Quality status of farmers' saved rice (*Oryza sativa*) seed in Bangladesh

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**ABSTRACT**

Farmers' saved seed is the principal source of rice seeds in Bangladesh. However, there is no enough information on the quality status of farmers' saved rice seed of the country. Henceforth, this study was carried out to evaluate the qualities of farmers' saved rice seeds across the country. The current study considered thirty (30) local and high yielding varieties of farmers' saved rice seed and subjected to moisture content, number count, purity and germination test. In the number count test, most of the contaminated varieties were admixed with other rice varieties. In most of the varieties, the purity of seed fluctuated from 95-100%. Among all varieties, the highest purity of seed was observed in Kalijira (100%), and the lowest purity was recorded in Kaliboro (85.20%). The seed moisture content varied between 12-15%. The majority of the tested varieties had moisture content above 12%, which reflected as low germination percentage in the laboratory and field condition. The 1000-seed weight was the maximum in cv. Hariath (32.33 g) and the lowest was 9.83 g in Tulsimala. Most of the variety represented better germination in the laboratory condition in compare to field. Further, investigations are needed to ascertain the seed health to come up with a concrete reason for poor germination as well as seed quality of farmers' saved rice seed of Bangladesh.

**Key Words**: Farmers' saved, Rice, Seed, Quality and Germination

I. Introduction

Rice (*Oryza sativa* L.) is a major cereal foodstuff of many people worldwide. More than half of the world’s population are using rice as their staple food, which provides 21% of the human per capita energy and 15% of protein (Maclean et al., 2013). In Bangladesh, rice has positioned at the top among the cereal accounts for 80% of the annual food grain production (Manik et al., 2016). Rice is occupying the top position of the daily dishes of both rich and poor people; rural and city consumers meet up 71% and 63% intake from rice consecutively (Minten et al., 2013). Hence, in Bangladesh 'Rice security' is synonymous with 'Food security' similar to many other rice-growing countries in the world (Broley, 2015). Moreover, it creates nearly 48% of rural employment, provides one-half of the agricultural GDP.
and one-sixth of the national income in Bangladesh (Manik et al., 2016). The population growth rate in Bangladesh is around 2 million per year and if this trend continues the total population will reach 218 million by 2050 (Streatfield and Karar, 2008). Besides, the cultivable land area decreasing rate is more than 1% per year owing to the construction works. Under changing climate (e.g., salinity, flood, drought) becoming a great challenge for rice production. Therefore, it is crucial to sort out the important barriers and potentiality and work with possibilities to meet up the future rice demand in Bangladesh.

Seed is a significant medium for plant regeneration and superior quality seed is the prime prerequisites for a healthy and vigorous crop (Christinck et al. 2014). Specifically, quality seed is considered as the basic, critical and cheapest input for enhancing productivity (Sapkota et al. 2011). Seed quality is amalgam of many properties of seed itself; genetic, physical, physiological, and health quality (Tripp et al., 1997). The crop yield can be increased up to 25%, which cannot be achieved by other inputs such as fertilizer, irrigation, plant protection (Kshetri, 2010; Nadew, 2018). Quality loss of seed is known as seed deterioration, which is generally associated with inappropriate storage conditions. The seed moisture content and storage temperature are the main reasons of seed deterioration.

In Bangladesh, most of the rice farmers are subsistence and smallholder (Biemond et al., 2012). Generally, these farmers use their produced seed for next year planting, consequently, they attempt to stock their own produced seed for several months to several years (Monajjem et al., 2014). In Bangladesh, about 80% of the rice seed sources the farmers’ stored seed (Iqbal and Toufique, 2016). However, there is no exact recent information on the quality of farmers’ stored rice seed. Most of the farmers of Bangladesh store seed in traditional storage tools due to lack of affordability of advanced storage techniques and proper knowledge. These structures are not so durable and poor in providing optimum storage conditions and therefore susceptible to deteriorates its quality (Alam et al., 2019). Studies imply that rice yield of Bangladesh could be increased by 12%-15% by using good quality healthy seeds alone, and nearly 20 lac tones of additional rice may be obtained per annum (Alam, 2015). The accessibility to good quality rice seed till now is the major constraint for farmers of Bangladesh despite the existence of national seed program for decades (Kolady and Awal, 2018). Farmers have been using their own saved seeds for cultivation without knowing its properties and thus incurring losses. Therefore, this study aims to assess the present status of seed quality of farmers’ saved rice seed in Bangladesh.

II. Materials and Methods
Experimental setup and design
The experiment was conducted in the Seed Science Laboratory at the Department of Agronomy and Haor Agriculture in Sylhet Agricultural University, Sylhet during September to November, 2019. The experiment was conducted following Completely Randomized Design (CRD) with four replications.

Collection of seed sample
A total of 30 farmers’ saved rice seed of different varieties (both high yielding and local) were collected randomly from major rice growing regions of Bangladesh (Figure 01).

