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Article

Seed health and quality of some selected rice varieties and their management

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Abstract: A study was conducted for assessing seed health status of four varieties of rice (*Oryza sativa*) viz. BR 11, BRRI Dhan 28, BRRI Dhan 29 and BRRI Dhan 40 and management of seed borne fungal pathogens by selected chemical namely Thiovit (4%) and a bio-control agent BAU-Biofungicide @ 2% (*Trichoderma* based preparation*)* at Seed Pathology Center (SPC) and M.S. Laboratory, Department of Plant Pathology, Bangladesh Agricultural University (BAU), Mymensingh. Seed health test by blotter method revealed that seven seed borne fungi belonging to six genera viz. *Alternaria padwickii* (0.5%-1%), *Bipolaris oryzae* (1%-6.5%), *Curvularia lunata* (1%-5.5%), *Fusarium moniliforme* (3%-8.5%), *Fusarium oxysporum* (2%-9%), *Aspergillus flavus* (0.5%-1.5%) and *Penicillium spp* (0.5%-1%) were associated with the seeds. Germination of seeds of the four selected rice varieties varied from 94% to 98.50% (blotter method). In treated seeds, germination ranged from 88-100%. The highest germination (100%) was found in BRRI Dhan 28 when seeds were treated with BAU-Biofungicide and the lowest was (88%) in BRRI Dhan 29. The tested samples produced healthy seedlings (77 to 98%), diseased seedlings (2 to 15%), diseased seeds (0 to 7%) and dead seeds (0 to 5%). Upto 18.18% higher formation of healthy seedlings over control was achieved by treating seeds with BAU-Biofungicide and it also significantly decreased (upto 81.82%) formation of diseased seedlings over the control treatment. The highest vigor index (1306%) was in BRRI Dhan 28 when seeds were treated with BAU-Biofungicide and the lowest was (2805%) in BRRI Dhan 29 under control (untreated). Moreover, BAU-Biofungicide increased up to 81.82% Vigor index over untreated control.

Keywords: rice; seed quality; BAU-Biofungicide; fungicide

1. Introduction

Rice is the staple food crop in Bangladesh and also in most countries of the world. Rice covers about 11533.60 ha land in Bangladesh and the production of rice is 33890 tons (BBS, 2012). The average world yield of rice is 3.84 tons/ha (Ahmed *et al*., 2013). But the average yield of rice in Bangladesh is only 2.98 tons/ha. So the average per hectare production of rice in Bangladesh is low as compared to other rice growing countries of the world. Rice covers about 11533.60 ha total cropped area in Bangladesh where 1138.46 ha by Aus, 5582.60 ha by Aman and 4812.15 ha by Boro season (BBS, 2012). The production of rice in Aus, Aman and Boro season is 2332, 12798 and 18759 tons, respectively (BBS, 2012). Among reasons of low yield of rice, diseases pose a major threat to its production (Ou , 1985; Groth *et al*., 1991; Webster, 1992). Most of the diseases of rice are seed borne. In Bangladesh, approximately 2.5 million tons of rice worth more than Tk. 12000 millions are lost annually due to diseases caused by seed borne pathogens (Fakir *et al.*, 2003). The predominant seed-borne fungal pathogens of rice that cause infection and proliferate in the field are *Alternaria padwickii, Bipolaris oryzae, Curvularia lunata, Fusarium moniliforme, F. oxysporum, Alternaria alternata* and so on (Fakir, 2000). Evidently, there is a need to increase the yield and improve the health and seed quality of the crop by controlling seed-borne fungal pathogens. Among the control practices used, seed treatment is one of the effective technique

to eliminate seed-borne inocula. Treatments of seed should be done as a routine practice as it is a cheap insurance against possible disasters at a later stage (Bilgrami and Dube, 1976).

Uncontrolled and indiscriminate use of chemicals disturbs the microbes. That is why, at present chemical seed treatment is discouraged. Therefore, it is wise to invent less expensive, less risky and environmentally friendly way to control seed-borne pathogens. BAU-Biofungicide increases the percentage of seedling emergence, vigor index, plant stand, less disease incidence and yield of crop (Hossain, 2011). Considering the above points the present research work has been undertaken to record and identify the seed-borne fungi associated with seed samples of BR 11, BRRI Dhan 40, BRRI Dhan 28 and BRRI Dhan 29 and to evaluate the effect of BAU-Biofungicide and Thiovit on germination and seedling vigor.

2. Materials and Methods

The experiment pertaining to the present investigation was carried out in the MS Laboratory, Department of Plant Pathology, Bangladesh Agricultural University (BAU), Mymensingh and Seed Pathology Centre (SPC), Bangladesh Agricultural University, (BAU), Mymensingh.

