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Effect of Storage Containers on the Quality of Wheat Seed at Ambient Storage Condition

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Abstract: This study was conducted to investigate the changes in wheat grain quality that may occur during storage in different types of containers commonly used in Bangladesh *i.e.,* tin container, earthen pots and plastic pots. Seeds of three different wheat varieties *viz.,* BARI Gom 21 (Shatabdi), BARI Gom 25 and BARI Gom 26 were stored in these containers during April to November, 2013, at existing environmental conditions of Department of Agronomy Laboratory, Sher-e-Bangla Agricultural University, Dhaka, Bangladesh. The result revealed that tin container showed an increase in germination percentage, shoot and root length, seedlings dry weight with decrease in 1000-seed weight, moisture percentage, days to germination and electrical conductivity of seeds during storage. Lowest quality performance was observed from earthen pot. BARI Gom 26 performed best quality in retaining highest germination percentage, shoot and root length, seedling dry weight with lowest electrical conductivity and days to germination. In case of interaction effect, the highest germination percentage, seedling shoot length, root length and dry weight was obtained from BARI Gom 26 stored in tin container and the lowest result was found from earthen pot with BARI Gom-26.

Key words: Electrical conductivity · Germination % · Storage period · Wheat · 1000-seed weight

INTRODUCTION

Wheat (*Triticum aestivum* L.) is the staple food for more than 35% of world population [1]. Wheat crop covers about 42% of total cropped area in South Asia [2]. Wheat seeds are the forms of basic and crucial input for wheat production. Maintenance of high seed germination and vigor from harvest until planting is of utmost used in a seed production program. Grain production of a country depends on good quality seeds. Quality seeds play a very important role for the production of healthy crop. Healthy seed plays an important role not only for successful cultivation but also for increasing yield of crop [3]. A good quality seed may be seriously deteriorated if stored under sub-optimal conditions. To compensate, farmers use very high seed rate, which is 85-133% higher than the actual requirement [4].

Preservation of seeds in the hot and humid climate of Bangladesh is difficult and the method of preservation is still now poor. For storing seed, farmers are commonly used biscuit tin and kerosene tin, gunny bag, polyethylene bag, earthen jar or motka with or without coalter coating, metal drums, dole cowdung coated dole etc. [5]. The main purpose of traditional seed storage is to secure the supply of good quality seed for a planting program whenever needed. All these points lead to form opinion that farmers seed may be of poor quality [6]. Proper storage condition can bring about considerable improvement in national economy by controlling the losses that are about 10% of the stored food grains [7].

Wheat seed has no lemma and palea so it absorbs moisture from the atmosphere easily. Thus it, deteriorates rapidly. So to overcome this problem it is necessary to find out more resistant to adverse condition and to select a standard storage device available to rural people. However, the farmers use all these storage practices traditionally and these have not been standardized. Considerable amount of works have been done on storage of seeds in relation to varied storage conditions in different countries of the world [8, 9]. Research works on

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storage of seeds in Bangladesh are limited and preliminary in nature but very little critical work has been done on safe storage of wheat seeds [10, 11]. Considering the above situation the present study was undertaken to investigate the effect of different some house hold containers on storability of wheat grains at ambient condition and to select the safe storage container for wheat seed.

MATERIALS AND METHODS

Experimental Site and Climate: The laboratory experiment was conducted during the period from April to November, 2013. The experimental area was situated at 23°46' N latitude and 90°23' E longitude at an altitude of 8.45 meter above the sea level. The experimental site is under subtropical humid climatic conditions. The monthly mean minimum and maximum temperature, relative humidity, rainfall during the storage period have been presented in Table 1.