Quality assessment
All collected samples were analyzed for seed quality parameters. The quality assessment was done based on the physical and physiological quality of seed. The quality assessment tests were conducted according to the International Seed Testing Association rules (ISTA, 1993). Within physical quality test, the number count test, analytical purity test and physiological Quality germination test in laboratory and field condition, moisture content. In number count test, other varieties of rice, other crop seed and weed seed were counted and recorded in number. In case of purity test, the working samples were splitted into pure seed, other crop seed, weed seed and inert matter and percentages of the components were determined (equation i). The moisture content of seed was estimated using grain moisture meter, and germination in lab and field condition was estimated based on equation ii.

\[
\text{Percentage of components} = \frac{\text{Weight of individual component}}{\text{Total weight of all components}} \times 100 \quad (i)
\]
Gemination percentage \(= \frac{\text{No. of total germinated seeds}}{\text{Total no. of seeds tested}} \times 100 \) (ii)

<table>
<thead>
<tr>
<th>Variety</th>
<th>Location</th>
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</thead>
<tbody>
<tr>
<td>V1</td>
<td>Moynashail (Sylhet)</td>
</tr>
<tr>
<td>V2</td>
<td>BR22 (Mymensingh)</td>
</tr>
<tr>
<td>V3</td>
<td>Rata (Sylhet)</td>
</tr>
<tr>
<td>V4</td>
<td>Hira (Gazipur)</td>
</tr>
<tr>
<td>V5</td>
<td>BRRI dhan89 (Narsingdi)</td>
</tr>
<tr>
<td>V6</td>
<td>Katarivhog (Bogra)</td>
</tr>
<tr>
<td>V7</td>
<td>BRRI dhan49 (Natrakona)</td>
</tr>
<tr>
<td>V8</td>
<td>BRRI dhan53 (Jamalpur)</td>
</tr>
<tr>
<td>V9</td>
<td>Khiloi (Kishoreganj)</td>
</tr>
<tr>
<td>V10</td>
<td>Zirashail (Bogra)</td>
</tr>
<tr>
<td>V11</td>
<td>Khatarivog (Bogra)</td>
</tr>
<tr>
<td>V12</td>
<td>BR23 (Bhola)</td>
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<tr>
<td>V13</td>
<td>Kaliboro (Sherpur)</td>
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<tr>
<td>V14</td>
<td>Kalijira (Narsingdi)</td>
</tr>
<tr>
<td>V15</td>
<td>BRRI dhan36 (Chapai.)</td>
</tr>
<tr>
<td>V16</td>
<td>BRRI dhan32 (Sherpur)</td>
</tr>
<tr>
<td>V17</td>
<td>Aijong (Netrokona)</td>
</tr>
<tr>
<td>V18</td>
<td>Mala (Panchagarh)</td>
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<tr>
<td>V19</td>
<td>Balam (Narsingdi)</td>
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<tr>
<td>V20</td>
<td>Hayrat (Sylhet sadar)</td>
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<tr>
<td>V21</td>
<td>Chinisagor (Jamalpur)</td>
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<tr>
<td>V22</td>
<td>Payzem (Jamalpur)</td>
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<tr>
<td>V23</td>
<td>Hariath (Sylhet)</td>
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<tr>
<td>V24</td>
<td>Lakhai (Sunamganj)</td>
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<tr>
<td>V25</td>
<td>BR11 (Gaibanda)</td>
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<tr>
<td>V26</td>
<td>BRRI dhan28 (Khagrachari)</td>
</tr>
<tr>
<td>V27</td>
<td>Gachi (Sunamganj)</td>
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<tr>
<td>V28</td>
<td>Biruin (Habiganj)</td>
</tr>
<tr>
<td>V29</td>
<td>Tulshimala (Sherpur)</td>
</tr>
<tr>
<td>V30</td>
<td>BRRI dhan29 (Khulna)</td>
</tr>
</tbody>
</table>

**Figure 01.** Location of collected rice seed sample throughout the country (the yellow dots indicate the locations seed source).

**Data analysis:** Analysis of variance was performed using the statistical software R software version 3.4.3. Mean separation was done using the least significant difference (LSD) at \( p < 0.05 \).

**III. Results and Discussion**

**Number count test**

The average physical purity in number count test of rice seed differed significantly among the rice growing regions. Among thirty varieties, only eleven varieties were admixed with the different components of number count test (Figure 02). Among the components of number count test other rice seed found in ten verities, and Biruin (V28) variety was the mostly admixed variety throughout the varieties tested. On the other hand, other crop seed was only found in one variety named by Hariath from Sylhet while weed seed was found in two varieties viz. Hariath and BRRI dhan29.

