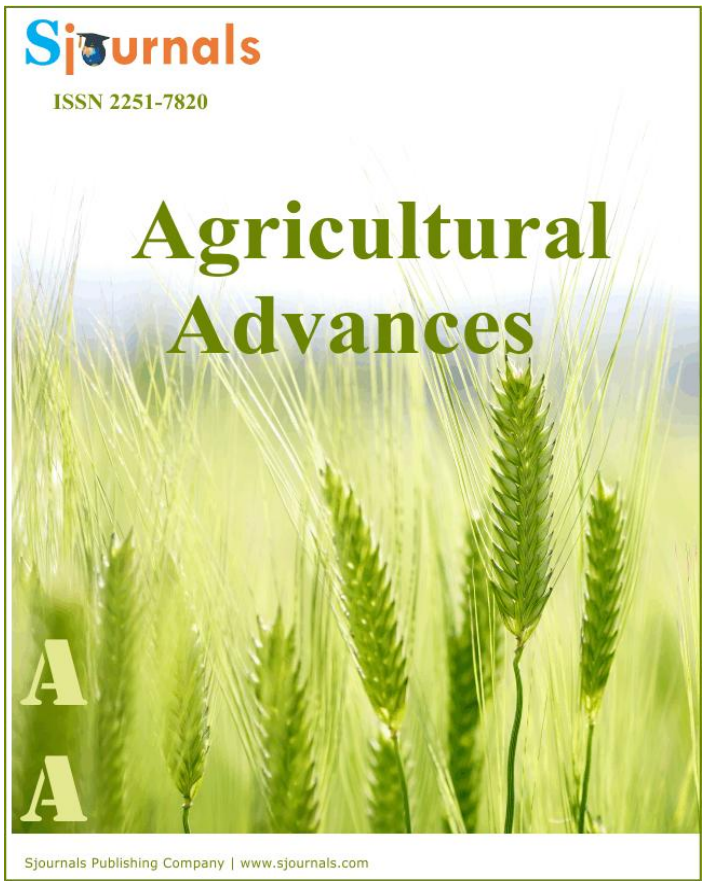

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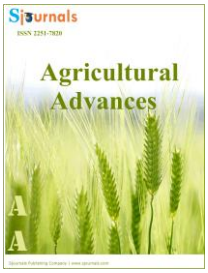

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Original article

Effect of storage periods and containers on the germinablity of mungbean seeds

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ABSTRACT

A germination test was carried out to observe the germinability of mungbean seed under storage periods and storage containers at Agronomy laboratory of Hajee Mohammad Danesh Science and Technology University (HSTU), Dinajpur, Bangladesh during April-May 2014. The experiment was designed completely randomized design (CRD) with eight replications under three storage periods (15, 30 and 45 days after storage (DAS)) and three seed containers (tin container, polythene bag and gunny bag). The maximum values of germination percentages (GP) were recorded of mungbean seed with 15 days after storage (DAS) and the GP reduced significantly with increasing storage periods from 15 to 30 and 45 DAS. The highest GP (82.00%) was found at 15 DAS in tin container while the lowest (51.01%) at 45 DAS in gunny bag. The rate of reduction was found to increase with the advancement of storage periods. The germinability of mungbean seed was observed maximum levels (82.00, 80.89 and 72.68%) when seeds stored in tin container, and the minimum levels (72.42, 66.11 and 51.01%) whilst the seeds stored in gunny bags among the three storage containers under all storage conditions. Mungbean seed kept in gunny bag and tin container provide the highest and lowest reduction of GP, respectively. An excellent performance of germination was observed in tin containers seed while the gunny bag provided the inferior seed germination among all of the three containers. Finally, it could be possible to enhance and maintain the quality of mungbean seeds through proper storage medium with the adequate periods.

