Eco-friendly Management of Seed Borne fungi for Sustainable Crop Production

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Abstract: A total of seven seed-borne fungi were detected from forty rice (*Oryzae sativa*) seed samples (cv. BR11 and BRRI dhan28) collected from two upazilas (Narshingdi Sadar and Shibpur) of Narshingdi district in Bangladesh. The identified species were *Bipolaris oryzae*, *Alternaria padwickii*, *Sarocladium oryzae*, *Curvularia lunata*, *Aspergillus niger* and *Fusarium* spp. The seed samples were composed of apparently healthy seed, spotted seed, discoloured seed, deformed seed, varietal mixture and chaffy grain. Prevalence of fungi and seed germination varied significantly with respect to variety and seed source. Seeds of rice variety BRRI dhan28 carried the lower infection of all the seed-borne fungi than the variety BR11. Seeds collected from Shibpur had higher seed-borne infection. An attempt has been made to control the seed-borne fungi by different plant extracts and chemicals. Garlic extract (1:1) dilution found best which successfully reduced seed-borne infection (80.3%) and also increased seed germination by 10.69% over control. Neem, allamanda and bishkatali extracts also increased seed germination 8.99%, 7.10% and 5.84%, respectively. Seed treating fungicides viz. Vitavax-200, Bavistin 50 WP and Captan were also tested to control seed-borne fungi. Seed treatment with Vitavax-200 @ 0.3% of seed weight eliminated all the seed-borne fungi and increased seed germination by 25.70% over control. Another chemical Bavistin also reduced seed-borne infection (88%) successfully and increased seed germination by 24.67% over control. Considering the high cost and deleterious effect of chemicals on environment, plant extracts may be recommended for controlling seed-borne fungal pathogens of rice as they are cheap, safe and eco-friendly.
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Introduction

The truth "Health is Wealth" is also equally applicable to the health of seed. Pathogen free healthy seed is urgently needed for desired plant populations and good harvest. Many plant pathogens are known to seed-borne, which can cause enormous crop losses. In Bangladesh, out of 16% annual crop losses due to plant diseases, at least 10% loss is incurred due to seed-borne diseases (Fakir, 1983). It has also been demonstrated that seed-borne fungi are responsible for poor health of seeds in many crops (Neergaard, 1979). As many as 490 seed-borne diseases are known to attack 759 different crop plants in Bangladesh of which at least 200 are of major concern (Fakir *et al*., 1991). Among reasons of low yield of rice, diseases pose a major threat to its production (Ou, 1985). Roughly 16% of total crop production in the world is lost due to plant diseases (James, 1989). A total of153 seed-borne pathogen was detected for rice of which 18% are of quarantine important, 65% are native and 17% are storage pathogen (IRRI, 1987). As many as 43 diseases are reported on rice in Bangladesh (Fakir, 2000). Among all these diseases, 27 are seed-borne of which 14 are of major importance. Of all the seed-borne diseases, 22 are caused by fungi. Ten diseases such as brown spot, narrow brown spot, blast, sheath blight, sheath rot, bacterial leaf blight, stem rot, bakanae or foot rot, tungro and ufra are considered as the main constrains for rice production in Bangladesh which can cause 10-15% average yield loss (BRRI, 1999). In Bangladesh, approximately 2.5 million tons of rice worth more than Tk. 12000 millions is lost annually due to diseases caused by seed-borne pathogens (Fakir *et al.* 2002). Heavy losses of rice are occurred both in quantity and in quality due to association of different pathogens with the grains. Field fungi viz. *Bipolaris, Curvularia, Fusarium, Phoma, Pyricularia, Rhizoctonia* and *Sarocladium* persists in grains that deter food value and storage quality of grains. In Bangladesh, farmer's saved seeds are the main source of seeds for rice cultivation where seed health condition is not so good. These seeds results in reduced germination rate and transmit pathogens from seed to seed bed and ultimately cause diseases in field. Reduction in yield and quality loss of grains of rice ranges from a trace to total crop loss depending on the

inoculum density, pathogen aggressiveness, environmental conditions, cultivar susceptibility and interaction with other cultural parameters (Savary *et al*., 2000). This cost farmers a huge amount of money in terms of reduced productivity and cost of control. 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 which prove the 'arsenal' of plant pathology is now equipped with most sophisticated ammunitions to wage war on the unscrupulous pathogens, which are many and deceitful. 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). Present days,use of chemicals is an established effective quick seed treatment practice. But the use of fungicides is hazardous and costly. Sowing of seed treated with fungicides, in general, results in accumulation of harmful fungicidal residues in soil as well in the plant products causing serious health hazards. Moreover, indiscriminate use of chemicals breaks down the natural ecological balance by killing the beneficial and/or antagonistic soil microbes. For this reason, chemical seed treatment now-a-days, is discouraged. It is, therefore, judicious to explore less inexpensive, less hazardous, non-chemical eco-friendly methods of seed treatment. Use of botanicals/plant extracts is a eco-friendly measure in controlling seed-borne pathogens is relatively a new approach. Successful use of plant extracts in controlling fungal pathogens have been demonstrated by a number of authors (Singh and Dwivedi, 1987; Miah *et al*., 1990; Hossain *et al*., 1997 and Suratuzzaman *et al.,* 1995).

