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Health and quality of BRRI released aromatic rice seed and their control by plant extracts

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ABSTRACT

Seed borne pathogens significantly affect the aromatic quality of rice but there is an urgent need for disease management of these pathogens using eco-friendly and easily available biopesticides. The aim of this study was to explore the health of seeds of four BRRI aromatic varieties (BRRI dhan 34, 37, 38 and 50) and to assess their sustainability by dry inspection and standard blotter method. The germination rates ranged considerably from one variety to another with the highest rate in BRRI dhan 38 (89%) and the lowest in BRRI dhan 50 (71%). Seven fungal pathogens were identified with Fusarium oxysporum being highly prevalent (up to 25.0%) and Bipolaris oryzae (18.36%). In order to suppress these, extracts of neem, garlic and allamanda extract were tested at different concentrations. The results showed that garlic extract (1:1 w/v) was the best treatment, which significantly reduced the fungal loads and maximized the rate of germination, close to neem extract (1:1 w/v). These indicate that plant-based treatments are highly effective and cost effective, as alternatives to synthetic chemicals. Routine pre-sowing seed health testing is strongly advised for sustainable crop management, and the actual use of 1:1 garlic extract by farmers to guarantee healthy seedlings and profitable agriculture with less environmental impact.

KEY WORDS

Aromatic rice; Seed health testing; Seed-borne fungi; Blotter method; Seed treatment

ARTICLE HISTORY

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Introduction

Bangladesh is basically a rural country, agrarian with a rural based economy. Agriculture is still the lifeline of the nation's development directly accounting for 19% of G.D.P and generating a substantial number of jobs for about 63.2% of the active population, a feat that is unmatched in any other sector. Rice is regarded as a key staple food bearer and is one of the main pillars for national food security [1]. The tropical and sub-tropical climate of the country enables rice to be grown all year round with the farmers growing approximately 7000 different varieties of rice in different seasons of the year. Of all the wide variety, aromatic rice is a unique and prestigious type. It has a unique and attractive aroma when cooked and is an integral part of the social and cultural life of the Bengalees in all their functions such as festivals, marriage and entertaining guests. It has a tremendous nutritive value due to its high protein and carbohydrate contents. The economic viewpoints are that aromatic rice is valued at premium prices in the local and international markets [2]. Moreover, its cultivation also involves much lesser production costs than coarse rice, due to its natural requirement of not needing to necessarily spend much more on synthetic fertilizers, pesticides and irrigation. Even though aromatic rice has a high value, it is grown in only around 12.5% of the total Transplanted Aman area. Its lower yield, averaging approximately 1.5 tons per hectare, is the main reason for its failure to be cultivated by farmers, compared with the regular high yielding varieties. One of the major limitations for this production is the high incidence of seed borne diseases. There is no reason why the warm and humid climate which is conducive to the growth of rice should not also be conducive to pathogenic development. The economic impact of these diseases is huge: rice rotting due to these diseases is estimated to be losing 2.5 million tons of rice in Bangladesh every year which is an unbelievable loss of 12 billion of all the 43 known diseases of rice in Bangladesh, 27 of them are seed-transmissible and interestingly, 22 are caused by aggressive fungal pathogens [3,4]. Infected seed lots experience low germination rates due to the fact that seeds are the main vectors for the disease; infected seed lots will also transmit deadly infections to susceptible seedling; finally, infected seed lots will result in mature plant failure [5]. Thus, the ability to obtain pathogen-free high-quality seeds is an essential pre-requisite in order to ensure maximum yield potential. Researchers are increasingly relying on extracts from natural plants in recent years to control disease in an eco-friendly manner, while also reducing the major environmental and health impacts of harmful chemical fungicides. A fungicidal treatment using these botanicals is safe and environmentally friendly. But robust information on the specific fungal susceptibility and quality status of the popular BRRI released aromatic rice varieties, BRRI dhan 34, BRRI dhan 37, BRRI dhan 38 and BRRI dhan 50 is still grossly lacking and needs further in-depth agricultural research.

Thus, the present study is aimed at the assessment of these four BRRI released aromatic varieties by categorisation of their seed component through dry inspection, isolation and identification of associated seed-borne pathogens, selection of the best variety based on seed health and assessment of the potential of eco-friendly plant extracts as seed pathogen control agents.

Materials and Methods

Experimental site and seed collection

The experiment was carried out at the Seed Pathology Centre, Bangladesh Agricultural University, Mymensingh from August 2024 to October 2025. The seed samples of four varieties of aromatic rice (BRRI dhan 34, BRRI dhan 37, BRRI dhan 38 and BRRI dhan 50), released by BRRI, Gazipur were

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kept under condition of 5 ± 1 °C, according to ISTA rules [6].

Dry inspection and germination test

For dry inspection, 400 seeds from each variety were classified visually into eight categories: apparently healthy, discolored, spotted, and insect damaged, partially filled, unfilled/chaffy, misshapen, and mixtures of varieties. Germinability was determined by sowing the seeds in Petri dishes and then scoring germination percentage after 7 days.

Detection of seed-borne fungi

The standard blotter method was used to detect fungal pathogens [7]. Seeds (300 per variety, 25 seeds/plate) were placed on three layers of moist Whatman filter paper in 9 cm Petri dishes. Fungi growths were seen with both stereo and compound microscope and identified according to the standard identification key and manual [8].