Experimental Material and Design: Three storage containers *i.e.* tin container, earthen pots, plastic pots) and three wheat variety *viz.,* BARI Gom 21 (Shatabdi), BARI Gom 25, BARI Gom 26 were selected as variable of this storage experiment. The seeds were collected from the experimental field of Agronomy Department, Sher-e-Bangla Agricultural University, Dhaka, Bangladesh which were grown in the cropping season of 2012-13. A total 2 kg healthy and uniform sized seeds were kept in different container as per treatment. After that the container made air tied by using masking tape and stored in clean and dry place. The stored containers kept under keen observation for 6 months in air tied condition. The experiment was arranged in Completely Randomized Design (CRD) with four replications each.

Moisture Percentage: Moisture content was determined at every 15 days during experimental period by using low constant temperature oven method (103°C, 18 hr) following International Rules for Seed Testing [12]. The moisture content of seed (wet basis) was determined by the following formula [13]:

$$\% \text{ MC} = \frac{M_2\text{-}M_3}{M_2\text{-}M_1} \times 100$$

Where,

MC = Moisture content.

M_1 = Weight (g) of container and its cover/lid.

M_2 = Weight (g) of the container, its cover and its contents before drying.

M_3 = Weight (g) of the container, cover and contents after drying.

Electrical Conductivity Test: For electrical conductivity test, a sample of 50 seed was taken from each treatment in a conical flask containing 50 ml de-ionized water and was incubated at 20°C for 24 hours following Ali *et al.* [14]. After 20 hours, water of the beaker containing seeds was decanted in order to separate the seeds. The electrical conductivity of the decanted water containing seed leachate was measured with a conductivity meter (Model-CM-30ET). Four repetition measures were made for each sample of seed.

Germination Percentage: A total of 100 pure seeds of each treatment combination were placed in plastic box containing filter paper soaked with distilled water. For each test four plastic boxes were used. The boxes were placed in room temperature (25-30°C) in open condition for germination. Seedling was counted everyday up to the completion of germination. Germination percentage was calculated using the following formula [15].

Table 1: Records of meteorological observation (monthly) during the storage period (April, 2013-November, 2013)

	Mean temperature (°C)			
Month	Minimum	Maximum	Mean relative humidity (%)	Mean rainfall (mm)
April	21.60	33.00	54.40	4.50
May	19.50	30.70	72.43	4.00
June	17.40	32.80	69.40	2.70
July	16.14	31.75	71.42	2.39
August	15.27	31.02	74.41	1.70
September	14.82	31.46	73.20	2.10
October	14.85	30.18	67.82	1.40
November	6.88	28.10	58.18	0.52

$$\% \text{ Germination} = \frac{\text{Number of seeds germinated}}{\text{Number of seed tested}} \times 100$$

Days to Germination: The germination of wheat seeds was recorded and considered to be germinated as the seed coat ruptured and radicle came out up to 2 mm length as per ISTA [16] rule and expressed days to germination.

Statistical Analysis: All the pooled data were statistically analyzed by using MSTAT-C [17] program and mean differences among the treatments were compared by Least Significant Difference (LSD) test at 0.05 level of probability.

RESULTS AND DISCUSSION

1000-Seed Weight: Significantly ($p \leq 0.01$) highest 1000-seed weight was recorded from earthen pots and the lowest weight was found from tin containers at different days after storage (DAS) (Table 2). As seed is highly hygroscopic living material; it absorbs moisture from air. The rate of absorbance was higher in earthen pot because of earthen pot is not air tight container, whereas tin container and plastic pot are moisture proof. The hydrophilic nature of wheat helps in more absorption of water, increases the hydrolytic enzyme activity, enhances respiration and increases in free fatty acid content and finally, deteriorates the seed quality [18-21].

It was observed that the different wheat varieties differed significantly in terms of weight of 1000 seeds at different DAS (Table 2). The highest weight of 1000 seeds was found from BARI Gom 26 and the lowest weight was found from BARI Gom 21. Different varieties of wheat have different size based on the size of wheat seeds weight of 1000 seeds also differ among varieties.

Results showed that the highest 1000-seed weight was recorded from combination of earthen pot and BARI Gom 26 whereas, the lowest was recorded from tin container and BARI Gom 26 treatment combination (Table 2).

