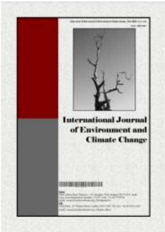

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Effect of Storage Containers to Stabilize the Seed Quality in Wheat (*Triticum aestivum* L.)

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Authors' contributions

This work was carried out in collaboration among all authors. All authors read and approved the final manuscript.

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ABSTRACT

Seed detoriation is a mjor constraint for right production of different crops and detoriation of seeds starts with physiological maturity of crop up to storage. The process of seed deterioration may be related to various physiological changes, such as a continuous fall in germinability, an increase in mean germination time, an increase in aberrant seedling frequency, and a lower tolerance to unfavourable climatic conditions. Numerous physical and chemical factors, such as moisture content, atmospheric relative humidity, temperature, preliminary seed quality, the physical and chemical makeup of the seed, gaseous exchange, storage structure, storage materials, etc., affect the viability and vigour of the seeds while they are in storage in addition to varying from genus to genus and variety to variety. Seeds of wheat variety, Sharbati C306 was stored in different containers *i.e.,* Polyethylene bag, Muslin cloth bag and Bamboo storage structure in the laboratory. Effect of storage containers were analysed for various storage period and found that all the containers are significantly with various parameters. The polythene bag recorded the least insect infestation (5.94%) and electrical conductivity (21.25), whereas, polythene was found to be effective in maintaining seed and seed quality parameters with highest germination (87.00%), mean seedling length (12.92 cm), seed vigor index was 1 (1125.65) and 2 (25.23), Dry weight (0.297 gm), test weight (43.79 gm) and biochemicals *i.e.,* Carbohydrate (71.00%) and gluten (11.36%).

Keywords: Wheat seed; seed storage; storage container; storage period; seed quality.

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1. INTRODUCTION

Wheat (*Triticum aestivum* L.) is a worldwide cereal that is farmed, consumed and traded and ranked third among all the cereals. Carbohydrate (78.1%), protein (14.7%), fat (2.1%), minerals (2.1%) all have considerable levels (Pawan et al.,2011). The wheat crop was planted on around 30 million hectares (14% of global land) to produce an all-time high of 99.70 million tons of wheat (13.64 percent of global production) with a recorded average productivity of 3371 kg/ha. (Ministry of Agriculture and Farmers Welfare, Government of India, 2020-21). It is very important to harvest wheat crop at right stage to ensure its quality of storage as well as next cropping season. However, soon after harvest many organized factors form complex interconnections affects the quality which leads to seed deterioration. Therefore, wheat crop should be stored safe using proper pre-storage treatments along with the suitable containers to be kept safely. Losses during wheat seed storage usually in the range of 1-2%when grains are well stored. However, these losses may go higher to 20–50% in the developing countries like India, particularly in poor managed storage facilities [1]. wheat seed storage with proper storage facilities is as good as additional production (Jha et al., 2015). The losses during storage depends on various internal and external factors such as its kind, motive of storage, environmental, duration, packaging methods, treatment during storage and storage of the grains *etc*. Besides, other factors cause storage losses are moisture percentage, microorganisms, pests and insects. Relative humidity and temperature are two other important factors which causes damage of seeds during storage. Many problems like loss in germination and poor eating quality may occurs if wheat grains are not dried before storing [2] (Ueno, 2013).

As need of storage is mainly done for short period of time therefore, knowing precise time of storage is of immense importance. Prolonging storage may lead to reduction in germination, seedling vigor, accelerated seed aging, increased germination time, electrical conductivity, insect infestation and eventually loss in seed weight (Mersal et al*.,* 2006). To estimate the quality of seed lot during storage it could be done by testing the traits such as germination percentage, electrical conductivity, SVI, test weight, root and shoot length *etc*. Significant increase in insect infestation during the initial stage of storage to next six months was also reported by Seadh et al*.* [3] and Salama et al*.* [4].

Packaging seed in different storage containers such as resistance moisture or sealed containers for storage is useful. These containers are suitable for maintaining quality of seed at safe storage moisture level. The magnitude of safest to least safe containers are in sequence of moisture proof containers, various laminate, polyethylene, paper and at last cloth were least effective in storage [5,6]. The effectiveness of other materials was directly associated with their ability to resist moisture [7]. Keeping the above-mentioned issues related to storage problems and to minimize the losses during different period of time, we aim to conduct present investigation entitled Studies on the effect of storage container to stabilize the seed quality in wheat (*Triticum aestivum* L.).