Materials and Methods

The experiments were conducted in Seed Pathology Center (SPC), Bangladesh Agricultural Univeresity (BAU), Mymensingh during April, 2006 to March, 2007. Forty seed samples of two popular as well as mega variety were collected from two upazila of Narshingdi District (Narshingdi Sadar and Shibpur) as it is a popular place for rice cultivation and marketing. Twenty samples of BR11 (ten samples from each upazila) and twenty samples of BRRI dhan28 were collected by this time. Each sample contained about 400g of seeds. The samples were enclosed in paper bags with proper labeling, brought to the SPC laboratory and kept in the refrigerator at 4 ± 1ºC until used for further studies. At first, dry inspection of the different seed samples were done. Then All the seed samples were assayed for the presence of fungal pathogens by the Standard Blotter Method following the rules of International Seed Testing Association (ISTA, 1976). Each individual seed was observed under stereo-microscope at X16 and X25 magnification in order to identify the seed-borne fungi. Most of the associated fungi were detected by observing their growth characters on the incubated seeds following the keys outlined by Ramnath *et al*. (1970), Khan and Islam (1975) and Kulshrestha *et al.* (1976). Temporary slides were also prepared and observed under compound microscope for proper identification. The fungi were identified to species level, wherever possible, following the keys of Malone and Musket (1964), Booth (1971), Ellis (1971) and Chidambara and Mathur (1975),). The results were presented as percent incidence for individual pathogen. Four samples which yielded highest percentage of pathogen considering respective variety and location were selected for next fungicidal treatment. Five different plant species were collected from different areas of Bangladesh Agricultural University, Mymensingh Campus which were used in this study. Garlic (*Allium sativum*), allamanda (*Allamanda cathartica*), neem (*Azadirachta indica*), marigold (*Tagetes erecta*) and bishkatali (***Polygonum hydropiper***) extracts were used for the experiment. Except garlic (clove is used) in every cases leaf is used to extract juice for seed treatment. In all cases 1:1 dilution ratio is used for seed treatment. To prepare desired concentrated plant extract, at first different plant parts were chopped after cleaning in running tap water. Then extracts were prepared by crushing the plant parts in a blender with distilled water in 1:1 ratio (eg. 1:1= 100 gm plant material crushed in 100 ml water) (Hossain et al., 1997). The extracts were filtered through cheese cloth. The extracts thus obtained were kept in a refrigerator at 4º±1 untill use. Selected seed samples of rice were treated following dipping method. The seeds were dipped in 1:1 dilution for 1 hour in previously prepared garlic, allamanda, neem, marigold and biskatali leaf extracts. After 1 hour, plant extracts were drained out from the petridishes. The treated seeds were allowed to be dried up on filter paper for some time and were tested following the standard blotter method (ISTA, 1976) to observe the growth of different fungal colonies on the seeds. For each treatment 400 seeds with four replications were placed on sixteen petridishes. Then the efficacy of the plant extracts was evaluated by comparing with an untreated control. The fungi yielded and germination of seeds was recorded. The seeds were also treated with chemicals viz. Vitavax 200 (Chemical name:5,6-dihydro-2-methyl-1,4-oxathiin-3-carboxanilide; a.i.: Oxathiin), Bavistin 50 WP (Chemical name: Methyl benzimidazol-2-yl-carbamate;a.i.: Carbendazim 50 %) and Captan (Chemical name: N-trichloro-methyl thio-4-cyclo-1,2-dicarboximide; a.i.: Chloro-methyl) (following two different concentrations 0.25% and 0.3%) by taking requisite amount of each fungicide and

seeds from each sample were taken in a 500 ml Erlenmeyer flask and were shaken mechanically for 10 minutes for proper coating of fungicides. After 24 hours, the efficacy of the fungicides was evaluated by comparing with an untreated control. The fungi yielded and germination of seeds was recorded. The experiments were conducted following the Completely Randomized Design (CRD) and the mean data were separated by Duncan's Multiple Range Test (DMRT).

Results and Discussion

Prevalance of Seed-Borne Fungi of Rice

During the present investigation seven species of fungi representing six genera were identified on the seeds of two rice varieties. The identified fungi were *Fusarium oxysporum*, *F. moniliforme, Bipolaris oryzae, Sarocladium oryzae, Alternaria padwickii, Curvularia lunata, Aspergillus niger*. Seed infection varied significantly with respect to variety as well as location to location. Per cent seed-borne infection in rice variety BR11 was higher than BRRI dhan28. Highest percentage of *Bipolaris oryzae*, *Sarocladium oryzae*, *Alternaria padwickii*, *Aspergillus niger*, *Curvularia lunata* and *Fusarium* spp. (10.7, 3.2, 8.7, 3.7, 6.5 and 9.7 respectively) were obtained from BR11 which were statistically different from BRRI dhan28 (5.7, 2.7, 7.0, 2.2, 4.2 and 8.7, respectively (Table 1). Location had a great influence on per cent seed-borne infection. All the seven species of fungi were detected in both locations. Seeds of Narshingdi Sadar were better than the seeds of Shibpur in terms of rice seed health status. Seeds from Shibpur upazila showed highest incidence 32.7% and 22.0% (fungal population) in BR11 and BRRI dhan28, respectively.