Preparation of plant extracts and seed treatment

Neem leaves (*Azadirachta indica*), Allamonda leaves (*Allamanda cathartica*), and Garlic cloves (*Allium sativum*) extracts were prepared in three concentrations (1:1, 1:2, 1:3 w/v) using distilled water. Ten treatments were given (9 botanicals + 1 tap water control) [9]. The extracts were applied to the seeds for 6 hrs and then the seeds were dried on blotting paper for 6 hrs before further testing.

Table 1. List of botanical treatments and their concentrations used in the experiment

Treatment	Name of the Plant Extract	Concentration (w/v)
T_0	Control (Tap water)	-
T_1	Neem	1:1
T_2	Neem	1:2
T_3	Neem	1:3
T_4	Garlic	1:1
T_5	Garlic	1:2
T_6	Garlic	1:3
T_7	Allamonda	1:1
T_8	Allamonda	1:2
T_9	Allamonda	1:3

Dry inspection of seed

In the dry inspection 400 seeds from each working sample were laid out on a clean laboratory table, separated at random and examined visually. For this examination, the seeds were placed in eight categories: apparently healthy seeds, discolored seeds, spotted seeds, insect-damaged seeds, partially filled seeds, unfilled/chaffy seeds, deformed seeds and varietal mixtures.

Data Analysis

The data collected were analyzed statistically with a software package called MSTAT. One way analysis of variance (ANOVA) and Duncan's Multiple Range Test (DMRT) were used to analyse difference and compare the analysis.

Results

Dry inspection

The results from visual dry inspection of total 400 seeds of four BRRI varieties of aromatic rice indicate (Figure 1) that BRRI dhan 38 has the best physical seed quality and BRRI dhan 34 has the highest defect. In particular, the highest percentage of apparently healthy seeds (84%) was obtained by BRRI dhan 38 while the lowest rate of unfilled, partially filled and deformed seeds was obtained by this variety. BRRI dhan 34 had the maximum damage in all most defect classes such as discoloured (4.5 %), spotted (5.75 %), insect damaged (2.5 %), unfilled (4.5 %) and deformed seeds (2.0 %). Meanwhile, the lowest percentage of healthy seeds (72%) and the highest percentage of partially filled grains (3.25%) were observed in BRRI dhan 50. In the end, the data clearly shows that there is a quality continuum, with BRRI dhan 38 being the most robust and pristine variety and BRRI dhan 34 being very susceptible to physical, environmental and pest damage.

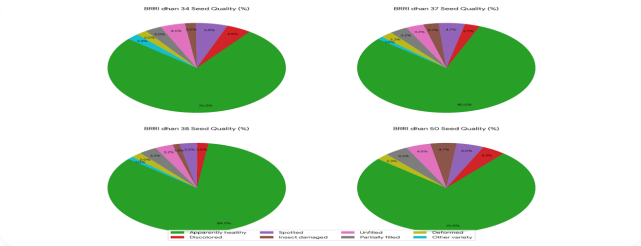

Figure 1. Pie charts illustrating the proportional distribution of different seed quality grades

Detection of seed borne fungi (Blotter Method)

Results of blotter method analysis revealed that there were considerable differences in seed germination and fungal infection rates among the four BRRI released aromatic rice varieties (Table 2). The germination percentages of all the varieties were between 71% and 89%, and the highest germination percentage was recorded in BRRI dhan 38 (89%) and the lowest percentage in BRRI dhan 50 (71%) (Table 2). A total of 409 fungal infections was recorded out of 1200 tested seeds. BRRI dhan 34 was the most susceptible to seed-borne pathogens which resulted 124 infections (30.32% of total burden). BRRI dhan 38 was the most resistant variety with the lowest infection level of 91 (22.25%) (Figure 2).

Seven species of fungi were isolated from morphological identification in all the samples of seeds, namely *Bipolaris oryzae, Fusarium moniliforme, Fusarium oxysporum, Alternaria padwickii, Aspergillus flavus, Aspergillus niger and Curvularia lunata*. Of these, *Fusarium oxysporum* was the most prevalent pathogen, with a total of 23.72% infection (97 infection sites in 51 seeds). The other fungi were *Bipolaris oryzae* (17.36%) and Fusarium moniliforme (16.14%) were closely followed (Figure 3). On the other hand, the incidence rates of *Aspergillus flavus* (9.54%) and *Aspergillus niger* were the minimum. BRRI dhan 34 was significantly more susceptible to both *Fusarium oxysporum* and *A. niger* than the other varieties tested, whereas the other varieties were only susceptible to *Fusarium oxysporum*.

**Significance at 1%level; * significance at 5% level; Percentage of total infections was calculated on the basis of 409 fungal infections on 1200 seeds

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Table 2. Frequency of occurrence of fungi recorded on four varieties of BRRI released aromatic rice

Varieties	Percent(%) seed borne fungi								
	Germination%	*Bipolariso ryzae*	*Fusariumoxysporum*	*Emonilifo rme*	*Aspergilusniger*	*A.flavus*	*Alternariapadwickii*	*Curvulariaalunata*	Total pathogens
BRRI dhan 34	84 bc	17.74 ab	22.58 c	17.74 a	10.48 a	8.87 d	12.90 a	9.68 cd	124 a
BRRI dhan 37	85 b	16.67 bc	25.00 a	15.63 bc	10.42 ab	9.38 b	12.5 ab	10.42 bc	96 bc
BRRI dhan 38	89 a	16.48 bc	24.27 ab	14.29 d	9.89 bc	10.98 a	12.09 abc	10.98 b	91 cd
BRRI dhan 50	71 d	18.36 a	22.44 cd	16.32 b	8.16 d	9.18 bc	11.22 bcd	14.28 a	98 b
LSD at 5%	2.96	1.19	1.27	1.09	1.04	1.09	1.11	1.17	6.29
Level of sig.	**	**	**	**	**	*	**	*	**

Efficacy of plant extracts on seed germination and fungal infection (Blotter Method)

Three botanical extracts namely neem, garlic and allamonda were tested at different dilutions (1:1, 1:2 and 1:3 w/v) and their effects on germination of seeds and suppression of seed-borne fungi (*Bipolaris oryzae, Fusarium moniliforme, F. oxysporum, Alternaria padwickii, Aspergillus flavus, A. niger* and *Curvularia lunata*) were investigated on four varieties of aromatic rice released by the Bangladesh Rice Research Institute (BRRI).