1. Introduction

Among pulse crops, mungbean (*Vigna radiata* L.) is one of the grain legume under the family of Liguminosae in Bangladesh (Islam et al., 2017a). In Bangladesh, it ranks the 3rd position next to grasspea and lentil both in acreage and production (AIS, 2017). Considering dietary and nutritional value as well as low-priced source of easily digestible dietary protein, it is an ancient and well known crop in Bangladesh. Mungbean seed contains a significant amount of protein(25.67%) fat(1-3%), carbohydrates (5.4%), fibers (3.5-4.5%) and ash (4.5-5.5%) with very low amount of flatulence effects (Ahmad et al., 2008; Frauque et al., 2000). Grains are consumed in many different forms including dhal (soup), bean sprouts, noodles, bean curd, dahl cake etc. Mungbean protein is highly and easily digestible than other legumes because it has less sulphur containing amino acid with evenless methionine than lysine. Mungbean takes part a key role to provide protein to the people of Bangladesh who accustomed the cereal-based low protein diet and it is known as "poor men's meat" due to the accessible origin of protein but the area and production of mungbean is gradually decreasing (AIS, 2017). It is very much important to produce extra food from decreasing agricultural land area for mitigating the proper food supply problem (Islam et al., 2017a,b). Farmers have full attention for growing more cereal crops with to meet up the fundamental food demand instead of pulses and consequently pulse cultivation is pushing to the less fertile and/or problems soils with diminutive management as well as using of low quality seed in Bangladesh. The productivity is greatly lower as compared with leading countries of the world that can be increased through the enhancement of mungbean cultivation in the whole year in Bangladesh. Seed is the most important input in agriculture and healthy seed can produce good crop as well as boost crop yields. Production can be increased up to 5-50% due to good seed as propagating material (Huda, 2001). About 10-15% yield increased through using good seeds instead of poor seed (Alim, 1977).

Generally, mungbean are grown by farmers in the Rabi season in our country (November to March) and for sowing in the next season, they stored seeds for 8-9 months harvested from crops. Biotic and abiotic factors viz. pathogens, high and low temperature and moisture etc significantly reduced viability of seed. Without proper drying of seed and of its atmosphere resulting faster deterioration of stored seed (Bass, 1973). The longevity of seeds greatly influenced by many factors viz. seed moisture content, temperature, relative humidity, initial viability, stage of maturity at harvest, storage gas and the initial moisture content of seed etc. during storage (Harrington, 1972). Seed quality as well as the initial moisture content of seed is one of the most important factors in seed storage (Brett, 1952). Adequate relative humidity plays an important role for the maintenance of seed viability (James, 1967). By storing the seeds in a climatic region with favourable relative humidity conditioning of the storage environment or storing seed in moisture proof containers, this condition can be achieved (Delouche, 1968; Bass, 1973). Seed quality retained by the deciding factor viz. storage containers during storage. Rice seed provided higher germination seed kept in metal container over gunny bag Haque (1982). The deterioration of seed during storage greatly influenced by storage period in the tropics and sub-tropics. All grains/seeds contain moisture at harvest and this moisture may has a little consequence if the grains are to be consumed immediately after harvest, but if the grains/seeds are to be stored for any length of time from one to the following season, seed quality will be deteriorated. Therefore, it is essential that its moisture level be reduced so that it does not exceed certain well defined limits. Seeds gradually declined their quality traits with the increment of storage periods as reported in many crops such as common bean (Nahar et al., 2009), lentil (Hasan et al., 2017a). Considering the above facts, the germination test was therefore, conducted to find the effects of storage periods and containers of the germinability of mungbean seeds.

2. Materials and methods

2.1. Location and duration

The research work was performed at the laboratory of the Department of Agronomy, Hajee Mohammad Danesh Science and Technology University (HSTU), Dinajpur, Bangladesh located in 25°37' N latitude and 88°39' E longitude on the eastern bank of the river Punarvhaba, and the altitude of the location was 37.5 m from the sea level. The research was continued from April-May, 2016.

