Original Research Article

SEED QUALITY STATUS OF RICE VARIETIES BASED ON PHYSICAL PROPERTIES, SEED HEALTH AND PROXIMATE COMPOSITION

ABSTRACT

In the present study, seed quality status of fifteen rice varieties were evaluated for physical properties, health status and proximate composition. Physical properties like moisture content, seed purity, germination and vigor index varied between 11.77-14.67%, 96.08-98.93%, 96.50 to 99.00% and 1972.74 to 2639.76, respectively. The shoot length and root length of seedlings were from 8.93 cm to 12.99 cm and 10.89 cm to 14.22 cm, respectively. Seed health was determined by blotter test performed. Five seed-borne fungi were detected and the identified fungi were *Bipolaris oryzae* (1.00-8.50%.), *Fusarium moniliforme* (0.50-3.50%), *Fusarium oxysporum* (0.50-9.00%.), *Curvularia lunata* (0.00-7.50%) and *Alternaria padwickii* (0.00-4.00%). Proximate composition analysis assessment was done using Association of Official Analytical Chemists (AOAC) method. The dry matter, ash, crude fiber, crude protein, crude fat and carbohydrate were between 92.52- 93.77%, 2.39-6.70%, 8.65-14.27%, 6.51-9.13%, 1.23-1.97% and 62.84-71.06%, respectively.

Key-words: Rice variety, Seed quality, Health status and Proximate composition.

INTRODUCTION:

Rice (*Oryza sativa* L.) is agronomically and nutritionally important cereal crop of Gramineae family and major source of calories for a large percentage of the world's population, especially in Asia. It is considered to be the staple food for nearly half of world's population (IRRI, 2013). Bangladesh has a long history of rice cultivation since the primitive period of time. It is the 4th largest rice producing country in the world. Nearly 90% people consume rice as their staple food in Bangladesh (Banglapedia, 2012). Major portion of daily caloric requirement is provided by rice in our country. In a typical diet of the people in Bangladesh rice alone provide 76% of the total calories and 66% of the protein. It is also very rich source of carbohydrate with substantial amounts of fat, fiber, mineral and vitamins. Approximately 11.38 million hectares of land covering 74.85% percent of total cultivatable land is under rice cultivation (BBS, 2016). The national average yield of rice is much lower (2.94 t/ha) in Bangladesh (BBS, 2012). Whereas the average yield of rice in China (5.3 t/ha), Indonesia (4.36 t/ha), Vietnam (4.72 t/ha) and South Korea (4.89 t/ha) t/ha) is much higher than Bangladesh (BRRI, 2010). There are many constraints responsible for this low production of rice in Bangladesh i.e. contaminated seeds, high moisture content of seeds, disease infected seeds etc. Contaminated seeds often result in poor germination percentage and low seedling vigor and unhealthy crops (Haque *et al*., 2007). Propagules of different pathogens present in crop debris or in soil particles mixed up with seeds during the process of harvesting, winnowing, storage and contaminate seeds. Presence of weed seeds, insects, seeds of other rice varieties or other crops are also not hygienic for seed lot. Seeds are also infected with pathogens and causes germination failure, rotting of seed, weight loss of seed, spotting and discoloration to the seed (Raymundo and Fomba, 1979). Due to seed-borne

diseases roughly 10% production loss occur annually in Bangladesh and according to the estimate, 2.5 million tons of rice worth TK. 30,000 million is lost annually (Fakir, 2004).

At present 34.71 million Matric. Ton of rice is produced annually (BBS, 2016). The population growth rate is 2 million per year. At the same time, the total cultivable land is decreasing at a rate of more than 1% per year. Therefore, the country requires more production of rice from per unit area. In these circumstances, production of rice needs to be increased in a sustainable manner for the food and nutritional security of this highly populated country.

By taking all this points into consideration, the present study was aimed at evaluating the following objectives:

i) To evaluate seed quality status based on physical characteristics of some commonly used varieties of rice.

ii) To assess seed health status of these varieties.

iii) To determine nutritional quality of these varieties.

MATERIALS and METHODS

Fifteen varieties of rice i.e. Binadhan-7, Binadhan-8, Binadhan-9, Binadhan-10, Binadhan-11, Binadhan-12, BRRI dhan28, BRRI dhan29, BRRI dhan34, BRRI dhan49, BRRI dhan52, BR11, Balia-2, Kalizira and Nazirshail were used in this study to compare the physical properties, health status and proximate composition. The study was conducted in Seed Pathology Centre (SPC), MS Laboratory of the Department of Crop botany, Department of Seed Science and Technology, Department of Animal Science, BAU, Mymensingh.