Effect on BRRI dhan 34

The germination rate for the plant extract treatments was considerably higher than the untreated control (T_0) which had 82% germination rate. The germination rate was highest in 1:1 garlic extract (T_4) (89%) and also very high in 1:1 neem extract (T_1) (88%) (Table 3, Figure 3). The highest amount of *Fusarium oxysporum* was found in untreated control (27.22%). In contrast, efficacy of T_4 was better because it significantly reduced the infection of *F. moniliforme* to 1.05%, and T_1 showed the efficacy in suppression of *A. padwickii* to 1.15%. Both garlic and neem extracts showed maximum effect in reducing the overall prevalence of fungi when used at 1:1 dilutions and moderate to low efficacy at 1:3 dilutions.

Effect on BRRI dhan 37

In the case of BRRI dhan 37, the seed germination rate was observed to have improved substantially with increasing from 81% in control to 87% in T_4 (1:1 garlic) and T_1 (1:1 neem) (Figure 3). *F. oxysporum* was still the most common pathogen in the untreated sample (22.75%). Treatment T4 was the most effective as it reduced *B. oryzae* to 1.05% (Table 4) being considered as the lowest rate. Allamonda extracts at lower concentration (T_8, T_9) were least effective in inhibiting fungal growth, while 1:2 concentrations of garlic and neem were moderately effective.

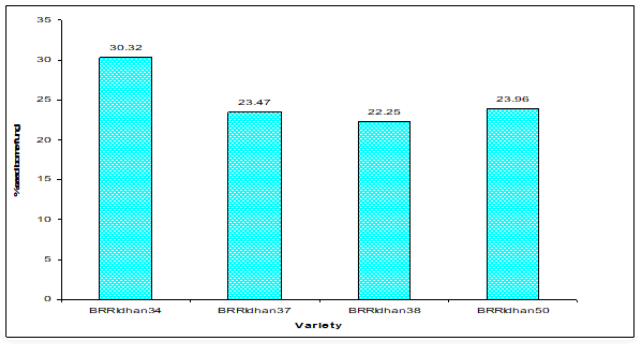

Figure 2. Total seed borne infections on four BRRI released aromatic rice

Effect on BRRI dhan 38

In the case of BRRI dhan 38, all the botanical treatments (T_1 to T_9) were effective in improving germination and reducing the seed borne fungi (Table 5). The maximum germination was observed (91%) in T_4 (1:1 garlic) while the untreated control gave 87% germination (Figure 3). Treatment T_4 had also proven to be very fungicidal with only 0.75% infected with *B. oryzae*. The 1:1 concentrations of garlic and neem extract were found to be the most effective while the highly diluted concentrations (1:3 neem, 1:2 and 1:3 allamonda) were the least.

Effect on BRRI dhan 50

Neem (T_1) and 1:1 garlic (T_4) extracts showed significant improvement in germination rate in BRRI dhan 50 variety (Table 6, Figure 3) which is most susceptible variety. The 1:1 garlic extract (T_4) was effective to keep *A. niger, C. lunata* and *A. padwickii* at 0.75% incidence. Also, 1:1 neem extract (T_1) showed significant inhibition of C. lunata (0.87%). The least concentrated treatments, T3 (1:3 neem) and T9 (1:3 allamonda) had very low fungicidal effect.

Overall prevalence of seed-borne fungi

In all the evaluated aromatic rice varieties, the untreated seeds always had the highest proportions of fungal infections. Garlic extract treatment at 1:1 dilution proved to be the most effective treatment with consistently lowest seed borne infection rates (e.g. 1.5% overall on BRRI dhan 34) followed by 1:1 neem and 1:1 allamonda extracts (Tables 8-11). All of the extracts showed a progressive decrease in efficacy with each successive dilution (1:1 to 1:3).

Table 3. Efficacy of plant extracts on germination and seed-borne infections on BRRI dhan 34

Treatment	Treatment with plant extracts on BRRRI dhan 34								
	Dose	% Germination	Percent of pathogens after treatment						
			Bipolariso ryzae	*Fusariumoxysporum*	*Emonilifo rme*	*Aspergilusniger*	*A.flavus*	*Alternariapadwickii*	*Curvularialunata*
T_0		82 g	22.5 a	27.22 a	23.45 a	13.54 a	11.33 a	15.5 a	12.25 a
T_1	1:1	88 ab	1.75 bc	2.33 c	2.5de	2.22 c	1.5 e	1.15 d	1.22 d
T_2	1:2	85 d	3.00 b	4.05 b	3.33 c	3.25 b	3.12 c	2.25 c	3.25 b

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Table 3 (continued)

