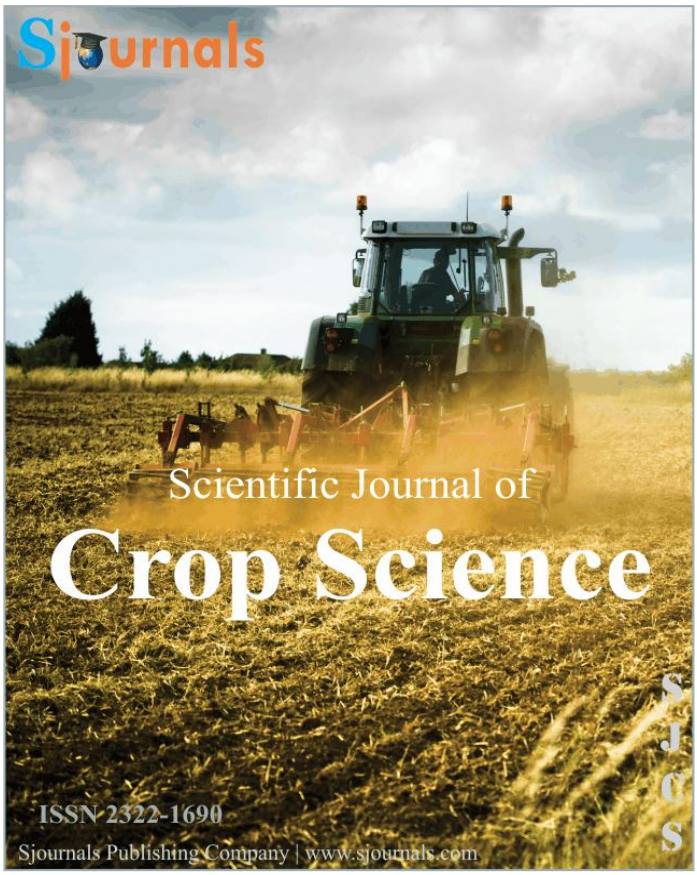

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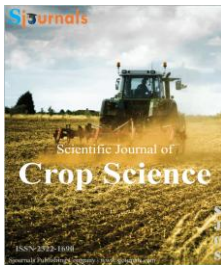

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Original article

Seed quality of Lentil (*Lens culinaris* L.) as affected by different containers and storage periods

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ABSTRACT

To investigate the effect of different containers and storage periods on the seed quality of lentil seed, the present study was carried out at Department of Agronomy, Hajee Mohammad Danesh Science and Technology University (HSTU) Dinajpur, Bangladesh during March-April 2016. In this study, three seed containers viz, sealed container, poly bag and gunny bag and three storage periods viz. 15, 30 and 45 days were used. The highest germination percentage (GP), better shoot and root length, vigor index and poor fungal incidence of lentil seed were found with 15 days after storage (DAS). The highest GP of 81.54% was found at sealed container with seed stored at 15 DAS while the lowest GP (63.24%) was found in the seeds stored in gunny bag at 45 DAS. Fungal incidence was found less in lentil seeds with the same initial days after storage (15 DAS). Among the storage condition, sealed container was found the advantage for lentil seed storage compared to the usage of polythene bag and gunny bag. The seed container of gunny bag was also found in inferior condition in case of above parameters. Among the three containers, sealed container was the best and the gunny bag was the worst storage container in all levels of storage periods for lentil seed. Finally, our results revealed that optimum and ideal storage conditions viz. sealed storage container and shortest period of storage have the greatest benefit on the quality seed.