Moisture Percentage: Seed moisture content is the most important factor that regulates the longevity of seed in storage. Higher moisture content in the seed enhances seed deterioration, which reduces the quality of seed. Significant ($p \leq 0.01$) variation was found on moisture percentage of wheat seeds recorded from different storage containers at different storage period (Table 2).

Table 2: Effect of storage container and/or variety on 1000-seed weight and moisture percentage of wheat seed

	1000-seed weight (g) at			Moisture (%) at		
Treatments	180 DAS	210 DAS	240 DAS	180 DAS	210 DAS	240 DAS
Storage container						
Tin container	41.22 c	41.78 c	42.63 c	8.88 c	10.00 c	10.79 c
Earthen pot	43.53 a	44.35 a	45.11 a	10.18 a	11.36 a	12.17 a
Plastic pot	42.35 b	43.12 b	43.76 b	9.61 b	10.73 b	11.46 b
$LSD_{(0.05)}$	0.98	1.12	1.09	0.28	0.33	0.32
Variety						
BARI Gom 21	41.79 b	42.31 b	43.13 b	9.49 b	10.76 a	11.53 ab
BARI Gom 25	42.19 ab	42.69 b	43.27 b	9.77 a	10.91 a	11.66 a
BARI Gom 26	43.12 a	44.24 a	45.10 a	9.41 b	10.42 b	11.23 b
$LSD_{(0.05)}$	0.98	1.12	1.09	0.28	0.33	0.32
Storage container × Variety						
Tin container						
BARI Gom 21	41.21 bc	41.57 c	42.35 c	8.90 de	10.32 c	11.09 c
BARI Gom 25	41.63 bc	42.21 bc	42.81 c	9.23 cd	10.43 c	11.20 c
BARI Gom 26	40.82 c	41.56 c	42.73 c	8.52 e	9.25 d	10.07 d
Earthen pot						
BARI Gom 21	42.34 bc	42.99 bc	43.88 bc	10.03 a	11.17 ab	12.07 ab
BARI Gom 25	42.82 b	43.13 bc	43.87 bc	10.17 a	11.43 a	12.21 a
BARI Gom 26	45.43 a	46.94 a	47.60 a	10.33 a	11.48 a	12.23 a
Plastic pot						
BARI Gom 21	41.81 bc	42.39 bc	43.18 bc	9.53 bc	10.78 bc	11.43 c
BARI Gom 25	42.11 bc	42.74 bc	43.14 bc	9.93 ab	10.87a-c	11.56 bc
BARI Gom 26	43.11 b	44.22 b	44.96 b	9.39 cd	10.55 c	11.38 c
$LSD_{(0.05)}$	1.69	1.94	1.90	0.48	0.56	0.55

Means with different letters in the same row indicate significant differences according to the LSD test ($p \leq 0.05$).

Table 3: Effect of storage container and/or variety on germination percentage and days to germination of wheat seed