Treatment	Treatment with plant extracts on BRRRI dhan 34								
	Dose	% Germination	Percent of pathogens after treatment						
			Bipolariso ryzae	*Fusarium oxysporum*	*Emonilifo rme*	*Aspergilu sniger*	*Aflav us*	*Alternariapa dwickii*	*Curvularialuna ta*
T_3	1:3	84 ef	3.50 b	4.75 b	4.50 b	3.33 b	4.25 b	4.5 b	2.05 c
T_4	1:1	89 a	1.13 d	2.25 d	1.05 e	1.08 d	1.25 e	1.33 d	1.1 d
T_5	1:2	87 bc	1.25 bc	2.33 cd	2.5 d	1.13 cd	1.05 e	1.00 d	2.13 c
T_6	1:3	86 cd	2.50 bc	3.25 c	3.00 cd	2.33 c	2.13 cd	2.25 c	1.75 c
T_7	1:1	86 cd	2.00 cd	2.75 c	2.13 de	1.33 cd	1.25 e	1.5 d	1.05 d
T_8	1:2	85 d	2.33 bc	3.25 c	3.75 bc	2.10 bc	2.66 c	2.25 c	1.75 c
T_9	1:3	83 de	3.50 b	4.25 b	4.67 b	3.25 b	2.5 cd	2.10 c	2.00 c
	LSD	1.301	0.695	0.443	0.652	0.693	0.447	0.440	0.408
	Level of sig.	**	**	**	**	**	**	**	**

**Significance at 1%level; * significance at 5% level

Table 4. Efficacy of plant extracts on germination and seed-borne infections on BRRI dhan 37

Treatment	Treatment with plant extracts on BRRRI dhan 37								
	Dose	% Germination	Percent of pathogens after treatment						
			Bipolariso ryzae	*Fusarium oxysporum*	*Fmonilifo rme*	*Aspergilu sniger*	*Aflav us*	*Alternariapa dwickii*	*Curvularial unata*
T_0		81 c	16.25 a	22.75 a	14.33 a	12.67 a	10.50 a	12.25 a	9.00 a
T_1	1:1	87 a	1.13 e	3.25 b	2.50 d	1.75bc	1.25 e	2.13 bc	1.50 bc
T_2	1:2	84 b	2.50 cd	4.00 b	3.50 bc	3.25 b	2.67 c	2.50 b	2.13 bc
T_3	1:3	81 cd	2.87 c	4.25 b	3.75 b	3.67 b	3.00 c	2.87 b	2.75 b
T_4	1:1	87 a	1.05 e	2.50 c	2.00 d	1.33 c	1.13 e	1.87 c	1.50 bc
T_5	1:2	84 b	1.75 d	3.00 c	2.25 d	2.13 bc	1.50 e	2.67 b	2.33 b
T_6	1:3	82 cd	2.5 cd	4.00 b	3.13 bc	2.75 b	2.25 d	2.05 bc	2.87 b
T_7	1:1	83 bc	1.67 d	3.50 b	3.00 bc	2.25 bc	2.27 d	1.50 c	1.75 bc
T_8	1:2	81 cd	3.13 c	4.50 b	3.75 b	2.50 bc	3.00	2.67 b	2.50 b

Table 4 (continued)

Treatment	Treatment with plant extracts on BRRRI dhan 37								
	Dose	% Germination	Percent of pathogens after treatment						
			Bipolariso ryzae	*Fusarium oxysporum*	*Fmonilifo rme*	*Aspergilu sniger*	*Aflav us*	*Alternariapa dwickii*	*Curvularialuna ta*
	LSD	1.586	0.348	0.880	0.440	0.695	0.317	0.860	0.665
	Level of sig.	**	**	*	**	**	**	**	**

**Significance at 1%level; * significance at 5% level

Table 5. Efficacy of plant extracts on germination and seed-borne infections on BRRI dhan 38

Treatment	Treatment with plant extracts on BRRRI dhan 38								
	Dose	% Germination	Percent of pathogens after treatment						
			Bipolariso ryzae	*Fusarium oxysporum*	*Fmonilifo rme*	*Aspergilu sniger*	*Aflav us*	*Alternariapa dwickii*	*Curvularialuna ta*
T_0		87 c	15.75 a	24.50 a	14.25 a	10.75 a	11.67 a	12.33 a	10.13 a
T_1	1:1	90 ab	2.25 bc	3.33 bc	1.75 e	1.25 d	1.00 d	1.25 c	1.13 d
T_2	1:2	89 b	2.67 bc	3.67 b	2.13 e	2.50 c	2.33 b	2.05 bc	2.00 c
T_3	1:3	87 c	3.33 b	4.00 b	3.87 b	3.13 b	2.67 b	2.75 c	2.33 c
T_4	1:1	91 a	0.75 cd	2.00 c	1.33 f	1.00 d	1.25 d	1.33 c	1.00 d
T_5	1:2	90 ab	1.50 bc	2.25 c	3.13 d	1.25 d	1.63 d	1.50 c	1.50 d
T_6	1:3	87 c	2.67 bc	3.13 bc	3.75 c	1.75 c	2.50 c	2.00 c	1.87 d
T_7	1:1	90 ab	2.13 bc	3.13 bc	2.87 c	2.13 c	2.33 c	2.25 bc	1.75 d
T_8	1:2	89 b	4.00 b	3.87 bc	3.50 c	3.25 b	2.67 c	2.87 b	2.50 c
T_9	1:3	87 c	4.25 b	4.33 b	4.05 b	3.87 b	3.13 b	3.33 b	3.13 b
	LSD	0.880	1.555	0.695	0.431	0.442	0.311	0.622	0.348
	Level of sig.	**	*	**	**	**	**	**	**