1. Introduction

Lentil (*Lens culinaris* L.) is one of the most important grain legume among pulses grown in different locations of Bangladesh. The total land area and production of lentil in Bangladesh are 8.857 lac ha and 10.053 lac metric tons respectively (AIS, 2017). It is recognized as a valuable pulse grain due to its high content of plant protein with essential amino acids, is known to be one of the most nutritious grain (Raghuvanshi et al., 1994; Bhatty, 1988; Jood et al., 1998). The protein content of lentil seeds is recorded to different from 21.75 to 32.48% (Purseglove, 1968; Dimitrive, 1973). It has been demonstrated by several investigators measured the physical properties, dehulling quality, cooking quality and nutritional quality of lentil (Amin, 2004; Isik, 2007; Tabil et al., 1999). The average yield of lentil is about 1085 kg ha^{-1} (AIS, 2017), which is very low as compared to the average yield of lentil growing countries of the world like Canada, India, Turkey and Australia (FAOSTAT, 2016). So, there is a lot of scope for reducing the yield gap of legumes at farmer's level. The main reasons for low yield of lentil are the traditional local cultivar, seed borne infection and low plant density, infestation and crop management practices. In our country, the major parts of seeds deteriorate their quality during storage. Seeds quality is generally deteriorated at the storage period. Huda (2001) reported that 10-15% production was found to reduce due to use of poor quality seed. They are generally stored the various seed as like their food grain. Various factors like temperature, types of container, relative humidity and seed moisture contents etc. deteriorates the seed quality. The most important input in agricultural production is the seed quality. Seed quality enhances the germination, seedling growth and better yield. The loss of seed viability and damage of seeds is the main obstacle for increasing seed production by biotic and abiotic factors during storage period. In Bangladesh, most of the farmers are generally stored their seeds for three to six months before using as planting materials. The farmer traditionally, stored their seeds in earthen vessels (Motka), bamboo containers (Dole), jute sack or plastic bags. To protect the seed from the microbial infestation, however these are not suitable and biotic causes can easily penetrate into the containers and infest to the stored seed. So, appropriate container could be an appropriate way to save the seed from deterioration of quality and viability. Hasan et al. (2016) reported that seeds stored in sealed container with low moisture maintained higher seed quality i.e. increased germination percentage, shoot and root length, and vigor index than gunny bag. Moreover, as seed is highly hygroscopic living material, it absorbs moisture from air if it is stored in an environment where relative humidity is higher than seed moisture level (Copeland, 1976). Therefore, storage container is the most important aspect for storing of seeds. Poor storage environments significant influence seed vigor (Heydecker, 1979). The condition of temperature, relative humidity and moisture levels of seed are regulated by different containers. Most of the storage pathogenic species are *Aspergillus* spp, *Penicillium* spp and *Rhizopus* spp. which cause discoloration of the seeds and germination failure (84.4%), yield loss (60%), development of the symptoms having color rot (84.4%) and wilt (60%), respectively (Fakir, 1983). The most common fungi for infection of lentil seeds are *Ascocytalentis, Botrytis spp*. and *Fusorium oxysporum*. As a result, the health of seed has been observed to be affected by quality of seed (Fakir et al., 1989). The sealed plastic container and polythene bags are the most effective storage containers among gunny bag or jute bag and earthen pot etc. Considering the above factors, the current investigation was undertaken to identify the best storage container and optimum storage period for lentil seed.

2. Materials and methods

This research work was conducted at the outreach building of Hajee Mohammad Danesh Science and Technology University (HSTU), Dinajpur, during 24 March to May 2016. The experiment was laid out in completely randomized design (CRD) with three replications. Three storage containers viz. i) Sealed container, ii) Poly bag (Transparent) and iii) Gunny bag along with three storage periods viz. i) 15, ii) 30 and iii) 45 DAS (days after storage) were used in this experiment. The used lentil seed was supplied by the Institute of Research and Technology (IRT), Hajee Mohammad Danesh Science and Technology University, Dinajpur. Seeds were kept in three containers and stored at room temperature and relative humidity for one and half months. The sealed pot was covered tightly, and the poly bag and gunny bag were tight with rope. During the storage period seeds samples were taken every 15 days from the containers for determination of moisture content of seeds and germination percentage (GP).