	Germination (%) at			Days to germination at		
Treatments	180 DAS	210 DAS	240 DAS	180 DAS	210 DAS	240 DAS
Storage container						
Tin container	96.86 a	95.16 a	93.50 a	5.45 c	5.09 c	4.64 c
Earthen pot	91.93 c	89.56 c	86.73 c	6.12 a	5.88 a	5.66 a
Plastic pot	95.00 b	93.39 b	91.57 b	5.84 b	5.53 b	5.28 b
$LSD_{(0.05)}$	0.95	0.76	1.04	0.26	0.20	0.18
Variety						
BARI Gom 21	94.44 b	92.55 b	90.32 b	5.74 ab	5.53 ab	5.25 a
BARI Gom 25	93.78 b	92.02 b	89.49 b	6.00 a	5.62 a	5.28 a
BARI Gom 26	95.57 a	93.54 a	92.00 a	5.67 b	5.35 b	5.06 b
$LSD_{(0.05)}$	0.95	0.76	1.04	0.26	0.20	0.18
Storage container × Variety						
Tin container						
BARI Gom 21	95.93 b	94.15 b	91.90 b	5.55 cd	5.33 d	4.93 de
BARI Gom 25	95.48 b	93.88 b	91.75 b	5.63 cd	5.35 cd	4.90 e
BARI Gom 26	99.18 a	97.46 a	96.84 a	5.18 d	4.60 e	4.10 f
Earthen pot						
BARI Gom 21	92.18 c	89.92 c	87.43 c	6.03 a-c	5.73 a-c	5.50 bc
BARI Gom 25	91.13 c	89.11 c	85.11 d	6.18 a	5.93 ab	5.63 ab
BARI Gom 26	92.49 c	89.64 c	87.65 c	6.15 ab	5.98 a	5.85 a
Plastic pot						
BARI Gom 21	95.20 b	93.58 b	91.63 b	5.65 cd	5.53 cd	5.33 bc
BARI Gom 25	94.75 b	93.07 b	91.60 b	6.20 a	5.58 b-d	5.30 bc
BARI Gom 26	95.04 b	93.53 b	91.49 b	5.68 b-d	5.48 cd	5.23 cd
$LSD_{(0.05)}$	1.65	1.31	1.81	0.46	0.34	0.30

Means with different letters in the same row indicate significant differences according to the LSD test ($p \leq 0.05$).

The highest moisture was observed from earthen pots while the lowest was recorded from tin containers. Impervious containers *viz.,* tin container and plastic pots have recorded lower mean moisture content throughout the storage period compared to pervious containers (earthen pots). The seeds of earthen pots came to the contact with air and their moisture contents were increased more than the other containers from initial moisture content. As tin container and plastic pots were more or less air tight and the seeds of these containers could not come to the contact with the ambient room air therefore, resulting lower change in their moisture contents. Irrespective of storage containers, moisture content of seeds increased gradually with increase of storage time. Similar result was found by Miah *et al.* [22]; Uddin, [23] and Quais *et al.* [24].

Moisture percentage at different storage period showed significant differences due to different wheat varieties (Table 2). The highest moisture was obtained from BARI Gom 25 which was statistically similar with BARI Gom 21 and the lowest was found from the variety BARI Gom 26.

Due to the interaction effect of storage containers and varieties significant variation was observed in terms of moisture percentage of wheat seeds at different storage period (Table 2). The highest moisture was attained from earthen pots and BARI Gom 26 whereas, the lowest was found from tin containers and BARI Gom 26 treatment combination.

Germination Percentage: Germination is the most important function of a seed as an indicator of its viability and worth as seed [21]. Germination of wheat seeds was reported to be affected by storage containers during storage period [25, 26, 27, 28]. Results of the present study revealed that germination percentage of wheat seeds was found decreased with the increase of storage time (Table 3). Seeds packed in tin container retained seed viability for longer time than in earthen pots. Germination percentage of the seeds of earthen pots, plastic pots and tin containers were decreased from 91.93-86.73%, 95.00-91.57% and 96.86-93.50%, respectively during the storage period. The results of the present study confirmed by Chattha *et al*. [27] who reported that germination capacity of wheat grains stored in different types of packing materials decreased with the progress of storage period. This decrease was closely related with the high moisture contents of the seeds. Due to high moisture content of seeds of earthen pots, germination percentage decreased rapidly than tin container and plastic pots stored seeds with lower moisture contents. These results were consistent with the findings of Akter *et al*. [21]. Adly *et al*. [26] observed the gain in moisture content of wheat seeds stored in permeable pot resulting lower germination percentage compared to sealed storage as it was completely airtight. The germination percentage of seeds stored in tin container was found higher than the seeds of other containers in all observations due to lower moisture content of seed.

