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Research Article

ASSESSMENT OF SEED QUALITIES IN RELATION TO STORAGE MATERIALS USED IN ETHNIC COMMUNITIES OF MOULVIBAZAR DISTRICT

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Abstract

Quality seeds are very important for successful crop production. Manipuri, Khasia and Garo ethnic communities cultivate different types of crops in their farmlands and save their own seeds traditionally which are quite different from general farmers. Quality analyses of farmer's saved seeds of ethnic communities have not been studied. Therefore, the experiment was designed to study the seed storage technologies used by ethnic communities. A total of 29 seed samples collected where 15 seed samples from the Manipuri, 4 from the Khasia, and 10 from the Garo ethnic communities to determine seed quality especially purity, germination, planting value of seed (PVS). In seed samples of the Manipuri community, the percentage germination, purity, and planting value of seeds (PVS) varied from 1.5% to 97.0%, 98% to 99%, and 0.5% to 94.1%, respectively. The highest germination (97.0%), purity (99.0%), and PVS (94.1%) were found in rice BRRI dhan 94 (Ranjit dhan) seed samples and the lowest germination (1.5%) and PVS (0.5%) was found in okra seed samples. The highest normal seedlings (95%) were also found in the rice (Ranjitdhan) seed sample. In seed samples collected from the Khasia community, germination percentage ranged from 3.3% to 93.8% whereas purity and PVS ranged from 98% to 99% and 1.7% to 91.1%, respectively. The highest germination was found in sponge gourd (93.8%) along with the highest normal seedlings (92.0%) and the lowest was found in country bean (3.3%). The highest PVS was found in sponge gourd (91.1%) followed by long yard bean (85.9%) and lai shak (80.4%) and the lowest were found in country bean (1.7%). In Garo communities, the purity percentage of seed samples ranged from 98% to 99% whereas germination percentage varied from 2.5% to 98.5%. The highest germination was found in okra seed (98.0%) whereas the lowest germination (2.5%) was in french bean and wax gourd, respectively. PVS was calculated which varied from 1.2% to 95.5%. The highest PVS was recorded in okra seed (95.5%) followed by lai shak (78.9%). The lowest PVS (1.2%) was in french bean and wax gourd. The highest normal seedlings were produced from okra seed samples (96.5%). A total of 14 fungi representing 12 genera were detected to be associated with the 15 seed samples collected from Manipuri ethnic community; 7 fungi representing 5 genera were detected from the seed samples of Khasia community and 9 fungi representing 8 genera were detected from seed samples of Garo community. The storage techniques used by three ethnic communities, keeping seeds in gunny bags, glass bottles, and cloth bags are suitable for the storage of seed samples. Fumigation was found to be good for keeping away from storage fungi and maintaining the quality of seeds, especially germination.

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Introduction

The overall economic development of Bangladesh greatly depends on successful crop production. Seed is the basic input for crop production and only quality seed can maximize the yield of crops (Huda et al., 2005). Quality seed alone can increase by 20% crop yield (Ahmed, 2013). High-quality seeds lead to excellent seedling performance with uniform growth stands in the field.

Healthy and quality seed is necessary not only for effective cultivation but also for enhancing crop yields. Quality seeds mean high seed weight with low moisture content, high vigor, high yielding potentiality with high nutritive value, and varietal purity with freedom from admixture, high germination capacity, and free from seed-borne pathogens (healthy seeds) (Huda et al., 2005).Therefore, the last criterion (free from seed-borne pathogens) is virtually the most important and determining factor for the quality of seed, because seeds are the most important and efficient vehicles of pathogens (Rashid, 2015). Seed health is the most significant seed quality criterion since most pathogens present in the seed can induce progressive disease development in the field, lowering the economic value of the crop, and imported seed lots might bring diseases or pests into new locations (Gebeyaw, 2020). Seed-borne infections are not only the cause of agricultural seed germination failure, but they are also responsible for plant morphological variation in the field, lowering output by up to 90% (Gebeyaw, 2020). The pathogens often get connected with the seeds or persist as contamination or simultaneous contamination with the seeds during development, maturation, harvesting, and threshing. Fungal infections are crucial in the decline of seed quality during storage. The degrading activities of the microorganisms in storage, which first affect the field performances by diminishing seed quality and plant stand, result in the loss of about 1% to 2% of the world's grain/seed output (Rashed, 2015).

There is an estimated 0.856 million tons of yearly seed demand for various crops in Bangladesh. The numerous NGOs supply only 2.2% of high-quality seeds out of this total, compared to BADC's 4.3%. The remaining 93.5% of seeds are either completely met by farmers saved seeds using traditional methods or a part of it are imported from abroad (Meah and Doullah, 2007).

The farmers conserve their own seeds using their own technique, which has a significant impact on the seeds' quality (Fakir et al., 2002). Materials that are often inexpensive and readily accessible are utilized as storage containers. To prevent the seed from absorbing moisture, farmers have used a variety of storage containers over the years (Chowdhury et al., 1990).

At least 350 million people worldwide are classified as indigenous, and over three million indigenous people from 45 diverse communities live throughout Bangladesh (Shikdar et al., 2013). In Bangladesh, the population of indigenous people is over 3 million which signifies 2% of the total population of the country. Manipuri, Khasia, and Garo indigenous communities are living in the Moulvibazar, Sylhet, and Sunamganj districts of the Sylhet division (Sheram, 2005). Their traditional livelihood is agriculture. As a plain land inhabitant, the system of agriculture is like the mainstream people of Bangladesh which is mainly based on traditional knowledge (Islam et al., 2016). Now-a-days like mainstream people, they are introducing a few modern technologies and types of equipment in traditional farming. They produce both food and seed grain on their farmlands and save their own seeds traditionally for next cultivation which is quite different from general farmers. Seed qualities of ethnic communities in relation their traditional techniques used for storing seeds have not been studied. Considering the importance of seed quality, the present research was designed to study seed quality by ethnic communities in relation to their storage techniques.

Materials and Methods

Survey

Three baseline surveys were conducted in three ethnic communities namely Manipuri of Kamalganj, Khasia of Kulaura, and Garo of Sreemangal upazila under the Moulvibazar district following Focus Group Discussion (FGD). FGD was conducted in each study site to acquire primary knowledge about the major crops, sources of seed and seed storage techniques.