2. MATERIALS AND METHODS

2.1 Design of Experiment

This Lab experiment was conducted in Completely Randomized Design (CRD) at the Genetics and Plant Breeding Laboratory, School of Agriculture, ITM University Gwalior us. Seeds of the Sharbati C306 variety was obtained from local farmers field and its true to type was checked with proper seed certification standards after seed multiplication at research field. Firstly, seeds having a moisture content of 12.0% were stored in different containers *i.e.,* Polyethylene bag (C_1), Muslin cloth bag (C_2) and Bamboo storage structure (C_3) in the laboratory. Each container contains 500 gm of seed and data were recorded in third month, sixth month and ninth month interval for seed quality attributes.

According to the technique outlined in the ISTA guidelines, the weight of 1000 seeds was recorded treatment-by-treatment. Grams were used to measure the test weight. The germination test was performed using the "between paper" method. On damp germination paper towels, four replicas of 100 seeds from each container were distributed evenly. For eight days, the rolled towels were incubated at 201°C. At the final count, the germination % was calculated solely using normal seedlings and expressed as a percentage. After eight days of incubation, ten seedlings from each replication were randomly selected to measure the length of the seedlings. From the tip of the primary root to the tip of the primary leaf, the length of the seedling was measured. The average length of 10 seedlings was determined and expressed in centimetres. Seedlings were dried using a “hot air oven method” as prescribed by ISTA at 80±2°C for 24 hours. The mean seedling dry weight of 10 seedlings were calculated and expressed in milligrams per ten seedlings.

Abdul-Baki and Anderson [8] reported the seedling vigour index was calculated using seedling growth characteristics and expressed as a whole number:

1) Vigour index I = Germination (%) x Mean seedling length (cm).

2) Vigour index II = Germination (%) x Mean seedling dry weight (mg).

Measurement of Electrical Conductivity (E.C.) of seed sample can be done by soaking a specific volume or number of seeds in de-ionized water at constant temperature for a certain duration. Measurement is based on leakage of solutes that occurs from seeds into water. These solutes include sugar, amino acid and most importantly electrolytes. The incidence of leakage can be detected by the measurement of the electrical conductivity of seed-soaked water. Low conductivity indicates low leakage, whereas high conductivity value is the result of high leakage.

Estimation of Total Carbohydrates by Phenol Sulphuric Acid Method [9] and Glutein estimate by a 10 gm sample of ground wheat is weighed and place in to glutomatic washing chamber on top of polyester screen. The sample is combined and washed with 2% salt solution for 5 minutes, wet glutein is removed from the washing chamber, placed in the centrifuge holder, and centrifuged. Remainder retained on top of the screen and through the screen is centrifuged, and residue retained in both of these locations is weighed. After that Glutein content was converted into percentage by dividation with 10.

Grain from each treatment was manually selected from each package at varied depths at the conclusion of each storage term (3, 6, and 9 months) for inspection. The grains with holes or infestation were removed, and the grains with visible insect damage were also deemed to be infested. The infestation level was expressed as number then, percentage damage grains was estimated according to the formula described by, Jood et al., [10].

$$\text{Insect infestation (\%)} = \frac{\text{Number of insect damage}}{\text{Number of total grains inspected}} \times 100$$

3. RESULTS AND DISCUSSION

The effect of storage in different storage of wheat seed (*Triticum aestivum* L.) were significantly affected all parameters of the quality of seed as well as reducing detoriation. After 90 Days storage, highest mean value for grain weight was notice in C1 followed by C2 and C3. Similar pattern was followed after 180 days of storage where C1 was recorded highest grain weight followed by C2 and C3 with 44.99g, 44.55g and 44.21 g respectively and after 270 days, similar result was obtained (Table 1). Highest mean value for grain weight was recorded in C1 followed by C2 and C3 with 43.79 g, 43.09 g and 42.04 g respectively. 1000 seed weight of the wheat variety kept in different containers during different period of time. Nabila et al., 2016 were also reported that with similar result with present study . The Germination percentage was taken after 90 days of storage. The all storage containers showed > 90% germinationw hereas germination percentage decreased after 180 days in C3 followed by C2 and C1 which was recorded mean value of 86.50, 88.89 and 89.60. Similar pattern was observed after 270 days of storage where maximum germination percentage was found in C1 followed by C2 and C3 with mean values 87.00, 86.10 and 83.14 (Table 1).