Determination of moisture content

Moisture content was determined using air oven dry method. The 10g seeds of each sample were taken and heated in air oven at 130℃ for 4 hours. The loss of weight during drying is calculated and expressed in percentage.

% Moisture = ((Initial weight-final weight))/(Initial weight) × 100

Determination of seed weight

The 1000 seeds were counted using seed counter and weight was taken by using an electronic balance and recorded. The results were expressed in gram (g).

Purity analysis

For purity analysis 70g seeds were taken according to standard procedure (ISTA, 1996). The seeds were categorized into three categories viz. pure seed, other seed and inert matter.

Determination of germination

Germination test and Seedling vigor test were done in plastic pots using sand. Eight replication of 50 seeds and altogether 400 seeds were tested for germination. Germination was recorded at 5 and 14 days after sowing. Total germinated seeds, normal seedlings, abnormal seedlings, non-germinated seeds and diseased seedlings were counted separately and expressed in percentage. After 20 days shoot length and root length were measured for vigor test. Fifteen seedlings from each 2 pots of 100 seeds were randomly selected. The seedling vigor was determined according to the formula of Baki and Anderson, (1972) as shown below:

Vigor Index = (mean of root length + mean of shoot length) × % of seed Germination

Detection of seed borne fungi

The seed borne pathogens were detected using blotter paper method. Three pieces of filter paper moistened with sterilized water were placed at the bottom of 9 cm plastic petri dishes. 25 seeds were placed in each petri dish. In total 200 seeds in eight replications were used for each sample. The seeds were incubated at 20 ± 2°C under alternating cycles of 12 hours near ultraviolet (NUV) light and darkness for 8 days. After incubation, the incidence of seed borne fungi was recorded using stereomicroscope at 16x and 25x magnification. Each seed was observed separately. Most of the fungi associated with seeds were detected by observing their growth characters on the incubated seeds following the keys outlined by Ramnath *et al*. (1970) and khan (1975). Temporary slides were also prepared and observed under compound microscope and identified following the keys suggested by Malone and Muskette (1964). The results were presented as percent incidence for individual pathogen.

Proximate analysis of samples

Chemical composition of collected seed samples were determined as per the methods described by Association of Official Analytical Chemist (AOAC, 2000). The total percentage of carbohydrate in the rice sample was determined by the difference method as reported by Onyeike *et al*., 1995.

Carbohydrate (%) = 100% − (100% moisture + fat + protein + ash)

Statistical analysis

The collected data were analyzed following computer package MSTAT-C and mean differences among the treatments were compared by Duncan's Multiple Range Test (DMRT).

RESULTS

Moisture content

The average moisture content of seeds of 15 rice varieties varied significantly from 11.77-14.67% (Fig. 1.). The maximum moisture content (14.67%) was found in seeds of Kalijira variety followed by Binadhan-7 (13.97%), whereas the minimum moisture content (11.77%) was recorded for BR11.

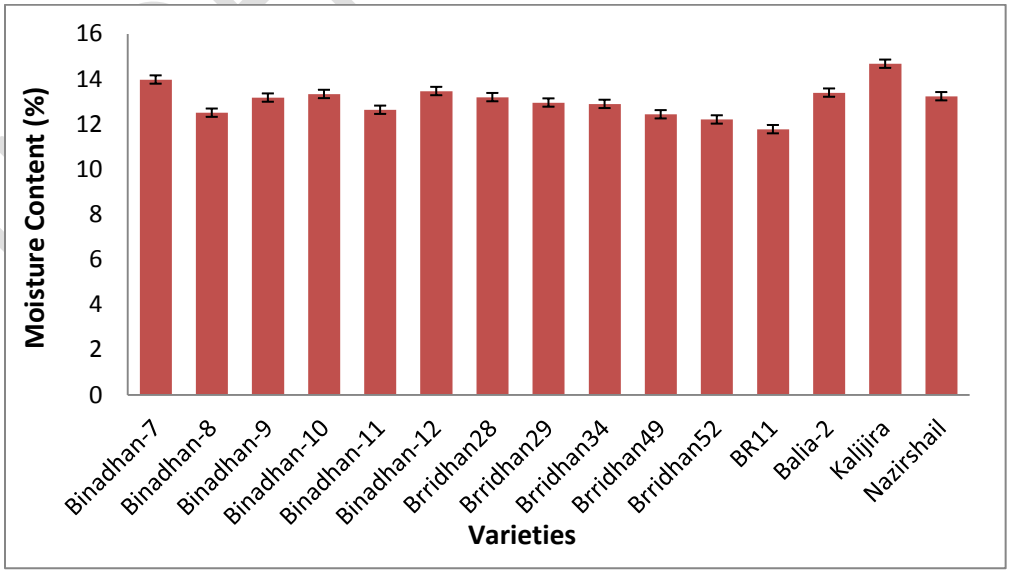

Fig. 1. Moisture content (%) of fifteen rice varieties. Data were subjected to Duncan's New Multiple Range Test (DMRT) using MSTAT-C. Each value represent the mean of three replications.

