KENAF is a natural fiber that is biodegradable and renewable. Kenaf plays an important role in the global economy, especially in countries such as Bangladesh and India, where they are major producers and exporters of jute and kenaf. Kenaf fiber is used in many different industries including textiles, packaging, and agriculture. The advantages of kenaf and jute contribute to environmental sustainability by reducing the use of synthetic materials. Jute and kenaf cultivation also contribute to carbon sequestration, which can mitigate the impact of climate change (Islam et al., 2014). Jute and kenaf fiber cultivation provides farmers with an additional farming option and diversifies their sources of income. In areas where fibre crop is grown alongside other crops, it can help reduce risks associated with monoculture and increase resilience to pests (Sarker and Alam, 2015).

Farmers in Bangladesh have traditionally grown seeds and fibers simultaneously from the same jute and kenaf plant. Seeds are the basic inputs of agricultural production. Bangladesh requires about 5,500 to 6,000 tons of jute and kenaf seeds every year, of which only 10 to 15% is produced and distributed by BADC (Ali et al., 2003). Quality seeds of improved varieties themselves have increased crop productivity by 20% (Hossen, 2008). Bangladesh supplies about 70% of jute to the world market (Hossain and Abdulla, 2015). However, jute suffers from more than a dozen diseases, of which 10 are seed transmitted (Rashid et al., 1995). To achieve high yields, seed quality must be properly maintained. Good seeds alone can increase yields by 5 to 50% compared to seeds from poor origins (Huda, 2001). Seeds are typically stored in dry, low-humidity conditions to prevent mold growth and maintain viability.

However, extremely low humidity can lead to desiccation and reduced grain quality due to lipid breakdown, protein denaturation, and DNA damage (Bewley and Black, 1994). Refrigeration, often at temperatures above freezing but below room temperature, can significantly extend the life of seeds by slowing metabolism and reducing spoilage. However, very low temperatures can cause the formation of ice crystals, which can damage cell structures and reduce seed viability (Ellis and Hong, 2007). Controlled atmosphere storage involves changing the gas composition of the storage medium, especially the oxygen and carbon dioxide concentrations, to prolong the life of the seed. This method can slow down the respiration and metabolism of seeds, thereby reducing spoilage.
However, improper gas composition can negatively impact seed quality (McDonald and Copeland, 1997). Improper temperature and humidity can cause seeds to deteriorate due to processes such as respiration, mold growth and enzyme activity. Adequate temperature and humidity control is essential to maintain seed viability and vigor (Ellis and Hong, 2007). Exposure to oxygen can lead to oxidative stress, causing lipid peroxidation and damage to cell structures. Vacuuming or using a low-oxygen environment can help extend the shelf life of seeds (Walters and Hill 2004). Exposure to light can promote premature aging and loss of seed viability due to photochemical reactions. Adequate light exclusion during storage is important (McDonald, 1999). Poor storage conditions can promote the growth of pests and pathogens, leading to seed spoilage and spoilage. Proper sanitation and pest control measures are essential (Navie and Adkins, 2006).

The choice of container material can affect seed quality. Improper materials can release toxic chemicals or provide poor moisture control. Jute seeds are very sensitive to drying out and require specific moisture levels to avoid spoilage. Insufficient moisture can lead to loss of viability (Bewley and Black, 1982). Inappropriate storage conditions can promote microbial growth on grain, leading to disease transmission and quality loss (Vieira and Krzyzanowski, 1999). Some seeds are very sensitive to freezing temperatures, which can damage cells by forming ice crystals. Appropriate freezing procedures are needed for long-term preservation (Walters, 2015). To maintain crop quality, good seeds must be used. Considering the above facts, the present study was carried out to develop an environmentally friendly, inexpensive, readily available and safe preservation technique for quality kenaf seeds.

2. METHODS AND MATERIALS

The experiment was conducted from 15th January 2022 to 15th May 2022 at Jute Agriculture Experimental Station (JAES), Manikganj. The experiment was designed according to completely randomized design with four replications. There were three kenaf (Hibiscus cannabinus) seed varieties viz. HC-95(V₁), HC-2(V₂) and BJRI kenaf-3(V₃) used in the experiment. Seeds were collected from the JAES, Manikganj Farm, with appropriate agronomic management. The premises was properly prepared; Crops were sown in mid-August 2021 and harvested in the last week of December 2021. Seeds were harvested when the fruit was about 80% ripe. After harvesting, the crop was dried for three days and then threshed. After that, the seeds were cleaned and dried for another five days in the sun to bring the moisture content of the seeds to about 8%. For mixing of containers: plastic pot (C₁), polythene bag (C₂), cloth bag (C₃) and earthen pot (C₄) were used in the experiment. Seeds were stored in their respective containers on January 15, 2022. Each container was filled with seeds according to experimental requirements and then sealed. Initial germination and field emergence rates were recorded as 98 and 95%, respectively. Seeds were stored at room temperature and normal relative humidity. Data of Germination, field emergence, moisture content and 100-seed weight were recorded timely. Data analysis was performed statistically using analysis of variance (ANOVA) techniques and means were compared using Duncan’s multiple range test (Gomez and Gomez, 1984).

