EFFICACY OF BAU-BIOFUNGICIDE ON BROWN SPOT AND BACTERIAL LEAF BLIGHT DISEASE AND VIGOUR INDEX OF RICE

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ABSTRACT

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Extracts of garlic (*Allium sativum*) and neem (*Azadirachta indica*), BAU-Biofungicide (*Trichoderma* based preparation), Potent 250 EC (Propiconazole) and Bavistin DF (Carbedazim) were evaluated under field condition in controlling brown spot and bacterial leaf blight disease of rice. Potent (0.1%) and BAU-Biofungicide (2%) were found to have significant effect in reducing disease severity of brown spot and bacterial leaf blight. Potent (0.1%) produced highest (26.75%) grain yield, while BAU-Biofungicide (2%) increased (24.`78%) grain yield over untreated control in the field as well as reduced cost of production with BCR. Maximum normal seedling, highest germination percentage as well as maximum 38.13% increase of vigour index were found with BAU-Biofungicide (3%) over control.

Key words: BAU-Biofungicide, Disease severity, Vigour index, Yield, Rice

INTRODUCTION

Rice is the main cereal food crop in Bangladesh. About 76% of the total cultivated land covering about 11.37 million hectares is under rice cultivation and total amount of rice production is approximately 34.36 million tons (Anon. 2014). The world average yield of rice is 4.43 t/ha while the national average yield of rice in our country is 4.43 t/ha which is lower in comparison to 7.73 t/ha in South Korea (Anon. 2016). There are many factors responsible for low yield of rice in Bangladesh. Among these, diseases are considered as major. Thirty two diseases of rice were reported to occur in Bangladesh. Among these, 10 diseases viz., blast, sheath blight, bakanae, brown spot, sheath rot, false smut, ufra, tungro, bacterial leaf blight and bacterial leaf streak are main constraints for rice production in Bangladesh which resulted 10-15% average yield loss (Anon. 1999). Rice is suffering from brown spot to a great extent. Brown spot disease of rice caused by *Bipolaris oryza* impairs grain quality and results in loss of about 4 to 52% yield (Barnwal *et al*. 2013). Survey on rice brown spot caused *B. oryzae* (Breda de Haan) Shoem. was carried out throughout Bangladesh and 18.75-22.50% yield loss was estimated as reported by Kamal and Mia (2009). The disease becomes severe under stress conditions, causes seed discolouration, reduced seedling vigour and the yield loss. The pathogen is responsible for germination failure, rotting of seeds, roots and coleoptiles, poor germination and poor seedling vigour (Naeem *et al*. 2001, Malavolta *et al*. 2002). At present, there are very limited strategies for the control of brown spot and cultivars with an adequate level of resistance are not available (Srinivasachary *et al*. 2011). So, at this satage, application of fungicides for the control of brown spot seems the most effective management option, but under high disease pressure effective control is not achieved (Lore *et al*. 2007). Bacterial leaf blight is devastating and can cause yield losses from 20 to 74% in Southeast Asia and India (Ahmed and Singh 1975, Ou 1985). The earlier studies have identified some chemicals and antibiotics with relative efficacy against the disease. Effective control of the disease has not yet been recorded (Reissing *et .al*. 1986). As there is no single most effective control measure available against this disease, the present investigation was undertaken to bring together an update of the research on the bacterial disease of rice and the management strategies in biological context.

Rice disease management strategies mainly aim at prevention of outbreak or epidemics through the use of host plant resistance and chemical pesticides. Although some plants have antifungal properties (Mia *et al*. 1990), but recommended dose of plant extracts has not yet been formulated. Biocontrol assumes special significance being an eco-friendly and cost effective strategy which can be used in integration with other strategies for a greater level of protection. *Trichoderma* spp. elicits biocontrol mainly by being mycoparasites and by being aggressive competitor of

the pathogens (Cumagun 2012). The present study was designed to control brown spot and bacterial leaf blight of rice diseases by using plant extracts and biocontrol agent as an alternative option in order to avoid environmental pollution. BAU-Previous studies showed that Biofungicide resulted significantly higher germination and plant stand, less disease incidence and higher yield of different crops (Hossain 2011, Chowdhury *et al*. 2013, Hossain and Hossain 2012). Mahmud and Hossain (2013) also reported that BAU-Biofungicide is a plant activator which have marked reduction of disease severity and ultimately increased grain yield of rice.

MATERIALS AND METHODS

Preparation of plant extracts. Healthy leaves of neem and garlic cloves were collected and the samples were washed thoroughly under running tap water followed by sterile distilled water (SDW). The extracts were prepared by homogenizing 5 g of plant sample in 50 ml of (SDW) using a blender and the extracts were then prepared at 1% and 2% concentration by dilution with water and kept in conical flasks separately before use.

Use of BAU-Biofungicide and Chemical fungicide. BAU-Biofungicide was used @ 2% and 3% in this experiment. BAU-Biofungicide is a *Trichoderma* based preparation (Hossain 2011), while Bavistin DF (Carbendazim) and Potent 250 EC (Propiconazole) are chemical fungicides and were used @ 0.1% and 0.05% concentrations.

Field experiments: The experiment was conducted during two Aman season from July to November, 2011 and 2012 in the field laboratory of the Department of Plant Pathology, Bangladesh Agricultural University, Mymensingh, Bangladesh. The field was fertilized as per recommendation of Bangladesh Rice Research Institute, Gazipur (Anon. 2004). The layout of Randomized Complete Block Design (RCBD) having three replications was followed. The individual plot size was 5.0 m x 2.0 m (10 m^2). Distance between block to block, was 1.5 m which was same for plot to plot also. Thirty four day old seedlings were uprooted from the seed bed and three seedlings per hill were transplanted in the field on 4 August, 2011 and 2012. Hill to hill and row to row distances were 15 cm and 25 cm, respectively. The spray schedule was started just after commencement of disease symptom and three sprays were done at 15 days interval. Disease severity of each plot was assessed following the procedure of Standard Evaluation System for Rice (Anon. 1996).