1000-seed weight

In this study weight of 1000 seed of the 15 selected rice seed categories are presented in Fig. 2. The weight for 1000-seed of 15 rice varieties varied between 10.72-28.32g. Binadhan-10 had the highest weight (28.32 g), where BRRI dhan34 variety weighed the lowest for 1000-seed (10.72 g).

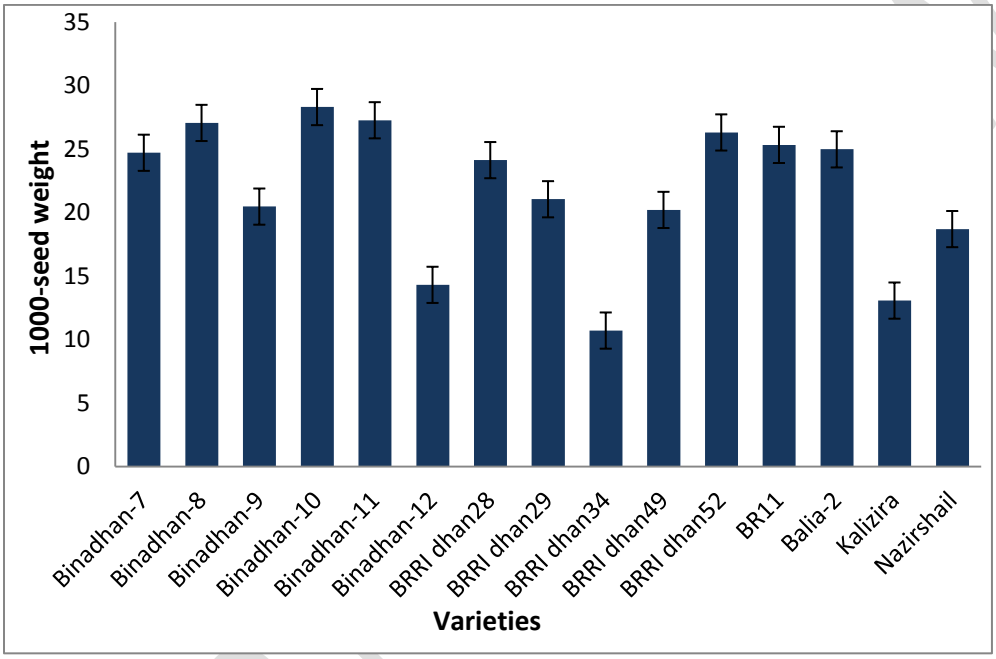

Fig. 2. 1000-seed weight of fifteen rice varieties. Data were subjected to Duncan's New Multiple Range Test (DMRT) using MSTAT-C. Each value represent the mean of three replications.

Purity analysis

Purity analysis revealed that the components of seeds i.e. pure seeds, other crop seeds, inert matter differ significantly among the collected seed samples (Table1). Pure seeds of fifteen rice varieties were from 96.08% to 98.93% where BR11 variety had the highest and Kalijira had the lowest pure seeds. Percent other seeds varied between 0.00-0.66. Kalijira variety had maximum other seeds and BR11 had no other seeds. Among all seeds, inert matter were found from 0.14% to 1.52%. Kalijira variety had the highest inert matter (1.52%), Binadhan-11 (0.14%) had the lowest.