In case of seedling length was found to have longer mean seedling length which was consistent throughout the storage period of time. As far as other two containers were concerned, both were found to have almost similar mean seedling length. Mean seedling length was consistently decreased in all the containers with increment of storage period. Mean seedling length of the wheat variety kept in different containers during different period of time (Table 1). The dry weight of seedling were aslo studied and found that dry weight was declined with long storage period. After the 90 days of storage, C1 recorded to have more dry weight (0.30) as compare to C2 (0.30) and C3 (0.29). After 180 days, C1 had recorded highest dry weight (0.30) as compare to C2 (0.291 gm) and C3 (0.287). Likewise, after 270 days, C1 had recorded highest values of dry weight as compare to other containers.

Table 1. Effect of storage containers for different storage periods on test weight, germination, seedling length & seedling dry weight

Treatments	Test Weight (g)				Germination (%)				Seedling Length (cm)				Seedling Dry Weight (g)			
	Initial	90 DAS	180 DAS	270 DAS	Initial	90 DAS	180 DAS	270 DAS	Initial	90 DAS	180 DAS	270 DAS	Initial	90 DAS	180 DAS	270 DAS
C-1	46.7	45.96	45.11^{a}	43.79^{a}	95.29	92.17^{a}	89.57^{a}	87.00^{a}	18.41	14.41	13.55^{a}	12.92^{a}	0.326	0.3	0.30^{a}	0.29^{a}
C -2	46.8	45.84	44.75^{b}	43.10^{b}	95.34	91.17^{b}	88.71^{b}	86.11^{b}	18.30	14.1	13.11^{b}	12.65^{b}	0.327	0.3	0.29^{b}	0.29^{b}
C -3	46.89	45.83	44.09^{c}	42.05^{c}	95.40	90.54^{b}	86.69^{c}	83.14^{c}	18.34	13.94	12.74^{c}	12.21^{c}	0.33	0.3	0.29^{c}	0.28^{c}
SE(m)	0.06	0.08	0.1	0.11	0.17	0.3	0.28	0.29	0.03	0.21	0.07	0.05	0.005	0.002	0.001	0.001
C.D	**NS**	**0.28**	**0.37**	**0.41**	**NS**	**1.11**	**1.04**	**1.06**	**NS**	**0.76**	**0.267**	**0.19**	**NS**	**0.01**	**0.004**	**0.002**
C.V	**0.71**	**0.98**	**1.33**	**1.51**	**1.061**	**1.92**	**1.86**	**1.97**	**1.01**	**8.55**	**5.04**	**2.44**	**9.59**	**3.276**	**2.252**	**1.086**

Table 2. Effect of storage containers for different storage periods on vigour index I, vigour index II & electrical conductivity

Treatments	Vigour Index I				Vigour Index II				Electrical Conductivity (dS/m/gm)			
	Initial	90 DAS	180 DAS	270 DAS	Initial	90 DAS	180 DAS	270 DAS	Initial	90 DAS	180 DAS	270 DAS
C-1	1755.58	1328.45^{a}	1214.60^{a}	1125.65^{a}	31.09	27.86^{a}	26.52^{a}	25.23^{a}	15.27	17.59	19.41^{c}	21.25^{c}
C -2	1745.67	1285.87^{ab}	1164.28^{b}	1090.49^{b}	31.20	27.38^{ab}	25.88^{b}	24.71^{b}	15.31	18.38	20.08^{b}	21.89^{b}
C -3	1750.19	1262.69^{b}	1105.89^{c}	1016.89^{c}	31.51	26.92^{b}	24.94^{c}	23.49^{c}	15.08	18.82	21.25^{a}	24.02^{a}
SE(m)	4.90	18.97	10.62	5.64	0.51	0.18	0.13	0.09	0.65	0.23	0.21	0.21
C.D	**NS**	**70.7**	**39.58**	**21**	**NS**	**0.67**	**0.48**	**0.34**	**NS**	**0.84**	**0.78**	**0.78**
C.V	**1.65**	**8.68**	**5.41**	**3.09**	**9.714**	**3.88**	**2.93**	**2.19**	**1.78**	**7.303**	**6.13**	**5.51**