3. RESULTS AND DISCUSSION

3.1 Effect of varieties and containers on germination of kenaf seeds

Seed germination varied significantly at 40, 80 and 120 DAS (Table 1) in different kenaf varieties. In the study it was observed that seed germination was higher at 40 DAS than that of 80 and 120 DAS i.e. germination % was reduced with passing the time after storing. The study also revealed that the highest seed germination (96.0%) was recorded for V₁ on the other hand V₃ showed the lowest seed germination (93.0%) at 40 DAS. Here V₁ remained in the middle position. At 120 DAS, highest seed germination (70.2%) was recorded for V₃ whereas lowest seed germination (67.7%) for V₁. V₁ remained in the middle position. Result revealed that from the above three varieties V₁ (HC-95) performed better compared to other two H. cannabinus (V₂ and V₃) varieties at 120 DAS.

Table 1: Effect of varieties on seed qualities in different storage time

<table>
<thead>
<tr>
<th>Treatment</th>
<th>Germination (%)</th>
<th>Field Emergence (%)</th>
<th>Moisture (%)</th>
<th>100-seed weight (g)</th>
</tr>
</thead>
<tbody>
<tr>
<td></td>
<td>40 days</td>
<td>80 days</td>
<td>120 days</td>
<td>40 days</td>
</tr>
<tr>
<td>V₁</td>
<td>96.0a</td>
<td>90.0a</td>
<td>70.2a</td>
<td>81.0a</td>
</tr>
<tr>
<td>V₂</td>
<td>95.5a</td>
<td>82.0b</td>
<td>69.7a</td>
<td>80.0ab</td>
</tr>
<tr>
<td>V₃</td>
<td>93.0b</td>
<td>79.7c</td>
<td>67.7b</td>
<td>78.5b</td>
</tr>
<tr>
<td>CV</td>
<td>1.91</td>
<td>1.83</td>
<td>2.28</td>
<td>3.09</td>
</tr>
<tr>
<td>LSD</td>
<td>0.73</td>
<td>0.570</td>
<td>0.751</td>
<td>2.088</td>
</tr>
</tbody>
</table>

Note: V₁= Variety; V₁ = HC-95, V₂ = HC-2, V₃ = BJRI Kenaf-3

The effect of container on seed germination of kenaf was found significant at 40, 80 and 120 days after storage (Figure 1 and Figure 2). In the study it was observed that seed germination was higher at 40 DAS than that of 80 and 120 DAS i.e. germination % was reduced with passing the time after storing. The study also revealed that the highest seed germination (95.3%) was recorded for C₁ followed by C₃ (94.6%), on the other hand C₂ showed the lowest seed germination (94.3%) followed by C₃ (95.0%) at 40 DAS. At 120 DAS, highest seed germination (81.6%) was recorded for C₁ whereas lowest seed germination (56.0%) was recorded for C₃. Result revealed that C₁ container performed better compared to other three (C₂, C₃ & C₄) containers at 120 DAS.

The interaction effect of varieties and containers on seed qualities in different storage time of kenaf was found significant at 40, 80 and 120 days after storage (Table 2). The study was observed that seed germination was higher at 40 DAS than that of 80 and 120 DAS in V₁xC₁ and V₁xC₄ treatment combination, i.e. germination % was reduced with the passing time after keeping variety in the container. The study also revealed that the highest seed germination (97.0%) was recorded for V₁xC₁ and V₁xC₄ treatment combination; on the other hand V₁xC₄ treatment combination showed the lowest seed germination (91.0%) at 40 DAS. At 120 DAS, highest seed germination (84.0%) was recorded for V₁xC₁ treatment combination, whereas lowest seed germination (54.0%) for V₁xC₄ treatment combination. Fakir and Alam reported that polythene bag and plastic pot maintained better seed quality in terms of final germination up to 12 month of storage period (Fakir and Alam, 1999).

A group researchers also reported that air tight containers were superior in maintaining viability of jute seed during storage (Haque et al., 2014). Similar results have also been found in kenaf (Mollah, 2014; Mollah et al., 2015). Ogunwale et al., 2019 reported that the type of container used for seed germination can affect aeration and drainage around the seeds. Containers with good drainage and aeration properties can help prevent waterlogged soil, which can inhibit oxygen availability to the germinating seeds. This could potentially impact germination rates, reported that the material and color of seed containers can influence temperature regulation around the seeds (Nersso et al., 1983). Dark-colored containers might absorb more heat from the sun, potentially raising the temperature inside the container. This could either speed up or slow down germination depending on the specific temperature requirements of the seeds. Light-colored containers, on the other hand, may reflect more heat and maintain a more stable temperature.
3.2 Effect of varieties and containers on field emergence of kenaf seeds

The effect of variety on field emergence of kenaf was found significant at 40, 80 and 120 DAS (Table 1). In the study it was observed that field emergence was higher at 40 DAS than that of 80 and 120 DAS i.e. field emergence % was reduced with the passing time after storing. The study also revealed that the highest field emergence (81.0%) was recorded for V1. On the other hand V3 showed the lowest field emergence (78.5%) at 40 DAS. Here, V2 remained in the middle position. At 120 DAS, highest field emergence (63.0%) was recorded for V2 whereas lowest field emergence (61.3%) was recorded for V3. V1 remained in the middle position. Result revealed that from the above three varieties V2 (HC-2) performed better compared to two other V1 and V3 (H. cannabinus) varieties at 120 DAS.