2.2. Plant material

Seed of mungbean (Binamung-5) was collected from the Bangladesh Institute of Nuclear Agriculture (BINA), Mymensingh, Bangladesh.

2.3. Experimental treatments

The following three sets of storage containers (Factor: A) viz. i) Metal tin container, ii) Polythene bag, iii) Gunny bag, and three storage periods (Factor: B) viz. i) 15 DAS, ii) 30 DAS and iii) 45 DAS (days after storage) were included in the experiment.

2.4. Experimental design

The germination test consist of eight replications under completely randomized design (CRD).

2.5. Storage condition

The data pertinent to weather was recorded from the meteorological station of HSTU, Dinajpur, Bangladesh. During germination temperature fluctuated from 24.0 to 30.0^{o}C. The average temperature was around 26.83^{o}C. The minimum humidity of those days was 54% and maximum was 86%. The fluctuations of temperature was minimum, but the relative humidity varied during the experimentation. The daily weather data on temperature (maximum, minimum and mean) and relative humidity during the experimentation have been presented in Fig. 1

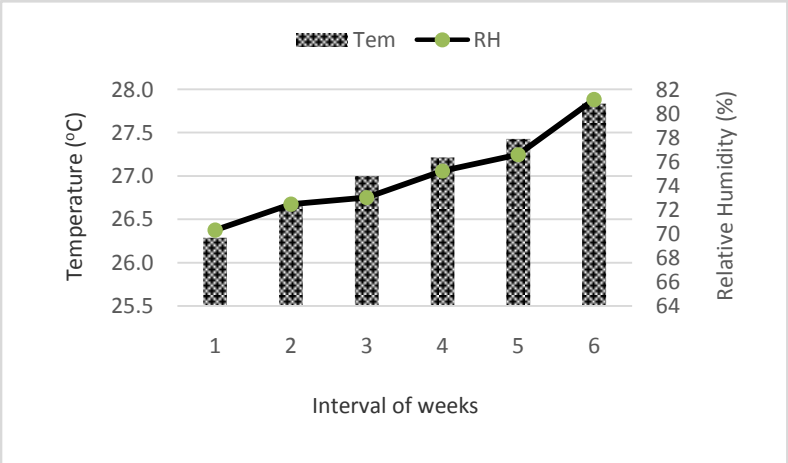

Fig. 1. Weekly average temperature and relative humidity during experimentation.

2.6. Germination test

Plastic tray was used for determining the germination test at the laboratory of the Department of Agronomy, HSTU, Dinajpur, Bangladesh. The collected sand should be washed and dried that was used as germination media. For better germination of mungbean seed, properly moisture level was maintained in the germination media. About 400 seeds at every sampling time in eight replications was performed for three storage containers to conduct this germination test. Careful observation was undertaken at normal seedlings were on each replicate of 50 seeds and removed, counted and recorded. The final count was done with all categories of seedlings at 10th days of the test. For providing the mean percentage of normal germination, the replicate results were averaged.

2.7. Sampling

Sampling was carried out at 15 day intervals up to 45 days i.e. 3 times. At each sampling, samples were randomly taken from every storage container.

2.8. Statistical analysis

The recorded data were statistically analyzed using a MSTAT-C software with the help of computer (Russel, 1986).

3. Results and discussion

3.1. Effect of storage periods on seed germination

The storage period under the study exerted significant effect on germination percentage (GP) of mungbean seed (Fig. 2). With the advancement of storage periods the GP significantly decreased. The highest GP (79.96%) was obtained from 15 DAS of storage period followed by while the lowest one (61.46%) from 45 days. The 30 days of storage period exhibited germination percentage intermediate and the rate of reduction was higher from 30 to 34 DAS than from 15 to 30 DAS. The life span of seeds as well as seed deterioration and reduction significantly increased with the passing of time. Seed deterioration processes progressively affected by the genetical and environmental factors.

