SCREENING OF DEVICES FOR THE STORAGE OF T. AMAN SEEDS AT FARM CONDITION

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SCREENING OF DEVICES FOR THE STORAGE OF T. AMAN SEEDS AT FARM CONDITION

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CERTIFICATE

*This is to certify that the thesis entitled “ **SCREENING OF DEVICES FOR THE STORAGE OF T. AMAN SEEDS AT FARM CONDITION”** submitted to the Faculty of Agriculture, Sher-e-Bangla Agricultural University, Dhaka, in partial fulfilment of the requirements for the degree of **MASTER OF SCIENCE (MS)** in **AGRONOMY,** embodies the results of a piece of bona fide research work carried out by **MOHMMAD ALI** Registration. No. **13-05797** under my supervision and guidance. No part of this thesis has been submitted for any other degree or diploma.*

I further certify that such help or source of information as has been availed of during the course of this investigation has duly been acknowledged.

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MY

BELOVED PARENTS

LIST OF ACCRONYMS AND ABBREVIATIONS

Agric.	Agriculture
Agril.	Agricultural
AIS	Agricultural Information Service
Anon.	Anonymous
AOSA	Association of Official Seed Analysis
BADC	Bangladesh Agricultural Development Corporation
BARC	Bangladesh Agricultural Research Council
BRRI	Bangladesh Rice Research Institute
BBS	Bangladesh Bureau of Statistics
BINA	Bangladesh Institute of Nuclear Agriculture
^{o}C	Degree centigrade
Cm	Centi-meter
CRD	Completely Randomized Design
CV	Coefficient of velocity
Dev.	Development
EC	Electrical conductivity
ed.	Edition
EG	Energy of emergence
Environ.	Environmental
et al.	And others
Expt.	Experimental
FAO	Food Agriculture Organization
GDP	Gross Domestic Product
GI	Germination index
Hr	hour
i.e.	idest (L), that is Inst. Institute
Int.	International
LSD	Least significant difference
ISTA	International Seed Testing Association
j.	Journal
Mg	Milligram
MGT	Mean germination time
Min	Methyl jasm-onate
µM	Micromole
ml	Milliliter
Mm	Millimeter
mM	Millimole
MoA	Ministry of Agriculture
M.S	Master of Science
No.	Number
Pgb	Polythene in gunny bag
Res.	Research
ROS	Reactive Oxygen Species
RH	Relative Humidity
SAU	Sher-e-Bangla Agricultural University
Sci.	Science
Technol.	Technology
TG	Total germination
UK	United Kingdom
US	United States
VI	Vigour Index
Viz	Namely
Wt.	Weight
%	Percentage

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ABSTRACT

The experiment was carried out at Seed Testing Laboratory, Beej Bhaban, BADC, Gabtoly, Dhaka to select the suitable varieties and the suitable devices for the storage of T. Aman seeds at farmer's level. Five T. Aman varieties *viz*: V_1= BINA dhan7, V_2=BRRI dhan33, V_3=BRRI dhan34, V_4=BRRI dhan51 and V_5=BRRI dhan52 and four storage devices *viz*: D_1= Plastic drum, D_2= Steel drum, D_3= Polythene in gunny bag, D_4= Gunny bag were used as treatment in this experiment. The experiment was carried out following completely randomized design with four replications. Data were collected in each month from January to July on moisture (%), germination (%), germination (%) after accelerated aging test, speed of germination, electric conductivity, seedling length, biomass production and imbibitions (%). The result revealed that BINA dhan7 showed the highest germination (83-86%) and highest seedling length (20-22.62 cm) and BRRI dhan52 showed the highest speed of germination (11.12-25.30) as well as the highest biomass production (0.175-0.207 gm/10 seedlings). Seeds stored in plastic drum performed better in maintaining significantly higher germination (82-93%), the highest speed of germination (26-55), the lowest electric conductivity (232-282 µm) for the storage period. On the other hand, seeds stored in gunny bag showed the lowest germination (75-82%, the lowest speed of germination (12.52-25.61), the highest electric conductivity (240-295 µm) at different months after preservation. Interaction of plastic drum × BRRI dhan7 gave the highest germination (83-95%) and interaction of plastic drum × BRRI dhan52 gave the highest speed of germination (30.58-56.00). From the present study, it may be concluded that BINA dhan7 and BRRI dhan52 as the variety, plastic drum as a storage device, and the interaction of D_1V_1 (plastic drum× BINA dhan7) as well as D_1V_5 (Plastic drum × BRRI dhan52) performed better in maintaining the T. Aman seed quality during storage for six months (January-June) at the farm condition.

CHAPTER I

INTRODUCTION

Rice (*Oryza sativa* L.), a cereal crop belongs to the family *Poaceae*. It is the most important crop of the tropical world. Rice is grown under an extremely wide range of environmental conditions, which growth depends on the surrounding climatic conditions. There are 134 rice-growing countries in the world that occupies about 178.50 million hectares of land of which over 90% are in Asia (IRRI, 2010). Rice is the staple food for nearly half of the world's population as well as for 156.80 million people of Bangladesh (AIS, 2014). To feed the fast increasing global population, the world's annual rice production must be increased to 760 million tons by the year 2020 (Kundu and Ladha, 1995).

Agriculture in Bangladesh is characterized by intensive crop production mainly rice. Rice plays absolutely dominant role in Bangladesh agriculture as it covers 75% of total cropped area (BBS, 2014). Annual per capita consumption of rice in Bangladesh is the highest in the world (Nasiruddin, 1993). It provides about 70% of an average citizen's total calorie intake (BRRI, 2010). It contributes 76% of the caloric and 66% of the protein intake (BNNC, 2008). Rice accounted for nearly 20% of the national GDP (BRRI, 2010). It is, by far, the largest sectoral source of income, employment, savings and investment in the economy. The fluctuations in the productivity of rice influence the food security and to some extent ensure political stability of the country. However, Bangladesh needs to increase the rice yield further in order to meet the growing demand. The national commission of agriculture projected that in order to remain self-sufficient, Bangladesh will need to produce 50 million tons of paddy by the year 2020, implying a required rate of growth of production is 2.1% per year. An earlier agricultural research strategy prepared by Bangladesh Agricultural Research Council (BARC) projected the required paddy production of 52 million tons (34.7 million tons of rice) by 2020, which would require a production growth of 2.2% per year (NFR, 2006).

In Bangladesh, food security has been and will remain a major concern because food requirement is increasing at an alarming rate due to increasing population. The average yield of rice is 3.10 t ha^{-1} (BBS, 2014), which is quite lower compared to that of many other rice growing countries like China, Japan, Korea and USA where yields are 7.03, 6.89, 6.91 and 7.50 t ha^{-1}, respectively (FAO, 2013). The average yield of our country is almost less than 50% of the world average rice grain yield. It is estimated that the population will gradually increase to 161 million in 2020. During this time, the total rice area will shrink from 10.80 to 11.12 million ha and rice yield will be needed to increase from 2.70 tons to 4.27 tons per capita. Rice area will gradually shrink to only 0.149 acre in 2020 and the required rice $head^{-1}$ day^{-1} will be decreased from 500 g in 2005 to 460 g in 2020 due to the increase of population. This indicates a decreasing trend of daily requirement of rice.

Rice is grown in three distinct growing seasons, viz. Aus, Aman and Boro of which Aman is the main season (BBS, 2006). Aman season rice is rather photo period sensitive and flowers in the month of October-November and matures during December-January (Atim, 1982).

The productivity of Aman rice, however, is not satisfactory. There exist enormous scopes to increase the productivity of Aman rice. Among them the most important one is the availability and use of good quality seed having highest possible standards of genetic and physical purity, germination capacity and health status (Kant *et al.,* 1999). In general, seeds are to be stored from the day of harvest up to the next sowing time. At physiological maturity, seed possesses its highest viability and vigour. From this point, seed gradually losses its viability and vigour and eventually dies (Kurdikeri *et al.,* 1995). The problems of maintaining viability and vigour of seed during storage have always been of vital concern to the seed producers and seeds men. The rate of decline in viability and vigour is conditioned by several factors of which storage temperature and seed moisture are the most important (Justice and Bass, 1978). Owing to the complicated relationship between these two factors on seed longevity, neither one can be discussed separately. Effect of temperature is influenced by seed moisture content.

Several authors (Verma *et al.*, 1996; Bhardwaj *et al.*, 2001; Singh and Dadlani, 2003) also observed that storage behaviour of different crop seeds are different and also concluded that storage life of seeds could be maintained over a longer period by using proper packaging materials and better storage environment. Life span of orthodox seeds like rice decreases in store as their moisture content and storage temperature increases (Ching and Tsan, 1998). In sealed storage, seed moisture content remains more or less constant, but in open storage it changes with the change of relative humidity of the air. Therefore, adequately dried seeds in sealed containers usually live longer than similar seeds in open containers. But traditionally in Bangladesh, seeds of most of the crops including rice are stored in cloth bags and gunny bag under ambient conditions of houses, warehouse, processing plants, godowns and in sale splints till next season (Miah *et al., 1*992). Because of humid tropical climate of Bangladesh, high temperature and high relative humidity prevail during most parts of the year which likely to accelerate the deterioration of viability and vigour of seeds. Rapid loss of seeds viability and vigour under such humid environment causes serious damage to crop productivity of tropical countries (Abbu and Lovato, 1999). In Bangladesh, for cultivation of Aman rice, seeds have to be stored for nearly six to eight months of which four to five months are very crucial because of its hot and humid environment. This emphasizes to assess the pattern of viability and vigour loss of T. Aman seeds under different storage environments till the next sowing season.

In the farmers do not have proper information and appropriate technology for storage of T. Aman seeds. Now-a-days, farmers usually store their seeds in Plastic drum, Steel drum, Gunny bags, polythene bags, polythene in gunny bag etc. These devices are comparatively low-cost as well as locally available. The farmers have no information about which device among them is most suitable in terms of maintaining seed viability and seed vigour. The seeds stored in these devices are low quality, show less germination and have less vigour. In this regard, a critical assessment of these alternate storage devices in context to the locally available varieties needs to be undertaken on maintaining the seed quality of rice.

The present study was therefore undertaken to compare the performance of alternate storage devices in maintaining seed quality of T. Aman and to find out the suitable storage device (s) for the farmers under Bangladesh condition.

Objectives of the Research work:

1. To find out the suitable variety to store as seed at the farm condition and
2. To select the suitable device (s) for the storage of T. Aman seed at farm condition.

CHAPTER II

REVIEW OF LITERATURE

A lot of research works have been carried out in many countries relating the effects of seed moisture content, storage container and storage environment on various aspects of quality deterioration of stored seeds. However, seed technological research in this line so far conducted in Bangladesh has been relatively very minor and poorly recorded. In Bangladesh considerable work has been done on the effect of different storage containers on the quality of rice seeds under laboratory condition. But research works on storage of rice seeds in Bangladesh are limited and preliminary in nature. Here some of the relevant literatures of rice and other crops have been reviewed and presented to have better understanding on the subject.

2.1 Effect of Storage Containers

Ching *et al.* (1960) stated that initial adjustment of seed moisture played a vital role in the preservation and longevity of seed. They reported that initial seed moisture content of the seed, however, could gradually increase during storage and the rate of increase depend on the type of storage containers. They observed that impermeable containers keep seed moisture content lower but in permeable containers, seed moisture content goes up gradually and reduces its quality. Depending on initial condition, seed deteriorates less rapidly in impermeable than permeable containers.

Rai and Croal (1973) observed that under humid and hot (60% RH and 70-90^{0}F) coastland in Guyana, unhusked rice grain with a moisture content of 11.3% did not lose viability when stored in 600 guage plastic bags for 15 months, whereas grain with moisture contents of 11.3, 14.2 or 15.8% began to lose viability after storage for 3.5 months in gunny bags affected seed vigour.

Rabbani (1976) also reported that storage cost and grain loss in the metal container was low. Therefore, metal storage structures were best for long-term use although a large initial investment was incurred. As our villagers are poor, with a nominal installation cost, woven bamboo structure are, however, preferable to gunny bags, because in case of gunny bag losses of all kinds were heavy.

Rao (1978) reported that metal bins proved to be a better container than polythene and gunny bags for sunflower seed storage.

Razzaque (1980) observed that farmers of Bangladesh usually store their wheat seed in storage structures of different types and sizes viz. tins (biscuit and kerosene), drums, gunny bags, paper or polythene bags, dole, kuthi, earthen pitcher or motka, coated with or without coaltar.

Warham (1986) reported that storage structures used in ancient timed were clay jar, woven grass, cane baskets and leather bags. Hessian bag was also used. These storage structures are being used today by the farmers in many parts of the world including Bangladesh.

Razera *et al.* (1986) stated that seeds of rice cv. TAC 1246 were stored at room temperature in cloth, paper, woven plastic or sheet plastic bags for up to 36 months at compinas and Ubatuba. They observed that deterioration was more rapid at Ubatuba than at campinas with rice seed at campinas having>80% germination after 15 months while at Ubatuba this level was maintained only up to 6 months.

Prasad *et al.* (1987) studied the influence of different containers on the invasion of storage molds in some cereal seeds and aflatoxin contamination. A total of 155 samples of wheat, rice, maize and Barley were stored under 4 different systems (kothi, made of mud and rice husk; mora, paddy hey ropes wind into a container, gunny bags and iron bins). *Aspergillus flavus* was the most frequently isolated species and the 536 isolates were screened for aflatoxin production in SMKY medium. A total of 124 isolates were toxigenic, of which

34% isolates from wheat and 23, 13 and 11.5% from paddy, maize and Barley, respectively. The amount of aflatoxin contaminating the stored cereal samples was 430-2830 p.p.b. and the greatest amount was detected in cereals stored in kothi.

Rough Pajam rice was stored at different moisture content (mc.) (13.8, 18.5, 22.22, 25.91 and 29.6%) to investigate the effect of mc. on changes in the rice during storage in small containers in Bangladesh. Open and closed storage conditions were investigated. The parameters studied were viability, changes in mc, a dry matter loss at an interval of 3 weeks for a storage period of 15 weeks. It was found that all samples of grains with higher mc. were only affected by fungi in closed containers, which might be due to the air space (approx. 10%) left inside the top of the containers. The viability of rice in open containers was higher than closed containers for all levels of mc. and was found to be an influential factor in germination. Grain mc. did not vary widely for both types of containers. In closed containers max. dry matter loss was found to be 0.33% at mc. of 29.83%. (Ullah *et al.*, 1990).

Bala *et al.* (1991) described that a Boro crop of rice cv. BR-2 grain was stored in 2 traditional bamboo storage structure berh and dole with or with polyethylene lining. They observed that the polyethylene lining caused little resistance to the flow of heat and slightly less moisture accumulation from the atmosphere; germination capacity and insect were not significantly affected. Temperature was always slightly higher in the berh than in the dole but germination was not affected.

Saha *et al.* (1996) observed in Bangladesh that 56 percent farmers store rice in ‘Dole’, 22 percent in ‘Gola’. 14 percent in earthen pots and only 8 percent in drum. On the other hand, a survey made by Krain (1985) in the district of Gazipur and Tangail and pointed out that 95% of all interviewed farmers preserved at least a part of their harvest for seed purpose. Out of the total number of farmers interviewed 30.6%, 22.4%, 20.4%, 16.3% and 10.3% stored seed in earthen jars, bamboo bins, jute bags, polythene bags and metal drum, respectively.

Sing (2001) made a survey on the storage structures used by the farming community in North Bihar, India. He reported that they owned at least 13 different types of storage structures for storing of their agriculture product. Among all, gunny bags were in maximum (25.78%), however, the farmers use different types of structures at a time. Srivastava *et al.* (1973) made another survey on grain storage in India and reported that food grains are stored in bulk and bags. Four types of traditional storage structures namely kuchikothi (made of unburnt bricks and mud), Puccikothi, Drums and Bag storage were used for storing.

Mia *et al.* (2002) conducted an experiment at BRRI, Gazipur on storage rice seed of four different containers viz. Plastic drum, Motka (Heavy earthen container), Metal drum and Sack with polyethylene lining and tested additives were Ash, Chalk powder, dried neem leaves and Naphthalene, respectively. Among different containers Plastic drum and Painted Motka and some additives were reported to be effective for safe storage of rice seed.

Hosan (2004) conducted an experiment on four containers viz. gunnybag lined with polythene, painted motka, plastic drum and tin with three additives viz. ash, neem leaves and chalk powder on the quality of T-Aman rice CV BR11 seeds stored 0-18 weeks. He reported that tin with 1-inch layer of chalk powder was the best method for storing T-Aman rice seed up to 18 weeks, followed by plastic drum with the same additives.

2.2 Seed Quality

Quality can be defined as “degree or standard of excellence”, so seed quality can be viewed as a standard of excellence in certain characters or attributes that will determine the performance of the seed when sown. Seed quality is therefore, concerned with the behavior of seed as an end-product of plant growth as biological entity in itself and as a determinant of future plant growth (Schwass, 1973). Copeland and McDonald (1995) commented that in practice, the expression 'seed quality is used loosely to reflect the overall value of seed for its intended purpose. It is a blend of complicated physiological, morphological and environmental interactive properties (Hampton, 2002).

Seed quality is a multiple concept comprising several components which have variable relative importance under different sets of circumstances (Thomson, 1979). Components of seed quality can be grouped into three categories:

(i) Description- species and cultivar purity, analytical purity, uniformity; seed weight;

(ii) Hygiene- noxious weed contamination, seed health, storage fungi contamination, insect and mite contamination;

(iii) Potential performance- germination, vigour, moisture content, field emergence and uniformity, and storability (Coolbear and Hill, 1998; Hampton, 1994).

Not all these components are of equal value, nor their order of relative importance the same in all circumstances (Thomson, 1979).