Germination percentage of wheat varieties was found significant at different storage period (Table 3). The highest germination was recorded from BARI Gom 26 and the lowest was found from BARI Gom 25. Seedling emergence itself is a genetical character and climatic conditions greatly influence the emergence performance of wheat cultivars [29, 30]. Strelec *et al*. [31] reported that different wheat varieties showed variation in germination percentage. Singh *et al*. [32] stated that germination was decreased during storage period in wheat because fresh seeds showed better germination percent than stored seeds.

Interaction effect of different storage containers and varieties showed statistically significant variation in terms of germination percentage of wheat seeds at 180, 210 and 240 DAS (Table 3). The highest germination was observed from tin container and BARI Gom 26 (97.79%, 96.37% and 94.93%, respectively) and the lowest germination was attained from earthen pot and BARI Gom 26 treatment combination (89.74%, 88.04% and 84.23%), respectively.

Days to Germination: Days to germination of wheat seeds showed significant ($p \leq 0.01$) variation at different DAS (Table 3). At 180, 210 and 240 DAS, the highest days to germination was found from earthen pot (6.12, 5.88 and 5.66 days, respectively) and the lowest was found from tin container (5.45, 5.09 and 4.64 days), respectively.

Wheat varieties differed significantly in terms of days to germination (Table 3). The highest days to germination was recorded from BARI Gom 25 which was statistically similar with BARI Gom 21. The lowest days to germination was found from BARI Gom 26. Seedling emergence itself is a genetical character, climatic conditions also influences days to germination of wheat cultivars [30].

Interaction effect of different storage containers and varieties showed statistically significant variation in terms of days to germination percentage of wheat seeds at different storage period (Table 3). At 180, 210 and 240 DAS, the highest days to germination was observed from earthen pot and BARI Gom 26 (6.20, 5.97 and 5.85 days) and the lowest was found from tin container and BARI Gom 26 treatment combination (5.18, 4.60 and 4.10 days), respectively.

Seedlings Shoot and Root Length: Statistically significant ($p \leq 0.01$) variation was recorded on seedlings shoot and root length at different storage period (Table 4). Data indicated that seedlings shoot and root length was highest in tin container in all cases. Higher seed moisture contents in earthen pots may be the main reason of this deterioration. As high seed moisture increases the seed respiration and decreases the seed quality therefore resulting into weak or abnormal seedling [33]. Rahman *et al*. [34] observed that seedling height of coriander gives highest value in tin than poly ethylene and jute bags in most cases of observation. Seedlings shoot and root length decreased over time in all cases of observation, irrespective of storage container.

Seedlings shoot and root length at 180, 210 and 240 DAS showed significant variations in wheat varieties (Table 4). The longest seedlings shoot and root length was observed from BARI Gom 26 which was statistically similar with BARI Gom 21 and the shortest was recorded from BARI Gom 25. The physiological symptoms of seed ageing include reduced rate of germination and emergence, decreased tolerance to sub-optimal conditions and poorer seedling growth in different variety [35].

Shoot and root length showed significant ($p \leq 0.01$) variation due to the interaction effect of different storage containers and varieties at different storage period (Table 4). The maximum seedlings shoot and root length was obtained from tin container and BARI Gom 26 treatment combination, again the minimum was found from earthen pot and BARI Gom 26 treatment combination.

Seedling Dry Weight: There was a significant ($p \leq 0.01$) difference in the seedling dry weight due to different storage containers for all storage periods in the study (Table 5). The maximum seedling dry weight was recorded from tin container and the minimum was observed from earthen pots. Similar results was found by Akter *et al*. [21] who reported that the deterioration of seed due to high moisture absorption in earthen pots, which is a progressive process accompanied by accumulation of metabolites and which progressively depresses germination and growth of seedling with increased age, ultimately reduces the dry matter of seeds during storage.

