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STUDIES ON THE QUALITY AND HEALTH STATUS OF T. AMAN RICE SEEDS COLLECTED FROM DIFFERENT SOURCES

Anup Pain[1], Amit Kumar Basunia[2], Mahmudul Hasan Chowdhury[3], Mir Enamul Haque [4], Md. Mohimenul Islam[5] and Ahmed Khairul Hasan[6]*

[1]Department of Seed Science and Technology, and [2]Department of Horticulture, Bangladesh Agricultural University, Mymensingh-2202; [3]Golam Ali Fakir Seed Pathology Centre, Bangladesh Agricultural University, Mymensingh-2202; [4]Deputy Manager(SPP), Bangladesh Agricultural Development Corporation, Dhaka; [5]Bangladesh Institute of Nuclear Agriculture, Mymensingh-2202; [6]Department of Agronomy, Bangladesh Agricultural University, Mymensingh-2202, Bangladesh.

***Corresponding author:** Ahmed Khairul Hasan; E-mail: akhasan@bau.edu.bd

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ABSTRACT

A laboratory experiment was carried out at the Professor GAF Seed Pathology Centre and Laboratory of Department of Seed Science and Technology, Bangladesh Agricultural University (BAU), Mymensingh during the period of July 2018 to January 2019 to determine the effect of seed sources on quality and health status in some Transplanted *Aman* rice varieties in Bangladesh. Among the seed sources, the moisture content was recorded from 10.40% to 13.37%. In case of purity analysis of seed pure seed ranged from 39.23g to 39.94g. Germination test of rice seeds was recorded and the percentage of total number of germination ranged from 55.75% to 93.0%, normal seedling (51.50 % to 86.50%), abnormal seedling (4.75 % to 10.75%), fresh ingeminated seed (1.75% to15.0%), hard seed (0.0 % to 11.75%), dead seed (2.75% to 21.25%), respectively. Vigour index in the seed sources ranged from (1255.80 to 2089.86). In dry inspection test apparently healthy seeds (17.74gto 28.92g), spotted seeds (9.8g to 17.34g), deformed seeds (0.36g to 5.58g), discolored seeds (0.34g to 3.40g), inert mater (0.00g to 0.38g), insect damaged seeds (0.00g to 0.24g) and chaffy seeds (0.08 g to 1.14g) were recorded(2.75% to 21.25%), respectively. In the seed health study, seven species of fungi were recorded. In the seed health test *Alternaria padwickii* (1.25 % to 5.50%), *Aspergilus niger* (0.0% to 1.75%), *Bipolaris oryzae* (0.0% to 1.50%), *Curvularia lunata (*0.00% to 1.0%), *Aspergillus flavus* (0.00% to 1.25%), *Penicillium* sp. (0.00% to 1.50%) were recorded, respectively. Most of the farmers were failed to obtain the quality and good health status. In this study, BRRI dhan34 in farmer's seed recorded the highest performance in the seed sources and the lowest performance was recorded in BRRI dhan49 in farmer's seed. Among the seed sources BR22 of BADC seed (T8) performed the best in respect of seed quality and seed health.

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INTRODUCTION

Rice (*Oryza sativa* L.) is the most important cereal crop and one of the major sources of calories for a large percentage of the world population, particularly in Asia (Datta, 1981). It remains the staple food for about 164.4 million people of Bangladesh (UN, 2011). Rice covers about 82% of the total cropped area in Bangladesh where 9% by *Aus*, 48% by *Aman* and 43% by *Boro* (BBS, 2018). It is also the major staple food of over half of the world's population. Rice production and consumption are the highest in Asian populations. In the world production of rice is 769.9 million tons and in Bangladesh the production of rice is 53.6 million tons (FAO 2018). The yield of rice in Bangladesh is quite low 3.6 t/ha (FAO 2018) compared to other rice growing countries of the world. The demand for rice is constantly rising in Bangladesh with nearly 1.56% people being added each year (CIA World Factbook, 2011). Although the country has reportedly attained self-sufficiency in food production, there is food deficit of around 2 million tons almost in every year. By the end of 2030, the country will need 50% more rice to meet the demand of growing human population (Khush and Brar, 2002). So the country has to face a challenge of producing an additional amount food.

The importance of rice in Bangladesh could never be overemphasized. Among the options to increase rice production, use of good seed is most important. It has been shown experimentally that only by using good quality healthy seed, rice yield could be increased by 10-15% (Mia *et al*., 2004). In the Philippines, yield increase due to use of good quality seed was 7-25% (Diaz *et al*., 2001). The farmers must be aware of the consequences of the crop losses with low quality unhealthy seeds. Although the seed system in Bangladesh is at a very rudimentary stage, a total of 5 lakh tons of seeds including the seeds of cereals and other crops per year is required, out of which only 18% of good quality seed is produced and distributed by GO, NGO's and private sectors. The rest of the seeds retained by the farmer's remain uncertified with unknown quality and outside the supervision of Seed Certification Agency. The quality or health of such huge amount of seed remains underlined. Using the same quality seed lot year after year without taking much care at farmers' level leads to severe deterioration of seed quality (Mew and Misra, 1994). Moreover, use of low quality seeds required high seed rate (Alam and Mustafi, 1995; Hossain*et al.,* 2002). In Bangladesh, 80% of the rice seeds are obtained from farmers' own harvest, about 10% are certified seeds or TLS that are purchased from the Bangladesh Agricultural Development Corporation (BADC), non-government organizations (NGOs) and private seed companies (Hossain, 2004). The certified seeds are recognized as good quality seeds in the country but the quality of these seeds are judged only by moisture, purity and germination; health of seeds is not considered.