It is self-evident that, the quality of seeds has a profound influence on the economic production of crops of all species. Seed quality affects crop establishment, growth and yield (Finch, 1995). In many modern crop production systems, seed of high quality that will consistently produce rapid and uniform seedling emergence from each seed is required (Pill, 1995). Many growers have the skills to produce seed which meet purity, health and germination standards, few know how to produce seed lots which provide rapid and uniform emergence under a wide range of conditions (i.e. high vigour seed). While there have been reports or the effects of both agronomic and environmental influences on seed vigour (Dornbos, 1995). The question how this quality seed is produced' cannot yet be answered. We still do not know enough about how seed production practices and the environment interact to affect the physiological processes that determine seed vigour (Hampton, 2000). The subject of seed vigour is complex and one that presents many challenges of seed technology and seed physiology. A greater understanding of this important seed quality component is required in order to better meet the seed quality requirements for modern crop production (Hampton, 2002).

The vigour of seeds at the time of storage is an important factor that affects their storage life. Vigour and viability cannot always be differentiated in storage environments, especially in seed lots that are rapidly deteriorating. Irrespective of this problem, several workers have demonstrated that seed lots that were rapidly declining contained some seeds low in vigour and other seeds that still might be vigorous. This progressive weakening with age continued until all the seeds became nonviable (Justice and Bass, 1978).

2.3 Seed quality tests

Germination is defined as the emergence and development from the seed embryo of those essential structures which for the seed in question indicate the seed's ability to produce normal plants under favourable condition in soil. Laboratory conditions must therefore, not only initiate the seeds growth but must also favour seedling development in a limited time to a stage in which all essential structures can be fully evaluated. Germination is expressed as a percentage of pure seed number that produces normal seedlings under optimal conditions (ISTA, 2006). Germination test is an integral component of seed quality assessment. A test on the germination capacity of seed lot provides reliable information with respect to the field planting value, as a germination test correlates positively with emergence under field conditions. Under controlled optimum conditions it gives most regular, rapid and complete germination for most samples and increases the reproducibility and uniformity of results (ISTA, 2006).

Dornbos (1994) defined seed viability as the capacity of the seed to germinate and produce a normal seedling. Germination capacity is the most practical indicator of seed viability and vigour. The seeds having low vigour values cannot germinate well under adverse field condition. The vigor of seeds at the time of storage is an important factor that affects their storage life. Vigour and viability cannot always be differentiated in storage environments, especially in seed lots that are rapidly deteriorating. This progressive weakening with age continues until all the seeds became nonviable (Anuja and Aneja, 2004). Zhang *et al.* (2005) opined that seed vigor will decline to low levels prior to planting, even for seeds lot with acceptable germination. Low vigour seed may result in poor field stands, especially if planted in less than ideal field conditions. Khandakar and Bradbeer (1983) reported a wide gap between laboratory test and field germination. Decline in vigour and death of seeds can be considered from two aspects:

(i) Loss of viability or death of a seed lot, i.e. a small or large quantity of seed or

(ii) Death of an individual seed.

The germination percentage of a seed lot is the proportion of individual seed capable of producing normal plants. For this reason the decline in vigour and eventual death of an individual seed should be considered (Justice and Bass, 1978).

For modelling the effects of unfavourable conditions on the field performance of seeds, a number of laboratory seed vigour tests have been developed. Among these, cold test, accelerated ageing test, conductivity test etc. are very-effective and are recommended for specific seed species (Abbu and Lovato, 1999; ISTA, 2006). Vigour information has been used as a marketing strategy for cereals in the UK and US (Dornbos, 1995). Hampton and Coolbear (1990) and Hampton (2000) gave due emphasis on vigour test information as a seed marketing tool.

The conductivity test provides a measurement of electrolyte leakage from plant tissues and was first recognized for seeds of several crop species by Hibbard and Miller (1928). It has been used for seeds of many species including large seeded legumes, onion, cabbage, cotton, tomato, ryegrass, wheat, maize etc. Conductivity measurement of the soak water in which a bulk sample (25-50 seeds) has been steeped identities seed lots that have high laboratory germination but poor field emergence potential. Such seed lots have high electrolyte leakage and are classified as low vigour while those with low leakage are considered high vigour (Justice and Bass, 1978). The integrity of cell membranes determined by deteriorative biochemical changes and for physical disruption can be considered the fundamental cause of differences in seed vigour which are indirectly determined as electrolyte to leakage during the conductivity test (Powell, 1998). Leaching of some compounds, particularly electrolytes, has often been associated with seed quality (Anuja and Aneja, 2004). As a seed rehydrates during early imbibitions, the ability of its cellular membranes to reorganize and repair any damage that may have occurred, will influence the extent of electrolyte leakage from the seed. The higher is the speed of re-establishing membrane integrity; the lower is the electrolyte leakage. High vigour seeds are able to reorganize their membranes more rapidly, and repair any damage to a greater extent, than low vigour seeds. Consequently, electrolyte leakage measured from high vigour seed is less than that measured from low vigour seed (ISTA, 2006). The conductivity test has the tremendous advantage of simplicity and rapidity, and meets most of the requirements for a good vigour test (Hampton and Coolbear, 1990).

2.4 Moisture content and seed quality

The moisture content of seeds during storage is no doubt the most influential factor affecting their longevity. It is important to harvest mature, relatively dry seeds or to reduce the moisture content of high moisture seed soon after harvest

(Justice and Bass, 1978). Bass (1953) found that the loss of viability of freshly harvested Kentucky bluegrass seed was correlated with the moisture content of the seed and length held at a given temperature. High seed moisture content is known to be detrimental to seed storage of many species (Ellis *et al.*, 1982). Khandakar (1983) found that the higher is the seed moisture content; the lower is the seed longevity. Heydeeker (1972) and Harrington (1972) also reported that seed deterioration increased as moisture content increased which resulted in loss of viability and poor germination.

Huda (1992) observed that higher moisture content was negatively correlated with germination percentage and positively with insect infestation. In an experiment, pea seeds with high viability and high moisture content, high viability and low moisture content, low viability and high moisture content or low viability and low moisture content were soaked in distilled water for 1, 2, 4, 8 or 12 hrs or not soaked. Low viability seeds lost viability more rapidly daring soaking than high viability seeds at both high moisture and low moisture. High viability low moisture seeds lost viability more rapidly than high moisture seeds (Sivritepe and Dourado, 1995). Fifty seed samples of different rice varieties stored in warehouses for varying periods were tested and significant correlations were found among the numbers of fungi, storage period and germinability. Significant relationships were also found between the fungi and moisture content, normal seedlings, abnormal seedlings, speed of germination and conductance of leachates (Misra *et al.*, 1995). Higher seed moisture content resulted in greater colonization by storage fungi and lower percentage seed germination (Ray, 1998). In an experiment on groundnut, Patra *et al.* (2000) found that with increase in storage period, viability of seeds decreased while pathogen activities, moisture content and sugar content in seeds increased gradually.

Rathi *et al*. (2000) found that increased moisture content caused seals to respire at faster rate and decreased the germination. In an experiment, Vietra *et al*. (2001) observed that storing of high moisture seeds at 5°C slightly extended the storage life, however viability loss was observed within one year. Extending the storability of seed by storing under reduced moisture content was reported in onion, tomato and carrot (Padma and Reddy, 2004), but they found that reducing the seed moisture beyond a critical level had not improved the storability of seed. In an investigation by Nakayama *et al*. (2004) dry seeds of nine soybean cultivars were soaked in water for 48 hrs and the effects of soaking (flooding stress) on the plant growth were studied in relation to initial seed moisture content. Both seedling mergence and subsequent growth were suppressed by soaking. Sensitivity to flooding stress was greatly influenced by the initial seed moisture content. Soaking of 6.5% moisture content seeds in water resulted in a marked reduction in dry matter accumulation in emerged seedlings from 0.5 to 54% of that in the non-soaked control. However, seeds with high moisture content were less sensitive to flooding. In the seeds contain 14.5% moisture and soaked in water, the dry matter accumulation in the emerged seedlings was 65 to 97% of that in the non-soaked control. The protective effect of increasing the initial seed moisture on flooding stress was observed in all cultivars although the effect varied with the cultivar. Storability of vegetable seeds could be extended by reducing seed moisture content before storage (Padma and Reddy, 2004).

2.5 Storage conditions and seed quality

Considerable research has been published on the effect of storage conditions on the viability of seeds of a range of species including legumes, vegetables and cereals. Although many factors are known to influence the storability of seeds, it is generally accepted that storability may be improved by controlling the storage environment (Lewis *et al*. 1998). Harrington (1972) his so called ‘Thumb Rules’, which relates seed moisture and temperature to the seeds lifespan. This rules states that the life of the seed is halved (1) for each 5^{o} increase in seed storage temperature (range 0-50^{o}C) and (2) for each 1% increase in seed moisture content. (Range 5-14%). These two rules apply independently, and the effects of temperature and moisture are additive. It is to be noted that this procedure gives approximate results (Roberts, 1972).

Safe storage conditions were defined as those which maintain seed quality without loss of vigour for three years. Delaniche *et al*. (1973) observed that such safe conditions are indeed favourable, but not always economically justified as they do not naturally occur except for small, quantities of genetically valuable seed or very costly seed of vegetables, ornamental or forest species (Abbu and Lovato, 1999). Canode (1972) found that the length of time that grass seed might be stored without serious reduction in germination depends on the species and storage condition.

Justice and Bass (1978) showed that within limits the storage life of seed vegetables, flowers and field crops decreased as the temperature increased. On the contrary, Gras and Bason (1990) opined that controlled atmosphere storage might have minor effects on the germination and physico-chemical properties of rice, maize, wheat and barley. In a study on rice Mazen *et al*. (1993) found that at all levels of moisture content, germination capacity of the grain decreased with increase in storage period, the rate of decrease being enhanced with rise in relative humidity. Complete mortality was recorded at 92% relative humidity alter 4 months and at 100% relative humidity after 3 months, when the moisture content of the paddy grain rose to 21.6 and 22.6, respectively. The total count of seed borne fungi increased with increase in moisture content and storage period, with highest estimates at 92 and 100% relative humidity after 3 and 4 months, respectively.

In an experiment conducted by Jian *et al*. (1998) the relationship between seed moisture content, relative humidity and temperature was studied and cucumber, lettuce, maize, onion, pea and watermelon seeds were equilibrated and best-fit subset models were selected. All models indicated that seed moisture content increased as relative humidity increased and decreased as temperature increased; but relative humidity had the greater influence. The inverse relationship between seed moisture content and temperature, although slight, was evident in the response surfaces. These results suggest that orthodox seed species respond similarly to temperature and relative humidity. Lewis *et al*. (1998) found that germination of the seed stored in a place where there was no control of temperature and humidity (granary) declined rapidly compared to the seed store. Seed stored in the granary also had the highest moisture content and the lowest vigour.

Studies on the development of the seed mycroflora of 10 varieties of rice revealed a gradual decrease in field fungi and an immediate increase in storage fungi when seeds were stored for up to 180 days. Storage temperature played a significant role in the development of seed mycroflora during storage, the minimum fungal development occurring at 40^o and 15^{o}C and the maximum art 20-30^{o}C (Ray, 1998). In stored seeds of chickpea, most of the fungi suppressed seed germination considerably when stored at 90% relative humidity (Prasad and Prasad, 1998).

According to Padilla and Reddy (2004), loss of vigour and viability during storage is rapid in most of the vegetable seeds in subtropics largely due to the prevailing high temperatures .and relative humidity. Temperature above 35^{o}C was reported to cause rapid deterioration of soybean seed (Abuja and Aneja, 2004). Relative humidity had a greater influence on longevity of seed because seed moisture content is directly related to the RH of the atmosphere (Padma and Reddy, 2004).

2.6 Storage condition, seed moisture and seed quality

It is generally accepted that the water content and temperature at which seeds are stored are the most important factors affecting seed longevity. However, the effects of extremely low water content on seed longevity and the possible interaction of water content and temperature are disputed (Ellis *et al.*, 1995; Hong and Ellis 1996; Vertucci and Roos, 1993; Vertucci *et al.*, 1994). They mentioned that the water content achieved by equilibrating seeds at 20^{o}C and 10-13% relative humidity is critical to seed longevity. At water contents above the critical value, seed longevity is a function of log water content. At water contents less than the critical value, seed longevity is unaffected by water content i.e. there is no benefit or detriment to drying. On the other hand, it might be a detrimental effect of drying seeds to low water contents (Vertucci and Roos, 1990) and it is suggested that there was optimum water content for storage. Based on their experiments at 35°C, they suggested that this optimum corresponded to the relative humidity between 19 and 27% at the storage temperature. Nkang and Urnoli (1996) observed that germinability of soybean cultivars differed significantly after six months of storage due to different temperatures and relative humilities.

There was an optimum relative humidity for storage and the optimum water content for storage changes as a function of temperature (Vertucci and Roos, 1993; Vertucci *et al.*, 1994). Because water content at a given relative humidity increases as temperature decreases, these authors again proposed that the optimum water content for seed would increase as the storage temperature was lowered. The critical water content might change with storage temperature, but they felt that it would be a minor effect (Ellis *et al.*, 1989). However, in storing lettuce and sunflower at temperatures between 35 and 65^{o}C showed no evidence of a temperature effect (Ellis *et al.*, 1995). In grasses, the importance of temperature and humidity within the store and seed moisture content at the beginning or store has been identified (Lewis *et al*., 1998).

In general, seed viability and vigour are reduced as temperature is increased as time of exposure to high temperature is increased, and as moisture content of the seed is increased. Damage is diminished at a given temperature as the seed moisture content is decreased (Justice and Bass, 1978). Han *et al.* (1995) observed that germination rates of rice seed dried to 15% moisture content and stored under aerated and non-aerated conditions in cooling aeration tank were 75 and 95%, respectively. Several authors have demonstrated that safe. storage-conditions for a short term period i.e., from harvest to the next planting season (1-9 months) are those in which the seed equilibrium moisture is less than 14%

for cereal seeds and 11% for oil seeds (Harrington, 1972) or, more properly, range from 12% to 13% and from 8% to 9.5%, respectively. This means a seed moisture in equilibrium with 50% relative humidity and 30°C or 60% relative humidity at 20^{o}C (Delaniche *et al.*, 1973).

2.7 Accelerated aging and seed quality

Delouche and Baskin (1973) developed accelerated aging test procedure to measure seed storability and evaluate vigor. The technique involved the exposure of seeds to adverse levels of temperature (40-45ºC) and 100% R.H. for varying length of time followed by regular germination test. The seeds absorbed moisture from the humid atmosphere and aged rapidly due to high temperature. The basis for this test is that higher vigor seeds tolerate the high temperature-high humidity treatment and thus retain their capability to produce normal seedlings in the germination test. Accelerated aging test has been suggested and recommended in many crops such as wheat, sorghum, corn, beans, soybean, onion, radish and lettuce (AOSA, 1983; ISTA, 1995). Several studies in seeds of french bean (Pandey, 1989), wheat (Bhattacharyya *et al.*, 1985), rice (Krisnasamy and Seshu, 1990, Ali *et al.*, 2003), cotton (Basra *et al.*, 2003), carrot (Al-Maskri *et al.*, 2003), aubergine, cucumber and melon (Demir *et al.*, 2004), beet root (Silva *et al.*, 2006), kale (Komba *et al.*, 2006), soybean (Torres *et al.*, 2004), radish (Jain *et al.*, 2006) have also proved that accelerated aging test could be successfully used as seed vigour test.

Few researchers have been conducted in accelerated aging test as rice seed vigour test and there are no suggested or recommended accelerated aging test variables available in the handbook on vigour testing from the ISTA (1995) or the AOSA (1983). Patin and Gutormson (2009) studied 10 rice seed lots to examine possible vigour tests for rice seeds. They evaluated several seed vigor tests such as and germination, cold germination, cool germination, accelerated aging and conductivity test in rice seeds. Based on their finding, it was concluded that cold test and accelerated aging test might be suitable in evaluating vigour in rice seeds. Similarly, Chea (2006) evaluated several vigour tests such as seedling growth rate, seedling growth test, osmotic stress test, accelerated aging at 41ºC for 84 hrs and conductivity test and their use in predicting field emergence in 2 rice varieties (KDML105 and RD6) of Thailand. He observed that accelerated aging, conductivity test, seedling growth test and standard germination test could be used in predicting field emergence of rice seeds but the accuracy was strongly dependent on field environment and cultural practices.

CHAPTER III

MATERIALS AND METHODS

This chapter presents a brief description about experimental period, site description, climatic condition, crop or planting materials, treatments, experimental design and layout, experimental procedure, data collection and statistical analysis. The details of experiments and methods are described below:

3.1 Experimental period

The experiment was carried out during the period January'2014 to July'2014 considering the T. Aman storage period at the farmer's level.

3.2 Experimental place

The experiment was carried out in the Seed Testing Laboratory, Beej Bhaban, BADC, Gabtali, Dhak-1216 during the period of January, 2014 to July, 2014.

3.3 Climate of the experimental place

The experiment was carried out during the month of January, 2014 to July, 2014. During this period the climate was mainly characterized by a tropical monsoon. January was the coolest month and May was the warmest. January to April was the driest period and rainfall typically occurs in the monsoon period during May to July. The minimum rainfall was 44 mm during January to April and maximum was 1433 mm during May to July, the temperature ranges minimum 13.9^{0}C in January and maximum 32.6^{0}C in the June, the average temperature in January was about 19^{0}C, and the average temperature in May was about 29^{0}C. The relative humidity ranges 73-86% during January to April and the relative humidity usually remains low prevailing dry weather and it was humid during the months of May to July and ranges from 75-90%. No devastating natural calamities like cyclone, flood and drought occur during period of experiment (Appendix I).

3.4 Collection and analysis of seed samples

A total about 500 kg seeds of 5 T. Aman rice varieties *viz*- Binadhan7, BRRI dhan33, BRRI dhan34, BRRI dhan51 and BRRI dhan52 were collected from Seed Multiplication Farm of BADC, Tebunia, Pabna.

