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RESEARCH ARTICLE

MOISTURE CONTENT AND VARIETY OF JUTE SEED IS AFFECTED BY LONG TERM SEED STORAGE

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ABSTRACT

Seed perform a vital role in agricultural sector for crop production as well as seed business. Scarcity of healthy seed hinder not only the crop production but also the quality of seed. Storing of healthy seed with proper storing condition is one of the suitable methods to maximize production however, healthy seed also lose its quality during seed storage. Seed remains viable for long time if the seed stored by maintaining seed moisture content, storage temperature with storage container. So, this experiment was carried out to observe the quality parameters of jute seed during long term storing. To find out the storage effect an experiment was conducted on march, 2020 at seed laboratory, Jute Agriculture Experimental Station, Jagir, Manikganj, Bangladesh during the period of January 2016 to March, 2020. Plastic pot was used in this experiment as a storage container to store jute seeds. Three tossa jute (*C. olitorius* L.) varieties viz., O-795 (V_1), O-9897 (V_2) and OM-1 (V_3) were used in this study. Result revealed that storage period and jute variety showed significant effect on different seed quality parameters. The highest seed germination, field emergence, seed vigour and the lowest 1000-seed weight, moisture content were recorded in T_5 (2019-20) treatment. On the other hand, the lowest seed germination, field emergence, seed vigour and the highest 1000-seed weight, moisture content were recorded in T_1 (2015-2016) treatment. Furthermore, seed germination, field emergence, seed vigour was negatively but 1000-seed weight was positively correlate with moisture content. Results revealed that extended storage period caused the decreasing seed quality and seed can be stored for three years in plastic container without hampering the seed quality.

KEYWORDS

Tossa jute seed, storage period, germination, field emergence, 1000-seed weight, vigour, moisture content.

1. INTRODUCTION

Jute grows abundantly in Bangladesh having best quality of fiber in comparison with that of India (Zakaria and Sayed, 2008). Jute and jute products earn a lot of foreign currency and jute alone contributes about 5.5% to the GDP in Bangladesh national economy (Sikder et al., 2008). For the foreign earning, jute is called golden fiber of Bangladesh. In 2016 - 2017, about 8.39 million tons of jute fibre were produced from 10.89 million acre of land and covered about 2.80% of the total cropped area (BBS, 2018). It has been reported that jute covers almost 6.0 billion of taka as export materials in the fiscal year 2018-2019 (Akter et al., 2020). Jute crop also significantly improves the soil fertility and soil quality by adding organic matter to the soil through the decomposition of dropped leaves and plant debris (Islam and Ali, 2017). In addition, jute and jute goods have been recognized as being ecofriendly to the environment globally (Abdullah, 2002).

Jute is mostly grown in the Indo-Bangladesh region and in some countries of Southeast Asia (Rahman et al., 2017). Among the jute growing countries, Bangladesh ranks the second position globally in respect of fiber production (Islam, 2007). For jute cultivation, Bangladesh require about 5000 to 5500 tons of jute seeds for every year, however only 15-20% of required seed are supplied by institutional resources (Islam, 2019). The rest of the seeds, about 85% or more of the requirement, are produced and managed and stored by farmer's level. In most cases, the quality of those stored seeds are not confirmed and hamper jute production (Sikder et al., 2008). It was reported that quality seed of an improved variety can itself provide 20% additional jute yield (Hossain et al., 1994).

Different factors including duration of storage, temperature, seed moisture, oxygen pressure, and pests and diseases infestation affect seed quality of stored seed (Pradhan and Badola, 2012). These factors significantly vary with the type of storage method used for seed storing. Farmers use various storage containers such as earthen pots, polythene bags, glass containers, and plastic jars, which influence seed quality differently depending on the crop species (Haque et al., 2014). Studies showed that different containers had distinct effect to maintain seed quality of different crop seed (Bakhtavar et al., 2019). However, the normal polythene bags do not achieve the same effect as the custom-made plastic bags (Camann et al., 2011). The longer a seed is stored the more the seed deteriorates due to the slow respiration that occurs in all stored seeds. Respiration depletes food reserves that are required for seed germination (Ali and Elozeiri, 2017).

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Hence, the production and quality of healthy jute seed as well as its quality of storage is highly essential to ensure the higher yield of quality fiber in order to meet the challenging need for natural fiber. Here, moisture is also one of the major factors contributing to the deterioration during storage especially in the tropics and sub-tropics (Suma et al., 2013). The lower ranges of moisture probably help to maintain the seed quality during the storage period (Ali et al., 2014).

Moisture percent, germination and vigour were differed significantly due to storage container and storage condition applied except 1000-seed weight (Islam et al., 2002). Storage of seed is an important factor on which the seed quality greatly depends (Islam, 2016). Very few researches were done on stored jute seed quality on prolong storage period. From the above fact the experiment was designed to find out tossa jute (*Corchorus olitorius* L.) seed quality on extended storage period.