**Significance at 1%level; * significance at 5% level

Table 6. Efficacy of plant extracts on germination and seed-borne infections on BRRI dhan 50

Treatment	Treatment with plant extracts variety BRRRI dhan 50

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Table 6 (continued)

Treatment	Treatment with plant extracts variety BRRRI dhan 50								
	Dose	% Germination	Percent of pathogens after treatment						
			Bipolariso ryzae	*Fusarium oxysporum*	*Emonilifo rme*	*Aspergilus nigeer*	*Aflavus*	*Alternariapadwickii*	*Curvulariaaluna ta*
T_1	1:1	80 b	2.13 de	2.50 e	1.75 d	1.25 de	1.33 c	1.13 cd	0.87 g
T_2	1:2	78 d	2.78 cd	3.2 cd	2.00 d	1.87 c	1.45 c	1.87 c	2.05 e
T_3	1:3	73 g	3.25 c	3.75 bc	3.13 b	2.13 c	2.33b	2.33 c	3.00 c
T_4	1:1	82 a	1.33 f	1.67 g	1.25 e	1.05 e	0.75 d	1.22 cd	0.75 g
T_5	1:2	79 c	1.67 ef	2.13 ef	2.00 d	1.50 de	0.87 d	0.75 cd	2.00 e
T_6	1:3	76 e	2.05 e	3.00 cd	2.50 c	2.00 c	1.25 c	1.87 c	2.50 d
T_7	1:1	77 e	2.25 d	2.13 ef	2.00 d	1.67 d	2.00 b	2.12 c	1.78 f
T_8	1:2	74 f	3.25 c	3.oo cd	3.33 b	2.00 c	2.25 b	2.33 c	2.13 e
T_9	1:3	73 g	4.13 b	4.78 b	3.50 b	3.13 b	2.33 b	3.75 b	3.33 b
	LSD	0.695	0.440	0.605	0.401	0.319	0.317	0.625	0.313
	Level of sig.	**	**	**	**	**	**	**	**

**Significance at 1%level; * significance at 5% level

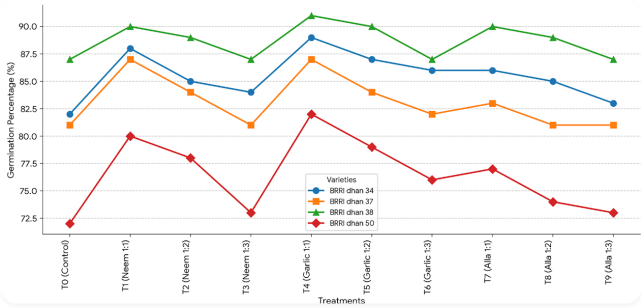

Figure 4. Effect of plant extracts on seed germination

Discussion

Various plant extracts at various dilutions have been compared to check their activity against seed borne fungi and health and quality of the released BRRI rice seeds. Germination and seed health and incidence of fungi was assessed by the blotter method which is still the common method used today in testing rice seed health [10,11]. The germination was between 71-89%, highest in BRRI dhan 38 (89%), lowest in BRRI dhan 50 (71%) and rest were in between. The range of germination in rice seeds from Bangladesh and other parts of the world has been reported to be similar and a recent survey at Mymensingh rice seeds indicates 80.0–85.0% germination of local rice seeds [12]. The result of dry inspection revealed 72.00-84.00% apparently healthy seeds per sample while the highest percentage was

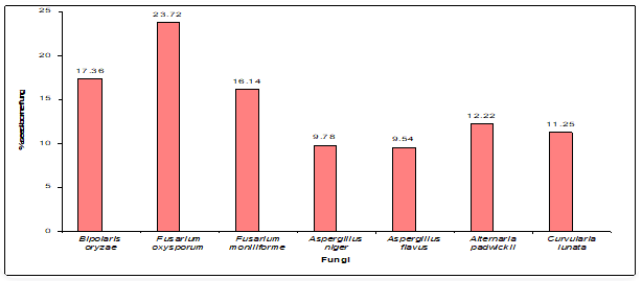

Figure 3. Prevalence of seed borne fungi recorded on the BRRI released aromatic rice

obtained from BRRI dhan 34 with 84 % seeds. Seed samples contained 1.25–4.50% discoloured, 3.00–5.75% spotted, 1.25–2.50% insect-damaged, 2.75–4.50% unfilled, 2.00–3.25% partially filled, 1.00–2.00% deformed seeds, and approximately 1.0% varietal mixtures. These results were akin to the earlier studies on seed quality of BRRI released varieties [6] and assessment of seed health and seed quality in Bangladesh [13].