The government of Bangladesh is considering the seed sector as high priority area. According to Huda(2001), the seed supply sources in Bangladesh can be divided into three sources: i) a formal sources which covers approximately 6% of the seed; the seed supplied from this source is generally of a good quality and originates from the public source, ii) an informal sources which covers the farmers' home saved seed that is subjected only to the farmers' own evaluation; the majority of seeds supplied from the informal source is of variable quality and iii) a semi-formal sources which is a mixture of the two above mentioned sources. It is estimated that the formal and semi-formal sources cover approximately 54% and 40%, respectively of the seed available in Bangladesh (Huda, 2005).It is important that clean and healthy seeds are to be used as planting materials in order to increase the germination percentage and productivity. Contaminated seeds can often result in poor germination and poor seedling vigour and resulting unhealthy crops (Shenoy*et al*., 1998, Haque*et al*., 2007). Poor quality of rice seeds can be caused by infection of pathogens like fungi, bacteria and nematode (Mew and Gonzales, 2002; Mew and Misra, 1994), weeds and varietal mixtures (Delouche, 1998), and insect pests (Peng and Morallo-Rejesus, 1988). Fakir and Mia (2004) stated that roughly 10% production loss of rice may be incurred annually due to seed-borne diseases in Bangladesh and according to this estimate, 2.5 million tons of rice worth Tk. 30,000 million is lost annually in Bangladesh.

Among the aforementioned major characteristics of good quality seed, healthiness is of prime importance. In Bangladesh, 27 of the 43 diseases known to occur on rice are seed-borne (Fakir and Mia, 2004). Seed borne diseases caused by fungi such as brown spot (*Bipoloris oryzae*), Blast (*Pyricularia grisea*), sheath rot (*Sarocladium oryzae*), seed rot and seedling blight (*Bipolarisoryzae*, *Sarocladiumoryzae*and *Fusarium* spp.) and grain spots (*Bipolaris oryzae*, *Curvularia lunata*, *Nigrospora oryzae*, *Phoma glumarum* and *Cladosporium* sp.); by bacteria such as bacterial blight (*Xanthomonas campestris* pv. *oryzae*) and bacterial leaf streak (*Xanthomonas campestris* pv. *oryzicola*) and nematode like white tip (*Aphelenchoides besseyi*) are harmful to rice seed health for inflicting diseases in seedbed as well as in the field. There are many constraints responsible for low yield of rice in Bangladesh. Among these constrains disease plays an important role, sometimes leading to disastrous consequences, which can cause 10-15% average yield loss (BRRI, 1999, Sultana *et al*., 2020).

Considering the above facts the experiment was undertaken with seed samples of farmer's and BADC rice seed sources with the following objectives:

- To assess the quality and health status of *T. Aman* rice seeds collected from different seed sources.
- To compare quality status of seeds from different sources.

MATERIALS AND METHODS

Ten rice seed samples were collected from two different sources namely farmer and BADC. Seeds of five rice varieties were collected from farmers of five different parts of Mymensingh Sadar Upzila (Viz. Bhabokhali, Char Nillokhia, Borochar, Barera and Khakdohor) and seeds of five rice varieties were collected from BADC Seed Processing Centre, Mymensingh.

Treatments: Ten rice seeds collected from farmers and BADC

T_1=BR11 of farmer's seed
T_2=BINA dhan7of farmer's seed
T_3=BRRI dhan32of farmer's seed
T_4= BRRI dhan34of farmer's seed
T_5= BRRI dhan49of farmer's seed
T_6= BR11 of BADC seed
T_7= BINA dhan7of BADC seed
T_8= BR22 of BADC seed
T_9= BRRI dhan49of BADC seed
T_{10}= BRRI dhan52of BADC seed

Seed sampling

The size of the unit sample was 1 kg which was collected following the International Rules for Seed Testing (ISTA, 1996). Seed samples contained in paper bags were correctly labeled and moisture content was determined after seed collection. Collected samples were sub-divided to get working samples for subsequent seed quality tests and the rest was kept in a refrigerator at 5°C until further use.

Seed Quality Analysis

Moisture test

The moisture content of the seeds of each sample was determined by a digital moisture meter (G.WouHitech Co. Ltd., S/N: HD-1450, GMK, Made in Korea) immediately after seed collection. For each sample, three readings were taken. The average moisture content was expressed in percentage.

Purity analysis

From each sample, 40g seeds were taken following standard procedure for purity test (ISTA, 1996). Seeds were divided into three components viz. pure seed, other seeds and inert matter.

Germination test

Plastic trays (18″x 7.5″) were filled with wet sand and mix with water. From each sample, 400 seeds were randomly taken and soaked in water for 24 hrs and then the seeds were incubated for another 48 hrs. Incubated seeds were sown at the rate of 100 seeds/tray. One tray was used as a replication for each sample. The experiment was laid out in CRD. Seedling emergences were recorded at 4, 7 and 14 days after sowing.

Determination of vigour index

After 15 days, shoot and root length were measured for each of the seedling. Seedlings (25/Tray) were randomly selected for measurement of shoot and root length**.** For determination of seedling vigour of rice, 10 seedlings per replication were selected randomly and their individual shoot and root lengths were measured. The vigour of the seedlings was determined by the following formula (Baki and Anderson, 1972):

Vigour index = (Mean of root length + Mean of shoot length) × Percentage of seed germination

Seed health test

Dry inspection of seed

For dry inspection, 40g seeds for each sample were visually inspected and graded into seven categories namely apparently healthy seeds, spotted seeds, deform seeds, inert matter, discolor seeds, chaffy seeds and insect damage seeds. On a clean laboratory table, the seeds of each working sample were spread and the seeds were separated and then grant into seven categories.