Table 1. Purity analysis of fifteen rice varieties

Variety	Purity analysis (%)		
	Pure seeds(%)	Other seeds(%)	Inert matter(%)
Binadhan-7	98.33ab	0.13d	0.10i
Binadhan-8	98.19ab	0.11de	0.17efgh
Binadhan-9	97.99abc	0.12de	0.23cd
Binadhan-10	98.86a	0.04ef	0.12hi

Binadhan-11	98.29ab	0.08de	0.12hi
Binadhan-12	98.74a	0.10de	0.16fgh
BRRI dhan28	98.64a	0.27c	0.33b
BRRI dhan29	97.31abc	0.24c	0.24cd
BRRI dhan34	98.90a	0.11de	0.27c
BRRI dhan49	97.86abc	0.07def	0.25cd
BRRI dhan52	97.53abc	0.12de	0.15ghi
BR11	98.93a	0.00f	0.20defg
Balia-2	98.70a	0.44b	0.21def
Kalizira	96.08c	0.66a	0.43a
Nazirshail	96.52bc	0.47b	0.22cde
$LSD_{0.05}$	1.73	0.075	0.053
Level of significance	*	**	**
CV (%)	1.05	20.14	8.90

* = Significance at 5% level. Data were subjected to Duncan's Multiple Range Test (DMRT). Each value represents the mean of three replications. In a column, figures with same letter do not differ significantly whereas figures with dissimilar letter differ significantly.

Seedling category

Percentage of normal seedling, abnormal seedling, diseased seedling and non-germinated seeds of 15 rice varieties in germination test varied significantly (Table 2). The highest count of normal seedlings was obtained in BRRI dhan49 (94.75%) whereas the lowest incidence of normal seedlings was observed in Binadhan-8 (89.75%). In case of abnormal seedlings, the highest count was obtained in BRRI dhan28 (4.75%) while the lowest incidence (1.25%) was in Binadhan-11. Non-germinated seeds were recorded the highest in Nazirshail (3.25%) and the lowest in BRRI dhan49 (1.00%). The highest counted diseased seedlings were recorded in Kalijira (4.50%) where the lowest was found for Binadhan-11 (1.50%).

Table 2. Normal seedlings, abnormal seedlings, non-germinated seeds and diseased seedlings of fifteen rice varieties.

Variety	Normal seedlings (%)	Abnormal seedlings (%)	Non-germinated seeds (%)	Diseased seedlings (%)	Insect-infested seedlings (%)
Binadhan-7	91cd	3.75c	3.00ab	2.25d	4.00
Binadhan-8	89.75g	4.25b	2.50cd	3.50b	3.25
Binadhan-9	90.75e	2.25f	2.25de	2.50cd	2.5
Binadhan-10	93.75ab	2.50ef	2.00ef	1.75e	4.75
Binadhan-11	94.5a	1.25g	2.75bc	1.50e	8.25
Binadhan-12	93.25b	2.25f	1.75f	2.75c	4.00
BRRI dhan28	90.5ef	4.75a	3.00ab	1.75e	4.25
BRRI dhan29	92.25c	2.50ef	2.25de	2.50cd	6.00
BRRI dhan34	90.5ef	4.50ab	2.75bc	2.25d	5.25
BRRI dhan49	94.75a	2.50ef	1.00g	1.75e	6.75
BRRI dhan52	91cd	3.75c	2.50cd	2.75c	4.00

BR11	92.25c	2.75de	2.25de	3.25b	5.5
Balia-2	93bc	2.25f	2.00ef	2.75c	6.00
Kalizira	90.25ef	3.00d	2.25de	4.50a	4.00
Nazirshail	90.75e	2.50ef	3.25a	3.50b	5.00
$LSD_{0.05}$	1.80	0.429	0.390	0.382	
Level of significance	**	**	**	**	
CV (%)	1.45	10.11	11.56	10.27	

* = Significance at 5% level. Data were subjected to Duncan's Multiple Range Test (DMRT). Each value represents the mean of three replications. In a column, figures with same letter do not differ significantly whereas figures with dissimilar letter differ significantly.

Germination and seedling vigor

The root length, shoot length, germination and seedling vigour index recorded for 15 varieties of rice seeds are presented in (Table 3). Root length, shoot length and germination varied significantly among 15 varieties of rice. The germination percentage of seeds found to vary from variety to variety and ranged between 96.50-99.00%. The highest germination percentage was recorded in BRRI dhan49 (99.00%) and the lowest germination was recorded in Nazirshail (96.75%).

Table 3: Germination percentage, root length, shoot length and vigor index of fifteen rice varieties