In 1200 seeds, 409 fungal infections were found and seven fungi, Bipolaris oryzae, Fusarium moniliforme, Fusarium oxysporum, Alternaria padwickii, Aspergillus flavus, Aspergillus niger and Curvularia lunata were identified, a pathogen complex consistent with recent rice seed surveys that repeatedly recover B. oryzae, Fusarium spp., C. lunata, A. padwickii, A. niger and A. flavus, F. oxysporum showed the highest number of infections (97), followed by B. oryzae (71), F. moniliforme (66), A. padwickii (50), C. lunata (46), A. niger (40), and A. flavus (39) [14,15]. Their incidence ranged from 16.48–18.36%, 14.29–17.74%, 22.44–25.00%, 9.68–14.28%, 11.22–12.90%, 8.87–10.98%, and 8.16–10.48%, respectively. BRRI dhan 34 had the highest incidence of F. moniliforme (17.74%), A. niger (10.48%), and A. padwickii (12.90%); BRRI dhan 37 had the highest F. oxysporum incidence (25.00%); BRRI dhan 38 had the highest A. flavus incidence (10.98%); and BRRI dhan 50 had the highest B. oryzae (18.36%) and C. lunata (14.28%). Rice seed-borne fungi have been reported earlier to have been associated with Fusarium and Curvularia and more recent work also indicates the presence of Fusarium and Curvularia as amongst the most prevalent genera of fungi in rice seeds [10,16,17]. The most frequent pathogens were Fusarium spp., B. oryzae and F. oxysporum which is consistent with the latest study, which reported that B. oryzae and Fusarium spp. caused the highest percentage of seed infection [18,19]. The extract from Neem, garlic and Allamonda (1:1, 1:2 and 1:3, w/v) exhibited significant reduction in seed borne fungal incidence and significant increase in the rate of seed germination when compared to the untreated (T0) control and this is supported by other recent evaluations that demonstrated control of rice seed-borne fungi and improvement in seed germination rate, especially when the extracts were diluted at 1:1 water [20–22]. For BRRI dhan 34, highest germination rate was obtained in the garlic extract treated at rate of 1:1 (T4) with 83-89% germination rate followed by garlic extract treated at 1:2 (T5) with 81-83% and garlic extract treated at 1:3 (T6) with 80-82% whereas garlic extract treated at 1:4 (T7) with 79-81% and untreated control 82% germination rate overall. The incidence of F. oxysporum was found to be greatest in untreated seeds (27.22%) while the garlic extract at 1:1 resulted in a lower incidence of F. moniliforme (1.05%). Recently garlic extracts have been found to inhibit both F. oxysporum and F. moniliforme in vitro, thought to be due to allicin and ajoene and to suppress seed

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borne fungi in a variety of crops [23–25]. Neem extract at 1:1 concentration reduced A. padwickii to 1.03% which is the best of the aqueous extract dilutions tested. T1 (neem 1:1) and T4 (garlic 1:1) were the most effective treatments while T5, T6 and T7 had moderate effects. The findings are consistent with those of earlier reports as well as recent studies evaluating botanicals for eco-friendly control of rice seed borne fungi [26,27]. The growth percentage of BRRI dhan 37 was 81% with control, 87% with T1 and 87% with T4. In case of garlic 1:1, B. oryzae infection was reduced to 1.05% while the highest incidence of F. oxysporum was recorded in the untreated (22.75%). The doses of garlic 1:2, neem 1:2 and 1:1 were moderately effective and 1:2 and 1:3 of Allamanda were the least effective. The efficacy of the garlic extract against seed-borne fungi is reported to be the same where garlic extract was reported to be effective in inhibiting Fusarium fujikuroi, Curvularia lunata and Helminthosporium oryzae rice seed pathogens at 10% and 20% concentrations [28]. In the case of BRRI dhan 38, the germination rate was 87% to 91% with garlic 1:1 (T4) and lowest in treated 1:3 garlic (T6) and treated 1:3 Allamanda (T9) respectively with 87% germination rate. The garlic-1:1 mixture treatment gave 0.75% infection of B. oryzae. The cultivars Neem 1:1, Allamonda 1:2 and 1:3 Allamonda were less effective. The higher efficacy of neem and garlic at 1:1 dilution confirmed with previous studies and the efficacy of Allamonda extract at 1:1 has been reported previously [9,29]. Neem and ginger aqueous extracts have also been reported to promote full (100%) germination in treated rice seeds and neem leaf extract is one of the most effective botanicals against rice pathogens like Bipolaris oryzae [29–31]. Neem leaf extract has also been found to be effective against the seed-borne fungal pathogens of neem, which is consistent with the general trend of plant-based extracts and treatments as eco-friendly alternatives to chemical fungicides [3,5,32]. The germination rate of BRRI dhan 50 was better in T1 (82%) and T2 (85%) than in control (73%). The garlic extract at 1:1 and 1:2 level showed as low as 0.75% infection by A. niger, C. lunata and A. padwickii while neem 1:1 reduced the incidence of C. lunata to 0.87%. The other cultivars, Neem 1:3, Allamonda 1:2 and Allamonda 1:3 did not have such a good effect [33]. The results are comparable to that reported for antifungal activity of garlic extract against various seed-borne pathogens and recently have been reported for garlic's ability to inhibit A. flavus and reduce the production of aflatoxin [4,15,31].

The overall effect of the garlic extract at 1:1 (w/v) and neem extract at 1:1 (w/v) was significant to improve germination of seed and reduce seed borne fungal infection. The garlic extract (1:1 (w/v)) was the most effective treatment that was tested [34]. The study was, however, carried out in a single season under laboratory conditions and thus more multi-season and field experiments with other rice varieties and plant extracts are needed to confirm its effectiveness in farmer conditions.

Limitations

The reason cannot be explained without knowing the field conditions of the mother plants, nature of cultivation and environmental condition during the plant growth, which, however, were not considered in this experiment. Further, this study was carried out on one season only, and laboratory experiments cannot be considered sufficient to draw conclusive results for the farmer, thus the need to conduct more extensive research with more varieties and plant extracts and field studies to validate the results.