Sampling was done randomly for 3 times from each storage container. The first, second and third sampling was done at 15, 30 and 45 DAS for testing germinability and health status of the seeds of storage containers. The

seeds were preserved in the containers and closed with the lids. The samples were enclosed in three different containers viz. sealed plastic container, polythene bag and gunny bag with proper labeling at 25±2°C until used for subsequent studies. About 300-400g seeds were used per container as required filling up the containers based on the size. The lids of the containers were placed firmly to make it air tight as far as possible. The containers were kept in the wooden rack in the laboratory.

Sand was used as substratum for the germination test. The sand was finely sieved to remove particles bigger than 0.8 mm and smaller than 0.05 mm in diameter. The rectangular plastic boxes were used to put the sand. A uniform layer of moist sand was selected for seed germination and then covered with sand to a depth of 10 mm, which was left loose. In each plastic tray one hundred seeds were planted and replicated with four times. At room temperature, the plastic trays with seed were incubated and irrigated at every odd day.

$$\text{Germination percentage} = \frac{\text{No. of seeds germinated at final count}}{\text{No. of seeds placed for germination}} \text{ X } 100$$

Seedlings from each plastic tray were collected as a sampling after 10 days of placement for germination. Length of shoot and root of individual seedling were recorded manually with scale. The mean lengths (cm) were calculated as per treatment combination. Vigor index (VI) was calculated by using the formula of Baki and Anderson (1973) as shown below:

Vigor index (VI) = Germination (%) X (Mean shoot length + mean root length)

Fungi associated with lentil seeds were detected by using Blotter method as followed by ISTA (1996).

In blotter test, three layers of blotter papers (Whatman filter paper No. l) were soaked in sterilized water and placed at the bottom of 9 cm diameter plastic petri-dish in which twenty five (25) seeds of lentil were placed on the moistened blotting paper at equal distance between seeds and petri-dish wall in each plate. About 100-seeds were tested for each replication. Petri-dishes containing seeds were incubated for seven to eight days at 25±2°C under 10-12 hours alternating cycles of Near Ultra Violet (NUV) light and 12-14 hours of darkness. The incubated seeds were inspected individually with the help of a stereo microscope of 25x25 magnification following the keys outlined by Ramnath et al. (1970) and Khan (1975). The pathogens were detected on the basis of their growth characters and expressed in percentage. The data were analyzed by using MSTAT-C program with the help of computer (Gomez and Gomez, 1984).

3. Results and discussion

3.1. Effects of containers and storage periods on germination of lentil seed

Germination percentage (GP) was positively affected by the different storage containers during the periods of 15, 30 and 45 DAS. The GP of seeds decreased with the increasing storage period from 30 to 45 DAS. Among the three containers, the highest (81.54%) GP of the seeds was observed in the sealed plastic container followed by poly bag (74.59%) with minimum significant variation (Table 1.). The lowest GP (63.24%) was observed in the seeds stored in gunny bag at 45 DAS.

Table 1
Effects of containers and storage periods on germination of lentil seed.

Containers	Storage periods		
	Germination (%)		
	15DAS	30 DAS	45 DAS
Sealed container	81.54 a	78.36 ab	76.56 ab
Poly bag	74.59 ab	67.11 cd	64.84 cd
Gunny bag	74.29 b	68.98 c	63.24 d
LSD		5.12	
CV%		2.33	

In a column, figures having similar letter (s) do not differ significantly whereas figure s bearing dissimilar letter (s) differ significantly (as per DMRT).