3.5 Collection of storage container

Four types of storage containers were collected as follows: plastic drum, steel drum, polythene in gunny bag (Pgb) and gunny bag.

3.6 Experimental Design

The two factors experiment was laid out following Complete Randomized Design (CRD) with four replications.

3.7 Preservation of seeds

The selected containers were filled with the collected seeds as per treatment and stored in the Agronomy Lab. in SAU campus. Amount of seed used per treatment was about 20 kg per container.

3.8 Description of the factors and the treatments

Two factors in the experiment were as:

Factor ‘A’: the five rice varieties like-

i) Binadhan-7
ii) BRRI dhan33
iii) BRRI dhan34
iv) BRRI dhan51
v) BRRI dhan52

Factor 'B': the four storage containers like-

i) Plastic drum
ii) Steel drum
iii) Polythene in gunny bag
iv) Gunny bag

Total treatments of the experiment were as follows:

T_1 = Binadhan-7 × Plastic drum
T_2 = Binadhan-7 × Steel drum
T_3 = Binadhan-7 × Polythene in gunny bag
T_4 = Binadhan-7 × Gunny bag
T_5 = BRRI dhan33 × Plastic drum
T_6 = BRRI dhan33 × Steel drum
T_7 = BRRI dhan33 × Polythene in gunny bag
T_8 = BRRI dhan33 × Gunny bag
T_9 = BRRI dhan34 × Plastic drum
T_{10} = BRRI dhan34 × Steel drum
T_{11} = BRRI dhan34 × Polythene in gunny bag
T_{12} = BRRI dhan34 × Gunny bag
T_{13} = BRRI dhan51 × Plastic drum
T_{14} = BRRI dhan51 × Steel drum
T_{15} = BRRI dhan51 × Polythene in gunny bag
T_{16} = BRRI dhan51 × Gunny bag
T_{17} = BRRI dhan52 × Plastic drum
T_{18} = BRRI dhan52 × Steel drum
T_{19} = BRRI dhan52 × Polythene in gunny bag
T_{20} = BRRI dhan52 × Gunny bag

Each treatment was replicated four times. The lids of the plastic drum and the steel drum were placed firmly as far as possible. The other containers, Polythene in gunny bag and gunny bag were tied firmly as far as possible. All these containers with seed were placed on a raised platform. The store-house was fully ventilated.

3.9 Data collection

3.9.1 Moisture determination

Seeds were tested for Moisture content in each month without delay after taking sample. The determination of mc. was carried out from the working sample of about 4 to 5g in weight. Fine grinding was done on the sub-samples before drawing the working sample. High constant temperature oven method was employed. The oven was maintained at 130 to133°C ± 1 and sample was dried for 2 hours. The moisture content was calculated as a percentage by weight means of the following formula (ISTA, 2006):

$$Moisture\ content\ (\%) = \frac{(M_2 - M_3)}{(M_2 - M_1)} \times 100$$

Where, M_1= weight of container

M_2= weight of container + seed before drying

M_3= weight of container + cover + seed after drying.

3.9.2 Germination test

Seed were tested for germination capacity in each month. From each sample, four replicates of one hundred seeds were counted at random from well mixed pure seed fraction. Seeds were spaced uniformly and adequately apart on two layers of moist filter paper substrate in 21 cm and I5.5 cm transparent germination trays. Germination trays were kept in a walk-in germinator maintained at 20°C for 16 hours in dark and 30^{o}C for 8 hours with light, for a total period of 14 days. Then each and every seedling was evaluated separately with reference laid down in ISTA (2006) rules. Classification was made as normal seedlings, abnormal seedlings, decomposed seeds and hard seeds. Germination percentage was calculated as:

$$Germination\ (\%) = \frac{No.of\ seeds\ germinated}{No.of\ seeds\ placed} \times 100$$

Maximum tolerated range for four replicates was consulted. The experiment was conducted on top of paper for ease so that germinating seeds and seedling structures could be observed easily.

3.9.3 Accelerated aging test

Four replications of 50 seeds of each seed lot were placed one layer deep in wire mesh baskets (8 cm in diameter and 9 cm in length including legs which the legs are 3.5 cm in height), One hundred twenty ml of water was then added to the plastic box (10 cm in diameter and 10.5 cm in height). To prevent the dropping of condensed vapour from the lid into the seeds, one piece of blotter paper of circular shape was placed on each basket. The accelerated aging test functions by exposing seeds to the most important environmental conditions which influence seed deterioration; high temperatures (40 to 45ºC) and high relative humidity (greater than 90%) for short periods of time (48 hrs or longer depending on the species). Under these extreme conditions, the rate of deterioration is greatly enhanced (AOSA, 1983).

3.9.4 Speed of germination

Speed of germination is an important vigour aspect because it provides a reasonably good index of vigour. A faster germination rate will facilitate early seedling establishment, a clear advantage under direct sown rice culture (Seshu *et al.*, 1987). Seed lots with similar total germination often vary in their rate of germination and growth. Unlike in standard germination test, the normal seedlings are evaluated on daily basis starting from first count till the final count and calculated as follows:

$$Speed\ of\ germination =$$
$$\frac{Number\ of\ normal\ seedlings}{Days\ of\ first\ count} + \ldots\ldots + \frac{Number\ of\ normal\ seedlings}{Days\ of\ last\ count}$$

3.9.5 Electrical conductivity measurement

Seeds were tested for electrical conductivity in each Month. Four replicates each of 50 gm from each sample. They were weighed and placed into 100 ml glass bottles containing 50 ml de-ionized water. Each bottle was gently swirled to ensure complete immersion of all seeds and was covered with aluminium foil and then kept at 20°C for 24 hours. A control bottle containing only de-ionized water was included to monitor water quality. At the end of 24-hour soak period, the bottles were swirled, the aluminium foil removed and the conductivity was determined by immersing a dip-type EC meter cell (model-HI 8820 N) into the seed steep water solution with due care to avoid direct placement of the cell on the seed. After testing the sample, the dip-cell was rinsed twice using de-ionized water prior to testing the next sample. The electrical conductivity value of the control flask of de-ionized water was subtracted from the reading recorded for each flask (ISTA, 1995). The conductivity per gram of seed weight for each sub-sample was calculated as:

$$Electrical\ conductivity\ (\mu S\ cm^{-1}\ g^{-1}) = \frac{Conductivity\ of\ each\ task}{Weight\ of\ seed\ sample\ (g)}$$

3.9.6 Seedling length

Randomly selected 10 seedlings were taken from each petridish to measure root and shoot length. It was measured with a measuring scale and expressed in centimetres. Root and shoot length of the seedlings were measured after 17 days of seed setting (ISTA, 1995).

$$Seedling\ length\ (cm) = Root\ length + Shoot\ length$$

3.10 Statistical analysis

The data obtained for different characters were statistically analyzed to observe the significant difference among the treatment by using the MSTAT-C computer package program. The mean values of all the characters were calculated and analysis of variance was performed. The significance of the difference among the treatments means was estimated by the Least Significant Difference (LSD) at 5% level of probability (Gomez and Gomez, 1984).

CHAPTER IV

RESULTS AND DISCUSSION

The experiment was conducted to find out the suitable devices in context to the locally available varieties for the storage of T. Aman seeds at farmers level. The results have been presented and discussed with the help of table and graphs and possible interpretations given under the following headings.

4.1 Moisture (%)

4.1.1 Effect of variety

Moisture (%) of T. Aman seeds was significantly influenced by different T. Aman varieties at different months after preservation (Figure 1). BRRI dhan34 showed the highest percentage of moisture. On the other hand, Binadhan-7 showed the lowest percentage of moisture. The figure showed that moisture (%) gradually decreased from January to April and then gradual increases from the month of May to July for all the varieties under study. In case of different month, the highest moisture (%) was recorded from the month of July, whereas, the lowest moisture (%) was recorded from the month of April for all the varieties.

4.1.2 Effect of storage device

Moisture (%) of different T. Aman varieties was significantly influenced by different storage devices at different months after preservation under the present study (Figure 2). Gunny bag retained the highest moisture (%) of T. Aman seed at different months after preservation among the storage devices. In comparison, plastic drum retained the lowest percentage of moisture among the storage devices. Moisture (%) of seeds of different T. Aman varieties gradually increased from April to July for all the storage devices. There was no significant difference in moisture (%) of T. Aman seeds in the month of

January and February. Moisture (%) gradually increased for all the storage devices from May to July. In case of different months, the highest moisture (%) was recorded from the month of July, whereas, the lowest moisture (%) was recorded from the month of April irrespective of storage devices.

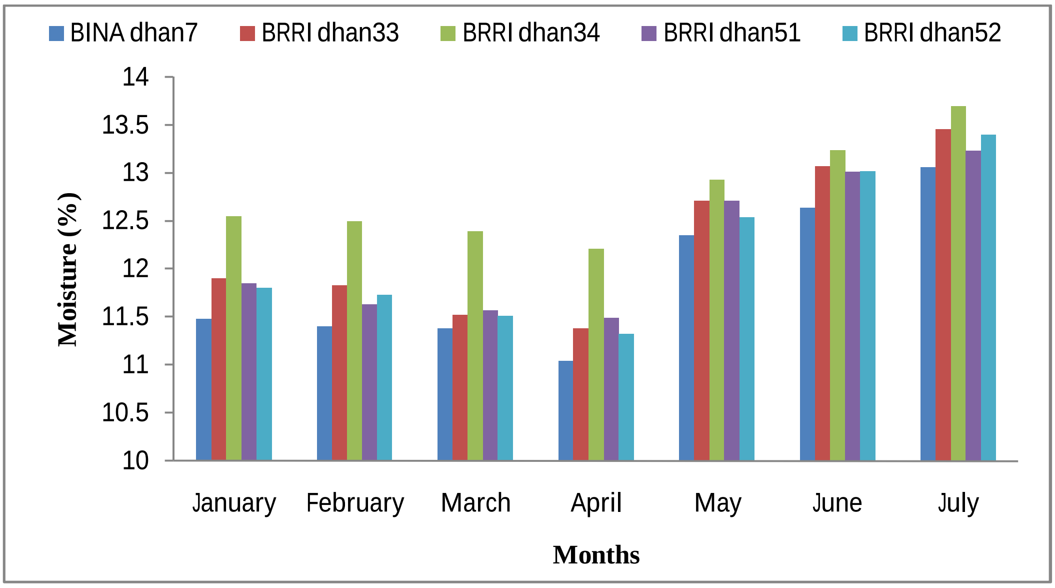

Figure 1. Effect of variety on moisture (%) of T. Aman rice seed at different months after preservation (LSD value = 0.19, 0.17, 0.10, 0.10, 0.13, 0.13 and 0.15 at January, February, March, April, May, June and July, respectively)

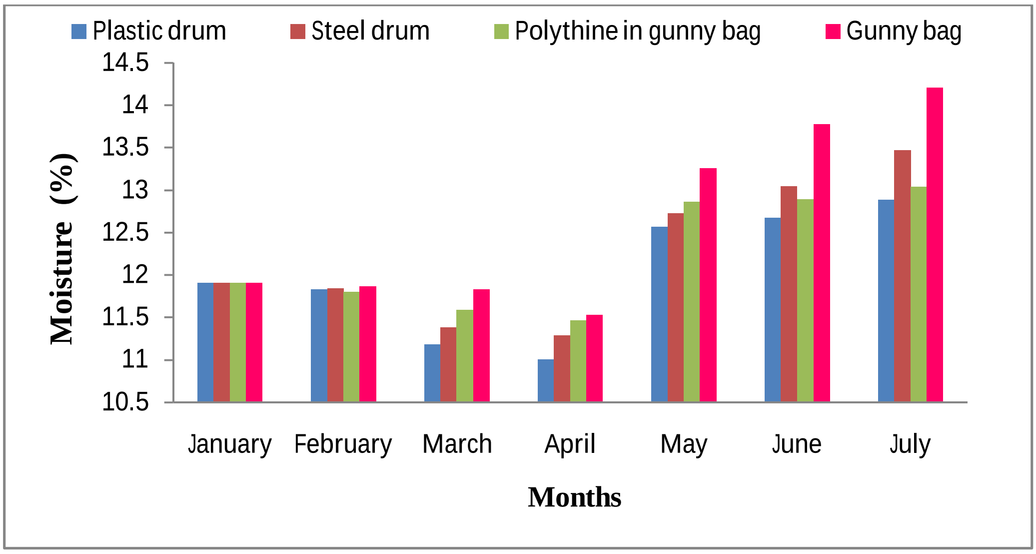

Figure 2. Effect of storage device on moisture (%) of T. Aman rice seed at different months after preservation (LSD value =NS, NS, 0.17, 0.09, 0.12, 0.12 and 0.13 at January, February, March, April, May, June and July, respectively)

Table 1. Interaction effect of variety and storage device on moisture (%) of T. Aman rice seeds at different months after preservation

Variety × Device	Moisture (%) at						
	January	February	March	April	May	June	July
Binadhan-7							
× Plastic drum	11.08 c	10.89 j	10.77 g	10.65 l	11.30 l	11.88 i	12.05 k
× Steel drum	11.08 c	10.99 i	10.97 f	10.88 k	11.70 jk	13.52 b	13.88 c
× Poly. in g.bag	11.08 c	11.00 h	10.93 f	10.80 k	11.60 k	12.48 h	12.48 j
× Gunny bag	11.08 c	11.07 g	11.00 f	10.98 j	11.78 j	12.70 g	14.08 b
BRRI dhan33							
× Plastic drum	11.50 b	11.22 f	11.12 ef	11.00 ij	13.00 b	13.02 de	13.88 c
× Steel drum	11.50 b	11.37 cd	11.30 c-e	11.23 f	12.63 de	13.02 de	13.50 ef
× Poly. in g.bag	11.50 b	11.40 c	11.35 cd	11.30 ef	12.50 ef	13.20 c	13.35 f
× Gunny bag	11.50 b	11.42 c	11.32 cd	11.30 ef	12.90 bc	13.03 de	14.10 b
BRRI dhan34							
× Plastic drum	12.15 a	12.00 b	11.70 b	11.64 d	12.73 d	12.90 ef	12.95 gh
× Steel drum	12.15 a	12.03 b	11.80 b	11.75 c	12.62 de	12.88 f	12.95 gh
× Poly. in g.bag	12.15 a	12.07 b	11.88 b	11.86 b	12.60 e	12.88 f	12.90 hi
× Gunny bag	12.15 a	12.15 a	12.08 a	12.02 a	13.25 a	13.83 a	14.30 a
BRRI dhan51							
× Plastic drum	11.45 b	11.30 de	11.25 c-e	11.10 gh	12.92 bc	13.50 b	13.60 de
× Steel drum	11.45 b	11.38 c	11.33 cd	11.20 f	13.00 b	13.10 cd	13.63 de
× Poly. in g.bag	11.45 b	11.40 c	11.30 c-e	11.12 gh	12.30 h	13.10 cd	13.38 f
× Gunny bag	11.45 b	11.43 c	11.40 cd	11.34 e	12.20 hi	12.90 ef	14.10 b
BRRI dhan52							
× Plastic drum	11.40 b	11.27 ef	11.20 de	11.08 h-j	12.43 g	12.88 f	13.68 d
× Steel drum	11.40 b	11.32 de	11.22 c-e	11.10 gh	12.80 c	13.52 b	13.40 f
× Poly.in g.bag	11.40 b	11.30 de	11.30 c-e	11.20 f	12.02 i	12.48 h	13.07 g
× Gunny bag	11.40 b	11.36 cd	11.30 c-e	11.25 ef	12.13 i	12.70 g	14.12 b
$LSD_{(0.05)}$	**0.19**	**0.07**	**0.19**	**0.10**	**0.13**	**0.13**	**0.15**
CV (%)	**1.12**	**1.97**	**1.14**	**1.63**	**1.78**	**1.72**	**1.81**

In a column means having similar letter (s) are statistically similar and those having dissimilar letter(s) differ significantly by LSD at 0.05 level of probability.

4.1.3 Interaction effect

4.1.3 Interaction effect of variety and storage device

Interaction effect of variety and storage device had significant influence on moisture (%) of T. Aman seed rice seeds at different months after preservation (Table 1). The highest moisture (%) of T. Aman rice seeds recorded from BRRI dhan34 preserved in gunny bag which were 12.15, 12.15, 12.08, 12.02, 13.25, 13.83 and 14.30 % in January, February, March, April, May, June and

July. On the other hand, the lowest moisture (%) of T. Aman seed at different months after preservation were recorded from Binadhan-7 preserved in plastic drum which were 11.08, 10.89, 10.77, 10.65, 11.30, 11.88 and 12.05 % in January, February, March, April, May, June and July respectively.

4.2 Germination (%)

4.2.1 Effect of variety

Germination (%) of T. Aman rice seed was significantly influenced by different T. Aman varieties at different months after preservation (Figure 3). Binadhan-7 showed the highest percentage of germination at different months after preservation among all the varieties. On the other hand, BRRI dhan51 showed the lowest percentage of germination at different months (except February) after preservation among all the varieties. Germination (%) gradually increased from January to April and then gradual decrease in germination (%) was recorded from the month of May to July for all the varieties. In case of different month, the highest germination (%) was recorded from the month of April, whereas, the lowest germination (%) was recorded from the month of July for all the varieties.

4.2.2 Effect of storage device

Germination (%) of different T. Aman varieties was significantly influenced by different storage devices at different months after preservation (Figure 4). Seeds preserved in plastic drum showed the highest germination (%) in comparison to seeds preserved in other devices. Seeds preserved in gunny bag showed the lowest percentage of germination among all the storage devices. Irrespective of varieties germination (%) gradually increased from January to April for all the storage devices (except gunny bag). In case of gunny bag, germination (%) increased gradually from January to March. In the month of May, germination (%) increased up to some extent for gunny bag from April. From the month of May, germination (%) gradually decreased for all the storage devices and it continued up to July. In case of different months, the highest germination (%) was recorded from the month of April, whereas, the lowest germination (%) was recorded from the month of July for all the storage devices.