Detection of seed borne fungi (Blotter method)

Four hundred seeds were randomly taken from each sample and placed on three layers of moist blotting paper (Whatman No.1) contained in plastic petridish according to???. Seeds (25/plate) were placed in each petridish and incubated at 25 ^{0}C under a 12-hour cycle of alternate Near Ultra Violet (NUV) light and darkness. Each seed was observed under stereo-binocular microscope after 7 days of incubation. Incubated seeds were examined under stereomicroscope. Seed borne fungi on rice seed surface were detected and identified. Temporary slide was prepared and examined under compound microscope with the help of keys (Ellis, 1971 and Chidambaram *et al.,* 1975). Data were recorded on percentage of seed borne fungi.

Analysis of data

The design of experiment was CRD (Completely Randomized Design). The recorded data on various parameters under the present study were statistically analyzed using MSTAT C statistical package the programme. The level significance and analysis of variance along with the Least Significance Difference (LSD) was done following Gomez and Gomez (1984). Mean difference were judged by Ducan's Multiple Range Test (DMRT).

RESULTS AND DISCUSSION

Moisture content

Moisture content of the seed samples varied significantly among the treatment that ranged from 10.40% to 13.37% (Figure 1). The highest moisture content (13.37%) was recorded in S5 (BRRI dhan49) followed by T_3 which was statistically similar with T_1, T_2, T_6 while the lowest moisture content was recorded in T_4 (10.40%). The moisture content of farmer's saved seeds ranged from 12.30 to 14.40% (Rahman, 2002 a). Fakir *et al.* (2002 and 2003) determine the moisture content of farmer's seeds collected from Rajshahi, Bogra and Rangpur. They reported that moisture content of farmers seed of 2002 ranged from 7.0 to 13.9% that varying with respect to crop season, farmers and locations of seed collection. But in 2003 they reported that the moisture content of farmer's seed of the same locations ranged from 12.87 to 13.30%. Chowdhury (2012) studied seed quality status of BADC seed in 2007-2008 and 2009-2010 the moisture contents of seeds were ranged from 12.83% and 12.72%.

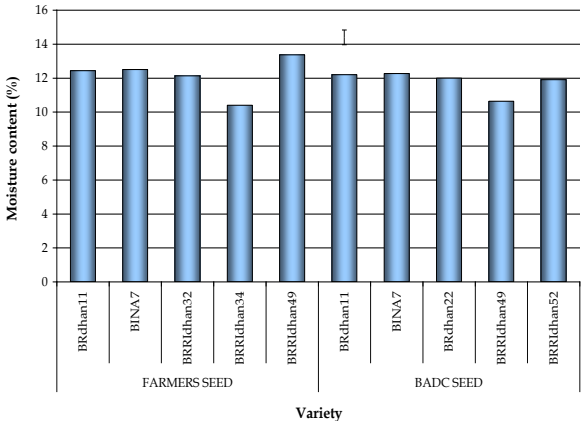

Figure 1. Moisture content of different seed samples collected from farmers and BADC sources. Here, T_1=BR11 of farmer's seed, T_2=BINA dhan7of farmer's seed, T_3=BRRI dhan32 of farmer's seed, T_4= BRRI dhan34 of farmer's seed, T_5= BRRI dhan49 of farmer's seed, T_6= BR11 of BADC seed, T_7= BINA dhan7 of BADC seed, T_8= BR22 of BADC seed, T_9= BRRI dhan49 of BADC seed and T_{10}= BRRI dhan52 of BADC seed. Vertical bar represents LSD at 5% level of significance.

Purity analysis

Pure seed

The Purity status of seed sources varied significantly among the treatments ranging from 39.23g (98.67%) to 39.94g (99.92%). The highest pure seed was recorded in T_9 (39.94g) which was statistically similar to T_6, T2, T_3, T_8, T_{10}, T_7 and T_4 while the lowest was recorded in V_5 (39.23g) (Table 1). Chowdhury (2012) studied the seed quality status of HYV rice seed in Bangladesh and Haque *et al.* (2007) found 99.01% pure seed from the farmer's produced rice seeds in seed samples of trained farmers and minimum (96.19%) in untrained farmers. Uddin (2005) determined the percentage of pure seed of Begumgonj Upazilla under Noakhali district that ranged from 95.59 to 99.39%. Fakir *et al*. (2002) reported the percentage of pure seeds ranging from 91.20 to 98.89% collected from farmers' stored rice seeds. Chowdhury (2012) observed the purity analysis of BADC seed, the highest pure seed were recorded from 99.86% and 99.18%, inert matter at 0.14% and 0.76%, while other crop seed was not found in BADC *Boro* seed 2007-2008 and 2009-2010.

Inert matter

Inert matter of the seed sources varied significantly among the treatments that ranging from 0.030g (0.08%) to 0.530g (1.33%). The highest inert matter was recorded inT_5 (0.530g) while the lowest inert matter was recorded in T_9 (0.030g) (Table 1).

Other crops seed

No other crops seeds were recorded in the seed samples of the treatments (Table 1).

Table 1. Purity (%), Inert matter (g), Inert matter (%) and other crops seed of different seed samples collected from farmers and BADC sources

Treatments		Purity (%)	Inert matter (g)	Inert matter (%)	Other crops
FARMERS SEED	T_1	99.65	0.14	0.35	0
	T_2	99.35	0.26	0.65	0
	T_3	99.57	0.17	0.43	0
	T_4	99.30	0.28	0.70	0
	T_5	98.67	0.53	1.33	0
BADC SEED	T_6	99.87	0.05	0.13	0
	T_7	99.65	0.14	0.35	0
	T_8	99.85	0.06	0.15	0
	T_9	99.92	0.03	0.08	0
	T_{10}	99.75	0.10	0.25	0
$LSD_{0.05}$			89.71		
SE (±)			0.016		
Level of significance			**		
CV (%)			21.40		