Absorption of moisture from the surrounding atmosphere is very much easier to seed as it's a highly hygroscopic living materials. The main reason of quick germination deterioration in the seeds due to absorption of moisture from atmosphere over a long period of time and the higher moisture present in the seed. In our experiment, the GP reduced 23.14% within 30 days of storage from 15 to 45 DAS. These results similar with the findings of Umarani and Selvaraj (1996) in soybean; Hasan et al. (2017b) in lentil; Islam (2008) in duram wheat who reported that the GP decreased gradually with increasing storage periods due to absorption moisture from the surrounding environment which depends on the nature of the storage containers.

The presence of pathogenic inocul on the seed enhanced with long storage duration resulting loss in seed germination as well as causing disease to the emerged seedlings (Kaur et al., 1990). The germination percentage greatly reduced due to the ambient absorption of moisture from air that tends to equilibrium with relative humidity. Physiological process of seed germination disturbed by high moisture content of seed resulting in loss of viability and germination rate (Harrington, 1972). The deterioration of seed increasing with higher moisture content of seed (Agrawal, 2003). Copeland (1967) reported that longer storage periods significantly declined the seedling vigor (growth rate).

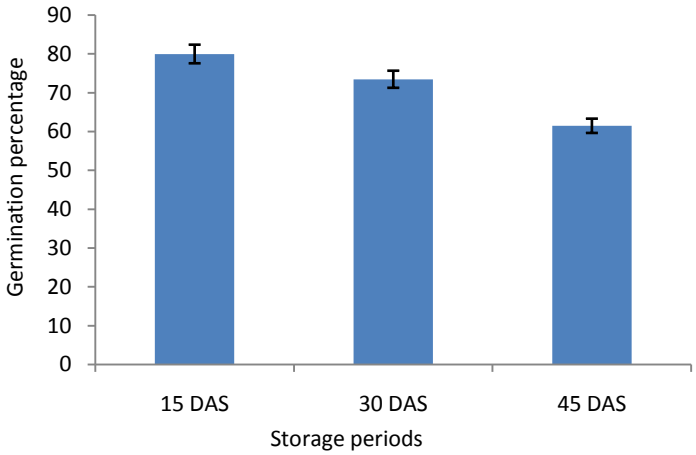

Fig. 2. Effect of periods on the germination percentage of mungbean seed.

3.2. Effect of storage containers on the seed germination

The result revealed that germination percentage of significantly varied seeds stored in the different storage containers. Metal tin and gunny bag produced maximum (77.08%) and minimum (65.29%) germination percentage, respectively. The seeds stored in polyethylene bag produced the intermediate germination percentage (72.75%) (Fig. 3). The present result confirms the findings of Majid and Nahar (1981) who also reported that polythene bag and tin containers found suitable for short duration storage of soybean seed. Seeds absorb moisture from the environment due to their highly hygroscopic behavior. The initial moisture content of seed kept in gunny bag is increasing due to come to the contact with air resulting remained near to their equilibrium moisture content (EMC). Respiration rate for the seed and microorganism accelerated by higher moisture that could produce rapidly enough heat resulting declined seed quality as well as GP (Branderburg et al., 1961). Seed quality and reduction of GP severely reduced due to higher absorption of moisture by gunny bag (Kaur et al., 1990;

Hasan et al., 2016a). The reason of less reduction of GP of the seeds contained metal tin container and polythene bag could not come to the contact with ambient room air as it was more or less air tight compared with gunny bag. The GP of the seeds of poly bag was found to decrease only 5.62% (from 77.08 to 72.75%) from the seeds of tin container, but the reduction was around three times i.e. 15.30% (from 77.08 to 65.29%) of the seeds of gunny bag. The best storage container is the metal container for higher germination among all of the studied containers as reported by Haque (1982). Higher quality of seed stored in metal drum compared to gunny bag with respect to germination and biotic infestation, although the seed moisture content was similar as mentioned by Eswarappa et al. (1991).