2.1. Detection of seed borne fungi (Blotter method)

To detect the seed borne pathogens associated with the seeds in seed samples the Blotter method was used by following ISTA rules for seed testing (ISTA, 1996). In this method, three layers of blotting paper (Whatman filter No. 1) were soaked in sterilized water and placed at the bottom of 9 cm dia plastic petridish and thereafter 25 seeds were plated. Eight replicates (petridishes) were used for each sample where 200 seeds were needed. The seeds in the petridishes were incubated in the incubation chamber at 20 ± 2 °C under alternating cycles of 12 hours near ultraviolet (NUV) light and darkness for 7 days. Time to time watering was done to keep the blotting paper moist.

2.2. Germination and seedling vigor test

This study was carried out in the greenhouse of Seed Pathology Centre using tray method. Seed treatment for improving quality of seeds were studied by treating seeds with BAU-Biofungicide (2% of seed weight), a Trichoderma based preparation along with the selected chemical namely Thiovit (4% of seed weight) (Hossain, 2011). The seeds were treated by soaking in solutions for 1 hr of each treatment separately, except in control. In case of control, seeds were soaked in normal water. After 1 hour the fungicidal solutions were drained out and the moistened seeds were kept in the blotter paper to remove excess moisture from the seed surface. Then the seeds were ready for sowing tray experiment. Plastic trays (18" × 9") were used to serve the purpose. One hundred seeds were selected at random from each sample and sown on sand in each plastic tray in four lines (25seeds/line) as per each treatment. A total of 400 seeds were set for each treatment according to ISTA rules for testing germination of seeds (ISTA, 2001). Germination was recorded twice at 7 and 14 days after sowing. Dead seeds, diseased seeds, diseased seedlings and healthy seedlings were counted and expressed in percentage. After 14 days shoot and root length were measured by using measuring scale. 10 seedlings per replication were selected randomly for measuring shoot and root length of rice. The vigor of the seedlings was determined by the following formula (Baki and Anderson, 1972): Vigor index = (Mean of root length + Mean of shoot length) × Percentage of seed germination

The laboratory experiment was carried out in Completely Randomized Design (CRD) with three treatments having four replications. The treatments were T_0= Control (untreated), T_1= Seed treatment with Thiovit @ 4% of seed weight and T_2 = Seed treatment with BAU-Biofungicide @ 2% of seed weight.

3. Results and Discussion

Health status of rice seeds of 4 varieties were tested by standard blotter incubation test (Table 1). It revealed that the seeds were found to be associated with 7 different seed borne fungi belonging to six genera viz. *Bipolaris oryzae, Fusarium moniliforme, Fusarium oxysporum, Aspergillus flavus, Alternaria padwickii, Penicillium* spp. and *Curvularia lunata*. The incidence of *Bipolaris oryzae (*1%-6.5%), *Fusarium moniliforme* (3%-8.5%), *Fusarium oxysporum* (2%-9%), *Aspergillus flavus* (0.5%-1.5%), *Alternaria padwickii* (0.5%-1%), and *Penicillium spp* (0.5%-1%) and *Curvularia lunata* (1%-5.5%) were recorded. In rice variety BR 11, *Bipolaris oryzae,* was found to be most prevalent one (6.5%), followed by *Curvularia lunata* (5.5%), *Fusarium moniliforme* (4%) and *Fusarium oxysporum* (2.5%). In BRRI Dhan 28, *Curvularia lunata* was found to be most prevalent one (4.5%) followed by *Bipolaris oryzae* (3.5%), *Fusarium moniliforme* (3%) and *Fusarium oxysporum* (2%). *Fusarium oxysporum* was found to be most prevalent one (9%) followed by *Fusarium*

moniliforme (7%), *Bipolaris oryzae* (1%), *Curvularia lunata* (1%), *Alternaria padwickii* (0.5%) *and Aspergillus flavus* (0.5%) in BRRI dhan 29.

In BRRI dhan 40 *Fusarium moniliformae* was found to be most prevalent one (8.5%) followed by *Bipolaris oryzae* (6.5%), *Fusarium oxysporum* (2%), *Curvularia lunata* (1.5%), *Aspergillus flavus* (1.5%) and *Penicillium* spp. (1%). 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). The germination of rice seeds of BR 11, BRRI Dhan 28, BRRI Dhan 29 and BRRI Dhan 40 was studied following standard blotter method and presented in Figure 1. The highest germination was obtained in BRRI Dhan 28 and BRRI Dhan 29 while the lowest germination was recorded in BR 11. The present findings clearly showed that the seven fungi were associated with the rice seed samples and they reduced percentage of seed germination. The prevalence of fungal infections and seed germination varied depending on rice varieties. This is in agreement with the observations made by Jayaweera *et al.,*1998*;* Naeem *et al.,* 2001; Mian and Fakir, 1977. Mian and Fakir (1977) studied the associated seed-borne fungi of rice. The most predominant fungi, in order of prevalence were *Helminthosporium oryzae, Curvularia lunata, Cladosporium cladosporioides, Aspergiltus spp*. and *Trichoconis padwickil*.