Experimental site and period

Field and laboratory experiments were carried out at the net house of the Department of Plant Pathology and Seed Science, Faculty of Agriculture, Sylhet Agricultural University (SAU) and Seed Pathology Centre (SPC), Bangladesh Agricultural University (BAU), Mymensingh. The experiments were conducted during July, 2022 to March, 2023.

Sample collection

Based on FGD, seeds used by specific ethnic communities were collected directly from the stores of the cooperator farmers according to the rules of International Seed Testing Association (ISTA, 1996). A total of 29 seed samples were collected where 15 seed samples from the Manipuri community, 4 from the Khasia community and 10 from the Garo community for determining seed quality in relation to purity, germination, planting value of seed (PVS) and seed health (seed-borne fungi) status. The collected samples were immediately stored in the lab at room temperature after proper registration (Table 1). The samples were stored untill it was used for the tests.

Table 1. Collected seed samples used by Manipuri, Khasia and Garo ethnic communities of Moulvibazar district

Sl.No.	Common mane	Scientific name	Storage condition
	Manipura community:		
1	Rice (Sail dhan)	*Oryza sativa*	Plastic bag
2	Rice (Chinigura)	*Oryza sativa*	Plastic bag
3	Rice (Ranjit dhan)	*Oryza sativa*	Gunny bag
4	Rice (Swarnomoshuridhan)	*Oryza sativa*	Plastic bag
5	Kaon	*Setaria italica*	Plastic Kowta
6	Sesame	*Sesamum indicum*	Plastic Kowta
7	Mustard	*Brassica campestris*	Glass Bottle
8	Lai Shaak	*Brassica juncea*	Glass Bottle
9	Amaranth	*Amaranthus viridis*	Plastic Kowta
10	French bean	*Phaseolus vulgaris*	Plastic Kowta
11	Franch bean (Hybrid)	*Phaseolus vulgaris*	Plastic Kowta
12	Country bean	*Lablab purpureus*	Plastic Kowta
13	Yardlong bean	*Vigna unguiculata* ssp.*sesquipedalis*	Plastic Kowta
14	Yellow berried nightshade/Bonbegun	*Solanum xanthocarpum*	Plastic Kowta
15	Okra	*Abelmoschus esculentus*	Plastic Kowta
	Khasia ethnic community:		
16	Yardlong bean	*Vigna unguiculatus* ssp. *sesquipedalis*	Cloth bag
17	Country bean	*Lablab purpureus*	Cloth bag
18	Sponge gourd	*Luffa aegyptiaca*	Cloth bag
19	Lai shaak	*Brassica juncea*	Cloth bag
	Garo ethnic community:		
20	Sponge gourd	*Luffa aegyptiaca*	Plastic bag
21	Country bean	*Lablab purpureus*	Plastic bag
22	Maize	*Zea mays*	Plastic Kowta
23	French bean	*Phaseolus vulgaris*	Plastic kowta
24	Pumpkin	*Cucurbita moschata*	Plastic bag
25	Chili	*Capsicum frutescens*	Plastic bottle
26	Wax gourd	*Benincasa hispida*	Plastic bag
27	Coriander	*Coriandrum sativum*	Plastic Kowta
28	Okra	*Abelmoschus esculentus*	Plastic bag
29	Lai Shaak	*Brassica juncea*	Glass bottle

Seed quality analysis

Purity test

Forty-gram (40g) seeds of each collected sample were taken for conducting a purity test. Accordingly, the seed was grouped into three categories as i) pure seed ii) other crop seed iii) inert matter following the International Rules for Testing Seeds (ISTA, 2001). Results were expressed as percentages.

Germination test

The germination percentage of farmer's saved seeds was determined according to the ISTA rule (ISTA, 2001). Tray (0.5 m ×1 m; made by steel sheet) filled with sterilized coarse sand was used for the germination test at net house of Plant pathology and Seed Science department. Two hundred (200) seeds were used for the germination test maintaining four replications (50 seeds in each replication and one replication in one tray). The trays were arranged following Completely Randomized Design (CRD). Germination was recorded at 4, 7, and 14 days after sowing. Normal seedlings, abnormal seedlings, and dead seeds were counted separately according to ISTA rule and were expressed in percentages.

Seed health test

Seeds health test were conducted at testing laboratory of Dr. Golam Ali Fakir Seed Pathology Centre (SPC), Bangladesh Agricultural University (BAU), Mymensingh. The seed health test was done by standard blotter method (ISTA, 2006). Two hundred seeds from each sample were tested maintaining four replications (50 seeds/replication). The associate fungi were identified by observing their growth on the incubated seeds on blotter paper under a stereo microscope at 25x magnification. In case of doubtful identification temporary slides were prepared and examined the spore under a compound microscope following the key outlined by Malone (1964), and Musket (1964) and Ellis (l97l).

Determination of Planting Value of Seed (PVS) or Pure Live Seed (PLS)

The planting value of the seed was determined by following the formula below in terms of the transmitting pathogenic effects on the growth exterminating parameters (Huda et al., 2006)

$$\text{Planting Value of Seed/ Pure Live Seed} = \frac{Pure\ seed\ (\%) \times Normal\ seedling\ (\%)}{100}$$

Experimental design and statistical analysis

The net house experiment was followed by Completely Randomized Design (CRD) with four replications. The rerecorded data on various parameters was analyzed using the R statistical package program. The level of significance and analysis of variance along with the Least Significant Difference (LSD) was followed by Gomez and Gomez (1994).

Results and Discussion

Survey

Following FGD (Focus Group Discussion), 3 baseline surveys was conducted in the Manipuri, Khasia and Garo ethnic community at Kamalgonj, Kulaura and Sreemangal upazila of Moulvibazar district to know about the major cultivated crops, sources of seed, and their seed storage techniques. A questionnaire was used to collect data about their saved seeds and seed storage techniques. A total of 29 seed samples where 15 were from the Manipuri community, 4 were from the Khasia community and 10 from the Garo community were collected directly from the stores of the cooperator farmers to determine the qualities of their saved seeds as presented in Table 1. Akhter et al. (2013) also used the focus group discussions (FGD) method in their studies of integrated homestead forestry systems among different ethnic communities especially Manipuri, Khasia, and Garo people and found that the seeds were kept in gunny bag (made of jute), cloth bag, plastic bag, plastic kowta (plastic bottle) and glass bottle, and store in their own house at room temperature for next year cultivation.

Percent purity, germination and planting value of seed (PVS)

Purity, germination and planting value of seed (PVS) of collected seed samples varied depending on seed samples within the communities.

