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RESEARCH ARTICLE

EFFECT OF STORAGE CONTAINER ON KENAF SEED QUALITIES

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ABSTRACT

Kenaf seeds lose their ability to germinate during storage, leading to a lack of quality seeds compared to planting requirements, hindering the expansion of kenaf cultivation in Bangladesh. The effects of different storage containers on the germination, field emergence moisture content and 100 seed weight of kenaf seeds of three varieties were studied during a 4-month storage period from mid-January 2022 to mid-May 2022 in a room. Four different containers viz. C_1=A plastic pot, C_2=a polythene bag, C_3=a cloth bag and C_4=an earthen pot are used to store kenaf seeds. Three varieties, V1=HC-95, V_2=HC-2 and V_3=BJRI Kenaf-3 were used in this experiment. This experiment revealed that the percentage of germination and field emergence of all three varieties were reduced with increasing the storage time. On the other hand moisture content and 100-seed weight of three selected varieties were increased with increasing the storage period. Among the four containers it was observed that after 120 days of storage germination percentage was maximum for plastic pot (81.6%) followed by polythene bag (80.6%), cloth bag (58.6%) and minimum for earthen pot (56.0%). Similarly in field emergence the highest result found for plastic pot (72.3%) and lowest for earthen pot (53.3%). On the other hand the highest moisture content and 100 seed weight were recorded in cloth bag (21.1%) and 4.7g in earthen pots respectively and the lowest moisture content (10.4%) and 100 seed weight (3.26%) in plastic pots. Germination rate at 120 DAS was recorded maximum in HC-95 (70.2%) and minimum in BJRI Kenaf-3 (67.7%). The highest filed emergence at 120 DAS was found in HC-2 (63.0%) and lowest in BJRI Kenaf-3 (61.3%). The highest moisture content and 100-seed weight at 120 DAS were obtained in HC-2 (15.8%) and BJRI kenaf-3 (4.04%) respectively. The results reveal that the quality of kenaf seeds decrease with increase the storage time.

KEYWORDS

Kenaf, storage, seed quality, moisture

1. INTRODUCTION

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 jute and kenaf industry provides employment to millions of people and contributes to the GDP of these countries (Miah and Uddin, 2017). Jute and kenaf 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 fibre cultivation provide 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 input 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.

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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 encourage 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(V_1), HC-2(V_2) and BJRI kenaf-3(V_3) used in the experiment. Seeds were collected from the JAES, Mainkganj 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%. Four types of containers: plastic pot (C_1), polythene bag (C_2), cloth bag (C_3) and earthen pot (C_4) 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 V_1; on the other hand V_3 showed the lowest seed germination (93.0%) at 40 DAS. Here V_2 remained in the middle position. At 120 DAS, highest seed germination (70.2%) was recorded for V_1, whereas lowest seed germination (67.7%) for V_3. V_2 remained in the middle position. Result revealed that from the above three varieties V_1 (HC-95) performed better compared to two other *H. cannabinus* (V_2 and V_3) varieties at 120 DAS.

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

Treatment	Germination (%)			Field Emergence (%)			Moisture (%)			100-seed weight (g)		
	40 days	80 days	120 days	40 days	80 days	120 days	40 days	80 days	120 days	40 days	80 days	120 days
V_1	96.0a	90.0a	70.2a	81.0a	69.0a	61.5a	10.5a	13.9a	15.4b	3.04a	3.42b	3.82c
V_2	95.5a	82.0b	69.7a	80.0ab	69.7a	63.0a	10.4a	13.8b	15.8a	2.96b	3.55a	4.00b
V_3	93.0b	79.7c	67.7b	78.5b	69.5a	61.3a	9.8b	13.7b	15.6b	2.96b	3.37c	4.04a
CV	1.91	1.83	2.28	3.09	5.58	5.57	4.55	2.98	3.75	2.53	2.09	2.01
LSD	0.733	0.570	0.751	2.088	3.278	2.920	0.395	0.114	0.231	0.041	0.036	0.039