Variety	Germination (%)	Root length (cm)	Shoot length (cm)	Vigor index
Brridhan-7	97.00cd	12.32cdefg	10.10efg	2174.74bcd
Binadhan-8	97.50bcd	12.50bcdef	9.350gh	2130.38bcd
Binadhan-9	97.75abcd	11.69efgh	8.930h	2015.61cd
Binadhan-10	98.00abcd	10.89h	9.240gh	2351.87d
Binadhan-11	97.25bcd	13.16bc	11.71bc	2418.28ab
Binadhan-12	98.25abc	11.98defgh	10.58def	2216.52bcd
BRRIdhan28	97.00cd	11.39fgh	9.660fgh	2041.85bcd
BRRIdhan29	97.75abcd	11.46fgh	9.600fgh	2037.56bcd
BRRIdhan34	97.25bcd	12.01defgh	10.75cde	2207.72bcd
BRRIdhan49	99.00a	13.52ab	11.44bcd	2421.12ab
BRRIdhan52	98.50ab	12.86bcd	11.75b	2399.48abc
BR11	97.75abcd	12.65bcde	11.41bcd	2351.87abcd
Balia-2	98.00abcd	14.22a	12.99a	2639.76a
Kalijira	97.75abcd	11.36fgh	9.530gh	2000.22cd
Nazirshail	96.75d	11.27gh	10.02efg	2022.55bcd
$LSD_{0.05}$	1.15	0.992	0.886	342.00
Level of significance	*	*	*	*
CV (%)	0.83	4.87	5.07	9.31

* = Significance at 5% level. Data were subjected to Duncan's Multiple Range Test (DMRT). Each value represents the mean of three replications. In a column, figures with same letter do not differ significantly whereas figures with dissimilar letter differ significantly.

Prevalence of pathogenic fungi

In this study five fungal species belonging to 4 genera- *Bipolaris oryzae, Fusarium moniliforme, Fusarium oxysporum, Curvularia lunata* and *Alternaria padcoickii* were identified. The average percent seed borne infection of the 15 rice varieties are shown in (Table 4). *Bipolaris oryzae* was the highest in Binadhan-11 (8.50%) and the lowest was observed in BRRI dhan29 (1.00%) and Binadhan-12 (1.00%), among the five identified pathogen, respectively. The maximum (3.50%) Incidence of *Fusarium moniliforme* was in Binadhan-9 and minimum (0.50%) incidence of *Fusarium moniliforme* was recorded in BRRI dhan29 and Binadhan-7, respectively. In case of *Fusarium oxysporum,* the highest count was recorded in BRRI dhan29 (9.00%) and Binadhan-7 (9.00%) where the lowest count was recorded in Binadhan-9 (2.50%). The highest (7.50%) seed-borne infection of *Curvularia lunata* was found in Binadhan-9 and BRRI dhan-34 while BRRI dhan-52 was detected totally free from *Curvularia lunata.* In case of *Alternaria padwickii* the highest (4.00%) was recorded in Nazirshail whereas BRRI dhan-49, BRRI dhan28, Binadhan-7, Binadhan-9 and Binadhan-10 were free from *Alternaria padwickii.*

Table 4: Prevalence of pathogenic fungi associated with fifteen rice varieties (Blotter Method)

Variety	Percent seed yielding fungi				
	Bipolaris oryzae	***Fusarium moniliforme***	***Fusarium oxysporum***	***Curvularia lunata***	***Alternaria padwickii***
Binadhan-7	3.50f	0.50g	9.00a	6.00c	0.00h
Binadhan-8	6.50d	2.50c	7.50bc	3.50g	2.51d
Binadhan-9	5.50e	3.50a	2.50j	6.50b	0.00h
Binadhan-10	5.50e	2.50c	4.00i	1.00i	0.00h
Binadhan-11	8.50a	1.00f	6.00ef	0.502j	1.00f
Binadhan-12	1.00h	1.50e	8.00b	4.50e	3.00c
BRRI dhan28	6.50d	1.00f	7.00cd	1.50h	0.00h
BRRI dhan29	1.00h	0.50g	5.00gh	0.500j	0.50g
BRRI dhan34	3.50f	2.00d	4.00i	0.000k	1.00f
BRRI dhan49	1.00h	3.00b	9.00a	3.50g	0.00h
BRRI dhan52	4.00f	2.00d	5.50fg	0.000k	3.50b
BR11	7.00cd	2.00d	4.62hi	1.00i	2.50d
Balia-2	2.00g	2.00d	6.50de	4.00f	0.50g
Kalijira	8.00ab	2.50c	6.50de	7.50a	2.00e
Nazirshail	7.50bc	3.00b	7.50bc	5.00d	4.00a
$LSD_{0.05}$	0.637	0.403	0.776	0.387	0.418
Level of significance	*	*	*	*	*
CV (%)	9.45	14.39	8.83	9.10	21.49

* = Significance at 5% level. Data were subjected to Duncan's Multiple Range Test (DMRT). Each value represents the mean of three replications. In a column, figures with same letter do not differ significantly whereas figures with dissimilar letter differ significantly.