Purity percentage ranged between 98-99% in all three communities. Germination percentage varied from 1.5 to 97% in 15 seed samples of Monipuri community. The highest germination percentage was found in rice seed samples that ranged between 87.0-97.0% followed by amaranth (86.8%), lai shaak (85.0%), mustard (84.3%), kaon (72.5%) and french bean (70.8%). Very low germination was recorded in okra (1.5%), french bean (hybrid) (1.8%) bonbegun (3.5%), sesame (14.5%), and yardlong bean (37.0%) (Table 2). In case of Khasia community, germination percentage was varied from 3.3

to 93.8% in four seed samples. Highest germination was obtained in sponge gourd (93.8%) and lowest germination was found in country bean (3.3%) seed samples (Table 2). In Garo community, germination percentages varied between 2.5 to 98.5%. The highest germination (98.5%) was found in okra seed sample whereas the lowest germination (2.5%) was in french bean and wax gourd, respectively (Table 2).

The planting value of seeds (PVS) was determined in collected seed samples of three ethnic communities. The PVS Monipuri community's seed samples ranged between 0.5 to 94.1%. The highest PVS was found in Rice (Ranjitdhan) (94.1%) and the lowest was found in okra (0.5) followed by french bean hybrid (0.7%) and bonbegun (1.5%) (Table 2). PVS varied from 1.7% to 91.1% in the seed samples of Khasia community. The highest PVS was recorded in sponge gourd (91.1%) followed by Yardlong bean (85.9%) and Lai shaak (80.4%), and the lowest PVS was found in country bean (1.7%) (Table 2). The PVS of 10 Garo comunity's seed samples varied from 1.2 to 95.5%. The highest PVS was recorded in okra seed (95.5%) followed by lai shaak (78.9%). The lowest PVS (1.2%) was recorded in french bean and wax gourd (Table 2).

Table 2. Percent germination, purity, and planting value of seed (PVS) of collected seed samples of three ethnic communities

Crop name	Germination (%)	Purity (%)	PVS (%)
Monipuri Community			
Rice (Sail dhan)	87.0±2.58	99.0	84.2
Rice (Chiniguradhan)	92.8±1.71	99.0	89.9
Rice (Ranjitdhan)	97.0±1.83	99.0	94.1
Rice (Swarnomoshuridhan)	94.5±2.08	99.0	91.0
Kaon	72.5±2.08	99.0	69.5
Sesame	14.5±1.29	98.0	12.0
Mustard	84.3±2.99	99.0	81.2
Lai Shaak	85.0±1.83	99.0	81.7
Amaranth	86.8±2.75	99.0	83.4
French bean	70.8±2.22	99.0	68.0
French bean(hybrid)	1.8±1.26	98.0	0.7
Country bean	54.3±2.22	99.0	51.7
Yardlong bean	37.0±1.83	98.0	34.1
Yellow berried nightshade/Bonbegun	3.5±1.29	98.0	1.5
Okra	1.5±1.29	98.0	0.5
Khasia Community			
Yardlong bean	88.8 ± 3.50	99.0	85.9
Country bean	3.3 ± 4.72	98.0	1.7
Sponge gourd	93.8 ± 5.38	99.0	91.1
Lai shaak	83.8 ± 3.77	99.0	80.4
Garo Community			
Sponge gourd	25.5 ± 3.42	98.0	21.6
Country bean	52.5 ± 6.45	99.0	48.3
Maize	66.5 ± 3.11	99.0	64.4
French bean	2.5 ± 2.08	98.0	1.2
Pumpkin	54.8 ± 2.22	99.0	52.7
Chili	35.8 ± 2.99	99.0	31.9
Wax gourd	2.5 ± 2.38	98.0	1.2
Coriander	37.0 ± 1.83	98.0	33.3
Okra	98.5 ± 1.29	99.0	95.5
Lai shaak	82.3 ± 2.22	99.0	78.9

Note: ± SD (Standard deviation)

Normal seedlings, abnormal seedlings and dead seeds

Percentage of healthy seedlings, non-healthy seedlings and dead seeds determined from collected seed samples of three ethnic communities are presented in Table 3. The occurrence of healthy seedlings, non-healthy seedlings as well as dead seeds varied depending on crops and the seed storage conditions. In case of Manipuri community, percentage of normal seedlings was ranged from 0.5 to 95.0. Rice seeds gave the best normal seedlings (85.0-95.0%) where okra gave the lowest

(0.5%) followed by French bean (hybrid) (0.8%) and bonbegun (1.5%) along with highest dead seed 98.5%, 98.3% and 96.5%, respectively. Beside this, lower normal seedlings were found in sesame (12.3%), yard long bean (34.8%), and country bean (52.3%) seed samples.

Table 3. Normal seedlings, abnormal seedlings, and dead seeds recorded in collected seed samples of three ethnic communities

Seed samples	Normal seedling (%)	Abnormal seedling (%)	Dead seed (%)
Manipuri community:			
Rice (Sail dhan)	85.0 ± 2.83	2.0 ± 1.16	13.0 ± 2.58
Rice (Chiniguradhan)	90.8 ± 2.22	2.0 ± 0.82	7.3 ± 1.71
Rice (Ranjitdhan)	95.0 ± 1.83	2.0 ± 0.82	3.0 ± 1.83
Rice (Swarnomoshuridhan)	92.0 ± 2.16	2.5 ± 0.58	5.5 ± 2.08
Kaon	70.3 ± 1.71	2.3 ± 0.50	27.5 ± 2.08
Sesame	12.3 ± 1.71	2.3 ± 0.96	85.5 ± 1.29
Mustard	82.0 ± 2.16	2.3 ± 0.96	15.8 ± 2.99
Lai shaak	82.5 ± 1.29	2.5 ± 0.58	15.0 ± 1.83
Amaranth	84.3 ± 2.99	2.5 ± 0.58	13.3 ± 2.75
French bean	68.8 ± 3.30	2.0 ± 1.16	29.3 ± 2.22
French bean(hybrid)	0.8 ± 0.50	1.0 ± 0.82	98.3 ± 1.26
Country bean	52.3 ± 2.63	2.0 ± 0.82	45.8 ± 2.22
Yardlong bean	34.8 ± 1.71	2.3 ± 0.96	63.0 ± 1.83
Yellow berried nightshade/Bonbegun	1.5 ± 0.58	2.0 ± 0.82	96.5 ± 1.29
Okra	0.5 ± 0.58	1.0 ± 0.82	98.5 ± 1.29
Khasia community:			
Yardlong bean	86.8 ± 4.27	2.0 ± 0.82	11.3 ± 3.50
Country bean	1.8 ± 2.87	1.5 ± 1.91	96.8 ± 4.72
Sponge gourd	92.0 ± 5.16	1.8 ± 0.96	6.3 ± 5.38
Lai shaak	81.3 ± 3.30	2.5 ± 1.29	16.3 ± 3.77
Garo community:			
Sponge gourd	22.0 ± 4.24	3.5 ± 1.29	74.5 ± 3.42
Country bean	48.8 ± 6.13	3.8 ± 0.96	47.5 ± 6.45
Maize	65.0 ± 2.94	1.5 ± 0.58	33.5 ± 3.11
French bean	1.3 ± 1.26	1.3 ± 0.96	97.5 ± 2.08
Pumpkin	53.3 ± 1.71	1.5 ± 0.58	45.3 ± 2.22
Chili	32.3 ± 2.99	3.5 ± 1.91	64.3 ± 2.99
Wax gourd	1.3 ± 0.96	1.3 ± 1.50	97.5 ± 2.38
Coriander	34.0 ± 2.94	3.0 ± 1.83	63.0 ± 1.83
Okra	96.5 ± 1.29	2.0 ± 1.15	1.5 ± 1.29
Lai shaak	79.8 ± 1.89	2.5 ± 1.29	17.8 ± 2.22

