2.53% over the previous year. Area decreased due to problems faced by the farmers in disposal of wheat produced last year, shifting of area to cotton & sugarcane crops in irrigated tract, late crushing by sugar mills and considerable increase in Potato (Autumn) crop. The production shows an increase of 8.16% over the last year, which is attributed to sowing in appropriate time and available moisture in barani tract, better weather conditions, recommended doze of inputs and use of high yielding varieties [5].

Wheat grains are generally oval shaped, although different wheat have grains that range from almost spherical to long, narrow and flattened shapes. The average length, breadth, thickness and TKW (Thousand kernel weights) were 6.85mm, 3.80mm, 3.55mm, and 49.3gram grains of irrigated wheat respectively [6]. The wheat grain contains 2-3% germ, 13-17% bran and 80-85% mealy endosperm (all constituents converted to a dry matter basis). The wheat contains protein 10 - 18%, starch 60-75%, fats 1-5%, and the contents of minerals (ash) and of dietary fibers are low; 0.5% and 1.5%, respectively [7].

The wheat quality is a complex of many factors depending on milling, chemical, baking and rheological dough properties. Wheat quality reflects suitability for a particular purpose or intended use. The major factors

*Address correspondence to this author at the Institute of Food Sciences and Technology, Sindh Agriculture University, Tandojam-70060, Pakistan; Tel: 03003063464; Fax: 02222765554; E-mail: sasheikhsau@gmail.com

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influencing quality are cultivar, climatic conditions, cropping year, process of harvest and storage conditions [8].

The quality of wheat is generally assessed on the basis of different physical, chemical and biochemical properties. The products prepared from wheat grains require different quality characteristics. The wheat flour's ability to be processed into different food products is mainly determined by the contents and quality of gluten proteins [4]. Wheat quality can be improved if both genetic as well as biochemical composition influencing technological properties are known [9].

Wheat in Pakistan grown in different agro-climatic regions. It is therefore necessary to investigate the nutritional status of wheat grown in dry land and wet land before using.

MATERIALS AND METHODS

In this study, four varieties of dry wheat Marvi, Sassi TK3 and PK-85 and four varieties of wet land wheat Inqulab, TD-1, Kherman and Sarsabz, were selected from popular varieties in Sindh province for determining the physical characteristics and their best use for human consumption. The samples of irrigated wheat were collected from Nuclear Institute of Agriculture Tandojam (NIA), Sindh Agriculture University Tandojam, and Agriculture Research Center Tandojam. The samples of dry land wheat were collected from the office of Arid Zone cities namely Johi and Kachoo at Thana Bola Khan. These samples were kept in plastic bags at available moisture content, and were labeled and transported from field to laboratory of Food Sciences and Technology at Sindh Agriculture University Tandojam

All the physical analysis was separately performed according to their nature. Laboratory tests were performed in the Cereals Technology Laboratory of Institute of Food Sciences and Technology, Faculty of Crop Production, Sindh Agriculture University Tandojam with the following parameters:

Physical Dimensions

Length, Breadth and Thickness

Physical parameters (length, breadth and thickness) of wheat kernels were measured by screw gauge. Fifty healthy and matured kernels were selected from each variety for measuring physical parameters.

Volume

The volume of grain kernels was calculated by equation developed by NurulIslam and Pedersen [10] is given below;

$$V= (\pi/6)*L*W*H\pm 3.485$$

Where,

L, W, and H are the length, breadth and thickness respectively.

Geometric Mean

The geometric mean diameter (D mg) of the grain kernel was calculated by using the following relationship;

$$D\ mg = (L*D*T)$$

Where,

L, D, and T are the length, breadth and thickness respectively.

Sphericity

The degree of Sphericity (Ø) of grain kernel was calculated by using equation developed by Mohsenin [11];

$$Ø= (L*D*T))/ L$$

Determination of Thousand Kernel Weight (TKW)

For measurement of 1000 grain weight, 100 randomly selected grains were weighed in a digital balance and that weight was multiplied by 10.

Hardness

The hardness of wheat grains was determined by Inframatic 9200 Grain Analyzer. It works on the principle of Near Infrared Technology.

Falling Number (sec)

It gives an indication of the amount of sprout damage that has occurred within a wheat sample. Generally, a falling number value of 350 seconds or longer indicates a low enzyme activity and very sound wheat quality. As the amount of enzyme activity increases, the falling number decreases. Values below 200 seconds indicate high levels of enzyme activity. The falling number of wheat grains was analyzed by AACC [12] method No. 56-81 B.