Highest percentage of *Bipolaris oryzae* (10.7%) was found in the seeds of BR11. The incidence was significantly higher than the others. The lowest incidence was found in the seeds of BRRI dhan28 collected from Shibpur (2.0%) and it was statistically similar with the variety BRRI dhan28 collected from Narshingdi Sadar (2.7%). Highest percentage (9.0%) of *Alternaria padwickii* was found in the seeds of BR11. The lowest incidence was found in BRRI dhan28 collected from Narshingdi Sadar (1.2%). *Sarocladium oryzae* was highest in the seeds of BR11 collected from Shibpur (3.2%) which is statistically similar with the BR11 collected from Narshingdi Sadar (3.0%). Percentage of *Aspergillus niger* was highest in BR11 collected from Shibpur (3.7%) which was statistically similar with BR11 collected from Narshingdi Sadar (3.7%). The lowest incidence of *Aspergillus niger* was found in BRRI dhan28 collected from Narshingdi Sadar. Highest percentage of *Curvularia lunata* was found in the seeds of BR11 collected from Shibpur and it was 6.5%. The incidence was significantly higher than the others. The lowest incidence was found in the seeds of BRRI dhan28 collected from Narshingdi Sadar (0.7%) which was statistically similar with BRRI dhan28 collected from Shibpur (1.0%). Highest percentage of *Fusarium* spp. was found in the seeds of BRRI dhan28 collected from Narshingdi Sadar and it was 13.2%. The incidence was significantly higher than the others (Table 1). Highest seed infection was recorded for *Fusarium* spp. followed by *Alternaria padwickii* and *Bipolaris oryzae* and rice seeds yielded the lowest percentage of *Sarocladium oryzae*. This is an agreement with Fakir *et al.* (2000) who found five important pathogenic fungi viz. *Alternaria padwickii*, *Fusarium* spp., *Bipolaris oryzae*, *Pyricularia oryzae* and *Sarocladium oryzae* in rice seed samples collected from three different locations in Bangladesh. Another researcher Nahar (2003) found *Bipolaris oryzae*, *Fusarium oxysporum*, *Fusarium moniliforme*, *Trichoconis padwickii*, *Aternaria tenuis* and *Curvularia lunata* in farmer's stored rice seeds. The association of seed-borne fungi of rice also have been reported by a good number of researchers (Mia and Mathur, 1983; Mendoza and Molina, 1980; Agrawal *et al*. 1990; Sisterna *et al*. 1994; Purushattam *et al*. 1996; Sharma *et al*. 1997; Bicca *et al*.1998 and Naeem Khalid *et al.* 2001).

Effect of Plant Extracts in Controlling Seed Borne Fungi

All the treatments used in the experiment significantly increased the seed germination of rice compared to untreated control. The highest germination 88.5% was obtained in T_1 (Garlic extract @ 1:1 dilution) which increased seed germination by 11.5%, respectively over control incase of BRRI dhan28 (Shibpur). Lowest germination was recorded in the treatment T_0 (Control) which was 74.5% incase of BRRI dhan28 (Table 5).

This might be due to association of different fungal flora such as *Bipolaris oryzae*, *Sarocladium oryzae*, *Alternaria padwickii*, *Aspergillus niger* and *Fusarium* spp. or it may be due to varietal genetic characterization to germinate. This is an agreement with the observations made by Hossain *et al* (1977) who found the prevalance of fungal infection and seed germination. Incase of variety BR11 the highest germination (84.5%) was found when the seeds were treated with garlic extract (*Allium sativum*) @ 1:1 dilution and it increased germination by 10.6% over control (Table 4). Among the other extracts neem and bishkatali also increased germination by 9.0% and 8.7%, respectively over control. This is an agreement with the findings of Rahman *et al*. (1999) who found garlic extract was superior in terms of reducing seed-borne infections by *Alternaria* spp., *Bipolaris sorokiniana*, *Curvularia lunata*, *Fusarium* spp. of wheat to other extracts followed by ginger and neem. Incase of variety BRRI dhan28, the highest

germination (88.5%) was found when the seeds were treated with garlic extract (*Allium sativum*) @ 1:1 dilution and it increased germination (11.5%) over control. Here, neem, allamanda and bishkatali also increased germination by 8.9%, 7.1% and 5.8%, respectively. This is an agreement with the findings of Ahmed (2002) who found neem and garlic extracts were more effective against *Bipolaris oryzae* at 1:1 dilution. Another researchers, Howlader (2003) reported that seed treatment with Allamanda leaf extract at 1:1 dilution effectively increased seed germination of egg plants and tremendously decreased nursery diseases. This is also a partial agreement with the findings of Khan and Kumar (1992). They found that seed treatment with the garlic extract, neem, gagra, vatpata, Bishkatali leaf extracts reduced seed-borne prevalence and increased germination percentage of wheat seeds. Among them garlic and neem bark gave better results. Rahman *et al*. (1998) observed that bishkatali, garlic, ginger and neem extract were effective against seed-borne *Curvularia lunata*, *Fusarium* spp. of wheat. Among the plant extracts, best performance in terms of reducing per cent seed-borne infection was obtained through treating the seeds with garlic extract at (1:1) dilution which reduced 80.3% seed-borne infection and also increased seed germination by 10.6% over control (BR11, Narshingdi Sadar). Neem, allamanda and bishkatali extracts reduced 66.2%, 53.7% and 56.2% seed-borne infection and also increased germination by 8.9%, 7.1% and 5.8%, respectively over control (BRRI dhan28, Shibpur).