**Figure 02.** Purity components in number count test.

**Purity test:** All components significantly differed among the varieties for physical purity of seed (Figure 03). V12 (BR 23) from Bhola was showed the 100% purity, whereas V13 (Kaliboro) from Sherpur was exhibited lowest (86%) purity as it was mostly admixed through other crop seed. Within
few varieties viz., V6, V9, V10, V30 found more than 5% inert matter. However, out of thirty, the presence of weed seed with very little amount was recorded in only two (V6 and V23) varieties. The presence of other crop seed was recorded in seven varieties with a considerable amount (15%) in V13 (Kaliboro) which was collected from Sherpur. The overall depiction among the purity components was pure seed 96% and inert matter 3% and other crop seed 1% (Figure 04).

Moisture content
There were significant differences among the varieties in terms of moisture content of seed (Figure 05). The variety V3 (Rata) had low moisture (12.13%) which was statistically similar to V9 (12.17%), whereas high moisture content (15.87%) recorded in V23 which was statistically similar to V17 (15.57). The moisture content of all of the varieties is above 12% and even few varieties above 14%. McDonald and Copeland (1997) stated that rice seed should be stored below 14% moisture content of seed for short term storage. However, it is better to keep the moisture content of seed below 12% for short term storage (maximum nine months), below 11% for intermediate term (18-24 months) storage and below 10% for long term storage (3 to ten years) of rice seed with 30°C and 50% relative humidity (Delouche et al., 2016). In Bangladesh, farmers usually store their seed one year to grow rice in the respective season of the next year and not possible to maintain the storage temperature and relative humidity in farmer’s seed store. Therefore, it is safe side to maintain the seed moisture percentage below 10%. The results of this study indicate, the high moisture content of farmers’ saved rice seed which prone to quality deterioration of seed. Losses in storage are induced by the deterioration of rice quality caused by rice metabolism, microorganisms, rodents, and stored-product insects (McDonald, 2007).
Thousand seed weight

Thousand seed weight varies from species to species; usually bold rice seed has higher and fine rice seed comparatively lower thousands seed weight (Figure 06). The variety V23 (Hariath) collected from Sylhet was showed maximum seed weight, whereas V29 (Tulshimala) was exhibited the lowest seed weight. Previous studies of thousand seed weight on some rice varieties such as BRRI dhan32 in line with the findings of Salahin (2016). However, thousand seed weight of few varieties like V30 (BRRI dhan29) does not match with the previous studies Siddiquee et al. (2002). The most considerable factor for this difference is the variability of the moisture content of seed (Zareiforoush et al., 2009).

Germination Test

In the germination test both laboratory and field conditions all varieties were significantly differed among them (Figure 07). V12 (BR 23) was showed 96% germination in lab condition, whereas V1 (Moynashail) exhibited the lowest (50%) germination. In field condition, V8 (BRRI dhan53) showed maximum germination which was statistically similar to V22 (Payzem), whereas V1 (Moynashail) showed the lowest germination percentage was statistically similar to V7 (BRRI dhan49) and V14 (Kalijira) respectively. Overall germination percentage of the varieties was higher when tested in the laboratory (75.8%) compared to field (59.6) (Figure 08).

The germination percentage and seed moisture content along with storage temperature are highly correlated with increasing predictably with decreasing temperature and moisture content (Rajjou and Debeaujon, 2008). High seed moisture content along with high temperature and ambient oxygen would trigger series of metabolic changes and increase in respiration and the consumption of storage reserves, and thus lead to seed deterioration (Liu et al., 2016; McDonald, 1999). According to the National Seed Board (NSB) of Bangladesh, the germination percentage of rice should be at least 80 for certified seed. However, the germination percentage of farmers’ saved rice seed is far away from the standard germination percentage of NSB. In the laboratory condition, the germination percentage is
also very low and that enforced to the very low germination percentage in the uncontrolled environment in the field. The germination drastically decreased as moisture content was increase in all the verities as we used in this study. This study was in line with Pedireddi et al. (2018).

Figure 07. Germination (%) of seed in lab and field condition.

Figure 08. Overall germination percentage of rice varieties in lab and field.

IV. Conclusion
In Bangladesh, farmers usually store rice seeds for their subsequent cropping as it becomes costly and scarce at the time of cultivation. Generally, farmers store their seed in customary systems and tools. But the quality of seed deteriorates in consequent of the farmer’s unconsciousness in storing their seeds. Hence, ensuring quality seed is a prime concern for their desired production. The present study was conducted to unveil the physical and physiological quality of farmer’s stored rice. In this study, farmer’s saved rice seed was recorded with high varietal admixture and high moisture content. Notably, storing seeds with higher moisture content renders the loss of reserve as well as germination power resulted in poor germination percentage in the field and laboratory conditions. Additionally, the varietal admixture resulted in genetic impurity and seed quality factor diminish the ultimate production. However, the seed-health and other quality attributes test of the farmers’ saved rice seed would be a promising solution for the overcoming of the poor quality seed of the farmer.

V. References


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