Note: ± SD (Standard deviation)

In Khasia community, the highest normal seedlings (92.0%) were recorded in sponge gourd seed followed by yard long bean (86.8%) and lai shaak (81.3%) where the lowest normal seedling was found in country bean seed (1.8%) with the highest dead seeds (96.8%) (Table 3). In Garo community, okra seed produced the highest number of normal seedlings (96.5%) followed by lai shaak (79.8%) where wax gourd and french bean seed produced the lowest number of normal seedlings (1.3%) along with highest dead seeds (97.5%).

The people of Manipuri ethnic community keep their own seeds in gunny bag (made of jute) and plastic bags for rice seeds, plastic kowta (plastic bottle) for kaon, sesame, country bean, french bean, yard long bean, okra, bonbegun seeds, and glass bottle for mustard, lai shaak, and amaranth seeds and store at room temperature in their own house. The rice seed sample showed the highest germination, which ranged from 87.0% to 97.0%. Brassica seed samples showed the second-highest germination (70.8% to 86.8%). Whereas country bean gave 54.3% and yard long bean 37.0% germination. The lowest germination was found in okra seed samples (1.5%) followed by french bean (hybrid) (1.8%) and bonbegun seed (3.5%).

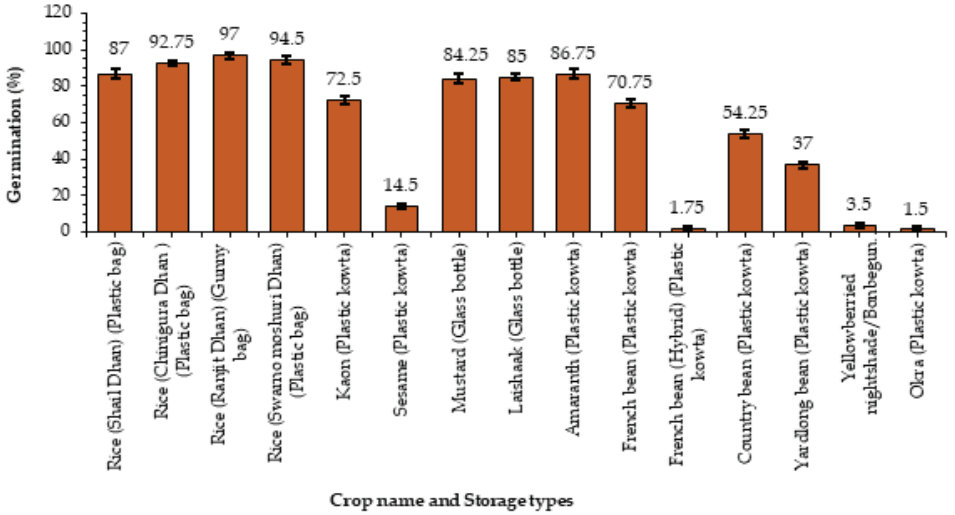

Figure 1. Germination percentage of collected seed samples in relation to storage techniques used by Manipuri community. Bar indicates ± SD (Standard Deviation).

The people of Khasia ethnic community store their own seeds in different ways. They dry the seeds under the sun properly. After drying, seeds are kept in cloth (cloth putli) and stored at 3-4 meters above on a furnace placed in the kitchen so that the seeds are fumigated until used. Figure 2 shows the storage technique used by the community in relation to germination. The highest germination was found in sponge gourd (93.75%) followed by yard long bean (88.75%) and lai shaak (83.75%). The lowest germination was found in country bean seed samples (3.25%).

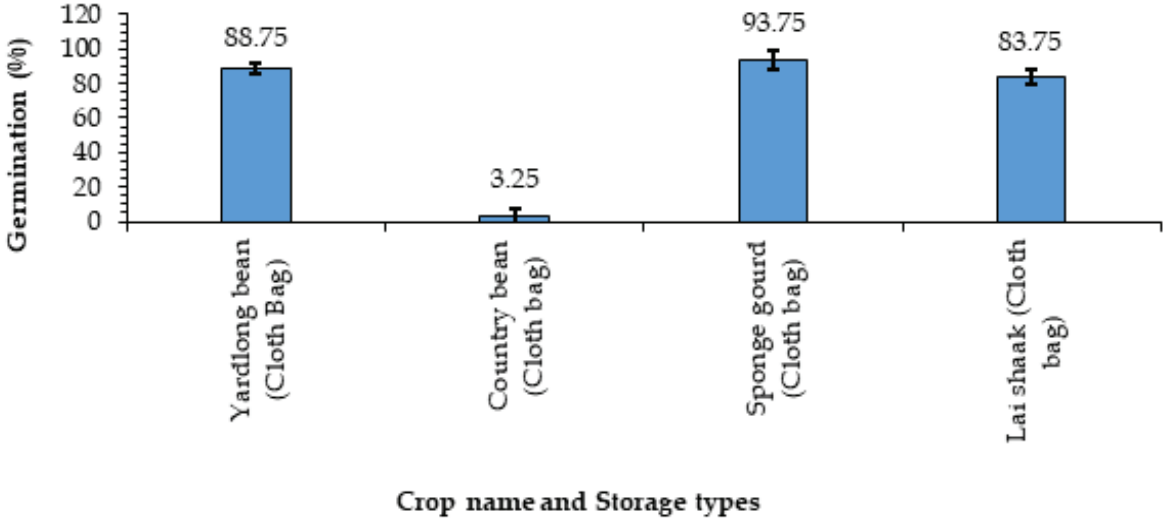

Figure 2. Germination percentage of collected seed samples in relation to storage techniques used by Khasia community. Bar indicates ± SD (Standard Deviation).