Effect of Fungicides in Controlling Seed Borne fungi

Fungicides also influenced seed germination by reducing seed borne infection. Treated seeds showed significantly higher rate of germination than untreated seeds. In the present study, significant difference was observed in germination percentage among the samples. All the treatments used in the experiment significantly increased the seed germination of rice compared to untreated control. The highest germination 91.7% and 93.5% was obtained in T_2 (Vitavax-200 @ 0.3% of seed weight) which increased seed germination by 25.7% and 11%, respectively over control incase of BR11 and BRRI dhan28 (Narshingdi Sadar) while lowest germination (70.0%) was recorded in the treatment T_0 (control) incase of BR11 (Table 2 & 3). 73% germination was recorded in variety BR11 collected from Narshingdi Sadar while the same variety showed 70.1% germination when collected from Shibpur. Again, BRRI dhan28 showed 83.0% and 80.0% germination, respectively when collected from Narshingdi Sadar and Shibpur, respectively. This might be due to association of different fungal flora such as *Bipolaris oryzae*, *Sarocladium oryzae*, *Alternaria padwickii*, *Aspergillus niger* and *Fusarium* spp. This is an agreement with the observations made by Hossain *et al*. (1997) who found the prevalence of fungal infection and seed germination varied depending on rice varieties and sources of seed collection. According to Fakir *et al.* (2002) prevalence of seed-borne infection may varied with respect to crop season and sites of seed collection. In the present finding, significant differences were observed in the germination percentage of two rice varieties collected from two upazila of Narshingdi district. The highest germination (91.7%) was found for variety BR11(Narshingdi Sadar) when the seeds were treated with Vitavax-200 @ 0.30% of seed weight and it increased germination by 25.7% over control. This is an agreement with the findings of Fakir and Halder (1993) who found Vitavax-200 increased germination of seeds. Another chemical Bavistin @ 0.30% of seed weight also increased germination (24.6%, second highest) over control. This is a partial agreement with the findings of Dash and Narain (1996) who found Bavistin + TMTD eliminated seed-borne mycoflora and improved seed germination of most of the test crops. Among the fungicides, Vitavax-200 reduced 92.0% and Bavistin reduced 80.8% seed-borne infection when the chemicals were used @ 0.25% of seed weight. This is an agreement with the findings of Suratuzzaman *et al.* (1994) found that the range of reduction of seed-borne pathogens was 55-94% for various treatments as against untreated seed. . Incase of variety BRRI dhan28 highest germination (93.5%) was found when the seeds were treated with Vitavax-200 @ 0.3% of seed weight and it increase germination (12.2%) over control. This is also an agreement with the findings of Oerke *et al*. (1987) and Rofrekl (1995) who found that the treatment Vitavax-200 @ 0.3% of seed weight was found to be the best as it controlled *Aspergillus flavus* and *Penicillium* spp. most effective among all the treatments and complete elimination of the rests were observed. Another chemical captan increased seed germination by 22.6% over control and reduced 88.0% seed-borne infection incase of BR11, whose performance is lower in comparison with the other two fungicides. This is also an agreement with the findings of Lakshmanan and Mohan (1988) who found organomercurial seed dresser, Carbendazim (Bavistin) and Mancozeb (Dithane M-45) were more effective than captan. Incase of BR11, highest seed borne infection recorded as 31.2% in the seeds of Shibpur upazilla while 28.2% infection recorded in the seeds of Narshingdi Sadar (control). In both cases 100% infection was reduced through Vitavax 200 @ 0.3%. Bavistin 50 WP and Captan also showed significant reduction of the pathogen when seeds were treated at 0.3% dose. Bavistin showed comparatively better performance than Captan both in seed germination

increased and reduction of seed borne infection. Seeds of Shibpur upazila showed higher per cent of seed-borne infection than the seeds of Narshingdi Sadar. This is also a partial agreement by Islam *et al.* (1992) who found average incidence of *Drechslera oryzae* and *Trichoconis padwickii* (*Alternaria padwickii*) was much higher in the north of the country compared to the south. Moreover, the variation of seed-borne fungi with variety and location has been demonstrated in a number of crops viz. Jute, corn, mustard, kaon, black gram and chilli by different research workers (Kabir and Fakir, 1988; Islam, 2005; Brama and Fakir, 1981; Dey and Fakir, 1988; Fakir *et al*., 1990 and Basak *et al.,* 1991).

Table 1. Seed germination(%) and percent seed infection with different rice seed samples