Here, T_1=BR11 of farmer's seed, T_2=BINA dhan7of farmer's seed, T_3=BRRI dhan32 of farmer's seed, T_4= BRRI dhan34 of farmer's seed, T_5= BRRI dhan49 of farmer's seed, T_6= BR11 of BADC seed, T_7= BINA dhan7 of BADC seed, T_8= BR22 of BADC seed, T_9= BRRI dhan49 of BADC seed and T_{10}= BRRI dhan52 of BADC seed

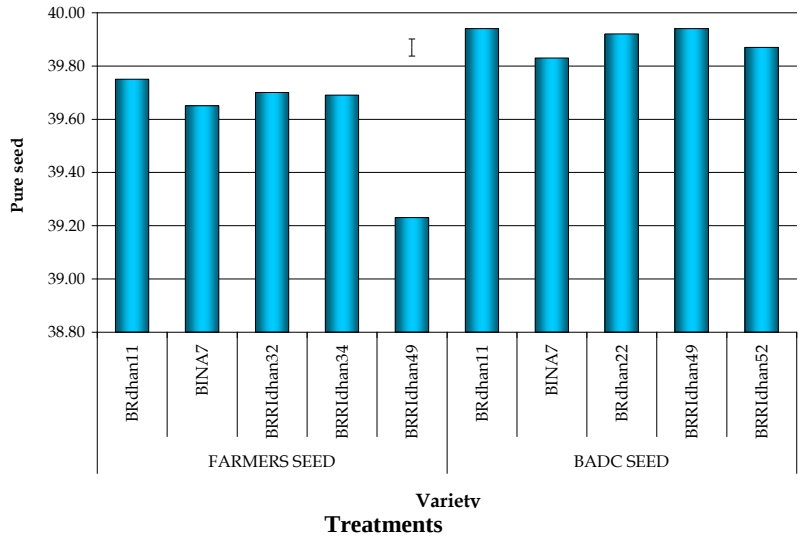

Figure2. Purity analysis of different seed samples collected from farmers and BADC sources. Here, T_1=BR11 of farmer's seed, T_2=BINA dhan7 of farmer's seed, T_3=BRRI dhan32 of farmer's seed, T_4= BRRI dhan34 of farmer's seed, T_5= BRRI dhan49 of farmer's seed, T_6= BR11 of BADC seed, T_7= BINA dhan7 of BADC seed, T_8= BR22 of BADC seed, T_9= BRRI dhan49 of BADC seed and T_{10}= BRRI dhan52 of BADC seed

Plate 1. Purity analysis of different seed samples collected from farmers and BADC sources

Germination test

Seed germination

The percentage of seed germination varied significantly that was ranged from 55.75% to 93%.Thehighest percentage of seed germination was recorded in T_4 (93%) while the lowest was recorded in T_5 (55.75 %) (Figure 3). Rahman *et al*. (2003) reported 71.00to 78.00% germination of farmers stored rice seed of Hobigonj district in Bangladesh. Fakir *et al.* (2003) conducted a detailed investigation to study the effect of different containers and additives on the quality of *Boro* rice seed germination, normal seedlings, abnormal seedlings, diseased seedlings and dead seeds ranged from 88.33 to 95.83%, 81.51 to 92.16%, 2.00 to 3.83%, 1.67 to 3.83% and 4.17 to 11.83% respectively. Chowdhury (2012) observed the germination of BADC seed of *T. Aman* season in 2009- 2010 and the germination ranged from 77.75% to 95.25%, normal seedling 65.50% to 85.50%, abnormal seedling 7.50 % to 12.50%, hard seed 4.25% to 14.25%, and dead seed 1.75% to 10.75%, respectively.

Normal seedling

The percentage of normal seedling in the seed sources varied significantly which was ranged from 51.50 % to 86.50%. The highest number of normal seedling was recorded in T_4 (86.50%) while the lowest was recorded in T_5 (51.50 %) (Table 2).

Abnormal seedling

The percentage of abnormal seedling varied significantly which was ranged from 4.75 % to 10.75%. The highest percentage of abnormal seedling was recorded in V_1 (10.75%) which was statistically similar with T_3 and T_6 while the lowest was recorded in T_5 (4.75 %) (Table 2).

Fresh ungerminated seed

In the seed sources the percentage of fresh ungerminated seed varied significantly which was ranged from 1.75 % to 15.0%. The highest fresh ungerminated seed was recorded in T_2 (15.0%) while the lowest was recorded in T_4 (1.75 %) (Table 2).

Hard seed

The percentage of hard seed varied significantly which was ranged from 0.0 % to 11.75%. The highest percentage of hard seed was recorded in T_{10} (11.75%) while the lowest was recorded in T_4 (0.0 %) (Table 2).

Dead seed

In the seed sources the dead seed varied significantly which was ranged from 2.75% to 21.25%.The highest percentage of the dead seed was recorded in T_5 (21.25%) while the lowest was recorded in T_8 (2.75%) (Table 2).

Table 2. Normal seed (no.), Abnormal seed (no.), Fresh seed (no.), Heard seed (no.), Dead seed (no.) of different seed samples collected from farmers and BADC sources

Treatments		Normal seed (no.)	Abnormal seed (no.)	Fresh seed (no.)	Hard seed (no.)	Dead seed (no.)
FARMERS SEED	T_1	55.00	10.75	7.50	9.00	17.75
	T_2	55.25	6.25	15.00	7.75	15.75
	T_3	54.50	10.50	7.75	9.50	17.75
	T_4	86.50	6.50	1.75	0.00	5.25
	T_5	51.50	4.75	11.00	11.50	21.25
BADC SEED	T_6	76.50	10.25	1.75	4.75	6.75
	T_7	75.25	9.50	2.00	7.00	6.25
	T_8	79.00	9.25	2.75	6.25	2.75
	T_9	71.75	6.25	5.75	9.50	6.75
	T_{10}	67.25	8.00	4.25	11.75	8.75
$LSD_{0.05}$		5.69	1.01	1.05	1.16	1.44
SE (±)		1.97	0.348	0.362	0.403	0.498
Level of significance		**	**	**	**	**
CV (%)		5.86	8.49	12.17	10.45	9.14

Here, T_1=BR11 of farmer's seed, T_2=BINA dhan7of farmer's seed, T_3=BRRI dhan32 of farmer's seed, T_4= BRRI dhan34 of farmer's seed, T_5= BRRI dhan49 of farmer's seed, T_6= BR11 of BADC seed, T_7= BINA dhan7 of BADC seed, T_8= BR22 of BADC seed, T_9= BRRI dhan49 of BADC seed and T_{10}= BRRI dhan52 of BADC seed. **= Significant at 1% level of probability.