Garo ethnic community stores their seed samples in accordance with the Manipuri community. The highest germination percentage was found in okra seeds (98.0%) followed by lai shaak seeds (82.3%) (Figure 3) where the lowest germination was found in okra seeds (1.5%) of the Manipuri community (Figure 3).

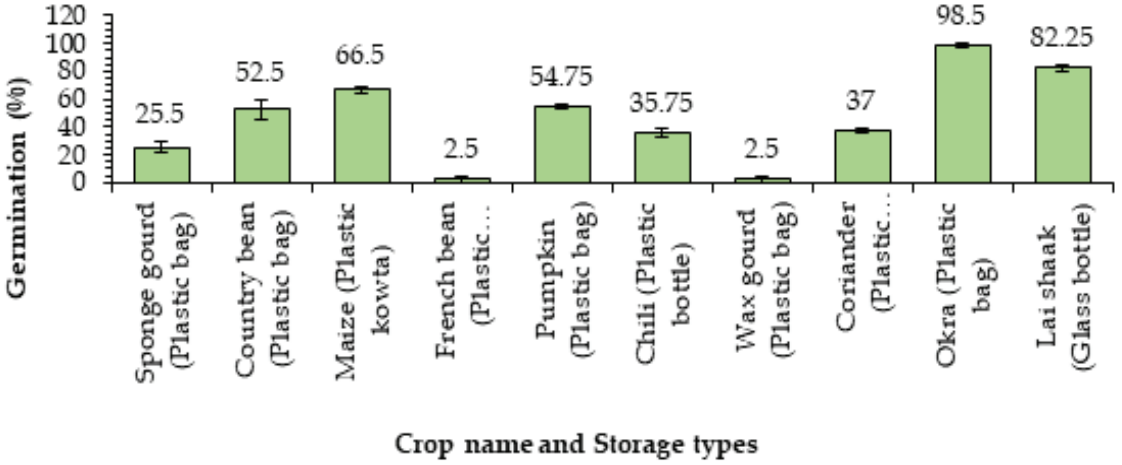

Figure 3. Germination percentage of collected seed samples in relation to storage techniques used by Garo ethnic community. Bar indicates ± SD (Standard Deviation).

Similar types of studies have been reported in other ethnic communities of India. Lamichaney et al. (2019) studied traditional seed storage practices of the Lepcha and Limboo tribes in Sikkim. They identified six common storage structures (bhakari, kotha, dalo, chindo, Jhutta and dhikuti) to store grains like rice and maize. The storage structures of bamboo, with occasional use of mud, wood, wheat straw, and cow dung were found to be predominant. Miah et al. (2018) conducted a study to assess the cost-effectiveness and sustainability of different seed storage methods for wheat farmers and revealed that among the various storage containers used, plastic sacs, poly bags, and plastic/metal drums, were the most effective techniques for maintaining seed quality that gave the highest normal seedlings. Harun et al. (2002) experimented with seven participatory rice farmers of Gazipur in 2001. They stored their boro rice seed in different storage materials. The performance of seed storage materials lemo foil bag+neem and plastic drum were better in terms of increasing normal seedlings, shoot length and vigor. Insect infestation and pathogenic incidence were lower in these materials. The storage tin+ naphthalene also had good performance and produced higher number of normal seedlings, increased shoot length and vigor index. The storage motka painted+neem was found efficient in producing normal seedlings and higher shoot length. Storage seeds in poly bag and polybag +chalk showed very poor results with respect to storage performance. The results is consistent with our result that polybag or plastick kowta are not good for keeping seeds for future cultivation in terms of maintaining seed quality. However, the use of kanaja/galagi (a bamboo structure), sandaka (a wooden structure), utrani (mud pots), Hagevu (an underground structure) for the storage of their seeds to maintain seed viability by ethnic communities in India (Channal et al., 2004). The study also revealed that the storage duration of seeds increased by using neem, turmeric, garlic, chili seeds, salt, Bengal gram seeds, etc. Kandil et al. (2013) studied some soybean cultivars, i.e. Giza 21, Giza 22, Giza 35, Giza 111, Crawford, and concluded that storage Giza 111 cultivar improved germination capabilities while stored in a refrigerator (10 ± 1ºC) using cotton bags for three months. It is reported that bamboo baskets mud constructions, gunny bags, and contemporary bins were used in traditional storage systems (Shaila and Begum, 2021).

In the Khasia community, the farmers keep their seeds in cloth (cloth putli) and store them at 3-4 meters above on a furnace placed in the kitchen for fumigation. We found good germination percentage and good number of normal seedlings in these seed samples. It seems that fumigation might have a positive impact on maintaining the quality of seeds, especially in germination and producing normal seedlings. Besides this, fumigation makes the seed samples free from pathogens and insect pests as found in our studies.

In case of Garo community, they store their seeds as like the Manipuri community. The highest planting value was found in okra seeds (95.5%) followed by lai shaak (78.9%). The reason behind the highest germination of okra seeds is that they kept the whole pod of okra in a plastic bag. It seems to be, keeping the whole pod retained its quality instead of seeds separated from the pod. Besides this, the lowest germination was observed in okra seeds (1.5%) of the Manipuri community. The reason behind, this might be they separated seeds from the pod and kept them in plastic bag. Keeping separated seeds from pod is not good for storing them for a long time in the case of okra seed. Plastic bags and plastic kowta gave the lowest germination and lowest normal seedlings. The result is supported by the findings of Harun et al. (2002).