Wheat varieties differed significantly ($p \leq 0.01$) seedling dry weight at different storage period (Table 5). The highest seedling dry weight was recorded from BARI Gom 26 and the minimum was observed from BARI Gom 25. Wheat varieties differed themselves in case of seedling dry weight [26]. Seedling dry weight also varied significantly ($p \leq 0.05$) variation due to the interaction effect of different storage containers and varieties at different storage period (Table 5). The maximum seedling

Table 4: Effect of storage container and/or variety on shoot and root length of wheat seedlings

	Seedling shoot length (cm) at			Seedling root length (cm) at		
Treatments	180 DAS	210 DAS	240 DAS	180 DAS	210 DAS	240 DAS
Storage container						
Tin container	2.56 a	2.70 a	2.95 a	2.32 a	2.48 a	2.67 a
Earthen pot	2.27 c	2.34 c	2.54 c	2.06 c	2.23 c	2.31 c
Plastic pot	2.42 b	2.50 b	2.76 b	2.18 b	2.36 b	2.45 b
$LSD_{(0.05)}$	0.05	0.07	0.09	0.04	0.04	0.05
Variety						
BARI Gom 21	2.41 ab	2.52 ab	2.75 ab	2.18 b	2.36 ab	2.49 a
BARI Gom 25	2.37 b	2.45 b	2.70 b	2.15 b	2.32 b	2.43 b
BARI Gom 26	2.46 a	2.56 a	2.81 a	2.23 a	2.39 a	2.51 a
$LSD_{(0.05)}$	0.05	0.07	0.09	0.04	0.04	0.05
Storage container × Variety						
Tin container						
BARI Gom 21	2.52 b	2.66 b	2.88 b	2.28 b	2.47 b	2.65 b
BARI Gom 25	2.48 bc	2.57 bc	2.84 b	2.26 bc	2.42 bc	2.58 bc
BARI Gom 26	2.68 a	2.86 a	3.15 a	2.43 a	2.57 a	2.77 a
Earthen pot						
BARI Gom 21	2.31 de	2.40 d-f	2.63 cd	2.09 ef	2.25 e	2.35 f
BARI Gom 25	2.25 e	2.34 ef	2.54 de	2.05 f	2.22 e	2.32 fg
BARI Gom 26	2.25 e	2.28 f	2.46 e	2.05 f	2.22 e	2.25 g
Plastic pot						
BARI Gom 21	2.42 bc	2.50 cd	2.75 bc	2.18 d	2.35 cd	2.46 de
BARI Gom 25	2.39 cd	2.45 c-e	2.73 bc	2.16 de	2.33 d	2.39 ef
BARI Gom 26	2.44 bc	2.54 bc	2.82 b	2.21 cd	2.39 cd	2.51 cd
$LSD_{(0.05)}$	0.09	0.13	0.15	0.06	0.06	0.08

Means with different letters in the same row indicate significant differences according to the LSD test ($p \leq 0.05$).

Table 5: Effect of storage container and/or variety on dry weight of wheat seedlings

	Seedling dry weight (mg) at		
Treatments	180 DAS	210 DAS	240 DAS
Storage container			
Tin container	16.25 a	14.54 a	13.67 a
Earthen pot	12.67 c	12.33 b	10.58 c
Plastic pot	15.13 b	12.96 b	12.13 b
$LSD_{(0.05)}$	1.107	0.784	0.909
Variety			
BARI Gom 21	14.75 b	13.08 b	12.21 b
BARI Gom 25	13.21 c	12.17 c	10.79 c
BARI Gom 26	16.08 a	14.58 a	13.38 a
$LSD_{(0.05)}$	1.107	0.784	0.909
Storage container × Variety			
Tin container			
BARI Gom 21	16.38 ab	13.88 b	13.88 ab
BARI Gom 25	14.38 cd	13.63 b	12.00 c-e
BARI Gom 26	18.00 a	16.13 a	15.13 a
Earthen pot			
BARI Gom 21	12.88 de	12.25 cd	10.50 ef
BARI Gom 25	11.25 e	11.25 d	9.50 f
BARI Gom 26	13.88 cd	13.50 bc	11.75 c-e
Plastic pot			
BARI Gom 21	15.00 bc	13.13 bc	12.25 cd
BARI Gom 25	14.00 cd	11.63 d	10.88 d-f
BARI Gom 26	16.38 ab	14.13 b	13.25 bc
$LSD_{(0.05)}$	1.918	1.357	1.575

Means with different letters in the same row indicate significant differences according to the LSD test ($p \leq 0.05$).