Note: V=Variety; V_1= HC-95, V_2= HC-2, V_3= 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 C_1 followed by C_2 (94.6%), on the other hand C_3 showed the lowest seed germination (94.3%) followed by C_4 (95.0%)) at 40 DAS. At 120 DAS, highest seed germination (81.6%) was recorded for C_1, whereas lowest seed germination (56.0%) was recorded for C_4. Result revealed that C_1 container performed better compared to other three (C_2, C_3 & C_4) 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 V_1xC_4 and V_2xC_2 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 V_1xC_4 and V_2xC_2 treatment combination; on the other hand V_3xC_3 treatment combination showed the lowest seed germination (91.0%) at 40 DAS. At 120 DAS, highest seed germination (84.0%) was recorded for V_1xC_1 treatment combination, whereas lowest seed germination (54.0%) for V_3xC_4 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 (Nerson 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.

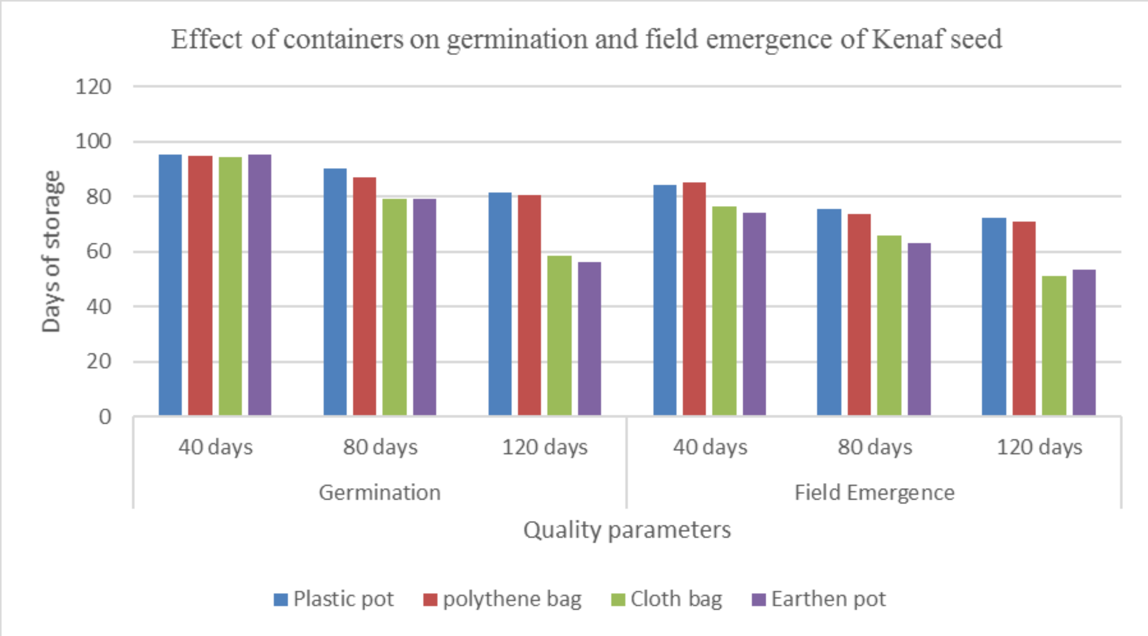

Figure 1: Effect of different storage containers on kenaf seed qualities (germination and field emergence)