At the end of one and half months, the GP of lentil seeds kept in sealed plastic container, poly bag and gunny bag were decreased to 76.56, 64.84 and 63.24%, respectively. The decline rate was higher in seeds of gunny bag than that of sealed container and poly bag. Seed deterioration is a natural phenomena and life span of seeds decrease with the passing of time. Seed deterioration processes however depend on a large number of genetically and environmental factors. As seed is highly hygroscopic living materials and it absorbs moisture from the surrounding atmosphere. This higher moisture in the seed may be the main reason of quick germination deterioration in the seeds of gunny bag. The present results are in agreement with the findings of Mian and Fakir (1989), Kaur et al. (1990) and Hasan et al. (2016) who reported that gunny bag absorbed more moisture resulting deteriorates quality and reduced GP.

3.2. Effects of containers and storage periods on shoot length

The shoot length of lentil seed, preserved in different containers greatly was influenced by types of the containers. Among all of the storage containers, the lowest shoot length (13.14 cm) was recorded at 45 DAS in gunny bag and the highest shoot length (16.08 cm) was recorded at 15 DAS in sealed plastic bag. The shoot length gradually decreased with increasing length of the storage period (Table 2). The similar findings were also reported by Kaur et al. (1990). Permeable container like gunny and the longest storage period might be enhanced absorption of moisture which influences the infestation of storage fungi resulting seedling abnormalities and reduced shoot length. These results are in line with those of Mendoza and Molina (1980), Mian and Fakir (1989) and Abo-Gendy et al. (2016).

Table 2
Effect of different containers and storage periods on shoot length of lentil seed.

Containers	Storage periods		
	Shoot length (cm)		
	15 DAS	30 DAS	45 DAS
Sealed container	16.08 a	14.96 d	13.85 g
Poly bag	15.69 b	14.60 e	13.60 h
Gunny bag	15.33 c	14.36 f	13.14 i
LSD		0.18	
CV%		0.76	

In a column, figures having similar letter (s) do not differ significantly, whereas figure s bearing dissimilar letter (s) differ significantly (as per DMRT).

3.3. Effects of containers and storage periods on root length

Storage containers and storage periods play an important role in the root length of lentil seed. The highest root length (8.77 cm) was found in sealed container at 15 DAS and the lowest root length (4.64 cm) was found in gunny bag with the highest storage period (45 DAS). Mendoza and Molina (1980) also reported that seed-borne pathogens are also responsible for seedling abnormalities like reduced root length. This is due to the fact that seeds stored in different containers absorbed moisture from the atmosphere during storage period. For this reason, absorbed moisture by seeds from the ambient air and tended to equilibrium with relative humidity resulting infestation of fungi increased, as well as GP, shoot and root length decreased. These results are in agreement with the results of Hasan et al. (2017) who reported that shoot and root lengths gradually decreased with increasing storage periods.

3.4. Effect of different containers and storage periods on vigor index

Vigor index or vigor of seedling was significantly influenced by the storage containers and the storage periods. The vigor index was decreased with the increase of storage periods. Statistically the highest vigor index (2048.79) was obtained in sealed plastic containers with initial storage periods (15 DAS), followed by the polythene bag (1716.52) and the gunny bag (1625.43), while the lowest vigor index (1158.59) was recorded in gunny bag with 45 DAS (Table 5). Longer periods of storage in seed is one of the main reasons for loses of vigor sooner due to absorbed moisture. The moisture accelerates the rate of respiration for the seed and microorganism. A higher moisture rate could produce rapidly heat enough to decline seed quality (Brandenburg et al., 1961).

Table 3
Effects of containers and storage periods on root length (cm) of lentil seeds.

Containers	Storage periods		
	Root length (cm)		
	15 DAS	30 DAS	45 DAS
Sealed container	8.77 a	7.18 b	6.11 de
Poly bag	6.94 bc	5.93 de	4.87 fg
Gunny bag	6.35 cd	5.51 ef	4.64 g
LSD		0.73	
CV%		3.55	

In a column, figures having similar letter (s) do not differ significantly whereas figure s bearing dissimilar letter (s) differ significantly (as per DMRT).

Table 4
Effect of different containers and storage periods on the vigor index of lentil seed.