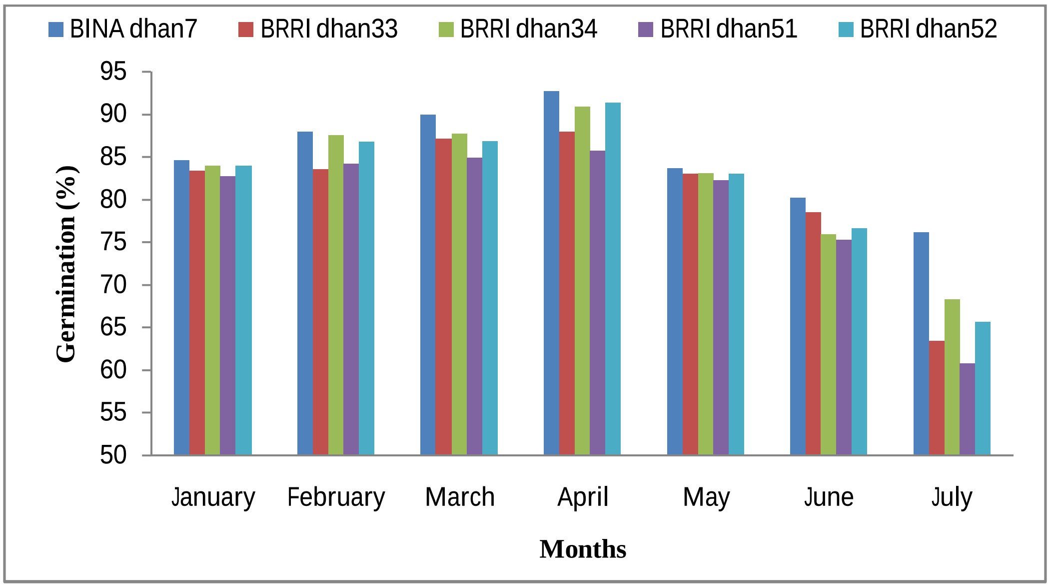

Figure3. Effect of variety on germination (%) of T. Aman seeds at different months after preservation (LSD value = 0.50, 0.62, 0.48, 0.33, 0.33, 0.61 and 0.57 at January, February, March, April, May, June and July, respectively)

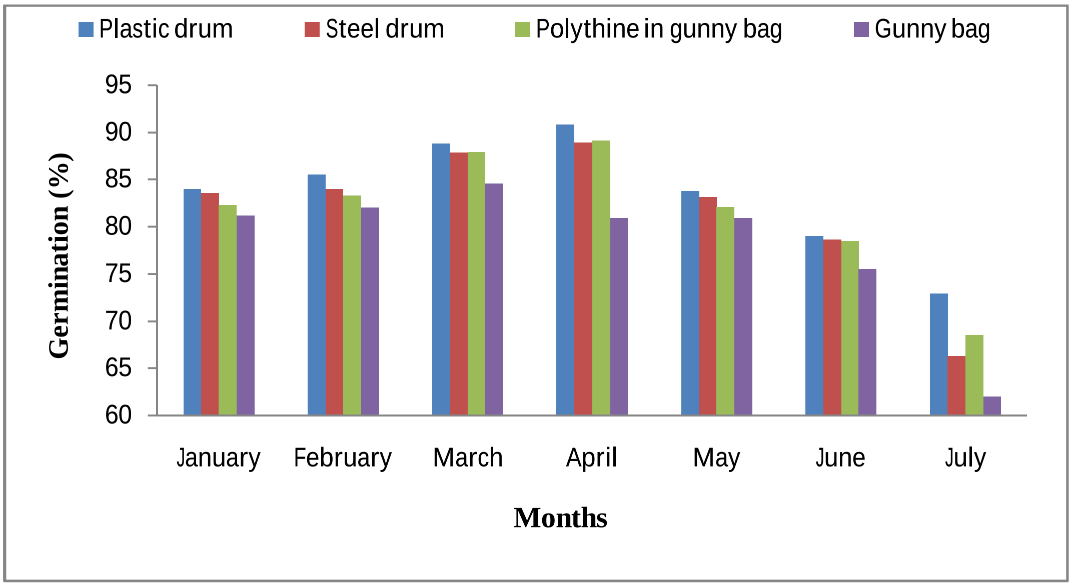

Figure 4. Effect of storage device on germination (%) of T. Aman seed at different months after preservation (LSD value = 0.29, 0.69, 0.45, 0.55, 0.43, 0.54 and 0.51 at January, February, March, April, May, June and July, respectively)

Table 2. Interaction effect of variety and storage device on germination (%) of T. Aman seed at different months after preservation

Treatment combination	Germination (%) at						
	January	**February**	**March**	**April**	**May**	**June**	**July**
Binadhan-7							
× Plastic drum	90.25 a	91.75 a	94.25 a	95.00 a	87.25 a	83.00 a	73.00 a
× Steel drum	88.67 b	89.00 b	93.00 b	94.00 b	85.75 b	81.25 b	72.75 b
× Pol. in g.bag	88.00 c	88.75 bc	89.95 c	93.00 c	84.00 d	80.75 b	68.00 c
× Gunny bag	87.95 c	88.75 bc	89.50 c	92.75 c	84.00 d	78.50 c	63.75 g
BRRI dhan33							
× Plastic drum	86.75 e	87.75 d	88.00 e	89.00 g	85.25 c	72.25 jk	68.00 c
× Steel drum	85.75 f	86.25 e	87.00 f	88.00 h	83.25 e	73.50 gh	67.00 d
× Poly. in g.bag	84.50 h	85.00 g	85.25 hi	88.00 h	81.75 g	76.25 d	66.50 e
× Gunny bag	84.25 h	85.00 g	86.00 g	87.00 i	81.25 h	71.00 mn	61.25 j
BRRI dhan34							
× Plastic drum	87.20 d	87.75 d	88.00 e	89.00 g	82.00 g	74.00 fg	66.00 ef
× Steel drum	84.00 h	84.25 h	85.00 i	88.00 h	81.00 h	74.25 f	62.25 i
× Poly. in g.bag	85.25 g	86.00 ef	87.00 f	88.00 h	81.25 h	76.00 e	61.25 j
× Gunny bag	84.25 h	85.50 fg	85.50 h	87.25 i	80.00 i	71.75 kl	60.25 k
BRRI dhan51							
× Plastic drum	81.25 j	83.75 hi	85.00 i	87.00 i	77.56 k	71.25 lm	57.50 l
× Steel drum	79.25 k	81.75 ij	84.00 j	86.00 j	75.37 l	70.50 n	53.25 m
× Poly. in g.bag	79.00 k	81.00 j	83.00 k	85.15 k	74.75 m	68.50 o	49.25 n
× Gunny bag	78.25 l	80.25 k	82.25 l	84.75 l	73.75 n	66.50 p	40.75 o
BRRI dhan52							
× Plastic drum	87.00 d	88.25 cd	89.75 bc	91.00 d	84.00 d	76.00 hi	65.75 f
× Steel drum	86.70 e	88.25 cd	89.50 c	90.00 f	82.75 f	71.00 mn	66.00 ef
× Poly. in g.bag	84.36 h	85.50 fg	89.00 d	90.00 f	81.25 h	73.00 hi	63.00 h
× Gunny bag	83.00 i	85.25 g	88.00 e	90.50 e	79.00 j	72.75 ij	53.50 m
$LSD_{(0.05)}$	**0.50**	**0.73**	**0.48**	**0.33**	**0.40**	**0.61**	**0.57**
CV (%)	**1.43**	**1.54**	**1.39**	**1.26**	**1.60**	**1.52**	**1.60**

In a column means having similar letter (s) are statistically similar and those having dissimilar letter(s) differ significantly by LSD at 0.05 level of probability.

4.2.3 Interaction effect of variety and storage device

Interaction effect of variety and storage device had significant influence on germination (%) of T. Aman seeds at different months after preservation (Table 2). The highest germination (%) was recorded from Binadhan-7 preserved in plastic drum which were 90.25, 91.75, 94.25, 95.00, 87.25, 83.00 and 73.00% in January, February, March, April, May, June and in July, respectively. On the other hand, the lowest germination (%) of T. Aman seed at different months after preservation were recorded from BRRI dhan51 preserved in gunny bag which were 78.25, 80.25, 82.25, 84.75, 73.75, 66.50 and 40.75% in January, February, March, April, May, June and July, respectively.

4.3 Germination (%) after accelerated ageing test

4.3.1 Effect of variety

Germination (%) of T. Aman seed was significantly influenced by different T. Aman varieties after accelerated ageing test at different months after preservation (Figure 5). BRRI dhan34 showed the highest percentage of germination after accelerated ageing test among the varieties. On the other hand, Binadhan7 showed the lowest percentage of germination after accelerated ageing test. Germination (%) of T. Aman seeds after accelerated ageing test gradually decreased from January to March and then gradual increase in germination (%) was recorded from the month of April to May. From the month of June, germination (%) after accelerated ageing test gradually decreased irrespective of varieties and it continued up to July. The highest germination (%) after accelerated ageing test was recorded in the month of January to May, whereas, the lowest was recorded in the month of July for all the varieties.

4.3.2 Effect of storage device

Germination (%) of different T. Aman varieties after accelerated ageing test was significantly influenced by different storage devices at different months after preservation (Figure 6). Seeds preserved in steel drum showed the highest germination (%) to that of gunny bag showed the lowest percentage of germination among the storage devices. Germination (%) of different T. Aman variety seed after accelerated ageing test gradually decreased from January to March for all the storage devices. In the month of January, there was no significant difference in germination (%) among the storage devices. From the month of April, germination (%) after accelerated ageing test gradually increased for all the storage devices and it continued up to May when it was recorded the highest value. From the month of June, germination (%) again decreased for all the storage devices and the decrease continued up to July when it was recorded the lowest. In case of different month, the highest germination (%) was recorded from the month of January and May, whereas, the lowest germination (%) was recorded from the month of July for all the storage devices.

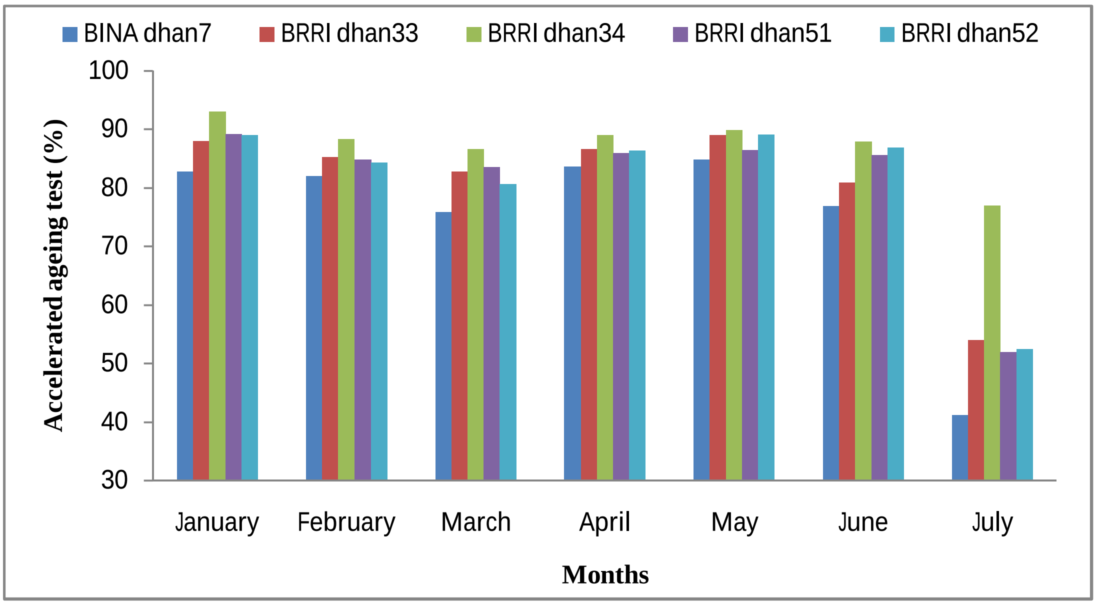

Figure 5. Effect of variety on germination (%) of T. Aman seeds after accelerated ageing test at different months after preservation (LSD value = 0.31, 0.52, 0.72, 1.74, 0.42, 0.65 and 0.60 at January, February, March, April, May, June and July, respectively)

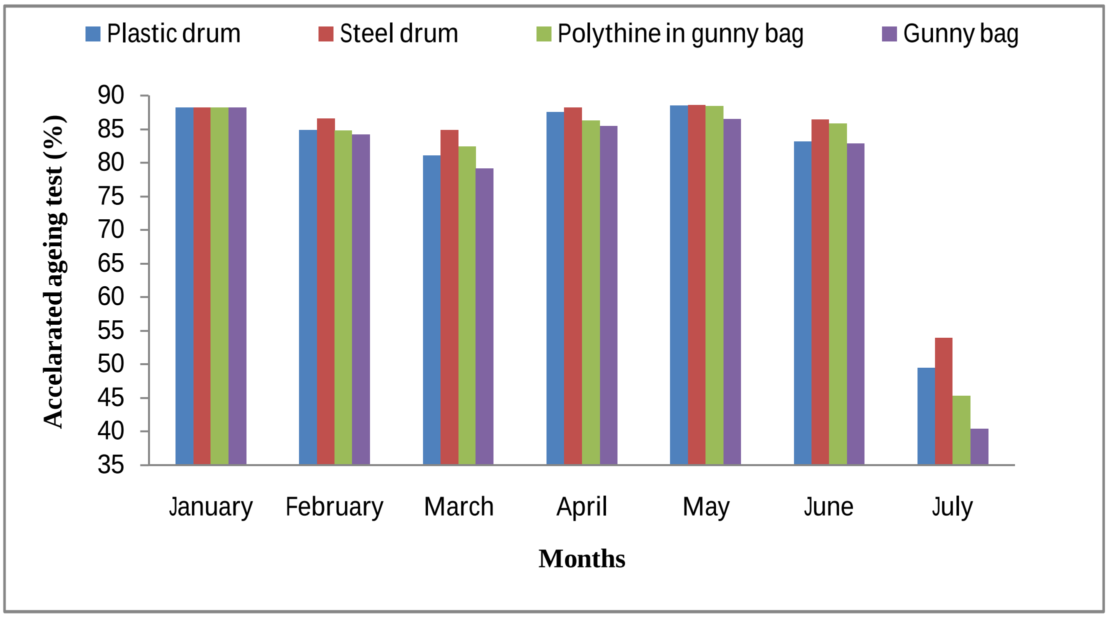

Figure 6. Effect of storage device on germination (%) of T. Aman seed after accelerated ageing test at different months after preservation(LSD value = NS, 0.46, 0.37, 0.56, 0.37, 0.58 and 0.54 at January, February, March, April, May, June and July, respectively)

4.3.3 Interaction effect of variety and storage device on germination (%) of T. Aman seed after accelerated ageing test at different months after preservation.

Interaction effect of variety and storage device had significant influence on germination (%) of T. Aman seeds after accelerated ageing test at different months after preservation (Table 3). The highest germination (%) of T. Aman seed at different months after preservation were recorded from BRRI dhan34 preserved in steel drum which were 93, 90, 88, 92, 94, 93% and 88% January, February, March, April, May, June and July, respectively. On the other hand, the lowest germination (%) of T. Aman seed were recorded from BINA dhan7 preserved in gunny bag which were 82, 80, 71, 80, 81, 74 & 18% in January, February, March, April, May, June and July, respectively.

Table 3. Interaction effect of variety and storage device on germination (%) of T. Aman seeds after accelerated ageing test at different months after preservation

Treatment combination	Germination (%) of accelerated ageing test at						
	January	**February**	**March**	**April**	**May**	**June**	**July**
Binadhan-7							
× Plastic drum	82.00 d	81.00 h	78.00 j	88.25 cd	90.00 c	88.50 b	61.50 d
× Steel drum	82.00 d	81.00 h	76.00 k	88.25 cd	90.00 c	88.50 b	61.50 d
× Poly. in g.bag	82.00 d	81.00 h	76.00 k	86.50 e-g	88.25 e	88.00 b	43.25 h
× Gunny bag	82.00 d	80.25 i	71.00 m	80.50 j	81.00 h	74.50 k	18.50 o
BRRI dhan33							
× Plastic drum	88.00 c	85.00 de	84.00 c	88.50 cd	90.00 c	81.50 f	20.75 m
× Steel drum	88.00 c	86.00 c	78.00 j	89.50 bc	90.00 c	80.00 g	20.05 n
× Poly. in g.bag	88.00 c	86.00 c	82.00 e	84.50 hi	89.00 d	83.25 e	20.00 n
× Gunny bag	88.00 c	85.00 d	87.25 b	90.50 b	90.25 c	79.00 h	23.00 l
BRRI dhan34							
× Plastic drum	93.00 a	86.00 c	79.00 i	86.00 f-h	89.00 d	78.25 i	43.25 h
× Steel drum	93.00 a	90.00 a	88.00 a	92.50 a	94.00 a	93.50 a	88.00 a
× Poly. in g.bag	93.00 a	88.50 b	80.75 g	85.00 gh	88.00 e	78.00 i	51.25 f
× Gunny bag	93.00 a	84.50 e	73.00 l	83.00 i	86.00 f	76.75 j	58.75 e
BRRI dhan51							
× Plastic drum	89.25 b	85.00 d	84.00 c	85.00 gh	85.25 g	83.50 e	76.00 b
× Steel drum	89.25 b	85.25 d	83.50 d	90.50 b	89.00 d	86.25 d	48.75 g
× Poly. in g.bag	89.25 b	85.00 d	81.50 f	87.00 d-f	89.25 d	83.00 e	25.75 k
× Gunny bag	89.25 b	84.00 f	84.00 c	82.25 i	83.00 g	83.00 e	25.50 k
BRRI dhan52							
× Plastic drum	89.00 b	84.00 f	81.00 g	87.00 d-f	88.25 e	83.25 e	30.75 j
× Steel drum	89.00 b	85.00 d	80.00 h	88.00 c-e	86.25 f	87.50 c	31.50 i
× Poly.in g.bag	89.00 b	83.25 g	79.75 h	86.00 f-h	88.00 e	87.25 c	63.00 c
× Gunny bag	89.00 b	85.00 d	81.00 g	90.50 b	92.00 b	88.50 b	32.00 i
$LSD_{(0.05)}$	**0.32**	**0.50**	**0.40**	**1.74**	**0.42**	**0.65**	**0.60**
CV (%)	**1.25**	**1.43**	**1.36**	**1.42**	**1.34**	**1.54**	**1.14**

In a column means having similar letter (s) are statistically similar and those having dissimilar letter(s) differ significantly by LSD at 0.05 level of probability.