Variety	Location		Germination (%)	Percent seed infection						
				B. oryzae	*S. oryzae*	*A. padwickii*	*A. niger*	*C. lunata*	*F.* spp.	Total
BR11	Narsinghdi Sadar	N_1	74.0	4.7	2.2	7.2	2.2	3.7	7.0	27.2
		N_2	69.2	3.2	2.0	2.2	3.2	3.2	7.0	21.0
		N_3	70.5	3.7	3.0	3.2	2.7	2.7	8.7	24.2
		N_4	73.0	4.7	0.0	6.7	2.0	2.0	9.7	25.25
		N_5	75.0	3.2	1.0	5.7	1.0	2.2	7.2	20.50
		N_6	72.5	10.7	2.2	6.2	2.7	2.7	4.7	29.50
		N_7	76.5	5.7	1.0	5.0	3.7	2.2	9.0	26.70
		N_8	70.0	4.2	0.0	5.5	1.0	3.2	6.7	20.75
		N_9	73.0	4.7	0.0	6.7	1.0	2.2	8.5	23.25
		N_{10}	75.2	3.5	1.0	6.0	2.7	3.2	7.0	23.50
	Shibpur	S_1	68.0	4.7	2.2	8.7	1.0	3.7	7.0	27.50
		S_2	72.5	5.2	1.0	7.0	2.0	2.7	7.0	25.00
		S_3	70.0	4.0	2.7	9.0	1.0	3.2	9.0	29.00
		S_4	74.0	7.2	1.0	8.0	3.7	3.2	8.2	31.50
		S_5	75.5	5.2	2.0	9.0	2.0	2.2	6.7	27.25
		S_6	72.7	8.7	1.0	7.0	1.0	2.7	4.7	25.25
		S_7	73.0	7.0	2.7	5.2	2.5	6.5	8.7	32.75
		S_8	69.0	5.7	2.0	8.2	2.0	2.7	8.2	29.00
		S_9	70.7	7.0	1.0	5.0	1.0	3.7	6.2	24.00
		S_{10}	70.0	4.2	3.2	6.0	2.2	3.0	8.7	27.50
BRRI Dhan 28	Narsinghdi Sadar	N_1	79.0	3.0	0.0	1.2	0.0	0.7	2.7	7.75
		N_2	77.5	2.7	1.0	2.2	1.0	2.2	6.2	15.50
		N_3	82.2	4.0	0.0	3.2	1.0	2.7	7.2	18.25
		N_4	80.0	4.2	0.0	4.2	1.0	2.7	5.7	18.00
		N_5	78.0	5.2	2.0	3.2	1.0	1.0	7.7	20.25
		N_6	77.0	3.0	0.0	3.0	1.0	2.7	6.5	16.25
		N_7	77.0	5.0	1.0	7.0	1.0	1.0	5.2	20.25
		N_8	75.0	5.7	2.2	5.0	1.0	2.7	5.2	22.00
		N_9	75.0	3.2	1.7	5.0	1.0	0.7	7.0	18.75
		N_{10}	77.5	2.7	1.0	3.0	1.0	2.0	7.2	17.00
	Shibpur	S_1	81.0	2.0	0.0	6.0	0.0	2.0	8.7	18.75
		S_2	79.0	2.2	1.0	5.0	1.0	4.2	4.2	17.75
		S_3	82.5	2.2	0.0	6.0	1.0	3.0	4.7	17.00
		S_4	81.5	3.7	2.0	7.0	1.0	2.0	5.7	21.50
		S_5	84.5	4.0	2.7	4.0	1.2	2.2	8.7	23.00
		S_6	80.0	3.2	1.0	7.0	1.0	1.7	8.7	22.75
		S_7	84.0	2.0	0.0	5.7	0.7	2.7	2.7	14.00
		S_8	83.0	3.7	1.0	7.2	1.5	1.7	8.7	24.00
		S_9	81.2	2.2	1.0	5.7	1.0	1.0	3.7	14.75
		S_{10}	85.0	2.7	1.0	6.2	1.0	1.7	3.7	16.50
CV(%)			3.2	15.2	18.4	12.5	18.9	16.2	15.3	
LSD (0.05)			3.4	0.8	0.3	0.9	1.2	0.7	1.4	

$N_{1\text{-}10}$= Sample collected from Narshingdi Sadar
$S_{1\text{-}10}$= Sample collected from Shibpur

Table 2. Effect of plant extracts in controlling seed-borne fungi of BR11

Treatment	Seed germination (%)	Percent Seed infection						
		Bipolaris oryzae	*Sarocladium oryzae*	*Alternaria padwickii*	*Aspergillus niger*	*Curvularia lunata*	*Fusarium* spp.	Total (%)
Narshingdi Sadar								
Control	76.2	7.0	4.2	5.2	2.0	4.2	9.0	31.7
Garlic	84.5	1.5	0.0	1.5	0.0	1.0	1.2	6.2
Allamanda	80.5	3.0	1.0	1.5	0.0	1.0	3.0	9.5
Neem	83.2	1.5	0.0	1.5	0.0	2.0	4.0	7.5
Marigold	82.0	3.0	0.0	2.2	1.0	1.7	6.0	14.0
Biskatali	83.0	2.0	1.0	3.2	0.0	1.0	3.50	10.7
LSD 0.05	3.4	0.8	0.3	0.8	0.9	0.3	1.1	
Shibpur								
Control	76.2	7.0	4.2	5.2	2.0	4.2	9.0	31.7
Garlic	84.0	2.0	0.0	0.0	0.0	0.0	4.0	6.0
Allamanda	83.0	3.0	1.0	2.0	0.0	1.0	3.5	10.5
Neem	82.5	2.0	1.0	2.0	0.0	1.0	4.0	10.0
Marigold	82.0	3.0	0.0	3.5	1.0	3.0	4.0	14.5
Biskatali	83.5	2.0	1.0	2.0	0.0	2.0	3.0	10.0
LSD 0.05	3.3	1.7	1.0	1.2	0.4	0.9	2.4	