Conclusion

This study shows the significant difference between the quality of the seeds and germination of BRRI released aromatic rice varieties, where BRRI dhan 38 and BRRI dhan 37 are of better quality and better germination rate than BRRI dhan 34 and BRRI dhan 50. The seven fungi found as seed borne were the most important factors limiting seed health, *Fusarium oxysporum, Bipolaris oryzae, Fusarium moniliforme,* and *Alternaria padwickii* being the parasites which caused the worst infections. However, the use of extracts from plants as a treatment for seed proved to be a very effective and environmental friendly intervention. In particular, garlic extract at 1:1 (w/v) dilution was the most effective treatment when it came to reducing fungal prevalence and increasing germination rates (up to 91%), with neem extract (1:1 w/v) coming in as the next most effective. It is highly recommended to use biopesticides such as garlic extract and pre-sowing seed health testing to ensure sustainable and profitable rice production in Bangladesh, which will be considered alternatives to synthetic pesticides.

Declarations

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Ethics approval

Not applicable

Consent to participate

Not applicable

Consent for publication

Not applicable

Data availability

All data generated or analyzed during this study are included in this published article and all experimental procedures complied with relevant institutional and national guidelines.

Conflict of interest

No potential conflict of interest was reported by the author.

References

1. Kabir MS, Salam MU, Islam AKMS, Sarkar MAR, Mamun MAA, Rahman MC, et al.. Doubling Rice Productivity in Bangladesh: A Way to Achieving SDG 2 and Moving Forward. Bangladesh Rice J. 2021;24(2):1–47. https://doi.org/10.3329/brj.v24i2.53447
2. Islam R, Hossain MS, Aktar S, Sharma DC, Islam S, Kayess MO. Genetic and multivariate analysis of some local and advanced selected Aman rice genotypes under Bangladesh condition. Discov Plant. 2025;2(1):271. https://doi.org/10.1007/s44372-025-00352-8
3. Almeida AR DADSIDSCAJSJDMEPK, Silva IC D, Souza CA D, Avelino JR, Santos JE, Medeiros EV D, et al.. Plant extract as a strategy for the management of seed pathogens: a critical review. Res Soc Dev. 2021;10(14):e174101421846. https://doi.org/10.33448/rsd-v10i14.21846
4. Behiry SI, Hamad NA, Alotibi FO, Al-Askar AA, Arishi AA, Kenawy AM, et