Prevalence of seed-borne fungi

Seed health test of collected seed samples from three ethnic communities was conducted by standard blotter method (ISTA, 1996). A total of 14 fungi representing 12 genera were recorded to be associated with the 15 seed samples of Manipuri ethnic community (Table 4). Rice seed samples were infected with 6 seed-borne fungi namely Alternaria padwickii (2.5-8.0%), Aspergillus nigar (1.0-2.5%), Bipolaris oryzae(0.5-5.5%), Curvularia lunata (0.5-5.5%), Penicillium sp. (1.0-5.5%), and Sarocladium oryzae (11.0-45%) where Alternaria padwickii and Sarocladium oryzae were predominant. In case of bean seed samples, 6 storage fungi viz. Aspergillus niger, Curvularia lunata, Penicillium sp. Alternaria tenuis, Rhizopus sp. and Aspergillus flavus were detected. Kaon seed sample was infected with Penicillium sp., Alternaria tenuis, Rhizopus sp. where sesame seed sample was infected with Aspergillus niger, Penicillium sp. Aspergillus flavus and Phoma sp. In case of brassica seed samples namely mustard and lai shak three storage fungi (Aspergillus niger, Curvularia lunata and Penicillium sp.) were found to be associated with the seed samples. Only 1 storage fungus (Penicillium sp.) was found in amaranth and bonbegun seed sample. Four fungi detected were Penicillium sp., Aspergillus flavus, Colletotrichum dematium and Fusarium oxysporum in okra seed sample (Table 4).

From the seed samples of Khasia ethnic community, 7 fungi representing 5 genera were detected (Table 5). The fungi detected were Penicillium sp. (0.0-3.0%), Aspergillus flavus (0.0-15.0%), Aspergillus niger (0.0-3.0%), Fusarium semitectum (0.0-1.0%), Rhizopus sp. (0.0-5.0%), Curvularia lunata (0.0-5%) and Fusarium oxysporum (0.0-25%). Among these fungi A. flavus, A. niger, Rhizopus sp. and Fusarium oxysporum were predominant.

A total of 9 fungi representing 8 genera were detected to be associated with collected 10 seed samples of Garo community. The detected fungi were Botryodiplodia theobromae (0.0-25.0%), Cercospora kikuchii (0.0-5.0%), Penicilliumsp. (0.0-25.0%), Aspergillus flavus (0.0-50.0%), Bipolaris maydis (0.0-5.0%), Curvularia, lunata (0.0-5.0%), Rhizopus sp. (0.0-16.7%) and Botrytis cinerea (0.0-4.0%) (Table 6). Among these fungi only four fungi – B. theobromae, C. kikuchii, B. maydis, and B. cinerea were predominant as these fungi are pathogenic and capable of transmitting diseases to the field from seed.

Seed health tests revealed the presence of various fungi associated with different seed samples collected from three indigenous communities. In Manipuri community, seven fungi namely A. padwickii, B. oryzae, S. oryzae, Phoma sp., C. dematium, F. oxysporum, and F. moniliforme were pathogenic and capable of transmitting diseases to the field among 14 fungi from 15 seed samples. Two pathogenic fungi, Alternaria padwickii and Sarocladium oryzae were found to be predominant species in rice seed samples where six storage fungi, namely Aspergillus nigar, Curvularia lunata, Penicillium sp., Aspergillus flavus, Alternaria tenuis, and Rhizopus sp. were predominant in Bean seed samples. Two pathogenic fungi Colletotrichum dematium, and Fusarium oxysporumin were found in okra seed samples.

In the case of the Khasia indigenous community, 7 fungi representing 5 genera were detected in their 4 seed samples which were Penicillium sp., Aspergillus flavus, Aspergillus niger, Fusarium semitectum, Rhizopus sp., Curvularia lunata, and Fusarium oxysporum where A. flavus, A. niger, and Rhizopus sp. were predominant as storage fungi.

Nine (9) fungi representing 8 genera namely Botryodiplodia theobromae,,Cercospora kikuchii, Penicillium sp., Aspergillus flavus, Bipolaris maydis, Curvularia, lunata, Rhizopus sp.and Botrytis cinerea were found to be associated with seed samples collected from Garo ethnic community where Penicillium sp., A. flavus, and Rhizopus sp. were predominant. All of these fungi are reported as seed-borne fungi (Richardson, 1990; Fakir, 1999). Archana and Prakash (2013) identified 16 fungal genera comprising 27 species in rice seed samples collected from various states in India where the most predominant

fungus was Bipolaris oryzae.

Mansur et al. (2013) detected nine different fungi associated with the rice seed samples collected from the Feni district of Bangladesh namely Fusarium oxysporum, F. moniliforme, Bipolaris oryzae, Alternaria padwickii, Curvularia lunata, Aspergillus flavus, Aspergillus niger, Penicillium sp., and Nigrospora oryzae. Eight fungal genera (Alternaria, Aspergillus, Bipolaris, Chaetomium, Curvularia, Fusarium, Sarocladium, and Trichoderma, comprising twelve species were identified in rice seeds by Gopalakrishnan et al. (2010).

Fakir et al. (2001) reported that as many as 70 fungi have been detected in more than 1,500 seed samples of five pulse crops (black gram, mungbean, lentil, chickpea, and grasspea) collected from different parts of the country where the 39 seed-borne pathogens encountered. However, Baker and Rahman (2001) also reported that 34 fungi representing 23 genera have been recorded in BARI from seed samples of major pulse crops grown in Bangladesh. Altogether 42 different seed-borne diseases comprising 64 different seed-borne pathogens have been reported from different oilseed crops grown in Bangladesh reported by Hossain et al. (2001). Besides this, 18 different fungi representing 10 genera on mustard, 14 genera representing 22 species on sesame, and 13 genera representing 16 species on groundnut were recorded in the country (Hossain and Ahmed, 2001). Ahmad et al. (2001) also reviewed that three to twelve genera of fungi comprising five to seventeen different fungal species were to be associated with different vegetables namely potato (TPS), cucurbits, okra, country bean, data, and spinach grown in different districts of Bangladesh where Aspergillus flavus was found predominant in most of the vegetable seeds.

Fungi associated with seeds may vary on seed samples, their storage conditions, and methods used for storage. In our studies, we found keeping seeds in gunny bag, glass bottle, and cloth bag are suitable for storing seed samples. Fumigation was found to be good for keeping away from storage fungi and maintaining seed quality especially germination. Fungi associated with the seed vary from sample to sample and depend on the containers and storage conditions where it was kept.