4.4 Speed of germination

4.4.1 Effect of variety

Speed of germination of T. Aman was significantly influenced by different T. Aman varieties at different months after preservation (Figure 7). BRRI dhan52 showed the highest speed of germination (%) at different months after preservation among the varieties. On the other hand, Binadhan-7 showed the lowest speed of germination (%) at different months after preservation among the varieties. The figure showed that speed of germination (%) decreased from January to February and then increase from the month of March to May (except BRRI dhan33) for all the varieties. From the month of June, speed of germination (%) again decreased irrespective of varieties (except BRRI dhan33) and it continued up to July. In case of BRRI dhan33, decrease in speed of germination (%) started from the month of May. In case of BRRI dhan52, the decrease of speed of germination (%) was less rapid compare to other varieties. In case of different month, the highest speed of germination (%) was recorded from the month of April and May, whereas, the lowest speed of germination (%) was recorded from the month of January and February for all the varieties.

4.4.2 Effect of storage device

Speed of germination of T. Aman seed was significantly influenced by different storage device at different months after preservation (Figure 8). Seeds stored in plastic drum showed the highest speed of germination at different months after preservation among the storage devices. On the other hand, gunny bag showed the lowest speed of germination at different months after preservation among the storage devices. Speed of germination decreased from January to February and then increase in speed of germination was recorded from the month of March to April among the storage devices. From the month of May, speed of germination (%) again decreased for all the storage devices and it continued up to July when it was recorded the lowest. In case of different month, the highest speed of germination was recorded from the month of April, whereas, the lowest was recorded from the month of February for all the storage devices.

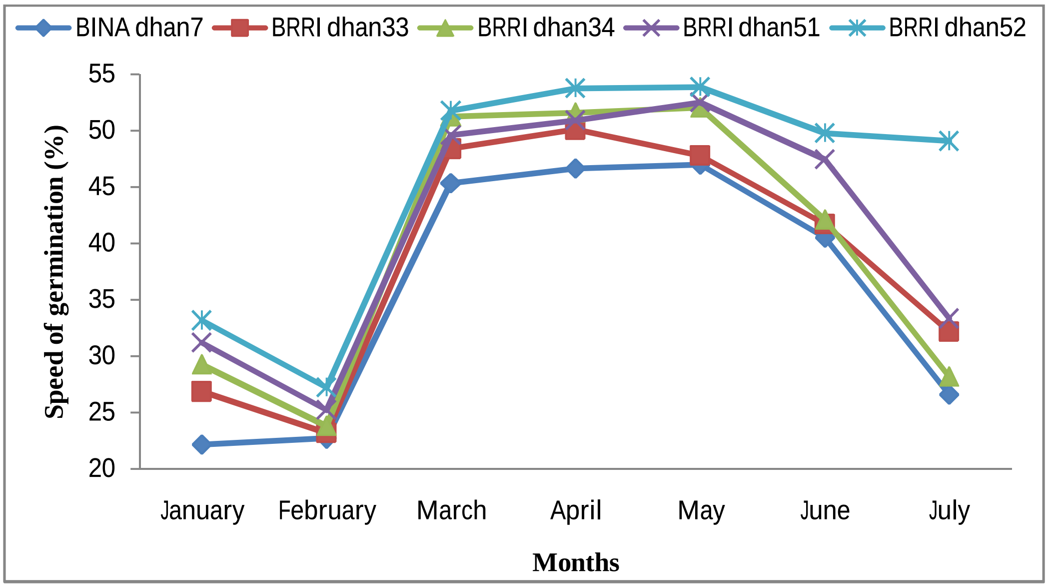

Figure 7. Effect of variety on speed of germination of T. Aman seeds at different months after preservation (LSD value = 0.41, 0.34, 0.52, 0.47, 0.68, 0.86 and 0.58 at January, February, March, April, May, June and July, respectively)

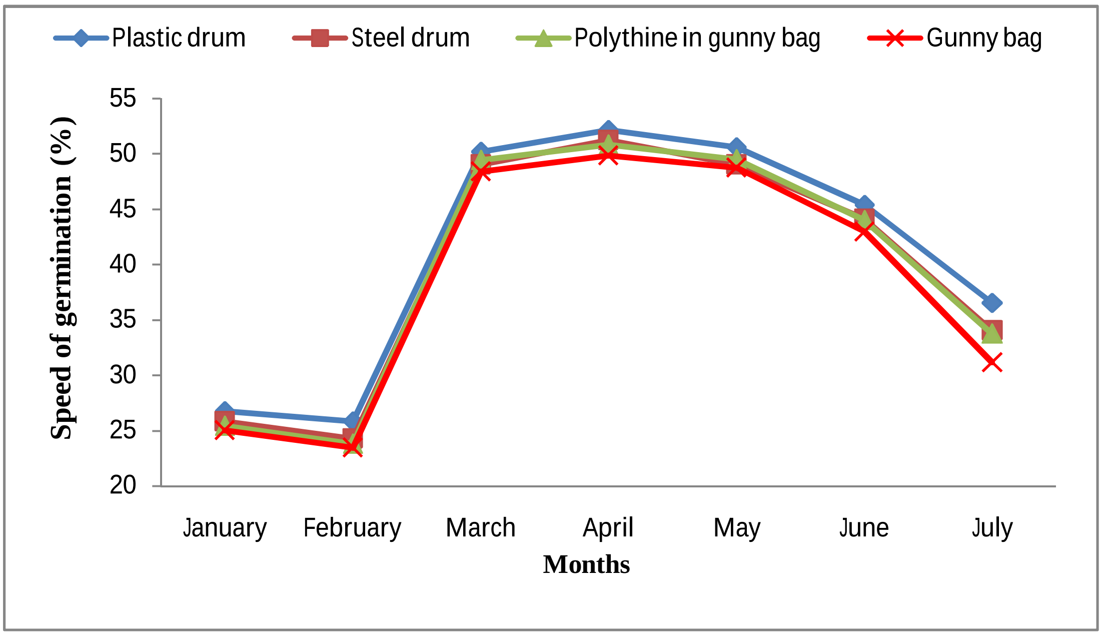

Figure 8. Effect of storage device on speed of germination of T. Aman seeds at different months after preservation (LSD value = 0.37, 0.30, 0.46, 0.42, 0.61, 0.77 and 0.52 at January, February, March, April, May, June and July, respectively)

Table 4. Interaction effect of variety and storage device on speed of germination of T. Aman seed at different months after preservation

Treatment combination	Speed of Germination at						
	January	February	March	April	May	June	July
Binadhan-7							
× Plastic drum	20.83 j	22.63 j	49.30 gh	54.40 c	47.80 f-h	50.50 c	48.60 b
× Steel drum	20.81 j	22.61 j	49.00 h	55.30 b	50.00 d	50.10 c	48.50 b
× Poly. in g.bag	17.09 l	23.04 i	53.10 ab	50.90 hi	51.60 b	51.60 b	24.00 o
× Gunny bag	17.98 k	22.24 k	44.50 m	44.70 n	46.20 i	36.20 l	20.30 p
BRRI dhan33							
× Plastic drum	27.11 h	24.55 d	50.10 ef	51.60 fg	48.30 f	47.00 e	25.50 n
× Steel drum	26.83 hi	22.50 jk	47.50 j	46.40 l	47.50 gh	41.40 ij	28.30 k
× Poly. in g.bag	26.66 i	23.38 h	48.10 i	48.80 j	47.40 gh	43.70 gh	42.50 c
× Gunny bag	26.82 hi	22.51 jk	47.90 ij	53.60 d	48.00 fg	40.80 j	32.30 g
BRRI dhan34							
× Plastic drum	30.87 d	23.54 gh	46.40 k	47.10 k	48.30 f	44.20 g	38.80 d
× Steel drum	30.03 e	24.38 de	49.70 fg	53.80 d	46.30 i	39.70 k	30.90 i
× Poly. in g.bag	28.49 f	23.54 gh	45.80 l	50.50 i	47.25 h	39.30 k	27.20 l
× Gunny bag	27.69 g	23.78 fg	44.70 m	45.70 m	50.90 c	39.60 k	31.70 h
BRRI dhan51							
× Plastic drum	31.24 cd	27.78 b	52.00 c	51.70 f	50.00 d	43.10 h	42.70 c
× Steel drum	31.39 c	23.78 fg	50.60 de	54.90 b	50.90 c	48.80 d	34.30 f
× Poly. in g.bag	31.01 cd	22.58 j	52.60 b	52.70 e	49.30 e	45.90 f	29.90 j
× Gunny bag	31.21 cd	24.06 ef	51.90 c	51.35 f-h	51.90 b	42.20 i	26.40 m
BRRI dhan52							
× Plastic drum	35.71 a	30.58 a	53.20 a	56.20 a	56.30 a	53.00 a	51.70 a
× Steel drum	32.17 b	28.06 b	50.40 e	49.20 j	50.50 cd	40.60 j	26.30 m
× Poly. in g.bag	32.32 b	26.48 c	47.80 ij	51.20 gh	49.30 e	39.60 k	26.60 m
× Gunny bag	32.43 b	26.54 c	51.00 d	51.70 f	51.00 bc	45.20 f	35.90 e
$LSD_{(0.05)}$	**0.41**	**0.34**	**0.52**	**0.47**	**0.68**	**0.86**	**0.58**
CV (%)	**1.12**	**1.98**	**1.74**	**1.65**	**1.97**	**1.38**	**1.21**

In a column means having similar letter (s) are statistically similar and those having dissimilar letter(s) differ significantly by LSD at 0.05 level of probability.

4.4.3 Interaction effect of variety and storage device

Interaction effect of variety and storage device exerted significant influence on speed of germination (Table 4). The highest speed of germination recorded from BRRI dhan52 preserved in plastic drum (35.71, 30.58, 53, 56, 56, 53, 51.70 in January, February, March, April, May, June and July, respectively) whereas the lowest speed of germination were recorded from Binadhan7 preserved in polythene in gunny bag (17, 22, 44, 45, 46, 36 and 20 in January, February, March, April, May, June and. July, respectively).

4.5 Electric conductivity (µm)

4.5.1 Effect of variety

Electric conductivity influenced significantly due to varieties at different months after preservation (Figure 9). BRRI dhan34 showed the highest electric conductivity at different months after preservation among the tested varieties. On the other hand, BRRI dhan51 showed the lowest electric conductivity at different months after preservation among the varieties. In case of different month, the highest electric conductivity was recorded from the month of July, whereas, the lowest electric conductivity was recorded in the month of January and March for different varieties.

4.5.2 Effect of storage device

Electric conductivity of T. Aman seed was significantly influenced by different storage device at different months after preservation (Figure 10). The figure showed that gunny bag had the highest electric conductivity among the storage devices. On the other hand, steel drum showed the lowest electric conductivity among the storage devices. In case of different month, the highest electric conductivity was recorded in July and that of lowest was observed in January and March for different storage devices.

4.5.3 Interaction effect of variety and storage device

Interaction effect of variety and storage device had significant influence on electric conductivity (µm) of T. Aman seed at different months after preservation (Table 5). The highest electric conductivity (µm) was recorded from BRRI dhan34 preserved in gunny bag which were 328, 289, 288, 289, 295, 321& 329 (µm) in January, February, March, April, May, June and July, respectively. On the other hand, the lowest electric conductivity (µm) values were recorded from BRRI dhan51 preserved in steel drum which were 265, 208, 202, 204, 220, 225 and 265 in January, February, March, April, May, June and July, respectively.

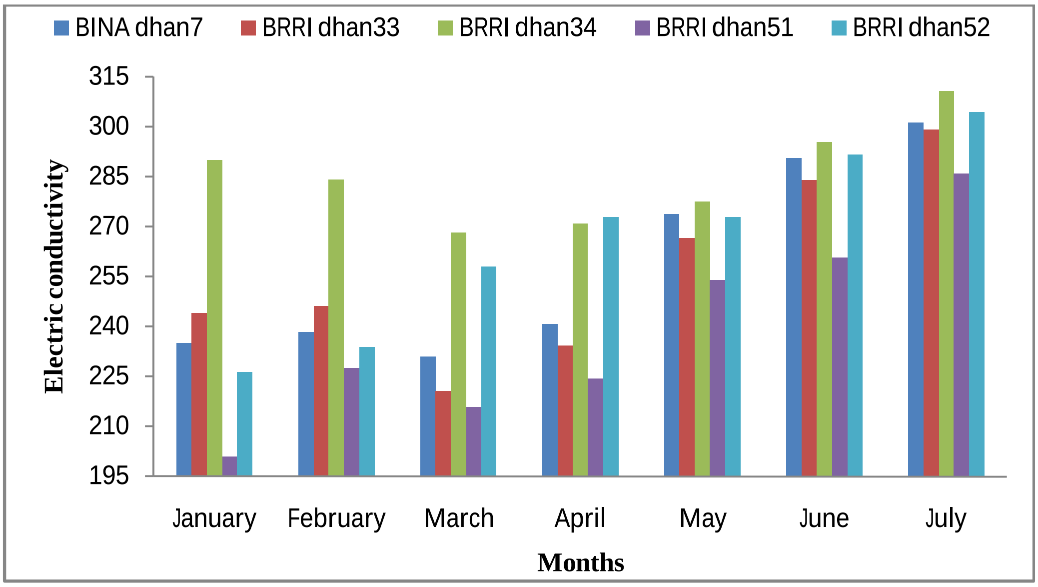

Figure 9. Effect of variety on electric conductivity of T. Aman seed at different months after preservation (LSD value = 3.96, 2.96, 3.19, 3.26, 3.27, 2.93 and 3.54 at January, February, March, April, May, June and July, respectively)

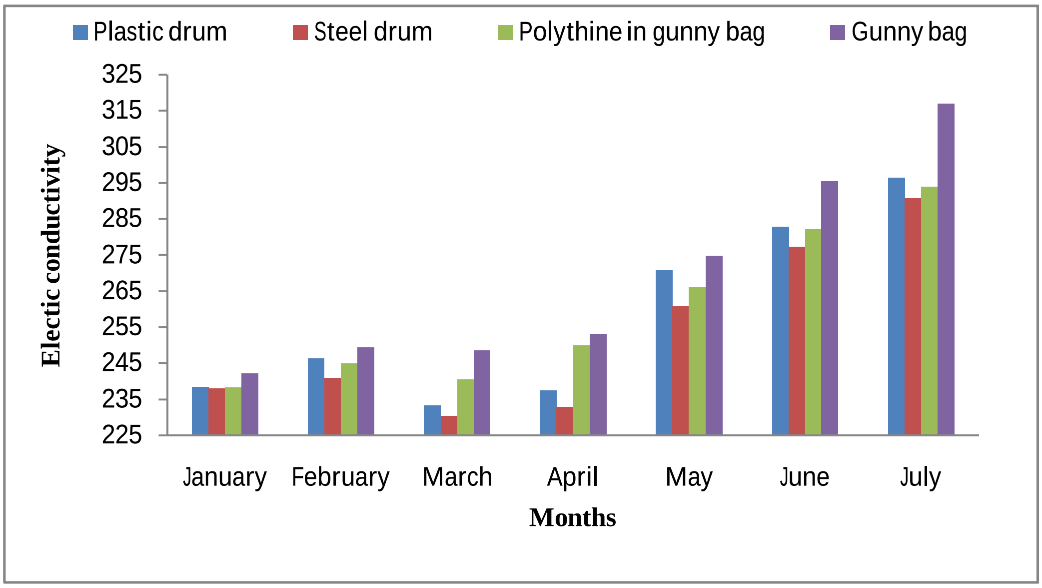

Figure 10. Effect of storage device on electric conductivity of T. Aman seed at different months after preservation (LSD value = 3.29, 2.65, 2.86, 2.91, 2.92, 2.62 and 3.16 at January, February, March, April, May, June and July, respectively)

Table 5. Interaction effect of variety and storage device on electric conductivity (µm) of T. Aman seeds at different months after preservation