Table 3. Effect of plant extracts in controlling seed-borne fungi of BRRI dhan28

Treatment	Seed germination (%)	Percent Seed infection						
		Bipolaris oryzae	*Sarocladium oryzae*	*Alternaria padwickii*	*Aspergillus niger*	*Curvularia lunata*	*Fusarium* spp.	Total (%)
Narshingdi Sadar								
Control	74.5	3.0	2.0	4.0	2.0	3.0	7.0	20.0
Garlic	85.7	1.5	0.0	0.0	0.0	0.0	2.0	3.5
Allamanda	82.0	3.0	1.0	1.2	0.0	1.0	1.0	7.5
Neem	85.2	1.5	0.7	1.0	0.0	1.0	1.0	5.2
Marigold	82.5	2.5	1.0	3.0	1.2	1.7	2.0	11.5
Biskatali	85.0	2.0	0.0	1.2	0.0	1.0	1.0	5.2
LSD 0.05	3.5	0.9	1.4	0.4	0.4	1.1	1.81	
Shibpur								
Control	74.5	3.0	1.0	6.5	2.0	3.0	5.7	20.0
Garlic	88.5	1.0	0.0	1.0	0.0	0.0	2.0	4.0
Allamanda	85.0	2.2	0.0	2.0	1.0	1.0	3.0	9.2
Neem	86.5	2.0	0.0	1.5	0.0	1.0	2.2	6.7
Marigold	83.0	2.2	1.5	3.0	1.0	1.5	4.0	13.2
Biskatali	84.0	1.5	1.0	1.5	0.0	1.7	3.0	8.7
LSD 0.05	3.3	0.9	0.7	1.5	0.7	1.0	2.3	

Table 4. Effect of fungicides in controlling percent seed infection of BR11

Treatment	Seed germination (%)	Percent Seed infection						
		B. oryzae	*S. oryzae*	*A. padwickii*	*A. niger*	*C. lunata*	*F.* spp.	Total (%)
Narshingdi Sadar								
Control	70.0	7.0	3.0	5.0	2.0	5.5	8.7	31.2
Vitavax(0.25%)	91.0	0.5	0.0	0.5	0.0	0.0	1.5	2.5
Vitavax (0.30%)	91.7	0.0	0.0	0.0	0.0	0.0	0.0	0.0
Bavistin (0.25%)	89.0	1.0	0.2	1.7	0.0	1.0	2.0	6.0
Bavistin (0.30%)	91.0	0.5	0.0	1.0	0.0	0.0	2.0	3.5
Captan (0.25%)	87.5	1.5	0.0	1.5	0.0	1.0	2.2	6.2
Captan (0.30%)	89.5	0.5	0.0	0.7	0.0	0.5	2.0	3.7
LSD 0.05	2.8	0.7	0.4	0.9	0.01	0.9	1.5	
Shibpur								
Control	70.0	7.0	3.0	5.0	2.0	5.5	8.7	31.2
Vitavax (0.25%)	88.2	1.0	0.0	0.5	0.0	0.5	2.0	4.0
Vitavax (0.30%)	91.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0
Bavistin (0.25%)	87.0	0.5	0.2	0.7	0.0	0.7	2.7	5.0
Bavistin (0.30%)	89.7	0.0	0.0	0.0	0.0	0.2	2.0	2.2
Captan (0.25%)	86.7	2.0	0.2	1.5	0.5	0.0	3.0	7.2
Captan (0.30%)	88.7	1.0	0.0	0.5	0.0	0.0	3.0	4.5
LSD 0.05	3.1	7.0	3.0	5.0	2.0	5.5	8.7	

Table 5. Effect of fungicides in controlling seed-borne fungi of BRRI dhan28

Treatment	Seed germination (%)	Percent Seed infection						
		B. oryzae	*S. oryzae*	*A. padwickii*	*A. niger*	*C. lunata*	*F.* spp.	Total (%)
Narshingdi Sadar								
Control	83.0	4.0	1.5	5.0	2.7	2.0	9.0	23.0
Vitavax (0.25%)	89.0	0.5	0.0	0.0	0.0	1.0	2.0	3.5
Vitavax (0.30%)	92.5	0.0	0.0	0.0	0.0	0.0	0.0	0.0
Bavistin (0.25%)	88.0	1.2	0.0	1.2	0.0	0.0	2.5	5.0
Bavistin (0.30%)	91.7	0.5	0.0	1.0	0.0	0.0	2.2	3.7
Captan (0.25%)	88.5	2.0	0.0	1.7	0.0	1.0	2.0	6.7
Captan (0.30%)	91.2	1.0	0.0	0.7	0.0	0.5	1.2	3.5
LSD 0.05	2.9	1.3	0.4	1.2	0.6	0.7	1.3	
Shibpur								
Control	83.0	4.0	1.5	5.0	2.7	2.0	9.0	23.0
Vitavax (0.25%)	92.5	0.5	0.0	0.5	0.0	0.5	2.0	3.50
Vitavax (0.30%)	93.5	0.0	0.0	0.0	0.0	0.0	0.0	0.00
Bavistin (0.25%)	90.0	1.5	0.0	1.5	0.2	0.2	3.0	6.50
Bavistin (0.30%)	91.5	1.0	0.0	0.2	0.0	0.0	2.0	3.2
Captan (0.25%)	89.7	1.5	0.2	1.0	0.3	1.0	2.0	6.1
Captan (0.30%)	91.5	1.5	0.0	0.5	0.0	0.0	1.7	3.7
LSD 0.05	2.9	1.3	0.4	1.1	0.6	0.8	1.1	