Containers	Storage periods		
	Vigor Index		
	15 DAS	30 DAS	45 DAS
Sealed container	2048.79 a	1754.85 b	1550.79 d
Poly bag	1716.52 b	1410.21 e	1229.82 f
Gunny bag	1625.43 c	1393.51 e	1158.59 g
LSD		59.03	
CV%		1.18	

In a column, figures having similar letter (s) do not differ significantly whereas figure s bearing dissimilar letter (s) differ significantly (as per DMRT).

3.5. Fungal infestation

There was a lack of information about biotic factors like insects and pathogen was recorded during the period of storage in all the containers, but during study, several fungi were found such as *Ascocytalentis, Botrytis spp*. and *Fusorium oxysporum*. The maximum number of fungus was observed in seeds of gunny bag than sealed plastic container and poly bag (Fig. 1).

The fungal infection of lentil seed kept in sealed container, gunny bag and poly bag rised with increasing periods of storage (15 to 45 DAS) and the highest fungal infection was recorded at the end of the 45 DAS. The minimum fungal infection was found at sealed container and the maximum was found at gunny bag in all storage periods.

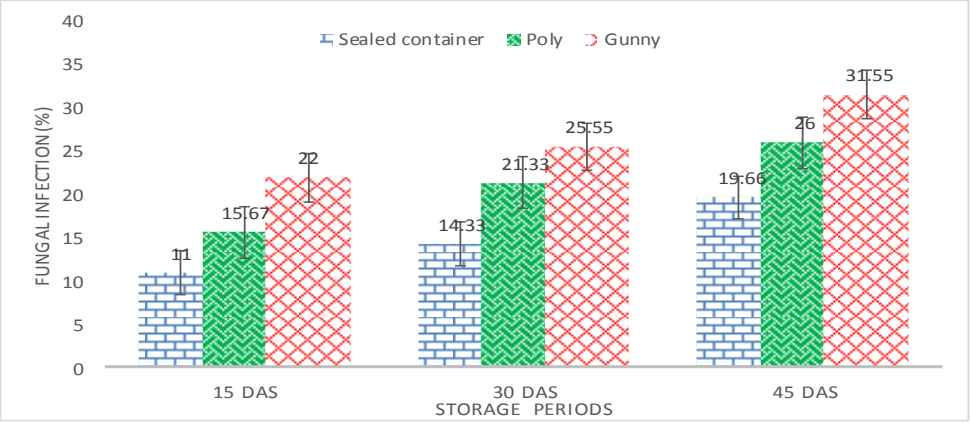

Fig. 1. Effect of different containers and storage periods on fungal infection (%) of lentil seed.

Among the containers storing of lentil seeds in sealed container had the lowest percent of seed-borne infestation and highest percent of seed germination. It was observed that storage periods affected the lentil seed-borne pathogens during storage. Moreover, lentil seed-borne fungi were dominant at 45 DAS compared to that of 30 and 45 DAS when kept in all the three selected containers. This phenomenon is supported by Sutherland (1981) and Hasan et al. (2017). Ching et al. (1960) reported that seed moisture plays a significant role in keeping the viability of seedand seed contamination by storage fungi. According to their findings, it was reported that increase of seed moisture may be higher in permeable containers like gunny bag.

4. Conclusion

Sealed plastic container recorded significantly the highest GP, shoot length, root length, vigour index and less fungal infection as compared to poly bag and gunny bag when seeds stored in those containers up to 45 DAS. There were significant variations among the different storage periodsof 15, 30 and 45 DAS for producing the above mentioned traits and the values of GP, shoot length, root length and vigour index were decreased significantly with increasing storage periods. From the study it is revealed that seeds preserved in sealed container with short storage periods (15 DAS) performed best for producing GP, vigor index, shoot length, root length, and less infections of fungal. Accordingly, it can be summarized that seeds should be stored in sealed container with short storage period.

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