2. Materials and Methods

The experiment was performed at the seed laboratory of Jute Agriculture Experimental Station (JAES) of Bangladesh Jute Research Institute (BJRI), Jagir, Manikganj. The crops were sown on August of 2015, 2016, 2017, 2018, 2019 and harvested at the last week of January in 2016, 2017, 2018, 2019, and 2020, respectively at full maturity. Land was prepared properly and crops were grown with proper agronomic management during crop growing season according to some study (Chowdhury and Hassan, 2013). The seed was dried in the sun on a triple set on the cemented floor for making moisture content as per experimental specification and stored in the plastic pot containers. Each container was completely filled with seed as per experimental specification and then made air tight. The room temperature was maintained 18-20^{o}C. The experiment was laid out in completely randomized design (CRD) with four replications.

Three types of tossa jute (*Corchorus olitorius* L.) varieties, viz. O-795(V_1), O-9897(V_2) and OM-1(V_3) were used in this experiment. Data on germination, field emergence, 1000-seed weight, vigour and moisture content were recorded on March, 2020. Germination and field emergence data were collected according to a study (Mollah, 2014). 1000-seed weight was measured by using digital electric balance. Vigour was calculated according to the process described by Islam, 2016. Seed moisture was recorded by using digital grain moisture meter (model: GMK-303). The data were analyzed statistically by using R Statistics Software version 3.5.3.

3. Results and Discussion

Quality of seeds is considered as a vital factor for increasing total yield of a crop. Seed must have to be varietally pure, disease and insect free as well as with proper moisture content. However, seed quality can be deteriorated in various ways and storage period is one of them (Anderson, 1970; Wang et al., 2018). In the present research, the effect of storage periods was evaluated on tossa variety (*Corchorus olitorius*) seed quality.

3.1 Effect of storage on tossa (*C. olitorius*) seed quality

Analysis found that seed quality was significantly affected by applying different treatments (Table 1). T_1 showed the highest (23.30%) and T_5 showed the lowest (8.44%) moisture contents compare to the other treatments. Similarly, thousand seed weight was higher (1.89 g) in T_1 treatment and T_4 and T_5 showed the lower seed weight (1.7 g). On the contrary, percentage of seed germination and field emergence as well as seed vigour was higher in T_4 and T_5 treatments and lower in T_1 treatment. Treatment T_2 and T_3 showed the intermediate results in all analyzed parameters (Table 1). It was also observed that percent of seed germination and field emergence was higher up to three year of seed storing. This result indicated that long term seed storing in plastic pot allowed seed to absorb moisture from the environment. These results clearly indicated that moisture content positively regulate seed weight however, seed germination, field emergence and seed vigour was negatively affected by moisture.

Moisture content of seed determine the seed quality and physical maturity however, specific seed moisture content is required for seed maturity in the field (McDonald, 2007). Moisture of seed is always changeable because of hygroscopic nature of seed that allow them to absorb and desorb water from environment (Khaldun and Haque, 2009; Stanwood and McDonald, 1989). In addition, seed moisture content is directly related to relative humidity of the atmosphere and seed weight also depends on the moisture absorption from the environment of storage condition (Copeland and McDonald 2005; Delouche et al., 1973). In this research, higher seed weight was observed in those seeds having higher moisture content (Table 1). Similar results were also reported by different scientists where storage periods affected jute seed quality (Islam et al., 2002; Tareq et al., 2015). Higher moisture content might be resulted from the long-term seed storing which also might affect seed germination and field emergence of jute seed. Different physical and chemical properties of seed changes during long the term seed storage, however short-term seed storage had no effect on seed germination, seedling growth (Silveira et al., 2014). Similarly, short term seed storage (up to three years) had no effect on seed quality of *C. olitorius* seed storage in this present study.

Table 1: Effect of storage period on tossa jute (*Corchorus olitorius*) seed qualities

Storage period	Germination (%)	Field emergence (%)	1000-seed weight (g)	Vigour (%)	Moisture (%)
T_1	48.33 e	33.33 e	1.89 a	18.33 d	23.30 a
T_2	72.67 d	62.00 d	1.81 b	26.33 c	19.85 b
T_3	85.00 c	74.00 c	1.76 c	30.33 b	16.16 c
T_4	94.00 b	83.67 b	1.72 d	36.67 a	10.42 d
T_5	96.00 a	91.33 a	1.71 d	37.00 a	8.44 e
Level of Significance	***	***	***	***	***
CV (%)	2.12	2.82	0.74	4.87	6.45
LSD	1.62	1.87	0.012	1.39	0.97
SE (±)	0.79	0.92	0.61	0.68	0.47

In column, means followed by different letters are significantly different.
***means at 0.1% level of probability

Results are showing the average of different parameters of three tossa varieties (*Corchorus olitorius*) (O-795, O-9897 and OM-1) in each year. T_1: five years old seed (2015-2020), T_2: four years old seed (2016-2020), T_3: three years old seed (2017-2020), T_4: two years old seed (2018-2020) and T_5: one-year old seed (2019-2020).