Treatment combination	Electric conductivity (µm) at						
	January	February	March	April	May	June	July
Binadhan-7							
× Plastic drum	290.0 hi	234.0 k	213.0 k	226.0 i	265.0 e	280.0 g	290.0 hi
× Steel drum	319.0 b	243.0 gh	232.0 h	243.0 fg	285.0 b	316.0 b	319.0 b
× Poly. in g.bag	294.0 fg	237.0 j	243.0 f	252.0 e	269.0 d	289.0 e	294.0 fg
× Gunny bag	302.0 e	239.0 ij	236.0 g	242.0 fg	276.0 c	296.0 d	302.0 e
BRRI dhan33							
× Plastic drum	286.0 j	249.0 d	218.0 j	240.0 g	276.0 c	281.0 g	286.0 j
× Steel drum	296.0 f	241.0 hi	207.0 l	222.0 j	255.0 fg	281.0 g	296.0 f
× Poly. in g.bag	286.0 j	246.0 ef	216.0 jk	225.0 ij	249.0 h	275.0 h-j	286.0 j
× Gunny bag	318.0 b	248.8 de	232.0 h	250.0 e	285.0 b	299.0 c	318.0 b
BRRI dhan34							
× Plastic drum	305.0 de	286.0 b	273.0 c	275.0 b	277.0 c	289.0 e	305.0 de
× Steel drum	309.0 c	286.0 b	262.0 d	265.0 c	278.0 c	291.0 e	309.0 c
× Poly. in g.bag	311.0 c	274.0 c	278.0 b	264.0 c	285.0 b	297.0 cd	311.0 c
× Gunny bag	328.0 a	289.0 a	288.0 a	289.0 a	295.0 a	321.0 a	329.0 a
BRRI dhan51							
× Plastic drum	280.0 k	224.0 m	209.0 l	211.0 k	258.0 f	265.0 k	280.0 k
× Steel drum	265.0 l	208.0 n	202.0 m	204.0 l	220.0 i	225.0 l	265.0 l
× Poly. in g.bag	291.0 gh	234.0 k	230.0 hi	251.0 e	265.0 e	277.0 h	291.0 gh
× Gunny bag	308.0 cd	244.0 fg	227.0 i	232.0 h	254.0 g	276.0 hi	308.0 cd
BRRI dhan52							
× Plastic drum	309.0 c	248.0 de	249.0 e	243.0 fg	278.0 c	299.0 c	309.0 c
× Steel drum	294.0 fg	224.0 m	249.0 e	244.0 f	262.0 e	274.0 ij	294.0 fg
× Poly. in g.bag	287.0 ij	234.0 k	246.0 ef	257.0 d	262.0 e	273.0 j	287.0 ij
× Gunny bag	318.0 b	229.0 l	260.0 d	265.0 c	269.0 d	285.0 f	318.0 b
$LSD_{(0.05)}$	**3.56**	**2.96**	**3.19**	**3.26**	**3.27**	**2.93**	**3.54**
CV (%)	**1.17**	**1.85**	**1.95**	**1.94**	**1.86**	**1.73**	**1.83**

In a column means having similar letter (s) are statistically similar and those having dissimilar letter(s) differ significantly by LSD at 0.05 level of probability

4.6 Seedling length

4.6.1 Effect of variety

Seedling length (cm) of T. Aman was significantly influenced by different varieties at different months after preservation (Figure 11). Among the tested varieties Binadhan-7 showed the longest seedling (cm) from the month of January to March and BRRI dhan52 showed the highest seedling length (cm) from the month of April to July. On the other hand, BRRI dhan34 showed the shortest seedling length (cm) at different months after preservation among the varieties. In case of different month, the longest seedling (cm) was recorded from the month of May and June, whereas, the shortest was recorded from the month of January to March for different varieties.

4.6.2 Effect of storage device

Seedling length (cm) of T. Aman was significantly influenced by different storage device at different months after preservation (Figure 12). Polythene in gunny bag showed the longest seedling (cm) in January to March and gunny bag showed the longest seedling (cm) from the month of April to July after preservation among the storage devices. On the other hand, steel drum showed the shortest seedling (cm) at different months after preservation among the storage devices. In case of different month, the longest seedling length (cm) was recorded in May, whereas, the shortest seedling (cm) was recorded from the month of February for different storage devices. In the month of January, there was no significant difference among the seedling length (cm) of T. Aman in different storage devices.

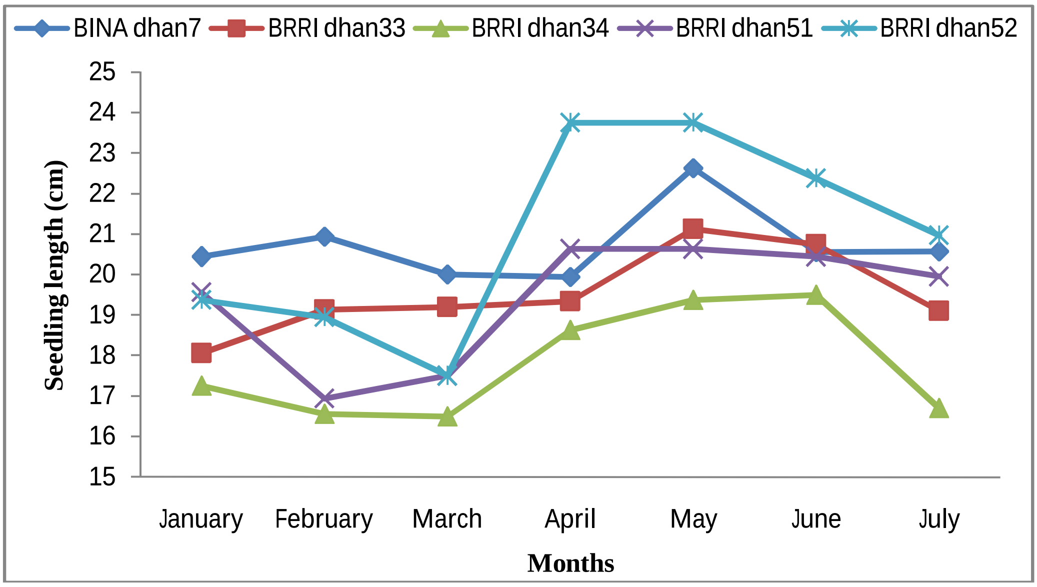

Figure 11. Effect of variety on seedling length (cm) of T. Aman at different months after preservation(LSD value = 0.71, 0.67, 0.78, 0.56, 0.63, 0.59 and 0.33 at January, February, March, April, May, June and July, respectively)

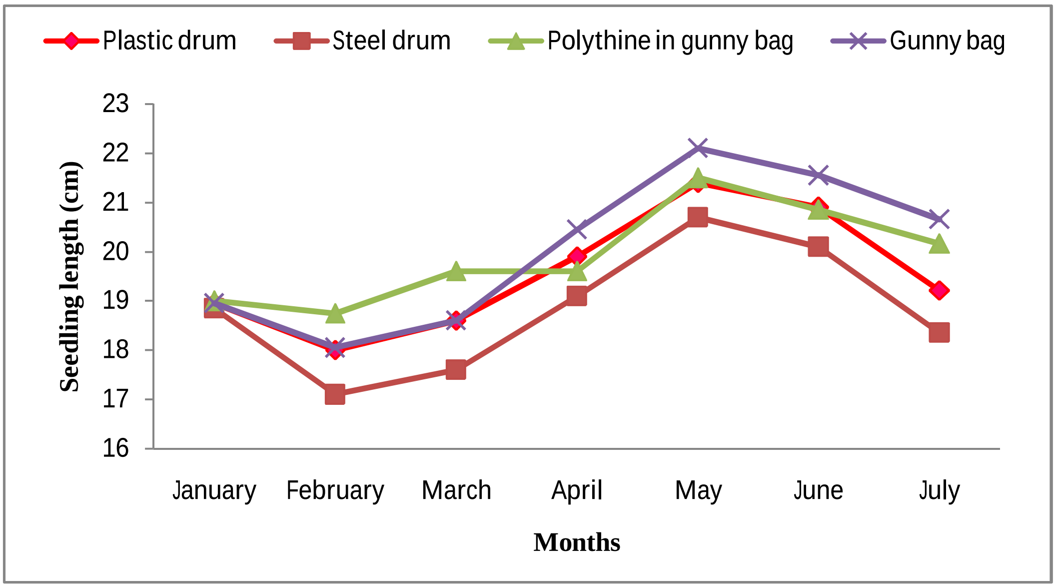

Figure 12. Effect of storage device on seedling length (cm) of T. Aman at different months after preservation (LSD value = NS, 0.60, 0.69, 0.50, 0.57, 0.53 and 0.30 at January, February, March, April, May, June and July, respectively)

4.6.3 Interaction effect of variety and storage device

Interaction effect of variety and storage device showed significant influence on seedling length (cm) of T. Aman at different months after preservation (Table 6). The longest seedlings at January, February and March (22.00, 21.50 and

22.00, respectively after preservation were recorded from Binadhan-7 preserved in polythene in gunny bag. In April, May, June and July BRRI dhan52 preserved in gunny bag showed the longest seedling (23.25, 24.70, 23.25 and 23.40, respectively). On the other hand, the shortest seedling was recorded from BRRI dhan34 preserved in steel drum which was 16.55, 16.00, 16.20, 16.50, 18.00, 17.00, 15.00 cm in January, February, March, April, May, June and July, respectively.

Table 6. Interaction effect of variety and storage device on seedling length (cm) of T. Aman at different months after preservation.

Treatment combination	**Seedling length (cm) at**						
	January	**February**	**March**	**April**	**May**	**June**	**July**
Binadhan-7							
× Plastic drum	20.00 b	20.75 b	20.00 c	20.75 c	23.50 bc	21.25 cd	21.60 bc
× Steel drum	19.75 bc	20.75 b	19.00 d	20.25 cd	22.50 de	16.25 h	16.20 l
× Poly in g.bag	22.00 a	21.50 a	22.00 a	19.00 e	22.50 de	21.75 bc	21.80 b
× Gunny bag	20.00 b	20.50 b	19.00 d	19.75 d	22.00 ef	22.50 b	20.40 e
BRRI dhan33							
× Plastic drum	18.00 f	19.50 cd	21.00 b	20.75 c	20.50 hi	21.75 bc	19.80 g
× Steel drum	18.00 f	19.00 de	18.00 e	19.00 e	20.00 ij	20.75 de	21.80 b
× Poly. in g.bag	18.25 f	19.75 c	19.00 d	20.00 d	22.50 de	19.25 g	21.40 c
× Gunny bag	18.00 f	18.25 f	19.00 d	17.75 f	21.50 fg	21.25 cd	20.90 d
BRRI dhan34							
× Plastic drum	17.25 g	18.00 fg	18.00 e	19.00 e	19.50 j	19.00 g	16.10 l
× Steel drum	16.55 h	16.00 k	16.20 g	16.50 g	18.00 k	17.00 h	15.00 m
× Poly. in g.bag	17.25 g	19.75 c	18.00 e	20.00 d	19.50 j	20.75 de	17.90 j
× Gunny bag	17.25 g	18.50 ef	17.00 f	19.00 e	19.50 j	19.25 g	16.60 k
BRRI dhan51							
× Plastic drum	19.75 bc	16.75 ij	17.00 f	18.00 f	21.00 gh	20.00 f	20.20 ef
× Steel drum	19.75 bc	17.25 hi	17.00 f	19.75 d	19.50 j	21.25 cd	18.80 h
× Poly. in g.bag	19.00 de	17.50 gh	19.00 d	20.75 c	21.00 gh	20.25 ef	20.80 d
× Gunny bag	19.75 bc	16.70 ij	17.00 f	20.75 c	21.00 gh	20.25 ef	20.00 fg
BRRI dhan52							
× Plastic drum	19.75 bc	17.25 hi	17.00 f	22.15 b	24.00 b	21.00 d	18.40 i
× Steel drum	20.00 b	16.75 ij	17.00 f	22.00 b	23.00 cd	22.50 b	20.00 fg
× Poly. in g.bag	18.50 ef	19.50 cd	18.00 e	21.75 b	23.50 bc	22.25 b	17.60 j
× Gunny bag	19.25 cd	16.75 ij	18.00 e	23.25 a	24.70 a	23.25 a	23.40 a
$LSD_{(0.05)}$	**0.71**	**0.67**	**0.77**	**0.56**	**0.63**	**0.59**	**0.33**
CV (%)	**2.66**	**2.56**	**2.98**	**1.96**	**2.08**	**2.02**	**1.21**

In a column means having similar letter (s) are statistically similar and those having dissimilar letter(s) differ significantly by LSD at 0.05 level of probability

4.7 Biomass (gm)

4.7.1 Effect of variety

Biomass (g/10 seedlings) of T. Aman seedlings was significantly influenced by different varieties at different months after preservation (Figure 13). BRRI dhan52 showed the highest biomass (g) after preservation among the tested varieties. On the other hand, BRRI dhan34 showed the lowest biomass (g) at different months after preservation among the varieties. The highest biomass (g) was recorded in the month of July that of lowest biomass (g) was recorded in the month of January and April for different varieties.

4.7.2 Effect of storage device

Biomass (g) of T. Aman was not significantly influenced by different storage devices at different months after preservation (Figure 14). Numerically, steel drum showed the highest biomass (g) at different months after preservation and that of plastic drum showed the lowest biomass among the storage devices.

4.7.3 Interaction effect of variety and storage device

Biomass yield varied significantly due to interaction of variety and storage device at different months after preservation (Table 7). The highest biomass (g) at January, March and July were recorded from BRRI dhan33 preserved in gunny bag, polythene in gunny bag and gunny bag (0.190, 0.23 and 0.38, respectively). In February, the highest biomass (g) of T. Aman seedlings was recorded from BRRI dhan52 preserved in plastic drum which was 0.22 g. In the month of April, the highest biomass (g) of T. Aman seedlings was recorded from BRRI dhan52 preserved in plastic drum which was statistically similar with steel drum and gunny bag and it was 0.18 g. In May, the highest biomass (g) of T. Aman seedlings was recorded from BRRI dhan52 preserved in polythene in gunny bag which was statistically similar with gunny bag and it was 0.22 g. In the month of June, the highest biomass (g) of T. Aman seedlings was recorded from BRRI dhan52 preserved in plastic drum which was statistically similar with gunny bag and it was 0.21 g. On the other hand, the lowest biomass (g) was recorded from BRRI dhan34 preserved in plastic drum which were 0.06, 0.08, 0.08, 0.07, 0.09, 0.08 and 0.10 g in January February, March, April, May, June and July, respectively.

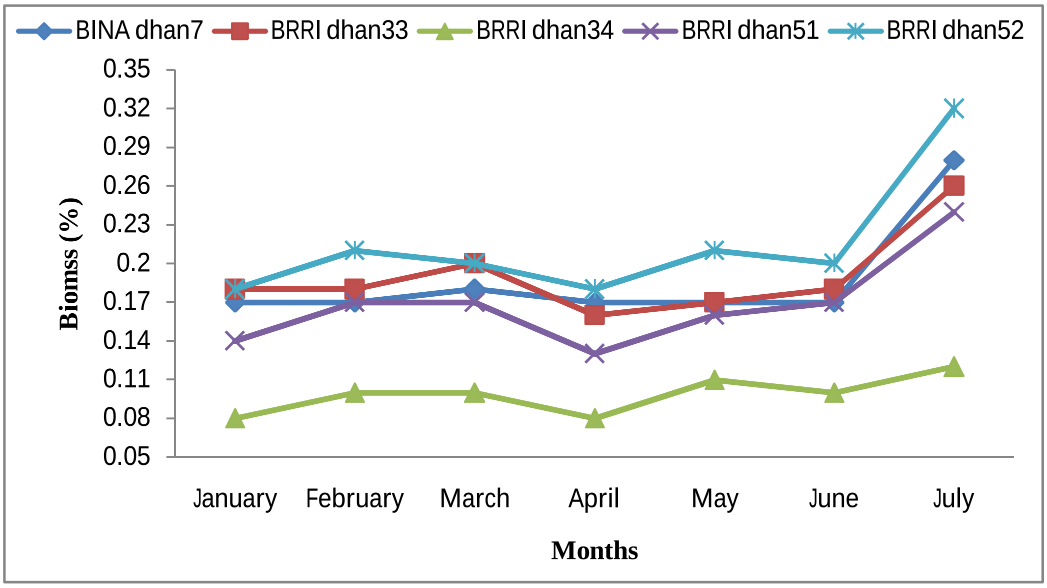

Figure 13. Effect of variety on biomass (g) of T. Aman seedling at different months after preservation (LSD value = 0.04, 0.04, 0.04, 0.04, 0.04, 0.04 and 0.04 at January, February, March, April, May, June and July, respectively)

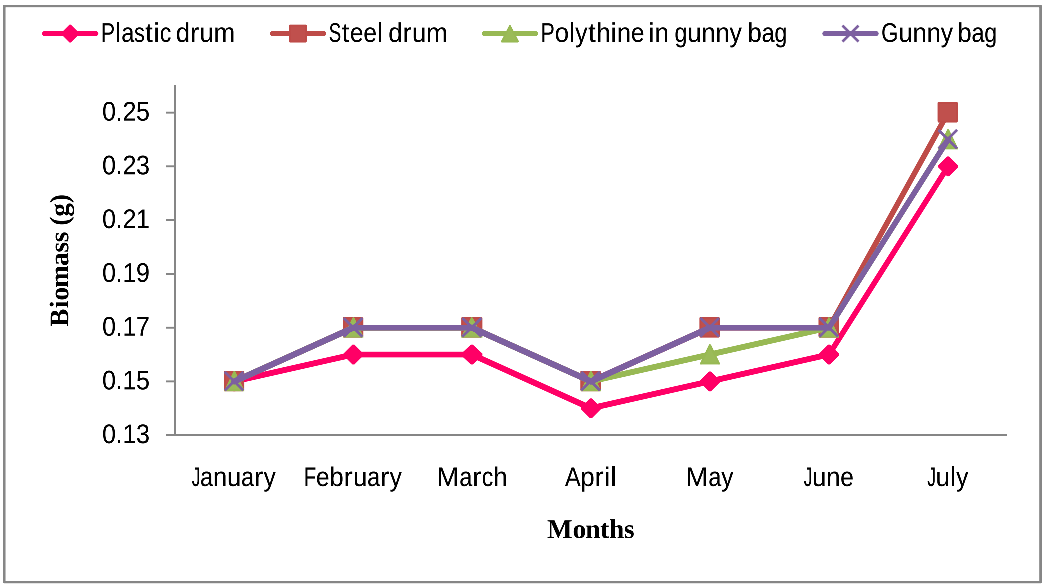

Figure 14. Effect of storage device on biomass (g) of T. Aman seedlings at different months after preservation (LSD value = NS, NS, NS, NS, NS, NS and NS at January, February, March, April, May, June and July, respectively)