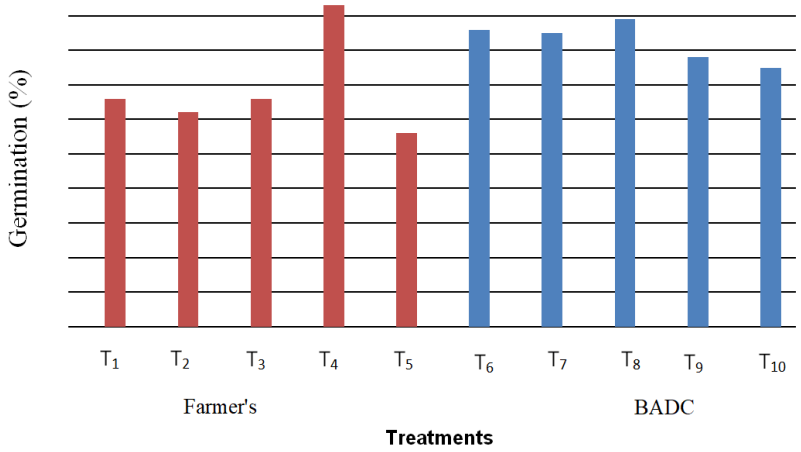

Figure 3. Germination status of different seed samples collected from farmers and BADC sources. Here, T_1=BR11 of farmer's seed, T_2=BINA dhan7 of farmer's seed, T_3=BRRI dhan32 of farmer's seed, T_4= BRRI dhan34 of farmer's seed, T_5= BRRI dhan49 of farmer's seed, T_6= BR11 of BADC seed, T_7= BINA dhan7 of BADC seed, T_8= BR22 of BADC seed, T_9= BRRI dhan49 of BADC seed and T_{10}= BRRI dhan52 of BADC seed

Vigour Index

In the vigour index, the shoot length of seed sources varied significantly which was ranged from 13.05 cm to 15.01 cm. The highest shoot length was recorded in T_8 (15.01cm) which was statistically similar with T_2, T_4, and T_5 while the lowest was recorded in T_1 (13.05 cm) (Table 3). On the other hand root length of seed sources also varied significantly which was ranged from 6.70cm to 12.90cm (Table 3). The highest percentage of root length was recorded in T_{10} (12.90cm) while the lowest was recorded in T_4 (6.70cm). Vigour index of seed sources varied significantly which was ranged from 1255.80 to 2089.86 (Figure 4). The highest Vigour index was recorded in T_7 (2089.86) which were statistically similar with T_8, T_4 and T_6 while the lowest was recorded in T_5 (1255.80). Chowdhury (2012) recorded the vigour index of BADC seed of *T. Aman* season in 2009- 2010 and ranged from 1664.88% to 2456.88%.Chowdhury (2012) recorded the Vigour index of farmer's seed of *T. Aman* season in 2009- 2010 and ranged from 1272.75 to 2155.28.

Table 3. Shoot length (cm) and Root length (cm) of different seed samples collected from farmers and BADC sources

Treatments		Shoot length (cm)	Root length (cm)
FARMERS SEED	T_1	13.05	8.65
	T_2	14.92	10.31
	T_3	13.37	9.18
	T_4	14.75	6.70
	T_5	13.47	8.95
BADC SEED	T_6	13.47	8.95
	T_7	13.38	11.08
	T_8	15.01	7.92
	T_9	13.17	7.57
	T_{10}	13.05	12.90
$LSD_{0.05}$		1.42	0.504
SE (±)		0.491	0.175
Level of significance		*	**
CV (%)		7.13	3.79

Here, T_1=BR11 of farmer's seed, T_2=BINA dhan7 of farmer's seed, T_3=BRRI dhan32 of farmer's seed, T_4= BRRI dhan34 of farmer's seed, T_5= BRRI dhan49 of farmer's seed, T_6= BR11 of BADC seed, T_7= BINA dhan7 of BADC seed, T_8= BR22 of BADC seed, T_9= BRRI dhan49 of BADC seed and T_{10}= BRRI dhan52 of BADC seed, *= Significant at 5% level of probability, **= Significant at 1% level of probability.

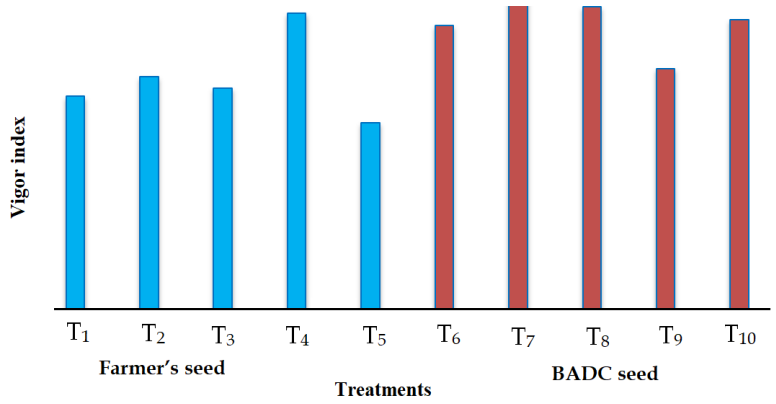

Figure 4. Vigour status of different seed samples collected from farmers and BADC sources. Here, T_1=BR11 of farmer's seed, T_2=BINA dhan7 of farmer's seed, T_3=BRRI dhan32 of farmer's seed, T_4= BRRI dhan34 of farmer's seed, T_5= BRRI dhan49 of farmer's seed, T_6= BR11 of BADC seed, T_7= BINA dhan7 of BADC seed, T_8= BR22 of BADC seed, T_9= BRRI dhan49 of BADC seed and T_{10}= BRRI dhan52 of BADC seed