Proximate composition

The result obtained for proximal composition of different rice varieties investigated in this study are depicted in (Table 5). The dry matter content of all rice varieties varied between 92.52-93.77%. Fat values among all rice varieties ranged between 1.23-1.97%. Binadhan-11 had the highest fat content 1.97% followed by BRRI dhan52 (1.93%), whereas Nazirshail exhibited the lowest fat content (1.23%). The protein content of rice varieties were appreciably high i.e. more than 7% for most of the varieties. Binadhan-11 (9.16%), BRRI dhan28 (9.13%) and Binadhan-9 (9.10%) exhibited higher protein content while BRRI dhan29 (6.51%) showed lower protein content. The values of ash content were found significantly different among all the rice varieties. Binadhan-11 had the highest amount of ash (6.70%) whereas BR11 had the lowest ash content (2.39%). The fiber percentage of all rice varieties varied between 8.65% to 14.27%. Binadhan-10 exhibited the highest fiber percentage (14.27%) and BRRI dhan52 contained the lowest fiber (8.65%). The carbohydrate content of all rice varieties varied between 62.84% to 71.06%. The highest amount of carbohydrate was found in BRRI dhan52 (71.06%) while the lowest was observed in Binadhan-11 (62.84%).

Table 5: Proximate composition of fifteen rice varieties

Variety	Dry matter content (%)	Crude fat (%)	Crude protein (%)	Ash (%)	Crude fiber (%)	Carbohydrate(%)
Binadhan-7	93.27abcd	1.650e	8.310bc	4.43cd	9.650i	69.23ab
Binadhan-8	92.81cde	1.340h	8.020cde	5.38b	9.700i	68.37bcde
Binadhan-9	93.27abcd	1.870bc	9.100a	5.13b	10.49h	66.68cdef
Binadhan-10	92.97 bcde	1.730d	7.990cde	4.11d	14.27b	64.87fg
Binadhan-11	93.30abcd	1.970a	9.160a	6.70a	12.63e	62.84g
Binadhan-12	92.86bcde	1.46f	8.550b	4.67c	12.99de	65.19fg
BRRI dhan28	93.77a	1.690de	9.130a	2.56h	9.550i	70.84ab
BRRI dhan29	92.52e	1.410fg	6.510g	4.49c	9.550i	70.56ab
BRRI dhan34	93.44abc	1.830c	8.410bc	3.14fg	13.53c	66.53def
BRRI dhan49	93.22abcde	1.870bc	7.760ef	3.03fg	11.50f	69.05abc
BRRI dhan52	93.13abcde	1.930ab	8.120bcde	3.37f	8.650j	71.05a
BR11	92.78cde	1.750d	7.510f	2.39h	11.36fg	69.77ab
Balia-2	92.80cde	1.390gh	8.360bc	3.77e	13.22cd	66.16ef
Kalizira	92.67de	1.890bc	8.220bcd	2.92g	10.95g	68.69abcd
Nazirshail	93.58ab	1.23i	7.850def	3.22fg	16.65a	64.63fg
$LSD_{0.05}$	0.626	0.063	0.405	0.334	0.423	2.20
Level of significance	*	*	*	*	*	*
CV (%)	0.47	2.47	3.48	5.94	2.55	2.29

* = Significance at 5% level. Data were subjected to Duncan's Multiple Range Test (DMRT). Each value represents the mean of three replications. In a column, figures with same letter do not differ significantly whereas figures with dissimilar letter differ significantly.

DISCUSSION

The experiment aimed at evaluating physical properties, health and proximate composition of fifteen rice varieties. The moisture content in this study was in the range from 11.77% to 14.67%. The moisture content was in the range of values reported by Oko *et al.,* (2012), Mbatchou and Dawda (2013) and Thomas *et al.,* (2013). Moisture content of some varieties were found to be within the acceptable limit (12%) for long term storage of rice (Adair *et al*., 1973) where other varieties have slight higher or lower moisture content (Table 1).

The 1000-seed weight of collected seed samples of 15 rice varieties ranged from 13.08 g to 28.32 g. BRRI (1997) reported 1000-seed weight of Nizershail was 25.2 g. In another study, Islam *et al*., (2009) stated that the 1000-grain weight for BRRI dhan31 was 24.21 g.

Pure seeds of seed samples of 15 varieties ranged from 96.08% to 98.93%, other seeds ranged from 0.00 to 0.66% and inert matter in seed samples ranged from 0.14 to 1.52%. The results varied from variety to variety. Henrita *et al*. (2015) determined seed purity of Adan rice 99.76±0.07%, other seed 0.00%, weed seed 0.00% and inert matter 0.23%. Akter and Hossain (2016) determined quality of 15 hybrid rice seed samples, where purity analysis revealed that pure seed ranged from 92.86 to 100.00%, other seeds 0 to 7.14% and inert matter 0 to 2.59%.