Table 7. Interaction effect of variety and storage device on biomass (g) of T. Aman seedlings at different months after preservation

Treatment combination	Biomass (g) at						
	January	**February**	**March**	**April**	**May**	**June**	**July**
Binadhan-7							
× Plastic drum	0.17 ab	0.16 c	0.17 bc	0.16 ab	0.17 b-d	0.16 bc	0.30 bc
× Steel drum	0.16 ab	0.17 bc	0.17 bc	0.17 ab	0.18 a-d	0.16 bc	0.28 c-e
× Poly. in g.bag	0.17 ab	0.18 a-c	0.18 bc	0.17 ab	0.17 b-d	0.19 ab	0.27 c-f
× Gunny bag	0.16 ab	0.17 bc	0.18 bc	0.16 ab	0.18 a-d	0.17 ab	0.25 d-g
BRRI dhan33							
× Plastic drum	0.18 ab	0.17 bc	0.16 c	0.17 ab	0.17 b-d	0.19 ab	0.22 g
× Steel drum	0.18 ab	0.19 a-c	0.21 ab	0.16 ab	0.18 a-d	0.18 ab	0.33 b
× Poly. in g.bag	0.19 a	0.19 a-c	0.23 a	0.16 ab	0.17 b-d	0.18 ab	0.33 b
× Gunny bag	0.18 ab	0.18 a-c	0.19 a-c	0.16 ab	0.19 a-c	0.18 ab	0.38 a
BRRI dhan34							
× Plastic drum	0.06 c	0.08 d	0.08 d	0.07 d	0.09 f	0.08 d	0.10 h
× Steel drum	0.08 c	0.10 d	0.10 d	0.09 cd	0.12 ef	0.10 d	0.11 h
× Poly. in g.bag	0.09 c	0.11 d	0.10 d	0.09 cd	0.12 ef	0.12 cd	0.13 h
× Gunny bag	0.09 c	0.10 d	0.10 d	0.08 d	0.12 ef	0.12 cd	0.12 h
BRRI dhan51							
× Plastic drum	0.14 b	0.16 c	0.16 c	0.13 bc	0.14 de	0.16 bc	0.26 c-g
× Steel drum	0.14 b	0.16 c	0.17 bc	0.13 bc	0.16 c-e	0.17 ab	0.23 fg
× Poly. in g.bag	0.14 b	0.17 bc	0.16 c	0.14 ab	0.15 c-e	0.16 bc	0.22 g
× Gunny bag	0.14 b	0.18 a-c	0.18 bc	0.13 bc	0.14 de	0.17 ab	0.23 fg
BRRI dhan52							
× Plastic drum	0.18 ab	0.22 a	0.21 ab	0.18 a	0.19 a-c	0.21 a	0.27 c-f
× Steel drum	0.18 ab	0.21 ab	0.19 a-c	0.18 a	0.21 ab	0.20 ab	0.29 b-d
× Poly. in g.bag	0.18 ab	0.21 ab	0.19 a-c	0.17 ab	0.22 a	0.19 ab	0.23 fg
× Gunny bag	0.18 ab	0.20 a-c	0.19 a-c	0.18 a	0.22 a	0.21 a	0.24 e-g
$LSD_{(0.05)}$	**0.04**	**0.04**	**0.04**	**0.04**	**0.04**	**0.04**	**0.04**
CV (%)	**1.12**	**2.97**	**2.12**	**2.87**	**2.67**	**2.88**	**2.32**

In a column means having similar letter (s) are statistically similar and those having dissimilar letter(s) differ significantly by LSD at 0.05 level of probability

4.8 Imbibitions at different months

4.8.1 Effect of variety

Imbibitions (%) of T. Aman seeds were significantly influenced by the varieties at different months after preservation (Figure 15). Binadhan-7 showed the highest imbibitions (%) of T. Aman seeds after preservation in January; BRRI dhan34 in February, March and April and BRRI dhan52 in May, June and July among the varieties. On the other hand, BRRI dhan33 showed the lowest imbibitions (%) at different months (except June) after preservation. In June, BRRI dhan51 showed the lowest imbibitions (%). The highest imbibitions (%) was recorded from the month of March and April, whereas, the lowest imbibitions (%) was recorded from the month of July for different varieties.

4.8.2 Effect of storage device

Imbibitions (%) of T. Aman seeds were significantly influenced by different storage devices at different months after preservation (Figure 16). Imbibitions (%) showed an increasing trend with increase of storage period and it increases steadily up to April. After that it gradually reduces and continued up to last storage time i.e. up to July. Seeds stored in plastic drum showed the highest imbibitions (%) in January, March and June; Polythene in gunny bag in February and July and gunny bag in April and May irrespectively of storage devices. On the other hand, gunny bag showed the lowest imbibitions (%) in January, February and March; plastic drum in April, May and July and steel drum in June after preservation among the storage devices. In case of different month, the highest imbibitions (%) were recorded from the month of April, whereas, the lowest imbibitions (%) were recorded from the month of July irrespective storage devices.

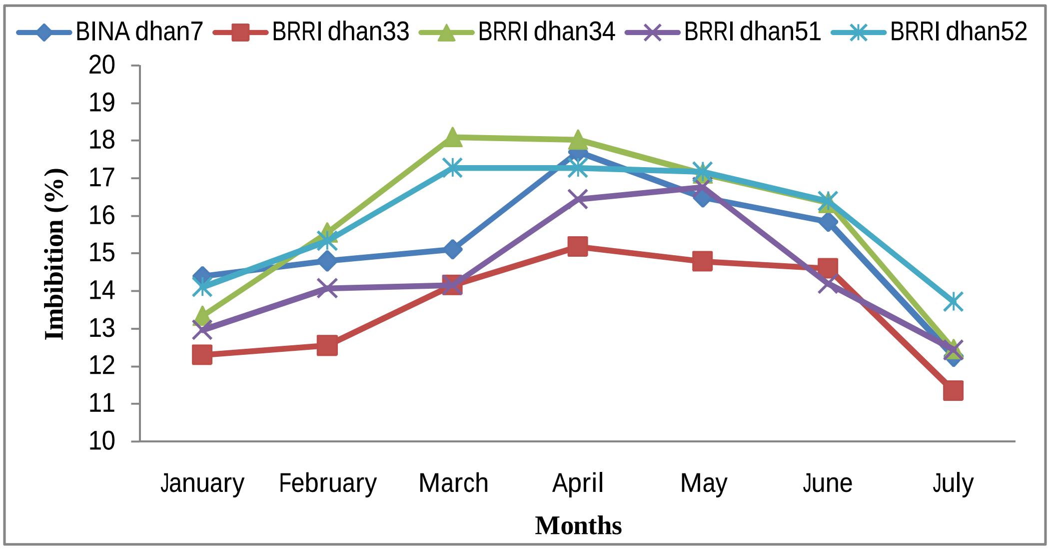

Figure 15. Effect of variety on imbibitions (%)of T. Aman seeds at different months after preservation (LSD value = 0.16, 0.13, 0.17, 0.30, 0.22, 0.26 and 0.18 at January, February, March, April, May, June and July, respectively)

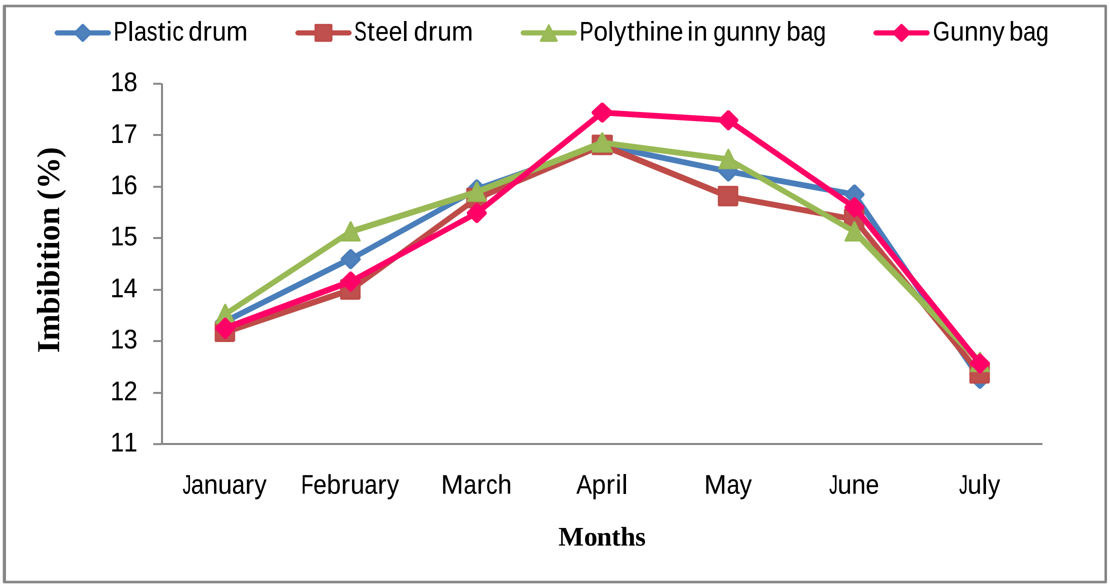

Figure 16. Effect of storage device on imbibitions of T. Aman at different months after preservation (%) (LSD value = 0.14, 0.11, 0.16, 0.27, 0.20, 0.23 and 0.17 at January, February, March, April, May, June and July, respectively)

4.8.3 Interaction effect of variety and storage device

Interaction effect of variety and storage device had significant influence on imbibitions (%) of T. Aman at different months after preservation (Table 8). The highest imbibitions (%) of T. Aman seeds at January and April were recorded from BINA dhan7 preserved in different storage devices i.e. 18.77% in plastic drum and 18.95% in steel drum, respectively. The highest imbibitions (%) of T. Aman seed at February, March, April, May and June were recorded from BRRI dhan34 preserved in different storage devices i.e. 16.21% in polythene in gunny bag, 18.84% in steel drum, 18.76% in gunny bag, 18.48% in gunny bag and 17.49% in plastic drum, respectively. In July, the highest imbibitions (14.32%) were recorded from BRRI dhan52 preserved in gunny bag. On the other hand, the lowest imbibitions (%) of T. Aman seed at January

(12.03%) and February (11.98%) were recorded from BRRI dhan33 preserved in steel drum. In April (14.73%), May (13.65%) and July (10.98%), the lowest imbibitions (%) was recorded from BRRI dhan33 preserved in plastic drum. The lowest imbibitions (%) of T. Aman seed at March and June were recorded from BRRI dhan51 preserved in gunny bag (13.37%) and steel drum (13.33 %), respectively.

Table 8. Interaction effect of variety and storage device on imbibitions (%) of T. Aman seeds at different months after preservation

Treatment combination	Imbibitions (%) at						
	January	**February**	**March**	**April**	**May**	**June**	**July**
Binadhan-7							
× Plastic drum	14.77 a	15.67 d	15.90 g	17.47 cd	15.87 h	15.32 ef	12.16 gh
× Steel drum	14.23 c	14.76 f	14.96 h	18.95 a	15.83 h	15.74 d	12.04 hi
× Poly. in g.bag	14.75 a	15.42 e	14.56 i	17.47 cd	16.87 f	15.52 de	12.99 d
× Gunny bag	13.85 d	13.33 l	15.04 h	16.94 e	17.64 b	16.81 b	11.86 ij
BRRI dhan33							
× Plastic drum	12.35 k	11.89 n	13.86 k	14.73 i	13.65 k	14.91 h	10.98 k
× Steel drum	12.03 l	11.98 n	13.71 k	14.93 i	14.01 j	15.24 fg	10.99 k
× Poly. in g.bag	12.52 j	14.14 ij	14.46 ij	15.33 h	15.49 i	13.88 k	11.71 j
× Gunny bag	12.32 k	12.17 m	14.63 i	15.74 g	15.99 h	14.43 i	11.73 j
BRRI dhan34							
× Plastic drum	13.89 d	15.62 d	18.64 b	18.31 b	17.36 c	17.49 a	13.20 c
× Steel drum	12.63 ij	14.61 g	18.84 a	18.03 b	16.90 ef	17.36 a	12.49 f
× Poly. in g.bag	13.65 e	16.21 a	18.74 ab	17.02 e	15.79 h	15.61 d	11.89 ij
× Gunny bag	13.17 fg	15.80 c	16.18 f	18.76 a	18.48 a	14.95 h	12.21 gh
BRRI dhan51							
× Plastic drum	13.22 f	14.36 h	14.47 ij	16.47 f	16.97 ef	14.08 jk	12.22 gh
× Steel drum	12.84 h	14.42 ij	14.31 j	14.90 i	15.93 h	13.33 l	12.29 g
× Poly. in g.bag	13.02 g	14.04 j	14.49 i	16.95 e	17.10 de	14.33 ij	12.55 f
× Gunny bag	12.78 hi	13.47 k	13.37 l	17.48 c	17.06 ef	15.05 gh	12.66 ef
BRRI dhan52							
× Plastic drum	14.55 b	15.40 e	16.90 e	17.03 e	17.62 b	17.44 a	12.73 e
× Steel drum	14.11 c	14.17 i	17.03 e	17.18 de	16.39 g	15.13 f-h	14.00 b
× Poly. in g.bag	13.68 e	15.81 c	17.27 d	17.49 c	17.38 c	16.24 c	13.82 b
× Gunny bag	14.10 c	15.96 b	17.93 c	18.29 b	17.30 cd	16.77 b	14.32 a
$LSD_{(0.05)}$	**0.16**	**0.13**	**0.17**	**0.30**	**0.22**	**0.26**	**0.18**
CV (%)	**1.84**	**1.61**	**1.78**	**1.24**	**1.95**	**1.17**	**1.05**

In a column means having similar letter (s) are statistically similar and those having dissimilar letter(s) differ significantly by LSD at 0.05 level of probability

4.9 Imbibitions at different hours

4.9.1 Effect of varieties

Imbibitions (%) of T. Aman seeds were significantly influenced by different varieties at different hours after preservation (Figure 18). BRRI dhan52 showed the highest imbibitions (%) of T. Aman at 1st hour, Binadhan-7 at 2nd and 4thhour and BRRI dhan34 at 3rd and 5th hour after preservation. On the other hand, BRRI dhan33 showed the lowest imbibitions (%) at 1st hour and 3rd hour, BRRI dhan51 at 2ndhour and BRRI dhan52 at 4th and 5th hour after preservation among all the varieties. In case of different hour, the highest imbibitions (%) was recorded from 1st hour whereas; the lowest imbibitions (%) was recorded from 4thand 5thhour for different varieties.

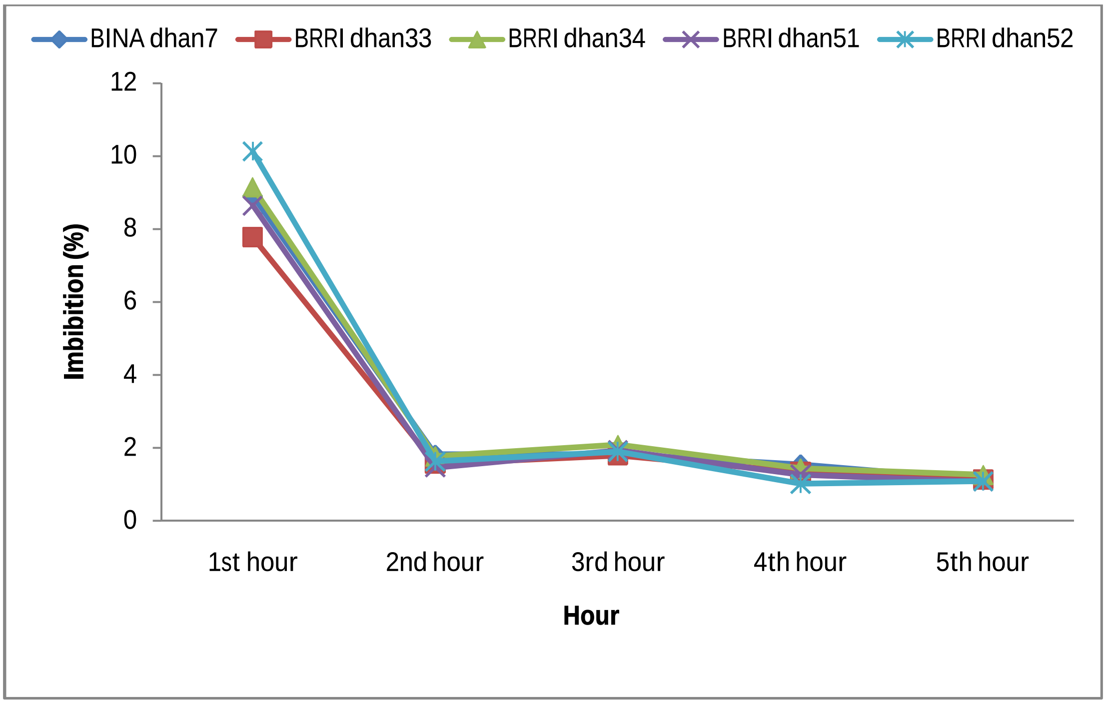

Figure 17: Effect of variety on imbibitions (%) of T. Aman seeds at different hours after preservation (LSD value = 0.14, 0.11, 0.01, 0.01 and 0.01 at 1st hour, 2nd hour, 3rd hour, 4th hour and 5th hour, respectively)

4.9.2 Effect of storage devices

Imbibitions (%) of T. Aman seeds were significantly influenced by different storage devices at different hours after preservation (Figure 19). Plastic drum showed the highest imbibitions (%) of T. Aman at 1st hour, steel drum at 2nd hour, gunny bag at 3rd hour, polythene in gunny bag at 4th hour and plastic drum at 5th hour after preservation. On the other hand, steel drum showed the lowest imbibitions (%) at 1st, 3rd and 4th hour, gunny bag at 2nd hour and polythene in gunny bag at 5th hour after preservation among all the storage devices. In case of different hour, the highest imbibitions (%) were recorded in 1st hour whereas; the lowest imbibitions (%) were recorded from 5th hour for different storage devices.