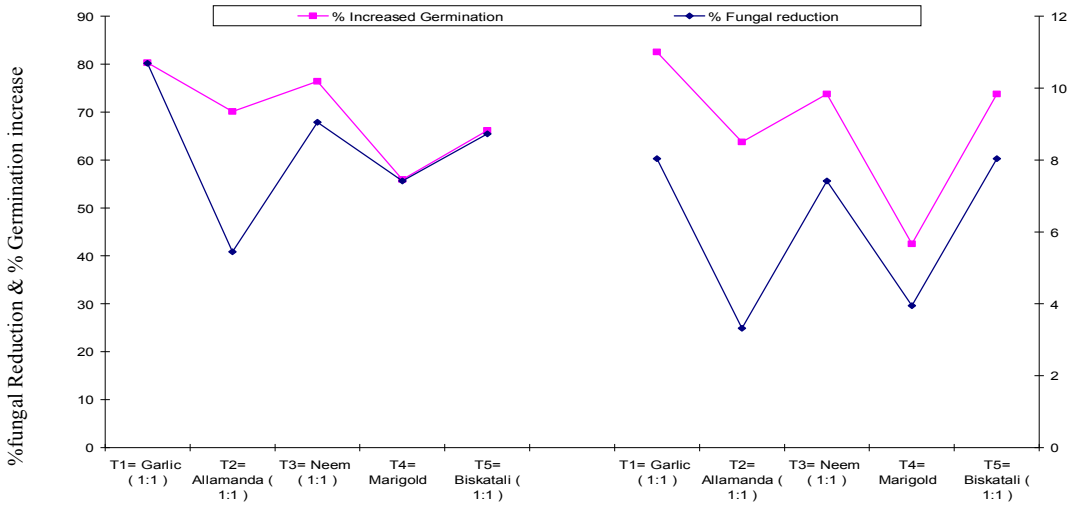
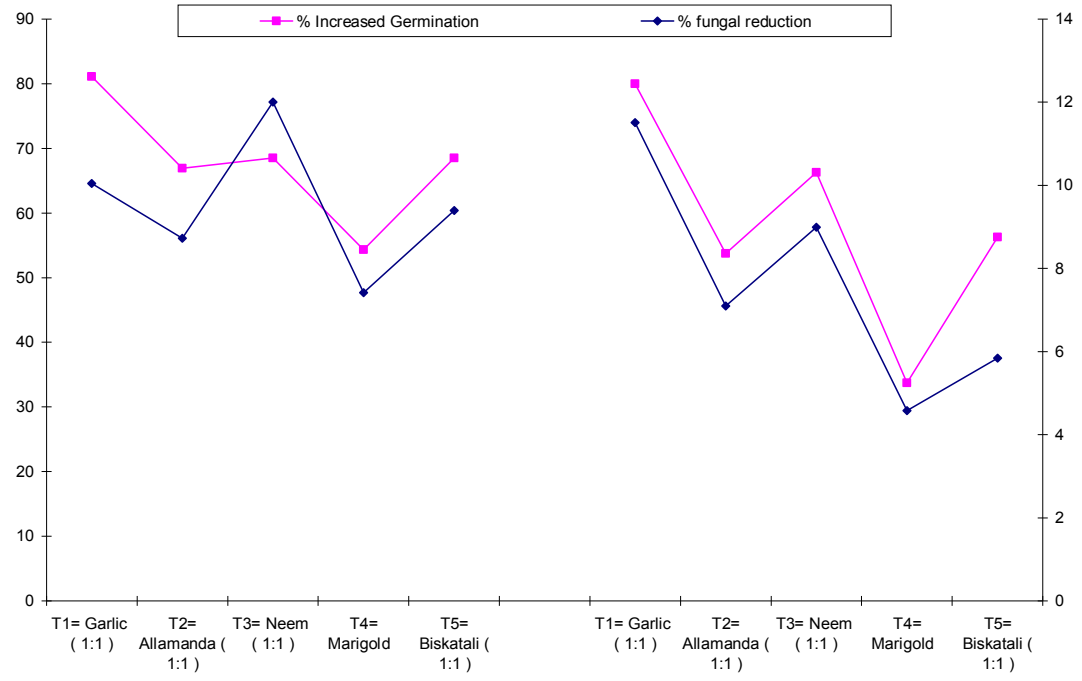
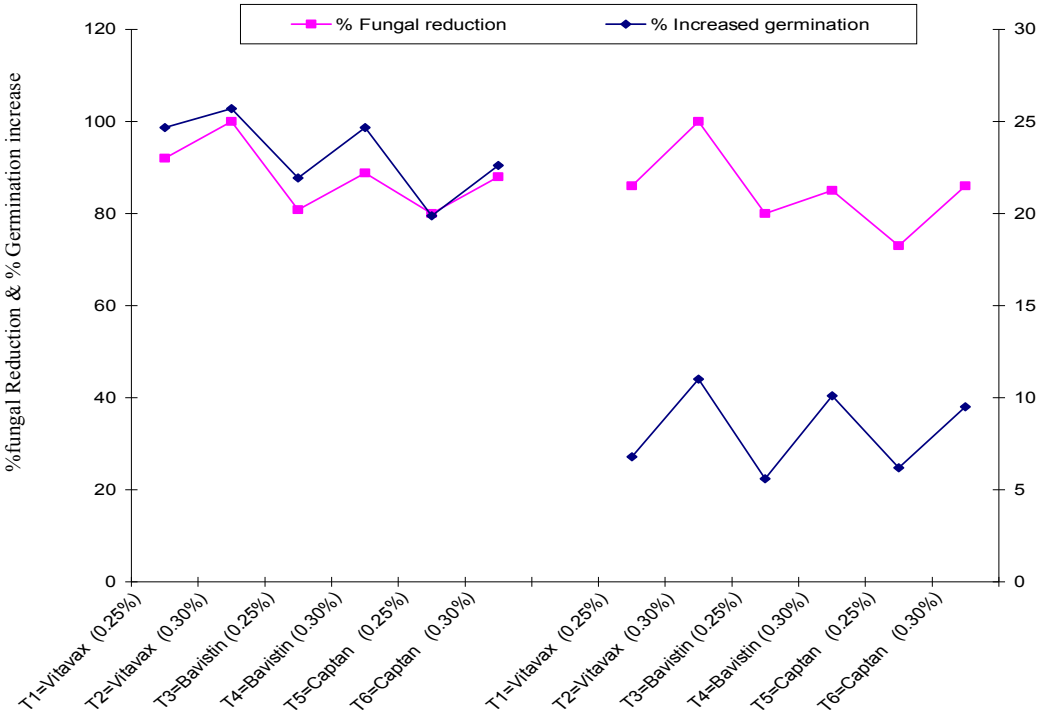