Table 4. Prevalence of seed borne pathogen associated with save seeds of Manipuri indigenous community

Sl. No	Crop name	Germination % (On blotter)	Seed infection (%)													
			Alternaria padwickii	*Aspergillus nigar*	*Bipolaris oryzae*	*Curvularia lunata*	*Penicillium sp*	*Sarocladium oryzae*	*Alternaria tenuis*	*Rhizopus sp.*	*Aspergillus flavus*	*Phoma* sp.	*Epicoccum purpurascens*	*Fusarium moniliforme*	*Colletotrichum dematium*	*Fusarium oxysporum`*
1	Rice (Shaildhan)	86.0	2.5	1.0	2.5	5.5	1.0	20.0	-	-	-	-	-	-	-	-
2	Rice (chiniguradhan)	92.0	8.0	1.5	0.5	3.0	5.5	11.0	-	-	-	-	-	-	-	-
3	Rice (Ranjit dhan)	95.5	5.5	-	5.5	1.0	1.0	45.0	-	-	-	-	-	-	-	-
4	Rice (Swarnomoshuri Dhan)	94.0	7.5	2.5	0.5	0.5	-	-	-	-	-	-	-	-	-	-
5	Kaon	71.5	-	-	-	-	1.0	-	0.5	2.0	-	-	-	-	-	-
6	Sesame	14.0	-	0.5	-	-	4.5	-	-	-	0.5	31.0	-	-	-	-
7	Mustard	82.5	-	3.5	-	2.0	10.0	-	-	-	-	-	-	-	-	-
8	Laishak	84.0	-	1.0	-	-	-	-	-	-	-	-	-	-	-	-
9	Amaranth	84.5	-	-	-	-	5.5	-	-	-	-	-	-	-	-	-
10	French bean	70.0	-	-	-	-	50.0	-	-	-	16.7	-	-	-	-	-
11	French bean (hybrid)	0.0	-	-	-	-	46.7	-	-	6.7	40.0	-	-	-	-	-
12	Country bean	53.3	-	26.7	-	-	20.0	-	-	-	26.7	-	-	-	-	-
13	Longyard bean	36.0	-	5.0	-	2.0	6.5	-	8.0	-	-	-	1.5	4.0	-	-
14	Yellow berried nightshade/ Bonbegun	1.5	-	-	-	-	5.0	-	-	-	-	-	-	-	-	-
15	Okra	0.0	-	-	-	-	32.0	-	-	-	14.0	-	-	-	18.0	28.0

Note: Based on 200 seeds; "-" indicates no fungi were encountered

Table 5. Prevalence of seed borne pathogen associated with save seeds of Khasia indigenous community

Sl. No.	Crop name	Germination % (On blotter)	Seed infection (%)						
			Aspergillus flavus	*Aspergillus niger*	*Penicillium* sp.	*Fusarium semitectum*	*Rhizopus* sp.	*Curvularia lunata*	*Fusarium oxysporum*
1	Yardlong bean	85	8	3	1	1	5	-	-
2	Country bean	00	15	-	-	-	-	5	25
3	Sponge gourd	95	-	-	-	-	-	-	-
4	Lai shaak	83	-	2	3	-	1	-	-

Note: Based on 200 seeds; "-" indicates no fungi were encountered.

Table 6. Prevalence of seed borne pathogen associated with saved seeds of Garo indigenous community

Sl. No	Crop name	Germination % (On blotter)	Seed infection (%)								
			Botryodiplodia theobromae	*Cercospora kikuchii*	*Penicillium* sp.	*Aspergillus flavus*	*Aspergillus niger*	*Bipolaris maydis*	*Curvularia lunata*	*Rhizopus* sp.	*Botrytis cinerea*
1	Sponge gourd	25	25	5	2.5	-	-	-	-	-	-
2	Country bean	50	-	-	25	50	20	-	-	-	-
3	Maize	65	-	-	10	15	-	5	-	-	-
4	French bean	00	-	-	35	40	5	-	5	3	-
5	Pumkin	54	-	-	3.3	6.7	-	-	-	16.7	-
6	Chili	35	-	-	-	2	-	-	1	1	-
7	Wax gourd	00	-	-	-	-	-	-	-	6.7	-
8	Coriander	36	-	-	1	5	-	-	-	3	4
9	Okra	98	-	-	12	26	-	-	-	3	-
10	Lai shaak	81	-	-	1	3	-	-	-	1	-

Note: Based on 200 seeds; "-" indicates no fungi were encountered.

Conclusion

Manipuri, Khasia, and Garo ethnic communities are living in the Moulvibazar district under Sylhet division. Traditional seed storage techniques in these ethnic groups are still not investigated to determine whether or not they significantly retain seed quality. Agriculture is the main source of income for the people of Manipuri community. They cultivate 15 different food crops. Khasia people cultivate 4 food crops where the cultivation of betel leaf (khasia pan) is their main source of income. These 4 crops are cultivated only for their family uses. Garo community cultivates 10 different food crops besides other works. Cultivation is not their main source of income. They saved their seeds for next year's cultivation. They use their own traditional technology to store the seeds. The quality of seeds was poor and not the same among the crops of the three communities. It depends on the crops and methods used by them. Stored seeds in gunny bags, glass bottles, and cloth bags were observed to be good for preserving seed samples. Preserve the whole pod with seeds to maintain good quality instead of separated seeds, especially okra and chili crops. Fumigation of seeds was found to be good for maintaining their quality, especially germination, planting value of seeds (PVS), and seed health (pathogens infection) as we found higher germination, higher PVS and lower seed-borne pathogen infection. Keeping seeds in plastic kowta and plastic bags is not good for long time preservation, especially for germination. The study might be concluded that the people of these communities need training and support for preserving seeds and maintaining their quality as because they have not received any training programs before.

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References

Ahmad MU, Hossain MM and Fakir GA. 2001. Research findings of BAU on seed borne fungal diseases of vegetables. Proceedings of the national workshop on seed pathology (Fakir, G.A., Hossain, I and Ali, M.A., eds. 2001), Seed Pathology Laboratory, Bangladesh Agricultural University, Mymensingh, Bangladesh. pp. 1-65.

Ahmed AHI. 2013. Quality assurance of seeds. In: Seed Pathological progress followed by 1st National seed health fair-2013 (Rashid, 2013). Seed Pathology centre, Bangladesh Agricultural University, Mymensingh. 21p.

Akhter S, Raihan F, Islam MS, Sohel, Syed MA, Das SK, and Alamgir M. 2013. Coping with Climate Change by Using Indigenous Knowledge of Ethnic Communities from in and around Lawachara National Park of Bangladesh. Journal of Forest Science. 29(3): 181-193.

Archana B and Prakash HS. 2013. Survey of seed-borne fungi associated with rice seeds in India. International Journal of Research in Pure and Applied Microbiology. 3(1): 25-29.