Table 1: Average Physical Characteristics of Different Wheat Varieties of Dry Land Grown in Sindh Province

Physical characteristics of dry land wheat varieties						
Parameters	**Verities**				**F Statistics (P Value)**	**DF**
	PK-85	**Marvi**	**TK-3**	**Sassi**		
Length (mm)	7.14±0.134a	7.29±0.04a	6.92±0.03b	6.96±0.06b	13.3 p = 0.001	3
Breadth (mm)	4.15±0.07a	2.99±0.06c	3.15±0.05b	3.09±0.04bc	251 p = 0.00	3
Thickness (mm)	2.93± 0.03b	3.25±0.03a	3.17±0.02a	2.94±0.07b	36.3 P= 0.00	3
Volume (mm^3)	45.3± 5.50a	37.2±0.02c	36.4± 4.47b	33.09± 3.96b	60.6 p = 0.00	3
Geometric (mm)	9.34± 0.66b	8.45±2.64a	8.33± 3.74a	7.88 ± 1.14b	140 p = 0.00	3
Sphericity (%)	1.35± 0.33a	1.17±0.95a	1.22±1.07a	1.15±0.68a	0.04NS p= 0.98	3
Thousand Kernel (g)	35.66±0.09a	36.5±0.48a	40.2±0.49c	38.5±0.08b	65.310 p = 0.001	3
Hardness (%)	55.3±1.24b	52.3±1.69ab	50.3±0.47a	50.6±1.24a	6.714 p = 0.014	3
Falling Number (Sec)	387±4.96d	344±3.74b	265±7.07a	373±3.41c	238.981 p = 0.00	3

Physical characteristics of dry land wheat varieties grown in Sindh province shown in Table **1**. The data indicates that maximum mean length 7.29mm was recorded in Marvi variety followed by PK-85 (7.14mm). The minimum mean length 6.92mm was recorded in TK-3 variety followed by Sassi (6.96mm) variety. The maximum mean 4.15mm breadth was recorded in PK-85 variety followed by TK-3 variety (3.15mm). The minimum mean breadth 2.99mm was recorded in Marvi variety followed by Sassi variety (3.09mm). The maximum 3.25mm thickness was recorded in Marvi variety followed by TK-3 (3.17mm) variety. The minimum mean 2.93mm thickness was recorded in PK-85 variety followed by Sassi (2.94mm) variety.

The data indicates that maximum mean volume 45.3mm^3 was recorded in PK-85 variety followed by Marvi (37.2mm^3) variety. The minimum mean volume 33.09mm^3 was recorded in Sassi variety followed by TK-3 (36.4mm^3) variety. The maximum mean Geometric mean 9.34mm was recorded in PK-85 variety followed by Marvi (8.45mm) variety. The minimum mean Geometric mean 7.88mm was recorded in Sassi variety followed by TK-3 (8.33mm) variety. The maximum Sphericity 1.35% was recorded in PK-85 variety followed by TK-3 (1.22%). The minimum mean Sphericity (1.15%) was recorded in Sassi variety followed by Marvi (1.17%) variety.

Physical characteristics of wet land wheat varieties grown in Sindh province shown in Table **2**. The data indicates that maximum mean length 7.29mm was recorded in Marvi variety followed by PK-85 (7.14mm) variety. The minimum mean length 6.27mm was recorded in Inqulab variety followed by Sarsabz (6.32mm) variety. The maximum mean 4.97mm breadth was recorded in TD-1 variety followed by Inqulab (4.65mm) variety. The minimum mean breadth 4.2mm was recorded in PK-85 variety followed by TK-3 (4.32mm) variety. The maximum mean 3.92mm thickness was recorded in Inqulab variety followed by Kherman (3.86mm) variety. The minimum mean 3.64mm thickness was recorded in Sarsabz variety followed by TD-1 variety (3.83mm).

The data indicates that maximum mean volume 59.7mm^3 was recorded in Inqulab variety followed by Kherman (59.1mm^3) variety. The minimum mean volume 22.7mm^3 was recorded in TD-1 variety followed by Sarsabz (51.7mm^3) variety. The maximum mean

Table 2: Average Physical Characteristics of Different Wheat Varieties of Wet Land Grown in Sindh Province

Physical characteristics of wet land wheat varieties						
Parameters	**Verities**				**F Statistics (P Value)**	**DF**
	Inqulab	**TD-1**	**Kherman**	**Sarsabz**		
Length (mm)	6.27±0.74a	6.79±0.93a	7.05±0.4a	6.32±0.08a	1.07NS p = 0.41	3
Breadth (mm)	4.65±0.11b	4.97±0.05a	4.2±0.09c	4.32±0.07c	45 p = 0.00	3
Thickness (mm)	3.92± 0.14a	3.83±0.09a	3.86±0.06a	3.64±0.06b	4.59 p = 0.03	3
Volume (mm^3)	59.7± 4.24a	22.7±0.26c	59.1± 0.91a	51.7± 2.12b	156 p = 0.00	3
Geometric (mm)	10.66± 1.50a	6.55±0.04b	10.66± 0.11a	9.96± 0.04a	20 p = 0.00	3
Sphericity (%)	1.72± 0.07a	0.97±0.05b	1.55± 0.11a	1.56± 0.36a	8.36 p = 0.007	3
Thousand Kernel Weight (g)	44.16±0.49a	45.9±1.48ab	46.4±0.63b	47±0.14b	4.126 p =0.048	3
Hardness (%)	49.6±1.24ab	51.3±0.47b	50.3±1.24ab	47.3±2.05a	3.059 p = 0.092	3
Falling Number (Sec)	384±3.31a	386±4.50a	419±3.31c	406±5.47b	31.590 p = 0.00	3

Geometric mean 10.66mm was recorded in Inqulab and Kherman varieties. The minimum mean Geometric mean 6.55mm was recorded inTD-1 variety followed by Sarsabz (9.96mm) variety. The maximum mean Sphericity 1.72% was recorded in Inqulab variety followed by Sarsabz (1.56%) variety. The minimum mean Sphericity (0.97%) was recorded in TD-1 variety followed by Kherman (1.55%) variety.