Fig 1. Effect of seed treatment through plant extracts on reduction of seed borne infection & increase seed germination in BR11 and BRRI dhan28 at N. Sadar Upazilla



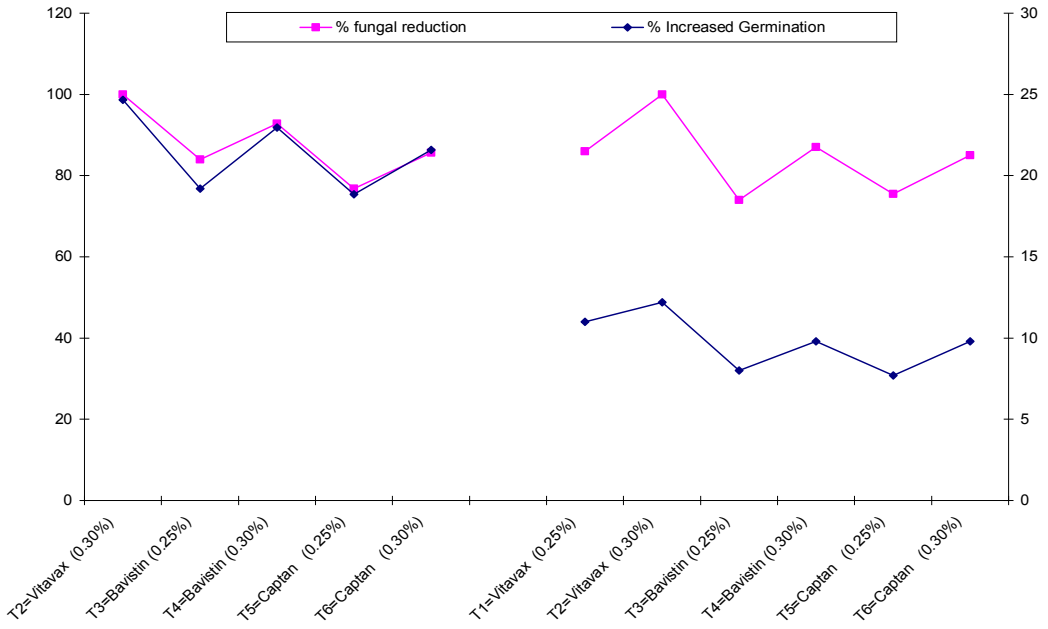
BR11 BRRI dhan28

Fig 2. Effect of seed treatment through plant extracts on reduction of seed borne infection & increase seed germination in BR11 and BRRI dhan28 at N. Sadar Upazilla



BR11 BRRI dhan28

Fig 3. Effect of seed treatment through chemicals on reduction of seed borne infection & increase seed germination in BR11 and BRRI dhan28 at N. Sadar Upazilla



BR11 BRRI dhan28

Fig 4. Effect of seed treatment through chemicals on reduction of seed borne infection & increase seed germination in BR11 and BRRI dhan28 at Shibpur Upazilla

Comparative Study

Plant extracts and fungicides both are effective against seed borne fungi of rice. But fungicides showed comparatively better performance {100% reduction-Vitavax 200 (0.3%)} than plant extract (81% reduction-Garlic). Incase of percent germination, both plant extracts and fungicides showed more or less equal response i.e. near about 7-12% germination increase observed in different treatments. But it we consider the hazardous effect of fungicides which accumulate in soil and plant products and ultimately leads to serious health hazards of mankind should be restricted in earliest possible time. In this phenomena, plant extracts would be a better option where farmers can successfully control seed borne infection with minimum cost. Not only this, plant extracts are eco-friendly and doesn't create any disturbance to natural balance.

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