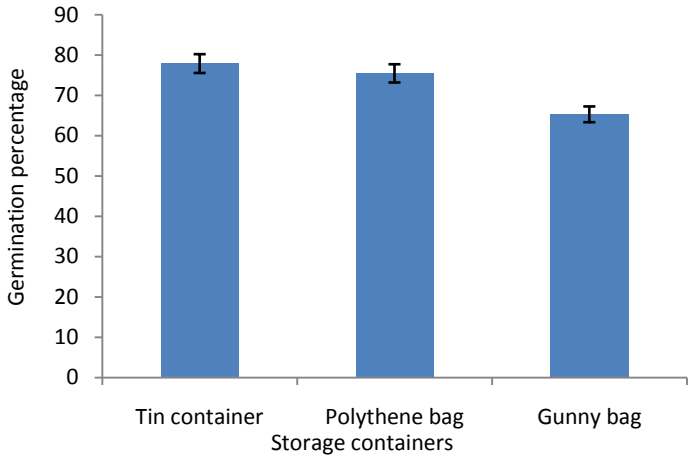

Fig. 3. Germination percentage of mungbean seed as affected by storage containers.

Table 1
Interaction effect of storage periods and containers on the GP of mungbean seed.

Interaction (Storage periods X containers)	Germination (%)	Reduction (%) over 15 DAS x Tin
15 DAS x Tin	82.00 a	-
15 DAS x Polythene bag	80.16 a	2.3
15 DAS x Gunny bag	72.43 b	11.67
30 DAS x Tin	80.89 a	1.35
30 DAS x Polythene bag	73.32 b	10.59
30 DAS x Gunny bag	66.11 c	18.16
45 DAS x Tin	72.68 b	11.37
45 DAS x Polythene bag	59.34 d	27.63
45 DAS x Gunny bag	51.01 e	37.79
Level of significance	0.92	0.01
Sx	1.01	1.05

3.3. Interaction effect of storage period and container

The interaction of storage container and storage period showed significant influence on seed germination percentage (Table 1). However, the highest germination (82.00%) was found at 15 days of storage period X Tin container treatment which was statistically similar to 30 days of storage period X Tin container treatment, and 30 days of storage X Tin container treatment. The lowest one germination percentage (55.75 %) was found in 45 days of storage period x gunny bag treatment. The rest treatments 30 days of storage X gunny bag and 45 days of storage X gunny bag did not show significant variation on germination of seed. Germination percentages (GP) of seeds preserved in different containers gradually decreased with increasing storage periods from 15 to 45 DAS. The lowest reduction of GP was recorded (1.35 and 11.37%) in Tin containers whereas the highest reduction was observed (18.16 and 37.79%) at gunny bag at 30 and 45 DAS, respectively (Table 1). The reduced GP is the results seed deterioration and seed deterioration is the natural phenomena of seed which depends on the moisture

content of seeds. Seeds absorb moisture from the surrounding environment where prevails higher moisture due to the hygroscopic nature of seed. Thus higher moisture in the seeds of gunny bag may be the main reason of quick and more reduction of GP with higher storage periods. We observed a noticeable reduction of GP in the seeds preserved into the air-unprotected container like gunny bag. Similar trends were found by Haque (1982), Kaur et al. (1990), Eswarappa et al. (1991), Umarani and Selvaraj (1996), Hasan et al. (2017a) who reported the suitability of air tight container over gunny bag in keeping the higher GP of seed.

4. Conclusion

The germination of mungbean seed was significantly as influenced by the storage containers and storage periods. The highest germination was obtained in the seeds which were stored in tin container. The lowest germination was found in the seed stored in gunny bag. The short time stored seeds exhibited highest capability of germination. In the interaction, the highest germination of seed was obtained in tin container under 15 days of storage period. So it may be concluded from our results and in agreement with other findings that metal tin container is the most effective one for long period of storage and may be recommended for general practice.

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Conflicts of interest

The authors declare no conflicts of interest.

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