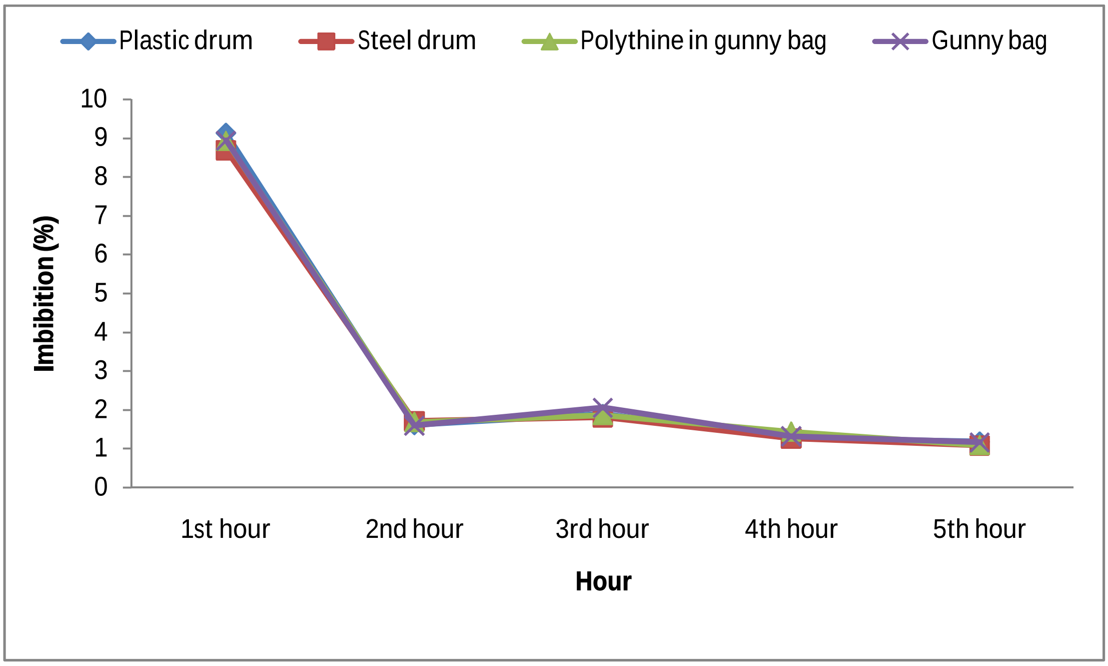

Figure 18: Effect of storage device on imbibitions (%) of T. Aman seeds at different hours after preservation (LSD value = 0.22, 0.10, 0.01, 0.01 and 0.01 at 1st hour, 2nd hour, 3rd hour, 4th hour and 5th hour, respectively)

4.9.3 Interaction effect of varieties and storage devices

Interaction effect of varieties and storage devices had significant influence on imbibitions (%)of T. Aman seeds at different hours after preservation (Table 8). The highest imbibitions (%) at 1st hour (10.50) were recorded from BRRI dhan52 preserved in gunny bag which was statistically similar (10.46) with BRRI dhan52 preserved in plastic drum. At 2nd hour, the highest imbibitions (%) were recorded from BRRI dhan34 preserved in steel drum (2.01). The highest imbibitions (%) at 3rd hour after preservation was recorded from BRRI dhan34 preserved in gunny bag

(2.35). At 4th hour, the highest imbibitions (%) after preservation was recorded from Binadhan-7 preserved in gunny bag (1.64) which was statistically similar (1.64) with BRRI dhan34 preserved in steel drum. The highest imbibitions (%) at 5th hour after preservation was recorded from BRRI dhan34 preserved in gunny bag (1.33).On the other hand, the lowest imbibitions at 1st hour (7.57) was recorded from BRRI dhan33 preserved in gunny bag. At 2nd hour, the lowest imbibitions (%) were recorded from BRRI dhan33 preserved in plastic drum (1.33). The lowest imbibitions (%) at 3rd hour after preservation was recorded from BRRI dhan33 preserved in plastic drum (1.58). At 4th hour, the lowest imbibitions (%) after preservation was recorded from BRRI dhan52 preserved in plastic drum (0.91). The lowest imbibitions (%) at 5th hour after preservation was recorded from BRRI dhan51 preserved in steel drum (0.95).

Table 9: Interaction effect of variety and storage device on imbibitions (%) of T. Aman rice seeds at different hours after preservation

Treatment combination	**Imbibitions (%) at**				
	1st hour	**2nd hour**	**3rd hour**	**4th hour**	**5th hour**
Binadhan-7					
× Plastic drum	8.76 f-h	1.92 ab	1.79 l	1.57 b	1.19 e
× Steel drum	8.82 e-g	1.84 bc	1.77 m	1.39 g	1.08 i
× Polythene in gunny bag	9.15 d	1.94 ab	1.68 n	1.57 b	1.13 fg
× Gunny bag	8.89 ef	1.57 f-i	2.04 de	1.64 a	1.08 i
BRRI dhan33					
× Plastic drum	7.78 k	1.33 k	1.58 o	1.31 h	1.20 e
× Steel drum	7.73 k	1.62 d-g	1.67 n	1.06 kl	1.11 h
× Polythene in gunny bag	8.02 j	1.59 e-h	1.91 g	1.50 d	1.08 i
× Gunny bag	7.57 l	1.70 de	2.03 e	1.45 f	1.12 gh
BRRI dhan34					
× Plastic drum	9.81 b	1.64 d-f	2.26 b	1.48 e	1.30 b
× Steel drum	8.69 g-i	2.01 a	1.86 i	1.64 a	1.28 c
× Polythene in gunny bag	8.95 e	1.69 d-f	1.87 hi	1.54 c	1.14 f
× Gunny bag	9.12 d	1.72 cd	2.35 a	1.07 k	1.33 a
BRRI dhan51					
× Plastic drum	8.79 fg	1.51 g-i	1.99 f	1.04 m	1.12 gh
× Steel drum	8.55 i	1.37 jk	1.87 hi	1.21 i	0.95 l
× Polythene in gunny bag	8.63 hi	1.48 h-j	2.07 c	1.45 f	1.07 i
× Gunny bag	8.58 i	1.50 g-i	1.84 j	1.40 g	1.07 i
BRRI dhan52					
× Plastic drum	10.46 a	1.65 d-f	1.83 jk	0.91 o	1.08 i
× Steel drum	9.63 c	1.70 de	1.88 h	0.96 n	0.97 k
× Polythene in gunny bag	9.89 b	1.70 de	1.82 k	1.13 j	1.03 j
× Gunny bag	10.50 a	1.46 ij	2.05 d	1.05 lm	1.23 d
$LSD_{(0.05)}$	0.14	0.13	0.01	0.01	0.01
CV (%)	2.08	1.18	2.38	2.81	1.54

In a column means having similar letter (s) are statistically similar and those having dissimilar letter(s) differ significantly by LSD at 0.05 level of probability

CHAPTER V

SUMMARY AND CONCLUSION

The experiment was carried out at Seed Testing Laboratory, Beej Bhaban, BADC, Gabtoly, Dhaka to select the suitable varieties and suitable devices for the storage of T. Aman seeds at farmers' level. Five T. Aman varieties *viz*: V_1= BINA dhan7, V_2=BRRI dhan33, V_3=BRRI dhan34, V_4=BRRI dhan51 and V_5=BRRI dhan52 and four storage devices *viz*: D_1= Plastic drum, D_2= Steel drum, D_3= Polythene in gunny bag, D_4= Gunny bag were used as treatment in this experiment. The experiment was carried out following completely randomized design with four replications.

Results showed that BRRI dhan34 showed the highest moisture (%) and Binadhan-7 showed the lowest moisture (%). Seeds preserved in gunny bag retained the highest moisture (%) and seeds in plastic drum retained the lowest moisture (%) at different months. In interaction, the highest moisture (%) recorded from BRRI dhan34 preserved in gunny bag which were 12.15, 12.15, 12.08, 12.02, 13.25, 13.83 and 14.30% in January, February, March, April, May, June and July, respectively. On the other hand, the lowest moisture (%) were recorded from Binadhan-7 preserved in plastic drum which were 11.08, 10.89, 10.77, 10.65, 11.30, 11.88 and 12.05% in January, February, March, April, May, June and July, respectively.

Binadhan-7 showed the highest and BRRI dhan51 showed the lowest germination (%) at different months after preservation among the varieties. Seeds preserved in plastic drum showed the highest germination (%) and seeds preserved in gunny bag showed the lowest germination (%) among the storage devices. The highest germination (%) was recorded from plastic drum × Binadhan-7 which were 90.25, 91.75, 94.25, 95.00, 87.25, 83.00 and 73.00% in January, February, March, April, May, June and in July, respectively. On the other hand, the lowest germination (%) were recorded from gunny bag × BRRI dhan51 which were 78.25, 80.25, 82.25, 84.75, 73.75, 66.50 and 40.75% in January, February, March, April, May, June and July, respectively.

Germination (%) after accelerated ageing test, BRRI dhan34 gave the highest and Binadhan-7 gave the lowest value. Seeds preserved in steel drum showed the highest germination (%) and seeds preserved in gunny bag showed the lowest germination (%) after accelerated aging test. The highest germination (%) were recorded from BRRI dhan34 preserved in steel drum which were 93, 90, 88, 92, 94, 93 and 88% January, February, March, April, May, June and July, respectively. On the other hand, the lowest germination (%) after accelerated aging test recorded from Binadhan-7 preserved in gunny bag which were 82, 80, 71, 80, 81, 74 & 18% in January, February, March, April, May, June and July, respectively.

BRRI dhan52 showed the highest and Binadhan-7 showed the lowest speed of germination at different. Seeds stored in plastic drum showed the highest and seeds stored in gunny bag showed the lowest speed of germination at different months. During interaction, the highest speed of germination were recorded from BRRI dhan52 preserved in plastic drum which were 35.71, 30.58, 53, 56, 56, 53, 51.70 in January, February, March, April, May, June and July, respectively. On the other hand, the lowest speed of germination were recorded from BINA dhan7 preserved in polythene in gunny bag which was 17, 22, 44, 45, 46, 36 and 20 in January, February, March, April, May, June and. July, respectively.

BRRI dhan34 showed the highest electric conductivity and BRRI dhan51 showed the lowest electric conductivity at different months after preservation among the tested varieties. Seeds preserved in gunny bag had the highest electric conductivity and seeds preserved in steel drum showed the lowest electric conductivity. During interaction, the highest electric conductivity (µm) was recorded from BRRI dhan34 preserved in gunny bag which were 328, 289, 288, 289, 295, 321& 329 (µm) in January, February, March, April, May, June and July, respectively. On the other hand, the lowest electric conductivity (µm) values were recorded from BRRI dhan51 preserved in steel drum which were 265, 208, 202, 204, 220, 225 and 265 µm in January, February, March, April, May, June and July, respectively.

Among the tested varieties Binadhan-7 and BRRI dhan52 showed the longest seedling (cm). On the other hand, BRRI dhan34 showed the shortest seedling length (cm) at different months. Polythene in gunny bag and gunny bag showed the longest seedling (cm) and steel drum showed the shortest seedling (cm) at different months after preservation among the storage devices. In interaction, the longest seedlings at January, February and March (22.00, 21.50 and 22.00 respectively) were recorded from Binadhan-7 preserved in polythene in gunny bag. On the other hand, the shortest seedlings were recorded from BRRI dhan34 preserved in steel drum which was 16.55, 16.00, 16.20, 16.50, 18.00, 17.00, 15.00 cm in January, February, March, April, May, June and July, respectively.

BRRI dhan52 showed the highest biomass (g) and BRRI dhan34 showed the lowest biomass (g) after preservation among the tested varieties. Biomass (g) production of T. Aman was not significantly influenced by different storage devices. Biomass yield varied significantly due to interaction of variety and storage device at different months after preservation but the lowest biomass (g) was recorded from BRRI dhan34 preserved in plastic drum which were 0.06, 0.08, 0.08, 0.07, 0.09, 0.08 and 0.10 g in January February, March, April, May, June and July, respectively.

The highest imbibitions (%) recorded from Binadhan-7 and the lowest were recorded from BRRI dhan33. Seeds stored in plastic drum showed the highest imbibitions (%) in January, March and June; Gunny bag showed the lowest imbibitions (%) in January, February and March. Imbibitions (%) rate varied significantly for different combinations.

BRRI dhan52 showed the highest imbibitions (%) and BRRI dhan33 showed the lowest imbibitions (%). In case of different hour, the highest imbibitions (%) was recorded from 1st hour whereas; the lowest imbibitions (%) was recorded from $4^{th}$and 5^{th}hour for different varieties. Plastic drum showed the highest imbibitions (%) at 1^{st} hour, and steel drum showed the lowest imbibitions (%) at 1^{st}, 3^{rd} and 4^{th}hour. In case of different hour, the highest imbibitions (%) were recorded in 1^{st} hour whereas; the lowest imbibitions (%) were recorded from 5^{th} hour for different storage devices. The highest imbibitions (%) at 1^{st} hour (10.50) were recorded from BRRI dhan52 preserved in gunny bag which was statistically similar (10.46) with BRRI dhan52 preserved in plastic drum.

The overall results indicated that Binadhan-7 showed the highest germination and the highest seedling length, and BRRI dhan52 showed the highest speed of germination, the highest biomass production which can be used to maintain better quality seeds at farm condition. Among the devices, plastic drum maintained germination at an excellent rate, showed the highest speed of germination and the lowest electric conductivity which can be used as suitable devices for the storage of T. Aman rice seeds at farm condition for six months of storage period. The interaction of plastic drum and Binadhan-7 as well as the interaction of plastic drum and BRRI dhan52 gave the better result in maintaining seed quality under the present study.

RECOMMENDATION

This was a single year and single location experiment. So, for wide acceptability of the result this experiment may be conducted in different year and in different region of the country taking more variety and more devices available at farms level.

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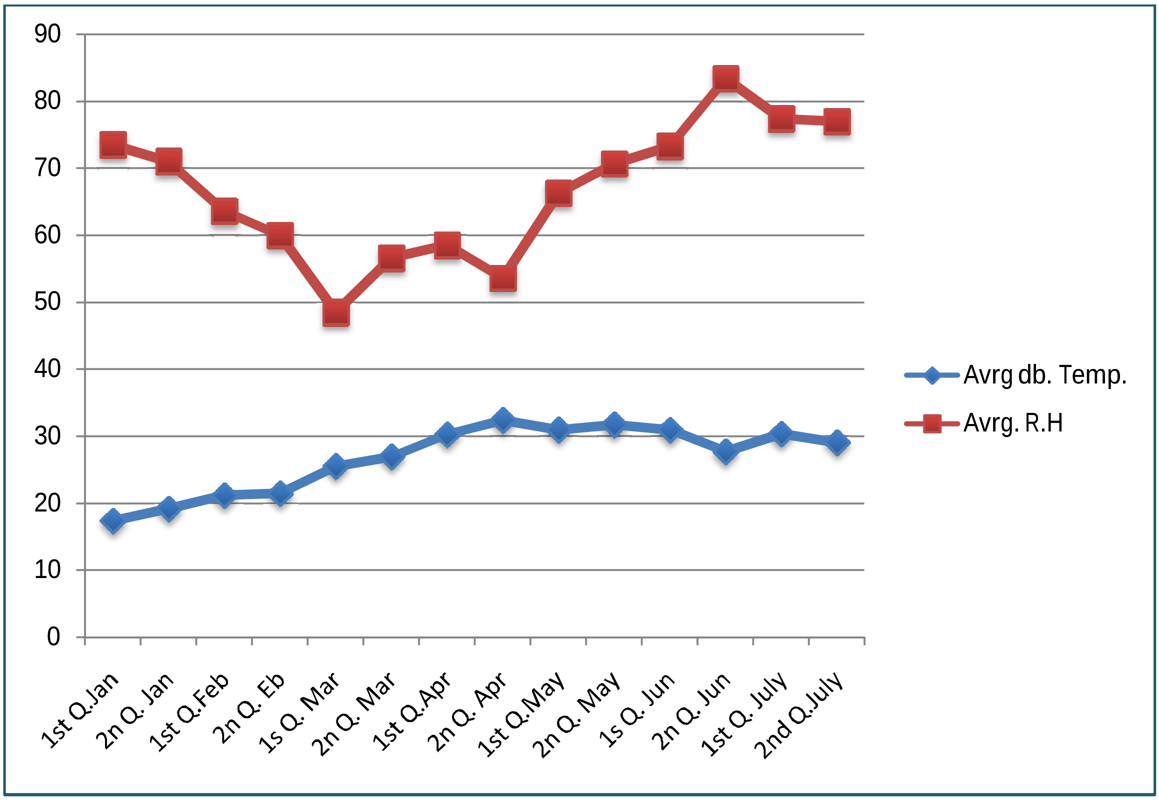
Appendix-1: Quarterly Average Temperature and Relative humidity during the study period (January-July'2014).



Source: Bangladesh Meteorological Department, Agargoan, Dhaka-1207.

LIST OF PLATES

Plate-1: Seed storage operations

Plate 2: Seed sample dividing operation.

Plate 3: Seed counting operation.

Plate 4: Seed sample drying operation in an electric oven.

Plate 5: Seed Desiccation operation

Plate-6: Operation of seed germination.

Plate-7: Imbibitions test operation.