Dry inspection test

Apparently healthy seeds

In the dry inspection test apparently healthy seeds varied significantly that was ranged from 17.74g to 28.92g (Figure 5). The highest percentage of the apparently healthy seeds was recorded in T_9 (28.92g) which was statistically similar with T_4 and T_7 while the lowest was recorded in T_2 (17.74g). Fakir *et al*. (2002), reported that rice seeds of Mymensingh district contain deformed and discolored seeds as found 14.43% to 24.44%, discolored seeds 8.46% to 15.50% in Rajshahi, Rangpur and Bogra districts of Bangladesh. This variation may be due to the variations of farmers' knowledge regarding the seed production & processing. Sharma *et al.* (1997) and Rahman (2002a) whose reported 4.35 to 79.82% discolored seeds. Chowdhury (2012) observed the dry inspection test of BADC seed of *Boro* season in 2007-2008 and the apparently healthy seed ranged from 27.01 %to 61.81%, spotted seed 30.54% to 60.65%, discolored seed 1.00% to 4.40%, deformed seed 4.57% to 14.51%, contaminants 1.72% to 5.61%.

Spotted seed

In the dry inspection test spotted seeds varied significantly that was ranged from 9.8g to 17.34g (Figure 5). The highest percentage of spotted seed was recorded in T_1 (17.34g) which was statistically similar with $T_4$and the lowest was recorded in T_9 (9.8g).

Discoloured seed

The percentage of discoloured seeds varied significantly which was ranged from 0.36g to 3.40g (Figure 5). The highest percentage of discoloured seed was recorded in T_3 (9.0g) while the lowest was recorded in T_4 (0.33g).

Deformed seed

In the dry inspection test deformed seeds varied significantly that ranged from 0.36g to 5.58g (Figure 5). The highest percentage of deformed seed was recorded in T_2 (5.58g) while the lowest was recorded in T_4 (0.36g).

Chaffy seed

The percentage of chaffy Seeds ranged from 0.08 g to 1.14g (Figure 5) which varied significantly. The highest percentage of chaffy seed was recorded in T_5 (1.14g) while the lowest recorded in T_3 (0.08g).

Insect damage seed

In the dry inspection test Insect damaged seed varied significantly that was ranged from 0.00g to 0.28g (Figure 5). The highest Insect damaged seed was recorded in T_2 (0.24g) while the lowest recorded in T_6 (0.00g).

Inert matter

In the dry inspection test inert matter varied significantly that was ranged from 0.00g to 0.38g (Figure 5). The highest Inert matter was recorded in T_1 (0.38g) while the lowest was recorded in T_6 (0.00g). Chowdhury (2012) studied seed quality status of HYV rice seed in Bangladesh and Haque *et al.* (2007) found 99.01% pure seed from the farmer's produced rice seeds in seed samples of trained farmers and minimum (96.19%) in untrained farmers. Uddin (2005) determined the percentage of pure seed of Begumgonj Upazilla under Noakhali district that ranged from 95.59 to 99.39%. Fakir *et al*. (2002) reported the percentage of pure seeds ranging from 91.20 to 98.89% collected from farmers stored rice seed. Chowdhury (2012) observed the purity analysis of BADC seed the highest pure seed were recorded from 99.86% and 99.18%, inert matter in 0.14% and 0.76%, while other crop seed was not found in BADC *Boro* seed 2007-2008 and 2009-2010.

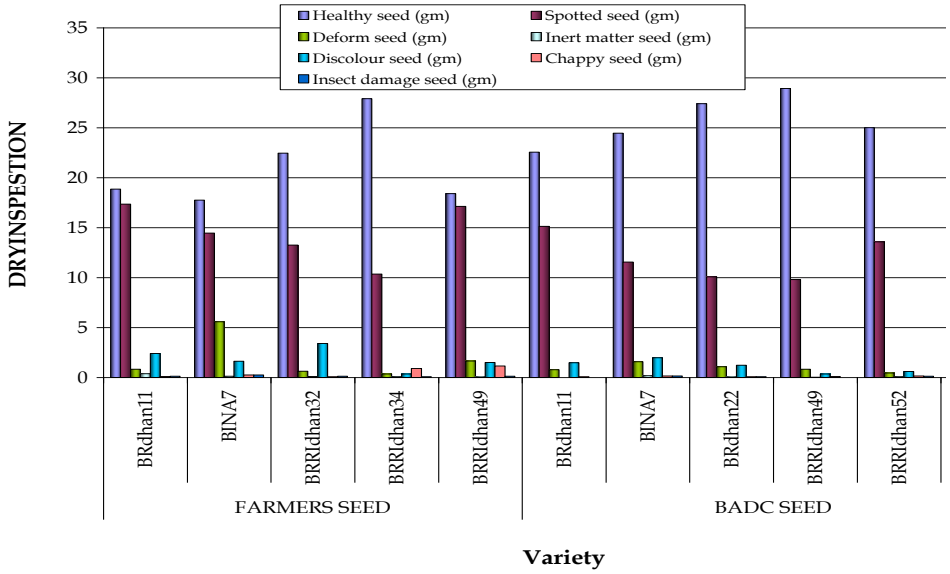

Figure 5. Dry inspection test on different seed samples collected from farmers and BADC sources. Here, T_1=BR11 of farmer's seed, T_2=BINA dhan7 of farmer's seed, T_3=BRRI dhan32 of farmer's seed, T_4= BRRI dhan34 of farmer's seed, T_5= BRRI dhan49 of farmer's seed, T_6= BR11 of BADC seed, T_7= BINA dhan7 of BADC seed, T_8= BR22 of BADC seed, T_9= BRRI dhan49 of BADC seed and T_{10}= BRRI dhan52 of BADC seed