Bakr MA and Rahman ML. 2001. Research findings of BAU on seed borne diseases of pulses. Proceedings of the national workshop on seed pathology (Fakir GA, Hossain I and Ali MA, eds. 2001), Seed Pathology Laboratory, Bangladesh Agricultural University, Mymensingh, Bangladesh.

Channal G, Nagnur S and Nanjayyanamath C. 2004. Indigenous grain storage structures. Indian Journal of Traditional Knowledge. 6(3): 10.

Chowdhury MAH, Hossain SMA and Talukder NM. 1990. Seed quality of lentil as affected by various storage techniques. Progressive Agriculture. 1(1): 31-37.

Ellis MB.1971. Dematiaceous hypomycetes. Commonwealth Mycological Institure. Kew, Surrey. England. 608p.

Fakir GA. 1999. An annotated list of seed-borne diseases in Bangladesh. Department of Plant Pathology, Bangladesh Agricultural University, Mymensingh. 41p.

Fakir GA, Hossain I, Ahmed MU, Doula MAU and Alam MM. 2002. Quality of farmer's Boro and T. aman rice seeds collected from Bogra, Rajshahi and Rangpur district of Bangladesh. Proceeding: A report for presentation in the review and planning meeting of the Rice seed health Improvement Subproject held at BRRI Gazipur, Bangladesh. pp. 1-16.

Fakir GA, Hossain I and Pramanik BK. 2001. Research findings of BAU on seed borne diseases of pulses. Proceedings of the national workshop on seed pathology (Fakir G A, Hossain I and Ali MA, eds. 2001), Seed Pathology Laboratory, Bangladesh Agricultural University, Mymensingh, Bangladesh. pp. 23-25.

Gebeyaw M. 2020. Review on: Impact of Seed-Borne Pathogens on Seed Quality, American Journal of Plant Biology. 5(4): 79-83.

Gomez KA and Gomez AA. 1994. Statistical procedures for agricultural research. John Wiley and Sons, New York. 68p.

Gopalkrishnan G, Kamalakannan A and Vulluvaparidasan V. 2010. Survey of Seed-borne Fungi Associated with Rice Seeds in Tamil Nadu, India. Libyan Agriculture Research Centre Journal International. 1(5): 307-309.

Harun ME, Rahman AJMM, Islam MK and Mia MAT. 2002. Status of rice seed quality and its socio-economic impact due to seed health management intervention in Gazipur. Paper presented in the review and planning meeting on rice seed health improvement for increasing yield and reducing pest pressure in Bangladesh, held at BRRI, Gazipur, Bangladesh. 20p.

Hossain I, Fakir GA and Pramanik BK. 2001. Research findings of BAU on seed borne diseases of oilseed crops. Proceedings of the national workshop on seed pathology (Fakir G A, Hossain I and Ali M A. eds. 2001), Seed Pathology Laboratory, Bangladesh Agricultural University, Mymensingh, Bangladesh. pp.20-22.

Hossain MM and Ahmed MU. 2001. Research findings of BARI on seedborne diseases of oilseed crops. Proceedings of the national workshop on seed pathology (Fakir GA, Hossain I and Ali MA. eds. 2001), Seed Pathology Laboratory, Bangladesh Agricultural University, Mymensingh, Bangladesh. pp. 26-28.

Huda MN, Halim MA, Razzaque MA, Haque MM and Hossain A. 2006. *Manual for seed quality control.* Seed wing, Ministry of Agriculture, Bangladesh. 89p.

Islam MA, Hossain MT, Sarwar G, Kawsar LA, Smrity A, Ashraf-Ul-Alam, M, Hossain KM and Bhuia MR. 2016. Is socio-economic condition of manipuri tribe improving?- A Two Phase Comparison Using Income Distribution Model. International Journal of Statistics and Applications. 6(3): 138-144.

ISTA. 1996. Seed Science and Technology. International rules for seed testing24, Zurich, Switzerland.

ISTA. 2001. International Rules for Seed Testing. Seed Science and Technology. 24: 39-42.

ISTA. 2006. Moisture Test Methods. International Rules for Seed Testing. International Rules for Seed Testing Association. Basserdorf, Switzerland. pp. 254-257.

Kandil AA, Sharief AE and Sheteiwy MS. 2013. Effect of Seed Storage Periods, Conditions and Materials on Germination of Some Soybean Seed Cultivars, American Journal of Experimental Agriculture. 3(4): 1020-1043.

Lamichaney A, Chettri PK, Mukherjee A, Maity A and Shubha K. 2019. Indigenous methods of grain storage followed by the Lepcha and Limbo tribes in the Himalayan tract of Sikkim. Indian Journal of Traditional Knowledge. 18(4): 769-774.

Mansur A, Hossain M, Hassan K and Dash CK. 2013. Seed health and quality test of three rice varieties for the detection of fungi associated with seed sample. Universal Journal of Plant Science. 1(2): 37-42.

Malon JP and Musket AE. 1964. Seed-borne fungi. Description of 77 fungi species. Proceedings of International Seed Testing Association. 29. 179-384.

Meah MB and Doullah MAU. 2007. Seed health in Bangladesh: Looking for a bright future. Paper presented at the symposium on Seed health & quality held at Spectra Convention Centre, Gulshan-1, Dhaka, organized by MoA/DSHC.

Miah MAM, Islam QM, Baksh ME, Rossi FJ and Tiwari TP. 2018. Impacts of wheat seed storage at poor household level in Bangladesh. Bangladesh Journal of Agricultural Research. 43(2): 345-360.

Rashid AQMB. 2015. Teaching Traning and research contributions in seed pathology and distance education in Agriculture & rural development. Seed Pathology centre, Bangladesh Agricultural University, Mymensingh. 65p.

Richardson MJ. 1990. An annotated list of seed-borne diseases. The International Seed Testing Association. P. O. Box 412. CH-8046 Zurich, Switzerland.

Shaila M and Begum N. 2021. Ancient farming methods of seed storage and pest management practices in india - a review. Plant Archives. 21: 499-509.

Sheram AK. 2005. Manipuri (Meitei) settlement in Bangladesh, Manipuri past and present: *The Ordeals and Heritage of a Civilization* 4(1): 113-134.

Shikdar MK, Biswas A and Mollick R. 2013: The Socio-Economic Background of Khasia Ethnic Community of Bangladesh. IOSR Journal of Humanities and Social Science (IOSR-JHSS). 7(4). 1-30.