The effect of container on field emergence of kenaf was found significant at 40, 80 and 120 days after storage (Figure 1 and figure 2). In the study it was observed that field emergence was higher at 40 DAS than that of 80 and 120 DAS i.e. field emergence % was reduced with the passing time after storing. The study also revealed that the highest field emergence (85.0%) was recorded for C2 followed by C1 (84.0%). On the other hand C4 showed the lowest field emergence (74.0%) followed by C3 (76.3%) at 40 DAS. At 120 DAS, highest field emergence (72.3%) was recorded for C1 whereas lowest field emergence (51.0%) was recorded for C4. Result revealed that C1 container performed better compared to other three (C2, C3 & C4) containers at 120 DAS.

The interaction effect of varieties and containers on seed qualities in different storage time of jute was found significant at 40, 80 and 120 days after storage (Table 2). In the study it was observed that field emergence was higher at 40 DAS than that of 80 and 120 DAS i.e. field emergence % was reduced with the passing time after storing. The study also revealed that the highest field emergence (86.0%) was recorded for V2xC2 treatment combination followed by others treatment combination. On the other hand V3xC2 treatment combination showed the lowest field emergence (72.0%) followed by other treatment combinations at 40 DAS. At 120DAS, highest field emergence (75.0%) was recorded for V2xC1 whereas lowest field emergence (50.0%) was recorded for V3xC1 treatment combination. The result is in agreement with the report of in kenaf (Fakir and Alam, 1999; Mollah, 2014; Mollah et al, 2015).

Figure 1: Effect of different storage containers on kenaf seed qualities (germination and field emergence)

Figure 2: Effect of different storage containers on kenaf seed qualities (moisture and 100 seed weight)
3.3 Effect of varieties and containers on moisture content of kenaf seeds

The effect of variety on moisture content of kenaf was found significant at 40, 80 and 120 DAS (Table 1). In the study it was observed that moisture percent was lower at 40 DAS than that of 80 and 120 DAS i.e. moisture % was increased with passing the time after storing. From the study it was observed that highest moisture content (10.5%) was recorded for V1. On the other hand V3 showed the lowest moisture content (9.8%) at 40 DAS. Here V1 remained in the middle position. At 120 DAS, highest moisture content (15.8%) was recorded for V2, whereas V3 showed the lowest (15.4%). Here V1 remained in middle position. From the result it was found that increasing moisture content is the cause of decreasing seed quality at all varieties. Many researcher reported the similar results i.e. (Islam, 2009; Ibrahim et al., 2013; Pulok et al., 2014; Mallah et al., 2015; Mallah et al., 2015).

The effect of container on moisture content of jute was found significant at 40,80 and 120 days after storage (Figure 1 and figure 2). In the study it was observed that moisture percent was lower at 40 DAS than that of 80 and 120 DAS i.e. moisture % was increased with passing the time after storing. From the study it was observed that highest moisture content (15.8%) was recorded for V1, whereas V2 showed the lowest (15.4%). Here V1 remained in middle position. From the result it was found that increasing moisture content is the cause of decreasing seed quality at all varieties. Many researcher reported the similar results i.e. (Islam, 2009; Ibrahim et al., 2013; Pulok et al., 2014; Mallah et al., 2015; Mallah et al., 2015).  

3.4 Effect of varieties and containers on 100-seed weight of kenaf seeds

100-seed weight varied significantly varied at 40, 80 and 120 DAS (Table 1) in different kenaf varieties. In the study it was observed that 100-seed weight was lower at 40 DAS than that of 80 and 120 DAS i.e. weight was increased with passing the time after storing. The study also revealed that the highest 100-seed weight (3.14) was recorded for V3, treatment combination followed by others treatment combination. On the other hand V2C treatment combination showed the lowest 100-seed weight (2.77) followed by other treatment combinations at 40 DAS. At 120 DAS, highest 100-seed weight (4.90) was recorded for V2C treatment combination, whereas lowest 100-seed weight (3.21) was recorded for V2C treatment combination, The result is in agreement with the report of (Fakir and Alam, 1999; Mallah, 2014; Mallah et al., 2015).

4. Conclusion

The results showed that the seed quality of the Hibiscus cannabinus HC-95 variety was better than the HC-2 and BJRI kenaf-3 varieties and the plastic polythene and polythene bags had better performance than the cloth bags and earthen pots for a storage period of four months. Plastic pots and polythene bags are more airtight and moisture resistant than the earthen pots and cloth bags. It can be concluded that increased humidity will reduce seed quality regardless of container type and variety.

**References**


Reviews In Food And Agriculture (RFNA) 4(2) (2023) 61-65