Percent germination of seed samples ranged from 96.50 to 99.00%. The germination percentage of rice seeds were determined by various investigators. Yeasmin *et al*. (2012) found seed germination percentage under controlled condition from 64 to 77%. Henrita *et al*. (2015) observed the germination percentage of Adan rice was 91.33±1.29%. In another study Alam *et al*. (2016) reported that the highest germination percentage (99.0-98.50%) from healthy seeds and lowest germination percentage (71.0-80.50%) from discolored seeds. Naher *et al*. (2016) recorded the highest and the lowest germination in seed samples of BRRI dhan30 (90%) and BRRI dhan33 (75%). Percent normal seedlings ranged from 85.25 to 89.25%, percent abnormal seedlings ranged from 1.25 to 4.75%, percent non-germinated seeds ranged from 1.00 to 3.25% and percent diseased seedlings ranged from 1.50 to 4.50%.

Altogether 15 collected rice varieties were tested for vigor index and it ranged from 1972.74 to 2639.76. The shoot length and root length of seedlings ranged from 8.930 cm to 12.99 cm and 10.89 cm to 14.22 cm respectively. Polan *et al*. (2004) assessed vigor index of 27 seed samples of three rice varieties (BR11, BRRI dhan28 and BRRI dhan32) collected from three locations (Shanboganj, Sutiakhali and Churhai) of Mymensingh district. The highest vigor index was recorded in BRRI dhan32 (1964.77) from Shanboganj and the lowest in BRRI dhan28 (1254.33) of Sutiakhali.

Seed health test revealed the presence of five fungal species associated with the seed samples were *Bipolaris oryzae, Fusarium moniliforme, Fusarium oxysporum, Curvularia lunata* and *Alternaria padwickii*. Of the five pathogens, *Fusarium oxysporum* had the highest percent of seed borne infection from 0.50 to 9.00%. Naher *et al*., (2016) investigated BR11, BRRI dhan30, BRRI dhan33 and reported incidence of seed borne fungi belonging to six genera i.e. *Bipolaris oryzae* (2.5 to 8.53%), *Alternaria padwickii* (5.3 to 13.35%), *Fusarium moniliforme* (11.66 to 21.67%), *Fusarium oxysporum* (1.25 to 4.35%), *Curvularia lunata* (1.95 to 7.5%) and *Aspergillus spp*. (1.75 to 6.54%). Seed borne pathogen *Bipolaris oryzae* was recorded in seed samples ranging from 1.00% to 8.50%. Incidence of *Fusarium moniliforme* ranged from 0.50 to 3.50%. *Alternaria padwickii* had the lowest percent of seed borne infection from 0.00 to 4.00%. Akter *et al*. (2016) investigated seeds of 15 hybrid rice varieties i.e. Durber, Agomoni, Meghna, Hybrid super, Moyna, Tia, Gold,

Aloron, Jagoron, Suborno, Safollo, Hira-1, Hira-2, Hira-4 and Hira-6. Seed health test revealed 11 different seed borne fungi viz. *Bipolaris oryzae* (0.0 to 25.5%), *Fusarium moniliforme* (0.00 to 3.0%), *Fusarium oxysporum* (0.0 to 18.0%), *Aspergillus flavus* (0.00 to 11.0%), *Aspergillus niger* (0.00 to 5.0%), *Aspergillus candidus* (0.00 to 15.0%), *Penicillium spp.* (0.0 to 7.0%) , *Alternaria padwickii* (0.0 to 1%), *Alternaria tenuis* (0.0 to 11.0%), *Curvularia lunata* (0.0 to 40.0%) and *Nigrospora oryzae* (0.0 to 4.0%). A number of studies had been done on seed health and association of seed borne fungi (Chellappan *et al*., 2010; Ahmed *et al*., 2013;).