Thousand kernel weight (g) of dry land and wet land wheat varieties grown in Sindh province is shown in Tables **1** & **2**. The data indicate that maximum mean 47g was recorded in Sarsabz variety followed by Kherman (46.4g) of wet land wheat varieties. The minimum mean 35.66g was recorded in PK-85 variety followed by Marvi (36.5g) dry land wheat varieties. The TKW ranged 35.5 - 47g in dry land and wet land wheat varieties respectively.

Hardness of dry land and wet land wheat varieties grown in Sindh province is shown in Tables **1** & **2**. The data indicate that maximum mean 55.3 hardness was recorded in variety PK-85 followed by Marvi (52.3) in dry land wheat varieties, respectively. The minimum mean 47.3 hardness was recorded in Sarsabz variety followed by Inqulab (49.6) in wet land wheat varieties, respectively. The hardness ranged 47.3 to 55.3 in wet land and dry land wheat varieties.

Falling Number (sec) of dry land and wet land wheat varieties grown in Sindh province is shown in Tables **1** & **2**. The data indicate that maximum mean 419sec was recorded in PK-85 variety followed by Sarsabz (406sec) in wet land wheat varieties. The minimum mean falling number 265sec was recorded in TK-3 variety followed by Marvi (344sec) in dry land wheat varieties. The falling number ranged 419 to 265sec in wet land and dry land wheat varieties respectively.

DISCUSSION

Physical dimensions are an indicator of the quality of wheat varieties. The results of the present study indicated that physical dimensions of dry land are quite different than those of wet land wheat varieties. It was observed that length of dry land wheat varieties was higher than those of wet land wheat varieties. The study indicated that breadth of dry land was lower than those of wet land wheat varieties. While thickness of dry land was lower than those of wet land wheat varieties. Tabatabeefar [13] reported that wheat

varieties of dry land were longer and thinner than those of wet land wheat varieties. Moreover, it was also observed that volume, geometric mean and sphericity of dry land wheat varieties were lower and volume, geometric mean and sphericity of wet land wheat varieties were higher. The study further revealed that shortage of water affects the physical dimensions of the wheat varieties.

Thousand kernel weights (TKW) is an indicator of the quality of soundness of the grain. The results of present study indicated that TKW of dry land wheat varieties was lower than wet land wheat varieties. The dry land harshly affected the wheat varieties grown in dry region and resulted in decreased grain weight. Analysis of data indicated significant differences in TKW in dry and wet land wheat varieties. The highest TKW was observed in wet land wheat varieties, while the lowest was recorded in dry land wheat varieties. The results are in line with Noorka *et al*. [14] they reported that TKW increased in case of wet land, while decreased in case of dry land wheat varieties.

The results of present study indicated that the hardness of dry land was decreased while the hardness of wet land wheat varieties is shown much significance. In the present study hardness ranged (47.33 to 55.33). It was also evident from the present study that availability of water and environmental changes has direct effect on the hardness of wheat grains**.** Weightman *et al.* [15] reported that grain hardness is the important factor that improves the quality of wheat. It is also reported that dry land wheat varieties are much harder than those of wet land wheat varieties.

The falling number has considerable significance since there is a direct relationship between enzyme activity (alpha-amylase) and finished product attribute. In bread, too much amylase activity will cause wet, sticky breadcrumbs with voids in the loaf, too much breadcrumbs and high loaf density [16]. The results of present study indicated that falling number of wheat varieties decreased in dry land wheat varieties, while increase in case of wet land wheat varieties. In present study falling number ranged (265 – 419 sec). The present result of falling number indicated that all the wheat varieties are not matching with standard for bread making quality (i.e. 300 sec) [12].

CONCLUSION

The analysis of the physical dimensions of dry land and wet land wheat varieties revealed that dry land wheat varieties longer than those of wet land. While the wet land varieties were higher in breadth, thickness, volume, geometric mean and sphericity. The TKW of wet land varieties was recorded higher than dry land varieties. This may due to more moisture content in wet land wheat varieties.

The grain hardness observed higher in dry land wheat varieties, because insufficient moisture increases the grain hardness. While, sufficient grain moisture decrease the ability of hardness and also reduce the yield of flour. Wet land varieties are more suitable as compared with dry land because of their softness.

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