Seed health test

Fungi such as *Alternaria padwickii, Aspergilus niger, Bipolaris oryzae, Curvularia lunata, Fusariam oxyporum, Aspergillus flavus, Penicillium* sp. ware morphologically identified in this study with the different seed samples. The percentage of *Alternaria padwickii* ranged from 1.25% to 5.50% (Figure 6) which was varied significantly. The highest *Alternaria padwickii* was recorded in T2 sample(5.50%) which was statistically similar with T_5while the lowest in T_8 (1.25%). The percentage of *Aspergilus niger* ranged from 0.00% to 1.75% which was varied significantly among the samples. The highest percentage of *Aspergilus niger* (1.75%) was record in the T_3 while there was no *Aspergilus niger in* T_8. The percentage of *Bipolaris oryzae* ranged from 0.00% to 1.50% which varied significantly. The highest percentage of *Bipolaris oryzae* was record in T_5 (1.50%) while there was no *Bipolaris oryzae* recorded in the T_3 and T_7. The percentage of *Curvularia lunata* ranged from 0.00% to 1.0% which varied significantly. The highest percentage of *Curvularia lunata* was record in T_5 (1.00%) which was statistically similar with T_1, T_8 and T_9 while no in T_{10} (0.00%). The percentage of *Fusariam oxyporum* ranged from 0.00% to 1.0% which also varied significantly .The highest percentage of *Fusariam oxyporum* was recorded in T_{10} (1.00%) while there was no *Fusariam oxyporum* was recorded in T_1, T_2, T_3, T_4, T_5, T_6, T_7 and T_9. The percentage of *Aspergillus flavu s*ranged from 0.00% to 1.25% which varied significantly.

The highest percentage of *Aspergillus flavus* was recorded in T_5 (1.25%) while there was no *Aspergillus flavus* recorded in T_3, T_4, T_8 and T_9. The percentage of *Penicillium* sp. ranged from 0.00% to 1.50% which varied significantly. The highest percentage of *Penicillium sp.* (1.50%) was recorded in T_5 while there was no *Penicillium sp.* recorded in T_4 and T_6. The association of seed borne fungi of rice has also been observed by a good number of researchers (Fakir *et al.,* 2002; Islam *et al.,* 2000*;* Rahman *et al.,* 2000*;* Bicca *et al.,* 1998; Islam *et al.,* 1994). Chowdhury (2012) observed the seed health of BADC seed of *T. Aman* season in 2007-2008 and *Aspergillus flavus* ranged from 1.00% to 4.00% and *Alternaria padwickii 0*.50% to 8.50%, *Bipolaris oryzae* 0-11%. *Fusarium oxysporum* 1.00% to10.50% and *Fusarium moniliforme* 1.50% to 11.50%, *Sarocladium oryzae* 1.00% to 4.00% and *Penicillium* sp. 1.00% to 2.00%.

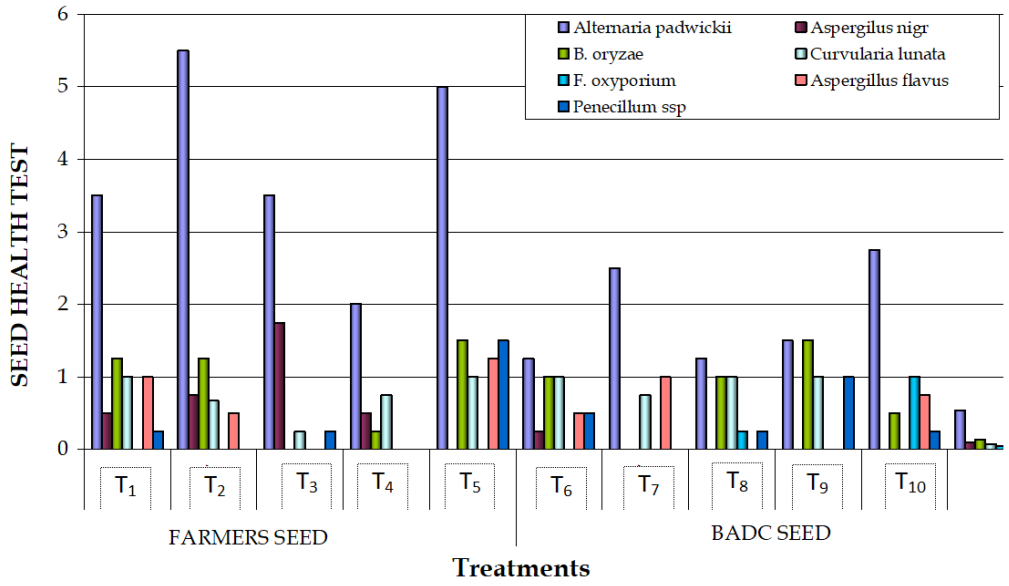

Figure 6. Seed health test on different seed samples collected from farmers and BADC sources. Here, T_1=BR11 of farmer's seed, T_2=BINA dhan7of farmer's seed, T_3=BRRI dhan32 of farmer's seed, T_4= BRRI dhan34 of farmer's seed, T_5= BRRI dhan49 of farmer's seed, T_6= BR11 of BADC seed, T_7= BINA dhan7 of BADC seed, T_8= BR22 of BADC seed, T_9= BRRI dhan49 of BADC seed and T_{10}= BRRI dhan52 of BADC seed