3.2 Effect of storage on seed qualities of tossa (*Corchorus olitorius* L.) jute varieties

Results revealed the significant variation on seed germination, field emergence, seed weight and seed vigour in same moisture content of different tossa variety seeds in five year of seed storing (Table 2). Tossa jute seed V_2 (O-9897) showed the best results in all tested parameters including seed weight compare to the V_1 (O-795) and V_3 (OM-1) variety. V_3 tossa variety showed the lowest percentage of seed germination (74%), field emergence (63%) and seed vigour (28.4%). Thousand seed weight of V_1 and V_3 was same in five year of seed storing however, lower than the V_2. This result pointing that seed size of V_2 (O-9897) is comparatively bigger than the V_1 (O-705) and V_3 (OM-1). Tossa variety V_1 gave the intermediate results in all tested parameters (Table 2). From the above results it can be predicted that size of tossa variety seed might helped to reserve more nutrient during long term storage than the other two tossa seeds.

Seed germination is highly depended on the source of seed collection (Gallagher and Wagenius, 2015; Rashid et al., 2007). It has been reported that jute seed germination varies from variety to variety and even differ in location to location (Roy et al., 2011). Bangladesh Jute Research Institute (BJRI) has developed several tossa (*C. olitorius*) jute varieties having some unique features (Akter et al., 2009). In this experiment, tossa variety V_2 (O-9897) showed the best results for having good quality of seeds even after five year of storage compare to the V_1 (O-795) and V_3 (OM-1) (Table 2). From the results of this research, it is highly likely that tossa jute variety had significant effect on seed quality. Tossa variety V_2 might have more ability to protect the higher respiration rate of seed during long term seed storing. The higher rate of respiration is related to the loss of reserve nutrient of seed which in turn reduced the seed weight as well as seed germination and field emergence (Ali and Elozeiri, 2017; Gupta and Aneja 2004).

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Table 2: Effect of storage periods on seed qualities of tossa (*Corchorus olitorius* L.) jute varieties.

Varieties	Germination (%)	Field emergence (%)	1000-seed weight (g)	Vigour (%)	Moisture (%)
V_1	80.20 b	70.40 b	1.767 b	29.60 b	15.32 a
V_2	83.00 a	73.20 a	1.78 a	31.20 a	15.77 a
V_3	74.40 c	63.00 c	1.77 b	28.40 c	15.82 a
Level of Significance	***	***	*	***	NS
CV (%)	2.12	2.82	0.74	4.87	6.45
LSD	1.25	1.45	4.25	1.08	0.75
SE(±)	0.61	0.71	1.30	0.52	0.36

In column, means followed by different letters are significantly different.
In column, means followed by same letters aren't significantly different.
***means at 0.1% level of probability
*means at 5% level of probability
NS means non-significant.

Results are showing the average of five years of three tossa (*Corchorus olitorius*) varieties. V1:(O-795), V2 (O-9897) and V3 (OM-1).

3.3 Interaction effect of tossa jute seed variety with period of storing

Results of interaction between different storage periods and tossa seed varieties are summarized in table 3. Germination percentage was higher in five individual interactions ($T_5 \times V_1$, $T_5 \times V_2$, $T_5 \times V_3$, $T_4 \times V_1$ and $T_4 \times V_2$) (Table 3). On the other hand, interaction between $T_1 \times V_3$ showed the lowest seed germination percentage (40%). In case of field emergence percentage, again interaction of $T_5 \times V_1$, $T_5 \times V_2$ and $T_5 \times V_3$ showed the higher percentage and similarly $T_1 \times V_3$ showed the lower field emergence. Interestingly, $T_1 \times V_1$ and $T_1 \times V_2$ interaction had highest value in thousand seed weight (1.9 g) and $T_5 \times V_1$ had the lowest seed weight (1.7 g). These results clearly indicated that storing longer period in plastic pot might help seed to absorb moisture resulted higher seed weight. Analysis also revealed that moisture content of seed is highly related to the seed vigour percentage (Table 3). Seeds having lower moisture from $T_5 \times V_1$, $T_5 \times V_2$ and $T_5 \times V_3$ interaction resulted in higher seed vigour percentage in the same interaction. From the above analysis it is evident that storage period rather than seed variety had significant effect on tossa jute seed quality.