Table 1. Incidence of seed borne Fungi associated with four varieties of rice seeds through blotter incubation method.

SL. No.	Variety	Percent Seed borne fungi						
		Bipolaris oryzae	***Fusarium moniliforme***	***usarium oxysporum***	***Aspergillus flavus***	***Alternaria padwickii***	***Penicillium spp.***	***Curvularia lunata***
1	BR11	6.5	4.0	2.5	1.0	1.0	0.5	5.5
2	BRRI dhan 28	3.5	3.0	2.0	0.0	0.0	0.0	4.5
3	BRRI dhan 29	1.0	7.0	9.0	0.5	0.5	0.0	1.0
4	BRRI dhan 40	6.5	8.5	2.0	1.5	0.0	1.0	1.5

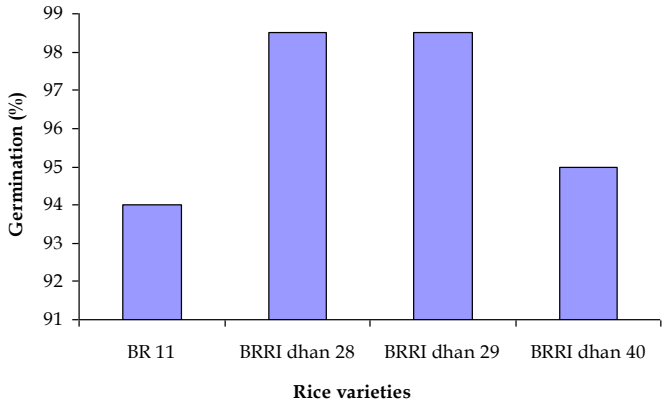

Figure 1. Germination of seeds of four rice varieties (Blotter method).

The Effect of seed treatment on germination of rice seeds of the four varieties (Tray method) was counted and presented in Table 2. Means germination percentage for these rice samples ranged from 88.0% to 100%. The highest (100.00%) germination was recorded in case of seed treated with BAU Bio-fungicide of variety BRRI dhan 28 and the lowest (88.0%) germination was found in Control (untreated) of variety BRRI dhan 29. Seed treatment with BAU Bio-fungicide and Thiovit showed effect on increasing germination percentage of the used rice samples. The highest % increase of germination over control was recorded in case of seeds treated with BAU Bio-fungicide (Table 2). Upto 9.09% higher germination over control was achieved by treating seeds with BAU Bio-fungicide. Rahman (2003a) recorded 71.00 to 78.00% germination of farmers stored rice seed of Hobigonj district in Bangladesh. Rahman *et al.* (2003b) also reported 86.2 to 93.3% germination in Rajshahi district in Bangladesh. Similarly, Fakir *et al. (*2003) recorded 88.33 to 95.83 % germination in different seed containers.

The effect of seed treatment on seedling health of different rice varieties (Tray method) was recorded and presented in Table 3. Category of germination viz. healthy seedlings, diseased seedlings, diseased seeds and dead seeds were recorded for each treatment. The healthy seedlings ranged from 77% to 98%. Healthy seedlings were found high in BRRI Dhan 28 when treated with BAU-Biofungicide, where healthy seedlings were found low in BRRI Dhan 29 in untreated seed. Diseased seedlings were found to be ranged from 2 to 15%, where minimum diseased seedlings were found in BRRI Dhan 29 when treated with BAU-Biofungicide and 15 % found in BRRI Dhan 11 in untreated (control) seeds. Dead seeds were found to be ranged from 0 to 5%. Dead seeds were not found in BRRI Dhan 11 and in BRRI Dhan 28 when treated with Thiovit and BAU-Biofungicide, respectively. Dead seeds were not found in BRRI Dhan 29 under control (untreated). This finding's in accordance with the finding of Parvin and Hossain 2006. Upto 18.18% higher formation of healthy seedlings over control was achieved by treating seeds with BAU-Biofungicide (Table 3). This finding is supported by Naznin and Hossain (2006), Sultana *et al*. (2009) and Hossain (2011). On the other hand, it results decrease (upto 81.82%) in formation of diseased seedlings over the control treatment (Table 3).
Parvin and Hossain (2006) investigated the effectiveness of cowdung, BINA Biofertilizer and BAU-Biofungicide either alone or in combination using tray method for controlling seedling diseases and growth of seedlings of some pulse crops. Seed treatment with BAU-Biofungicide was the best for controlling seedling diseases and resulted in higher germination percentage, plant stand and vigor index of the tested summer mungbean varieties.