Table 3. Effect of storage containers for different storage periods on carbohydrate, gluten & insect infestation

Treatments	Carbohydrate (%)				Gluten (%)				Insect Infestation (%)			
	Initial	90 DAS	180 DAS	270 DAS	Initial	90 DAS	180 DAS	270 DAS	Initial	90 DAS	180 DAS	270 DAS
C-1	71.9	71.48 [a]	71.11[a]	71.00 [a]	11.89	11.61	11.47[a]	11.36[a]	0.00	1.46	3.31[c]	5.94[c]
C -2	72.11	71.27 [ab]	70.61[b]	70.43 [b]	11.87	11.58	11.34[b]	11.26[b]	0.00	1.77	4.11[b]	7.49[b]
C -3	72.56	71.06[b]	70.25[c]	70.03[c]	11.97	11.47	11.51[a]	11.40[a]	0.00	1.77	5.40[a]	9.37[a]
SE(m)	0.2	0.08	0.05	0.06	0.5	0.07	0.04	0.03	0.00	0.16	0.2	0.17
C.D	**NS**	**0.3**	**0.2**	**0.21**	**NS**	**0.26**	**0.15**	**0.12**	**NS**	**0.59**	**0.73**	**0.62**
C.V	**1.61**	**0.67**	**0.45**	**0.47**	**3.56**	**3.52**	**2.03**	**1.71**	**0**	**56.32**	**27.24**	**12.94**

A significant decline was noticed in seedling vigour index as the storage period increases. There was variation or difference noticed among all the containers after 90, 180, and 270 days of storage. C1 recorded the highest SVI-I & II followed by C2 and C3 during all period of storage (Table 2). Mean Seedling vigour index of the wheat variety kept in different containers during different period of time. Similar result reported by Nabila et al., [11]; Sohidul et al*.,* [12] and Mekonnen [13]. After 90 days of storage, C3 was found have more EC value followed by C2 and C1 with mean values 18.91, 18.46 and 17.68 respectively. Similar pattern was observed after 180 days of storage. After 270 days, high increases were noticed in C3 having EC of 24.01 followed by C2 (21.89) and C1 (21.24); (Table 2). Electrical conductivity of the wheat variety kept in different containers during different period of time. Similar result reported by Baldaniya et al., [14] and Gadewar, [15]. Gupta et al., [16] also reported in his investigation Electrical conductivity sowed negative corelation with Seedling vigour index. No significant variation was observed for carbohydrate content among different containers but decreases consistently with increment of storage period. Similar trend was obtained for all period of storage. Highest percentage was present in C1 followed by C2 and C3. Mean percentage for C1, C2 and C3 after nine month of storage was 70.99,70.43and 70.02 respectively (Table 3).

No significant variation was observed for gluten percentage among different containers but protein decreases consistently within increment of storage period. Similar trend was obtained for several period of storage. Highest percentage was present in C1 followed by C2 and C3. Mean percentage for C1, C2 and C3 after 270 days of storage was 11.36,11.26 and 11.40 respectively (Table 3). C2 and C3 (1.77 and 1.77) has found more insect infestation followed by C1(1.45) after 90 days of storage whereas after 180 days of storage, C3 has been found more infestation followed by C2 and C1. Sudden uptrend was noticed in C3 followed by C2 and C1 after 270 days of storage with 9.37, 7.48 and 5.94 respectively (Table 3). Insect infestation of the wheat variety kept in different containers were significant during different period of time. The Similar result reported by Badawi et al*.,* [17].

4. SUMMARY AND CONCLUSION

Study of effect of storage container to stabilize the seed quality in wheat (*Triticum aestivum* L.) concluded that different type of containers were significantly affected the reduction in germination, seedling vigor, accelerated seed aging, increased germination time, electrical conductivity, insect infestation and eventually loss in seed weight. The all storage containers showed > 90% germination and seedling length was found to have consistent throughout the storage period. No significant variation was observed for carbohydrate content among different containers was non significant. Insect infestation of the wheat variety kept in different containers were significant during different period of time. Bamboo lined storage were more supportive in order to rduce the insect infestation level for storing of wheat.

COMPETING INTERESTS

Authors have declared that no competing interests exist.

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