Table 6: Effect of storage container and/or variety on electrical conductivity of wheat seed

	Electrical conductivity ($\mu S\ cm^{-1}\ g^{-1}$)		
Treatments	180 DAS	210 DAS	240 DAS
Storage container			
Tin container	25.71 b	31.78 c	38.55 c
Earthen pot	27.28 a	38.00 a	52.79 a
Plastic pot	26.87 a	34.36 b	43.79 b
$LSD_{(0.05)}$	0.79	1.28	1.10
Variety			
BARI Gom 21	28.41 a	36.54 a	46.47 a
BARI Gom 25	26.61 b	34.75 b	45.26 b
BARI Gom 26	24.84 c	32.85 c	43.39 c
$LSD_{(0.05)}$	0.79	1.28	1.10
Storage container × Variety			
Tin container			
BARI Gom 21	27.33 b	33.86 de	39.78 e
BARI Gom 25	25.94 cd	31.76 ef	38.98 e
BARI Gom 26	23.86 e	29.72 f	36.88 f
Earthen pot			
BARI Gom 21	28.92 a	39.26 a	53.89 a
BARI Gom 25	26.98 bc	38.17 ab	52.87 ab
BARI Gom 26	25.93 cd	36.57 b	51.60 b
Plastic pot			
BARI Gom 21	28.99 a	36.49 bc	45.72 c
BARI Gom 25	26.91 bc	34.33 cd	43.93 c
BARI Gom 26	24.72 de	32.26 de	41.71 d
$LSD_{(0.05)}$	1.37	2.22	1.91

Means with different letters in the same row indicate significant differences according to the LSD test ($p \leq 0.05$).

dry weight was found from tin container and BARI Gom 26 (18.00, 16.13 and 15.13 mg), while the minimum was observed from earthen pot and BARI Gom 25 treatment combination (11.25, 11.25 and 9.50 mg), respectively.

Electrical Conductivity: Electrical conductivity (EC) test of seed leachate provides a quick decision about seed vigour [21]. Storage containers had significant ($p \leq 0.01$) effect on EC of wheat seed (Table 6). The highest EC of seed leachate was recorded from the seeds stored in earthen pots for all storage periods. Conversely, the lowest EC was recorded from tin container for all storage periods. High EC of seed is assumed due to membrane deterioration during the imbibitions period of lower quality seeds. In tin container, the quality of seed was good and that is why they leak less leachate compared to that of low quality seeds stored in cloth bag.

Wheat varieties differed significantly ($p \leq 0.01$) in terms of electrical conductivity at different storage period (Table 6). The highest EC was recorded from BARI Gom 21 whereas, the lowest was observed from BARI Gom 26. Adly *et al*. [26] found wheat varieties showed variation in terms of EC.

Interaction effect of different storage containers and varieties showed significant ($p \leq 0.05$) variation on EC of wheat seeds at different storage period (Table 6). The highest EC was observed from earthen pots and BARI Gom 21 whereas, the lowest was found from tin containers and BARI Gom 26 treatment combination.

CONCLUSIONS

The storage of wheat grains at different storage conditions is accompanied with quality changes. Grains in the earthen pot lost their quality more as compared to tin container. The study concluded that tin storage container was superior in relation to different seed quality parameters. BARI Gom 26 was superior compared to other varieties used in this experiment. The present study suggests that BARI Gom 26 should be stored in tin containers under ambient condition which seems to be promising for wheat seed storage.

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