Table 2. Effect of seed treatment on germination of rice seeds of four varieties (Tray method).

Seed treatment	% Germination			
	BR 11	**BRRI Dhan 28**	**BRRI Dhan 29**	**BRRI Dhan 40**
T1	94	97	88	97
T2	98 (+4.26)	98 (+1.03)	94 (+6.82)	96 (+1.03)
T3	96 (+2.13)	100 (+3.09)	96 (+9.09)	96 (+1.03)

Data in parenthesis indicate % increase over control.
T1 = Control, T2 = Thiovit (4%) and T3= BAU-Biofungicide (2%)

Table 3. Effect of seed treatment on seedling health of different rice varieties (Tray method).

Variety	Seed treatment	Healthy seedling (%)	Diseased seedling (%)	Diseased seed (%)	Dead seed (%)
	T1	79	15	4	2
BR 11	T2	85 (+7.59)	13 (-1.33)	2 (-50)	0 (-100)
	T3	90 (+13.92)	6 (-60)	2 (-50)	0 (-100)
	T1	86	11	2	1
BRRI Dhan 28	T2	94 (+9.30)	4 (-63.64)	1 (-50)	1 (-50)
	T3	98 (+13.95)	2 (-81.82)	0 (-100)	0 (-100)
	T1	77	11	7	5
BRRI Dhan 29	T2	86 (+11.69)	8 (-27.27)	4 (-42.86)	2 (-60)
	T3	91 (+18.18)	5 (-54.55)	3 (-57.14)	1 (-80)
	T1	84	13	1	3
BRRI Dhan 40	T2	90 (+7.14)	6 (-53.85)	3 (+200)	2(-33.33)
	T3	93 (+10.71)	3 (-76.92)	1 (0.00)	1 (-66.67)

Data in parenthesis indicate % increase over control.
T1 = Control, T2 = Thiovit (4%) and T3= BAU-Biofungicide (2%)

Table 4. Effect of seed treatment on vigor index of different rice varieties (Tray method).

Treatment	Vigor Index			
	BR 11	**BRRI Dhan 28**	**BRRI Dhan 29**	**BRRI Dhan 40**
T1	1677.90	1852.70	1306.80	1823.60
T2	2356.90 (+40.47)	2464.70 (+33.03)	1969.30 (+50.7)	2438.40 (+33.71)
T3	2774.40 (+65.35)	2805.00 (+51.40)	2376.00 (+81.82)	2692.80 (+47.66)

Data in parenthesis indicate % increase over control.
T1 = Control, T2 = Thiovit (4%) and T3= BAU-Biofungicide (2%)

The vigor index was calculated and presented in Table 4. The results revealed that, the highest vigor index (2805.0) was observed when seeds were treated with BAU-Biofungicide in variety BRRI dhan 28 and lowest vigor index (1306.80) was observed under control (untreated) in variety BRRI dhan 29. The vigor index of treated seeds is increased by up to 81.82% over the untreated control when seeds treated with BAU-Biofungicide (Table 4). Plant height was increased significantly over control by treating seeds with BAU-Biofungicide. This is in agreement with the observations made by Shamsuzzaman *et al.,* 2003b; Naznin, 2004; Hossain and Naznin, 2005 and Rahman 2006.

Naznin (2004) found that *Trichoderma* based Biofungicide (BAU-Biofungicide) increased shoot length, root length, shoot weight, root weight and vigour index of the vegetables seedlings.

Naznin and Hossain (2004) studied the effect of BAU-Biofungicide on germination and seedling vigour of some vegetables. In sweet gourd, BAU-Biofungicide increased germination up to 5.22% in pot and 46.25% in field over the untreated control, while in cowpea, cucumber and okra the germination increased up to 46.245, 7.92% and 50.80%, mespectively in pot experiment and 102.95, 28.8% and 47.8% in field trial. The Biofungicide also enhanced vigour index of sweet gourd, cowpea, cucumber and 4ba by 32.185, 48.08%, 22.69% and 112.88%, respectively, in pot and 126.145%, 106.69%, 157.48% and 184.99%, in field trial.

4. Conclusions

From the study a conclusion may be drawn that seeds can successfully be treated with BAU-Biofungicide and Thiovit for controlling seed borne fungal pathogens with the aim of increasing seedlings growth and higher seedling stand.

Conflict of interest

None to declare.

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