Plate 2. Seed health test in Blotter method

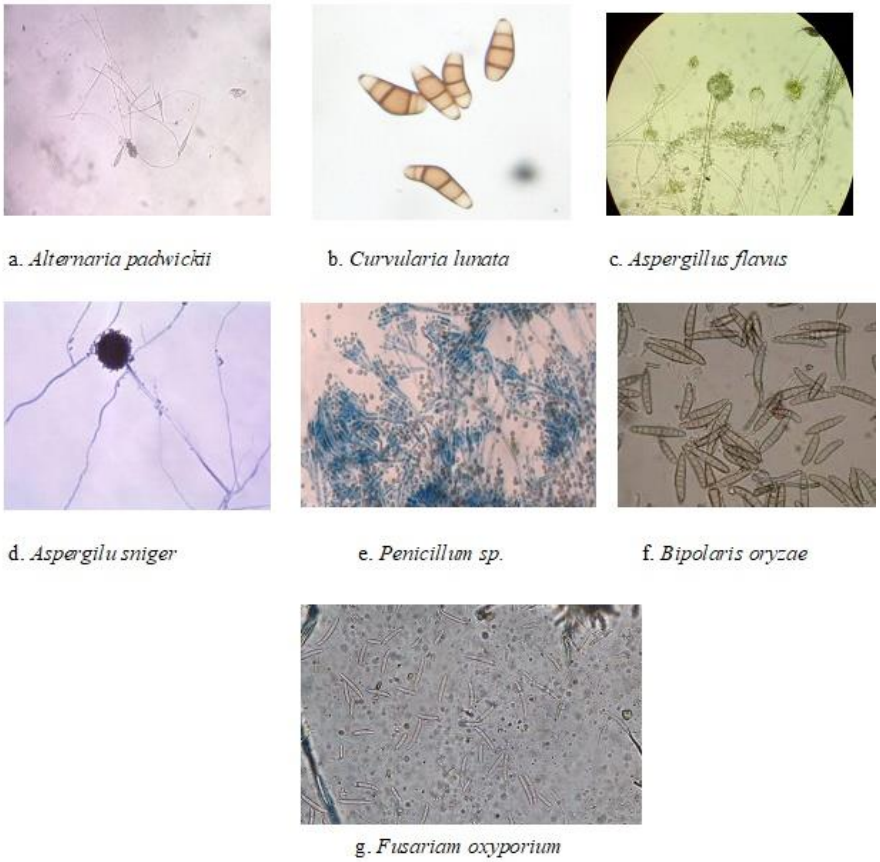

Plate 3. Seed borne fungi on rice seeds

Summary and conclusion

Seed samples of different *T. Aman* rice varieties (BR11, BINA dhan7, BR22, BRRI dhan32, BRRI dhan34, BRRI dhan49, BRRI dhan52) were collected from Farmer's seed sources and BADC seed sources. Five seed samples of farmer's sources were collected from five different parts of Mymensingh Sadar Upzilla (Viz. Bhabokhali, Char Nillokhia, Borochar, Barera and Khakdohor) and BADC seed sources were collected from BADC seed processing centre, Bolashpur, Sadar, Mymensingh in the year of 2018.

In the seed sources the moisture content was ranged from 10.40% to 13.37%**.** In case of purity analysis of seed, pure seed ranged from 39.23g (98.67%) to 39.94g (99.92%), inert matter 0.03g (0.08%) to 0.530g (1.33%) and no other seeds were recorded. Germination test of rice seeds was recorded and the percentage of total number of germination ranged from 55.75% to 93%, normal seedling51.50 % to 86.50%), abnormal seedling 4.75 % to 10.75%, fresh ungerminated seed 1.75% to 15.0%, hard seed 0.00% to 11.75%, dead seed 2.75%to21.25%.Vigour index in the seed sources ranged from 1255.80 to 2089.86. In dry inspection test apparently healthy seeds 17.74g to 28.92g, spotted seeds 9.8g to 17.34g, deformed seeds 0.36g to 5.58g,discoloured seeds 0.34g to 3.40g, inert mater 0.00g to 0.38g, insect damaged seeds 0.00g to 0.24gand chaffy seeds 0.08 g to 1.14 respectively. In the health study there was seven species of fungi were recorded. The identified fungi were *Alternaria padwickii, Aspergilus niger, Bipolaris oryzae, Curvularia lunata, Aspergillus flavus, Penicillium* sp. and *Fusariam oxyporum.* In the seed health test *Alternaria padwickii* 1.25% to 5.50%, *Aspergilus niger* 0.00% to 1.75%, *Bipolaris oryzae* 0.00% to 1.50%, *Curvularia lunata* 0.00% to 1.00%, *Aspergillus flavus* 0.00% to 1.25%, *Penicillium* sp. 0.00% to 1.50% were recorded, respectively.

Most of the farmers were unable to maintain the moisture content and the purity status strictly. For this reason most of the farmer's seed were failed to obtain the quality and good health status. Now a day's some of our well educated farmers maintain the quality and health of their seeds. In this study, BRRI dhan34 in farmer's seed recorded the highest

performance in the seed sources and the lowest performance was recorded in BRRI dhan49 in farmer's seed. The seed sources such as BR11 in BADC seed, BINA dhan7 in BADC seed, BR22 in BADC seed, BRRI dhan49 in BADC seed and BRRI dhan52 in BADC seed performed relative similar in all quality attributes and BR22 of BADC seed (T8) performed the best in respect of seed quality and seed health. Therefore, it may be concluded that seeds from BADC seed sources may be recommended the best for seed quality and seed health aspects.

CONFLICT OF INTEREST

The authors declared that there is no conflict of research interest.

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