© 2026 Reseapro Journals
https://doi.org/10.61577/jpri.2026.100002

al.. Antifungal and Antiaflatoxigenic Activities of Different Plant Extracts against Aspergillus flavus. Sustainability. 2022;14(19):12908. https://doi.org/10.3390/su141912908
5. Bhateshwar DC, Prabha D, Jangid D, Salman M. Effect of Seed Priming with Botanicals on Plant Growth and Seed Yield of Lentil (Lens culinaris M.). Int J Curr Microbiol Appl Sci. 2020;9(7):3484–3499. https://doi.org/10.20546/ijcmas.2020.907.407
6. A DK, D GM, S N, D PT, Z L. Incidence of seed borne fungi in farm saved rice seeds, quality declared seed and certified seed in Morogoro Region in Tanzania. J Plant Breed Crop Sci. 2018;10(7):162–168. https://doi.org/10.5897/jpbcs2017.0700
7. Mew TW, Gonzáles PAC, M TW. A handbook of rice seedborne fungi. Int Rice Res Inst. 2002.
8. Signaboubo S, Tsopmbeng Noumbo GR, Roger KJ. Seed-Borne Fungi Associated with Rice Seeds Varieties in Bongor,Chad Republic. Int J Curr Microbiol Appl Sci. 2016;5(12):161–170. https://doi.org/10.20546/ijcmas.2016.512.018
9. Yeasmin F, Ashrafuzzaman M, Hossain I. Effects of Garlic Extract, Allamanda Leaf Extract and Provax -200 on Seed Borne Fungi of Rice. The Agriculturists. 2012;10(1):46–50. https://doi.org/10.3329/agric.v10i1.11064
10. Hosen S, Shamsi S, Chakravorty S. In Vitro Control of Pathogenic Fungi Associated with Selected Brri Rice Varieties. Bioresearch Commun. 2023;10(1):1393–1397. https://doi.org/10.3329/brc.v10i1.70668
11. Aidoo AK, Appiah-Kubi Z, Bam RK. Mycoflora associated with seeds of five rice (Oryza sativa) varieties in Ghana. Greener J Plant Breed Crop Sci. 2015;3(1):015–019. https://doi.org/10.15580/gjpbcs.2015.1.050415065
12. Chowdhury P, Shamsi S, Begum HH, Bashar MA. Mycoflora associated with diseased rice grains in Bangladesh and their pathogenic potentiality. Bioresearch Commun. 2021;7(1):932–940. https://doi.org/10.3329/brc.v7i1.54251
13. Sarkar MAR, Habib MA, Sarker MR, Rahman MM, Alam S, Manik MNI, et al.. Rice farmers' preferences for seed quality, packaging, and source: A study from northern Bangladesh. PLoS One. 2024;19(6):e0306059. https://doi.org/10.1371/journal.pone.0306059
14. Kumar N, Khurana SMP, Pandey VN. Deciphering of seed Health of common food grains (wheat, rice) of North Eastern UP and Gurgaon Haryana, India. Sci Rep. 2023;13(1):8480. https://doi.org/10.1038/s41598-023-34510-3
15. Loi M, Paciolla C, Logrieco AF, Mulè G. Plant Bioactive Compounds in Pre- and Postharvest Management for Aflatoxins Reduction. Front Microbiol. 2020;11:243. https://doi.org/10.3389/fmicb.2020.00243
16. Moussa S, Itolou KA, Mariam B, Kadidia K, Issa W. Effects of Plant Extracts and Pesticides on Rice Seed Microbial Communities in Burkina Faso. J Exp Agric Int. 2025;47(8):139–152. https://doi.org/10.9734/jeai/2025/v47i83656
17. Mahal MF. Effects of fungicides and plant extracts on seed germination and seed associated mycoflora of Lens arietinum L. and Lathyrus sativus. J Biosci. 2016;22:101–110. https://doi.org/10.3329/jbs.v22i0.30014
18. Prasad N, Theerthagiri A, Karuppannan R, Ranganathan U, Sharma P. Assessing the Impact of Brown Spot Disease on Seed Health, Quality and Transmission in Paddy. J Phytopathol. 2025;173(1):e70033. https://doi.org/10.1111/jph.70033
19. Ministry of Agriculture Bangladesh, Haque M, Rashid M, Zhumur TK, Hossain MD, Bangladesh Agricultural University Mymensingh. Prevalence of seed-borne fungi of local aromatic rice and their control by plant extracts. Int J Bus Soc Sci Res. 2025;13(1):1–8. https://doi.org/10.55706/ijbssr13101
20. Navoda H, Anupama DD. Evaluation of antifungal plant extracts against cereal and legume seed-borne pathogens for effective management. Stud Fungi. 2022;7(1):1–11. https://doi.org/10.48130/sif-2022-0009
21. Mohana D, Prasad P, Vijaykumar V, Raveesha K. Plant Extract Effect on Seed-Borne Pathogenic Fungi from Seeds of Paddy Grown in Southern India. J Plant Prot Res. 2011;51(2). https://doi.org/10.2478/v10045-011-0018-8
22. Bhuiyan MR, Rashid MM, Khan MA, Hoque M, Nessa B, Rafii MY, et al.. Eco-friendly management of seed borne fungi for sustainable crop production.. 2013.
23. Cobbinah P, Doffour J, Abengmeneng CS, Abukari A, Nasare LI. Effect of antifungal botanical extracts on seed-borne fungi prevalence and germination of Terminalia ivorensis seeds in Ghana. Magna Scientia Adv Biology Pharm. 2023;10(2):068–079. https://doi.org/10.30574/msabp.2023.10.2.0084
24. Anjorin TS, Salako EA, Asarivwo EO, Edeh JA, Dauda WP. Antifungal efficacy of garlic (Allium sativum L.) on selected crop seed-borne fungi. World Journal of Advanced Research and Reviews. 2024;22(1):870–878. https://doi.org/10.30574/wjarr.2024.22.1.1033
25. Manna H, Hamza EM, Sorour NM, Adak M, Teixeira J, Agi V. Eco-friendly Approach for the Biocontrol of Two Fusarium spp. Using Allium sativum Extract. Middle East J Agric Res. 2023. https://doi.org/10.36632/mejar/2023.12.2.20.
26. Bhusal KK, Devkota S, Malla S, Magar SK. Study on research works and future research directions of post-graduate program at pathology department, IAAS, Rampur, Chitwan, Nepal. I-Tech Mag. 2022;4:01–09. https://doi.org/10.26480/itechmag.04.2022.01.09
27. Ahmed M, Hossain M, Hassan K, Kanta Dash C. Efficacy of Different Plant Extract on Reducing Seed Borne Infection and Increasing Germination of Collected Rice Seed Sample. Univers J Plant Sci. 2013;1(3):66–73. https://doi.org/10.13189/ujps.2013.010302
28. Chowdhury P, Bashar MA, Shamsi S. In vitro evaluation of fungicides and plant extracts against pathogenic fungi of two rice varieties. Bangladesh J Bot. 2018;44(2):251–259. https://doi.org/10.3329/bjb.v44i2.38514
29. Safari Motlagh MR, Hamdami S. Antifungal activity of some plant extracts against Pyricularia oryzae, the causal agent of rice blast disease. Environ Pollut Bioavailab. 2025;38(1):2610087. https://doi.org/10.1080/26395940.2025.2610087
30. Sultana T, Shamsi S, Bashar MA. Prevalence of Fungi With Seeds of Twenty Brri Released Rice Varieties and Seed Quality Analysis. J Asiat Soc Bangladesh Sci. 2018;44(1):79–89. https://doi.org/10.3329/jasbs.v44i1.46548
31. Waris M, Hemalatha P, Mishra MK, Kar AK. Management of Seed Borne Pathogens of Rice. Int J Curr Microbiol Appl Sci. 2018;7(10):3638–3648. https://doi.org/10.20546/ijcmas.2018.710.421
32. Pain A, Basunia AK, Chowdhury MH, Islam MM, Haque ME, Hasan AK. Studies on the Quality and Health Status of T. Aman Rice Seeds Collected From Different Sources. Res Agric Livest Fish. 2022;9(2):103–116. https://doi.org/10.3329/ralf.v9i2.61616
33. Sharma S, Parwan S, Bhardwaj N, Banyal DK. Evaluation of mycoflora associated with Indian red rice landraces in Himachal Pradesh, India. Seed Sci Technol. 2025;53(2):159–172. https://doi.org/10.15258/sst.2025.53.2.02
34. P Renganathan RK, T Suthin Raj PB. Detection of Seed-Borne Mycoflora associated with Paddy Seeds and its Influence on Seedling Health. Int J Curr Microbiol Appl Sci. 2021;10(7):539–544. https://doi.org/10.20546/ijcmas.2021.1007.059

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