Proper moisture content and seed weight is one of the most important indicators for the good quality of seeds (Bekele et al., 2019). Jute seeds containing higher moisture normally poor at seed germination leading to less plant in the field (Masum et al., 2010). Moisture content of jute are highly dependent on the jute variety which may also significantly affect seed quality of jute (Tareq et al., 2015). In this experiment, jute variety and extended storage period showed significant effect on seed germination in the similar moisture content of jute seed (Table 1 and Table 2). So it was expected that combination of jute variety with seed storage periods might play important role for keeping seed quality and similar results were found in this experiment (Table 3).

3.4 Correlation coefficient analysis between moisture and other seed quality characters

Statistical analyses were carried out to understand the associations among moisture and seed quality characters of jute seed. Analysis found the significant, and negative correlation of moisture with the seed germination, field emergence, seed weight and seed vigour (Table 4). Germination percentage was significantly and positively related with the field emergence and seed vigour, however negatively related with thousand seed weight. In addition, field emergence of seed negatively correlated with thousand seed weight but positively related with seed vigour. These results clearly pointing that moisture content of seed during seed preservation has significant role of determining tossa seed quality. Moisture of seed is a critical influencing factor for seed germination, filed emergence and seed weight (Bakhtavar et al., 2019). Various mechanism involved in the loss of seed viability leading to seed quality deterioration and lipid peroxidation is one of them (Da Silva et al., 2018). Seed moisture is increased during long term seed storing that increase lipid peroxidation result in less seed germination (Cai et al., 2011; Sung, 1996). Correlation of moisture with other parameters also indicating the significance of moisture as one of the major reasons for seed quality assurance (Table 4).

Table 3: Effect of Storage period × Varieties interaction on tossa jute (*Corchorus olitorius* L.) seed qualities

Storage period × Varieties	Germination	Field emergence	1000-seed weight	Vigour	Moisture
$T_1 \times V_1$	50.00 i	35.00 g	1.90 a	18.00 gh	22.68 a
$T_1 \times V_2$	55.00 h	40.00 f	1.91 a	20.00 g	23.66 a
$T_1 \times V_3$	40.00 j	25.00 h	1.85 b	17.00 h	23.56 a
$T_2 \times V_1$	75.00 f	68.00 d	1.79 c	26.00 f	19.55 b
$T_2 \times V_2$	79.00 e	70.00 d	1.80 c	27.00 ef	19.86 b
$T_2 \times V_3$	64.00 g	48.00 e	1.81 c	26.00 f	20.15 b
$T_3 \times V_1$	85.00 d	76.00 c	1.75 de	30.00 cd	15.80 c
$T_3 \times V_2$	89.00 c	78.00 c	1.76 d	32.00 c	16.80 c
$T_3 \times V_3$	81.00 e	68.00 d	1.76 d	29.00 de	15.89 c
$T_4 \times V_1$	95.00 a	83.00 b	1.71 fg	37.00 ab	10.05 def
$T_4 \times V_2$	95.00 a	85.00 b	1.72 f	38.00 a	10.15 de
$T_4 \times V_3$	92.00 b	83.00 b	1.73 ef	35.00 b	11.05 d
$T_5 \times V_1$	96.00 a	90.00 a	1.70 g	37.00 ab	8.50 efg
$T_5 \times V_2$	97.00 a	93.00 a	1.72 f	39.00 a	8.36 g
$T_5 \times V_3$	95.00 a	91.00 a	1.71 fg	35.00 b	8.45 fg
Level of Significance	***	***	*	*	*
CV (%)	2.12	2.82	0.74	4.87	6.45
LSD	2.81	3.25	0.02	2.42	1.68
SE(±)	1.37	1.58	0.01	1.18	0.82

In column, means followed by different letters are significantly different.
***means at 0.1% level of probability
*means at 5% level of probability.

Table 4: Correlation co-efficient between moisture and seed quality related characters

	Moisture (%)	Germination (%)	Field emergence (%)	1000 seed weight (g)	Vigour (%)
Moisture (%)	1				
Germination (%)	-0.90***	1			
Field emergence (%)	-0.90***	0.99***	1		
1000 seed weight (g)	-0.91***	-0.91***	-0.92***	1	
Vigour (%)	-0.93***	0.95***	0.94***	-0.92***	1

***means at 0.1% level of probability

4. Conclusion

Requirement of jute seed is increasing day by day but the total production of jute is hampered due to the unavailability of quality seed in Bangladesh. Major jute seed is supplied from the farmer's house but the seed quality is questionable. Moreover, preserving seed for long time affect the seed quality due to the absorption of water from the storage environment. In this research it was evident that storing tossa jute (*Corchorus olitorius*) seed in plastic pot can maintain seed quality up to three years. This research will help to maintain seed quality in the farmer's level.

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Conflict of Interest

The authors declare no conflict of interest.

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