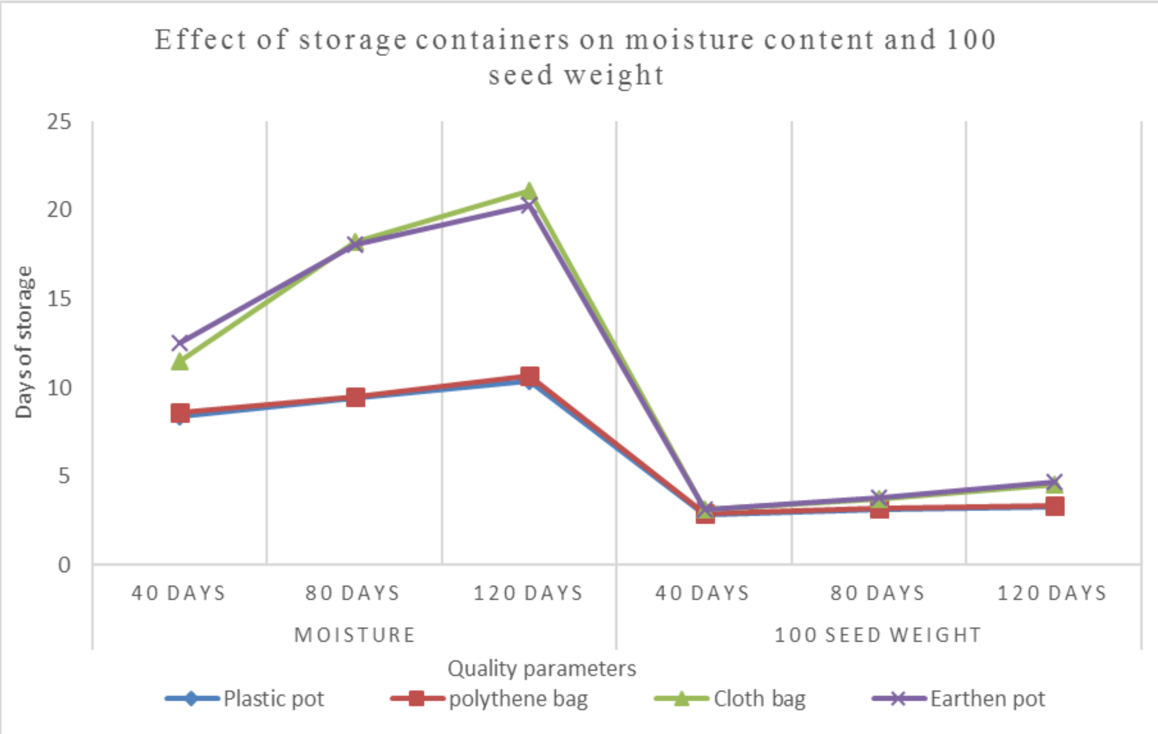

Figure 2: Effect of different storage containers on kenaf seed qualities (moisture and 100 seed weight)

3.2 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 V_1. On the other hand V_3 showed the lowest field emergence (78.5%) at 40 DAS. Here, V_2 remained in the middle position. At 120 DAS, highest field emergence (63.0%) was recorded for V_2, whereas lowest field emergence (61.3%) was recorded for V_3. V_1 remained in the middle position. Result revealed that from the above three varieties V_2 (HC-2) performed better compared to two other V_1 and V_3 (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 passing the time after storing. The study also revealed that the highest field emergence (85.0%) was recorded for C_2 followed by C_1 (84.0%). On the other hand C_4 showed the lowest field emergence (74.0%) followed by C_3 (76.3%) at 40 DAS. At 120 DAS, highest field emergence (72.3%) was recorded for C_1, whereas lowest field emergence (51.0%) was recorded for C_3. Result revealed that C_1 container performed better compared to other three (C_2, C_3 & C_4) 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 V_2xC_2 treatment combination followed by others treatment combination. On the other hand V_3xC_4 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 V_2xC_1, whereas lowest field emergence (50.0%) was recorded for V_3xC_4 treatment combination. The result is in agreement with the report of in kenaf (Fakir and Alam, 1999; Mollah, 2014; Mollah et al., 2015).

Table 3: Interaction effect of varieties and containers on seed qualities in different storage time