Protein content in this study varied from 6.51 to 9.13% and was comparable to that found by Thomas *et al,.* (2013) and Lestari *et al.,* (2014). The protein content values of Asaduzzaman *et al.,* (2013) and Rohman *et al.,* (2014) were found less or near to the results of this study. Proteins form the basic building blocks for cells and tissue repairs in the body (Mbatchou and Dawda, 2013). Rice grain contain 8% of protein (Juliano, 1985), which is low in amount but have high nutritional value (Chaudhary and Tran, 2001). The variations of protein content in different rice varieties might be due to several factors such as water supply, environmental stress (such as temperatures and diseases), growing conditions and time which tend to increase the seed protein content (Buresova *et al*., 2010). Ash content of 15 rice varieties ranged from 2.39% to 6.70% which is higher than those reported by Saikia *et al.,* (2012) and Thomas *et al.,* (2013). Ash content determines the mineral elements of rice (Mbatchou and Dawda, 2013) and gives an idea about the levels of essential minerals present in rice (Edeogu *et al*., 2007). Fiber content in this study ranged from 8.65 to 14.27% for all the varieties and these values are considerably higher than values reported by Saikia *et al.* (2012); somewhat similar in range of Mbatchou and Dawda (2013). Fiber has the ability to decrease the blood cholesterol and sugar after meals (Yeager, 1998). Rice digestibility is affected by crude fiber content and rice digestibility is lowered due to high content of crude fiber (WHO, 1985).

Fat content in this study ranged from 1.23 to 1.93%. The range is higher than values reported by Asaduzzaman *et al*., (2013), Mbatchou and Dawda (2013), Thomas *et al*., (2013) and Rohman *et al*., (2014) and somewhat similar to the value reported by Saikia *et al*., (2012). Rice does not contain cholesterol and is a good source of linoleic and other essential fatty acids (Eggum *et al*., 1982). The variations in fat value in rice varieties may be due to oxidation as rice contain mostly unsaturated fats which undergoes oxidation easily by atmospheric oxygen (Hirokadzu *et al*., 1979). Carbohydrate content in 15 varieties ranged from 62.84 to 71.06% which is lower than the values reported by Saikia *et al*., (2012), Thomas *et al*., (2013) and Rohman *et al*., (2014), but neither higher nor within the range of values reported by Subudhi *et al*., (2013). Rice carbohydrates are mainly starch which is composed of amylose and amylopectin. Mbatchou and Dawda (2013) reported that because of high level of starch individual grains stick well to each other while low starch content prevents well sticking of the grains after cooking.

CONCLUSION

Investigation conducted on fifteen rice varieties varied for physical properties, proximate composition and health status. As determining the quality status of seeds varieties exhibited different potentialities for different parameters. The findings of this study along with precautionary measures are listed below for better understanding:

- The variety BR11 had the lowest moisture content (11.77%) and the highest percentage of pure seeds (98.93%). The average moisture content of rice varieties (11.77- 14.67%) can

be considered as good measure for germination but not safe for storage. Therefore seed should be dried to expected moisture level before storage.

- Percentage of germination, normal seedlings was much higher and seedling vigor index was also high for fifteen rice varieties which can be considered for cultivation. The variety BRRI dhan49 had the highest germination percentage (99.00%), on the other hand, the highest normal seedlings were found in Binadhan-12 (89.25%).
- Incidence of seed borne fungal pathogens was a bit high for most of the varieties. Considering this, seeds should be treated with fungicide before sowing. Five fungal species namely *Bipolaris oryzae, Fusarium moniliforme, Fusarium oxysporum, Curvularia lunata* and *Alternaria padwoickii* were detected in this study. Occurrence of all the five target pathogenic fungi was found mostly higher in Kalijira and Nazirshail varieties. The variety BRRI dhan29 exhibited the lowest overall infection of the five target fungal pathogens.
- Besides this, rice varieties showed considerable amount of carbohydrate, fat, fiber, ash and protein. The variety Binadhan-11 exhibited the highest percentage of protein (9.160%), ash (6.70%) and crude fat (1.97%). The highest carbohydrate was found in BRRI dhan52 (71.05%) whereas the variety Nazirshail exhibited the highest percentage of fiber (16.65%). Therefore, more attentions should be given to these varieties in terms of nutritive value.

RECOMMENDATIONS:

This experiment outlined determinents of seed quality like high moisture content, purity percentage, seedling establishment rate, disease infection and nutritional quality. The moisture content is good for cultivation but for storage seed should be dried to safe moisture level before storing. High germination percentage and vigor indicates field stand but the rate of disease infestation could affect the final productivity. This indicates the need for seed treatment with fungicide. But in terms of nutritional value varieties have balanced proportion of carbohydrate, protein, fat and fibre which increases their value as a source of nutrition. Seed quality is the result of crop management issues like water availability, fertilization and treatment of diseases. Hence further comprehensive research regarding their performance under field condition is needed to evaluate the productive outcome of these varieties. Thus farmers will be able to have overall information regarding these varieties.

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