Treatment	Germination			Field Emergence			Moisture			100 seed weight		
	40 days	80 days	120 days	40 days	80 days	120 days	40 days	80 days	120 days	40 days	80 days	120 days
V_1xC_1	96.0ab	95.0a	84.0a	85.0a	72.0bcd	70.0ab	8.50d	9.80d	10.50fg	2.86d	3.08h	3.21i
V_1xC_2	95.0bc	93.0b	82.0b	84.0a	70.0cd	69.0b	8.70d	9.60de	11.10e	2.96c	3.13gh	3.25hi
V_1xC_3	96.0ab	87.0c	57.0ef	79.0bc	68.0de	52.0cd	12.0b	18.50a	20.50c	3.18a	3.69d	4.17e
V_1xC_4	97.0a	85.0d	56.0f	76.0cd	66.0def	55.0c	13.0a	17.90c	19.60d	3.19a	3.77c	4.64c
V_2xC_1	94.0cd	87.0c	82.0b	84.0a	78.0ab	75.0a	8.20d	9.50e	10.60f	2.77e	3.18g	3.35fg
V_2xC_2	97.0a	84.0d	80.0c	86.0a	79.0a	74.0ab	8.50d	9.70de	10.40fg	2.81de	3.30f	3.41f
V_2xC_3	96.0ab	79.0e	61.0d	76.0cd	62.0ef	48.0d	11.80b	17.80c	21.60a	3.08b	3.83b	4.54d
V_2xC_4	95.0bc	78.0e	58.0e	74.0d	60.0f	55.0c	13.20a	18.20b	20.80bc	3.17a	3.90a	4.72b
V_3xC_1	96.0ab	88.0c	79.0c	83.0ab	76.0abc	72.0ab	8.40d	8.90g	10.10g	2.82de	3.14gh	3.23hi
V_3xC_2	92.0ef	84.0d	80.0c	85.0a	72.0bcd	70.0ab	8.60d	9.20f	10.50fg	2.82de	3.12gh	3.29gh
V_3xC_3	91.0f	72.0g	58.0e	74.0d	67.0de	53.0cd	10.80c	18.50a	21.20ab	3.16a	3.62e	4.90a
V_3xC_4	93.0de	75.0f	54.0g	72.0d	63.0ef	50.0cd	11.50bc	18.20b	20.60c	3.04b	3.62e	4.75b
CV	1.91	1.83	2.28	3.09	5.58	5.57	4.55	2.98	3.75	2.53	2.09	2.01
LSD	1.466	1.141	1.503	4.176	6.556	5.841	0.790	0.229	0.597	0.077	0.063	0.067

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 120DAS (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 V_1. On the other hand V_3 showed the lowest moisture content (9.8%) at 40 DAS. Here V_2 remained in the middle position. At 120 DAS, highest moisture content (15.8%) was recorded for V_2, whereas V_1 showed the lowest (15.4%). Here V_3 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; Mollah et al., 2015; Mollah 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 (12.5%) was recorded for C_4 followed by C_3 (11.5%), on the other hand C_1 showed the lowest moisture content (8.36%) followed by C_2 (8.60%) at 40 DAS. At 120 DAS, highest moisture content (21.1%) was recorded for C_3, whereas C_1 showed the lowest (10.40%) (Haque et al., 2014).

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. seed weight was increased with passing the time after storing. The study also revealed that the highest 100-seed weight (3.04) was recorded for V_1; on the other hand V_2 and V_3 showed the same weight of 100-seed (2.96) at 40 DAS. At 120DAS, highest 100-seed weight (4.04) was recorded for V_3, whereas lowest 100-seed weight (3.82) for V_1. V_2 remained in the middle position.

The effect of container on 100-seed weight 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 100-seed weight was lowest 40 DAS than that of 80 and 120 DAS i.e. 100 seed weight was increased with passing the time after storing. The study also revealed that the highest 100-seed weight (3.14) was recorded for C_3 followed by C_4 (3.13), on the other hand C_1 showed the lowest 100-seed weight (2.81) followed by C_2 (2.86)) at 40 DAS. At 120DAS, highest 100-seed weight (4.70) was recorded for C_4, whereas lowest 100-seed weight (3.26%) was recorded for C_1. Result revealed that C_4 container performed better compared to other three (C_1, C_2 & C_3) 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). In the study it was observed that the 100-seed weight was higher at 120 DAS than that of 40 and 80 DAS i.e. 100-seed weight was increased with passing the time after storing. The study also revealed that the highest 100-seed weight (3.19) was recorded for V_1xC_3 treatment combination followed by others treatment combination. On the other hand V_2xC_1 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 V_3xC_3 treatment combinations, whereas lowest 100-seed weight (3.21) was recorded for V_1xC_1 treatment combination. The result is in agreement with the report of (Fakir and Alam, 1999; Mollah, 2014; Mollah 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 pot 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.

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