Tray method (sand culture) - The collected sand was sterilized with 5% formalin (Dashgupta 1988). The formalin treated soil was covered with polythene sheet for 48 h and then exposed for 48 h for aeration before setting experiment. The plastic trays (12″×8″) were filled with the sand. Three hundred harvested seeds of each treatment including control were sown in plastic trays (100 seeds/tray) maintaining equal distances among the seeds following Completely Randomised Design (CRD) with three replications for each treatment. Trays were watered as and when necessary for maintaining proper moisture. Randomly selected 10 seedlings were uprooted carefully from each tray and washed thoroughly with running tap water. Data on Vigour Index (VI) for each treatment at 14 days after sowing (DAS) on different parameters was computed using the following formula of Baki and Anderson (1973): Vigor index = (Mean shoot length + Mean root length) × %Germination

RESULTS AND DISCUSSION

The lowest disease severity (3.33, 5.25% at 105 DAT) of brown spot of rice was recorded with foliar spray of Potent (0.1%) followed by BAU-Biofungicide (2%) among three counting periods (Table 1). These findings of this trial were in accordance with the observation of Razu and Hossain (2015). They reported that BAU-Biofungicide (2%) and Tilt 250EC (0.1%) were found to have significant reduction of disease severity of brown spot when they were applied as foliar spray for 3 times on rice cv. BRRI Dhan49 under field condition. Similar results were also observed by Fattah *et al*. (2007) who reported the efficacy of application of a spore suspension of *T. harzianum* as foliar spray for control of rice brown spot disease under field conditions. Similar observations were also reported by Gupta *et al.* (2013). They found that Propiconazole and Azoxystrobin (0.1%) significantly increased the grain yield by 19%, 12% and 21% in three rice varieties viz., Basmati-370, Jaya and PC-19 as compared to their respective controls in successive two years 2011 and 2012. The lowest disease severity of bacterial leaf blight (3.00, 3.25%) was also found in plots sprayed with BAUBiofungicide (2%) followed by Potent 250EC (0.1%) and the highest disease severity was recorded in control. Tang *et al.* (2001) supported this finding. They evaluated the biological control efficiency of *Trichoderma* spp. against the bacterial leaf blight pathogen, *Xanthomonas oryzae*. These findings are in accordance with the findings of Razu and Hossain (2015). They reported that BAU-Biofungicide (2%) showed significant reduction of disease severity of bacterial leaf blight when they

were applied as foliar spray 3 times on rice cv. BRRI Dhan49 under field condition.

The highest 30.16% increase of normal seedlings obtained from harvested seeds was observed with BAU-Biofungicide (2%). Maximum 40.02% reduction of diseased seedling was found in BAU-Biofungicide 2% followed by Potent (0.1%) over control as shown in Table 2. Lowest percentage of germination failure was achieved with BAU-Biofungicide (2 & 3%) followed by Potent (0.1%). Maximum increase of 14.29% seed germination was found with BAU-Biofungicide (3%) over control, while BAU-Biofungicide (3%) resulted 38.13% higher increase in vigour index over control followed by BAU-Biofungicide (2%) having 37.74%. The results were supported by Ora *et al*. (2011), Mahmud and Hossain (2016) and Mahmud *et al.* (2016). Ora *et al*. (2011) showed better performance in terms of lowest pathogenic incidence, rotten seed, dead seed, seed germination and seedling vigour index. Mahmud *et al*. (2016) reported that 35.23% and 32.25% vigour index were increased over control with Proud (0.1%) and BAU-Biofungicide (2%), respectively from harvested seeds of rice cv BRR1 dhan28 as foliar spray, at 14 days after sowing.

The highest net profit Tk. 49619.00 was achieved in foliar application of Potent (0.1%) followed Tk. 47860/- by BAU-Biofungicide (2%). Benefit-Cost Ratio (BCR) 2.34:1 was found in Potent (0.1%), while BAU-Biofungicide (2%) showed 2.28:1 (Table 3). Hasan *et al*. (2014) reported that BAU-Biofungicide and Bavistin were found controlling tikka disease of groundnut under field condition. They obtained Benefit-Cost Ratios by 2.64:1 and 2.30:1 in application of BAU-Biofungicide (3%) and Bavistin (0.1%), respectively as foliar spray. Mahmud *et al*. (2016) also applied BAU-Biofungicide and Proud for controlling brown spot disease of rice cv BRRI dhan28 under field condition. Benefit-Cost Ratio (2.78:1) was observed with BAU-Biofungicide (2%) which is close to 2.87:1 in Proud (0.1%) when application of foliar spray. From this experiment, *T. harzianum* (BAU-Biofungicide) showed profound effect in reducing disease severity of brown spot and bacterial leaf blight disease in the field. It also increased grain yield as well as reduced cost of production. BAU-Biofungicide showed significant effect in increasing germination of seeds, seedling growth and vigor index in harvested seeds of sprayed plot with BAU-Biofungicide. BAU-Biofungicide (2%) can be recommended as foliar application in controlling diseases of brown spot and bacterial leaf blight of rice avoiding environmental pollution.

Table 1. Effect of extracts of Garlic and Neem; BAU-Biofungicide, Bavistin and Potent on disease severity of Brown spot and Bacterial leaf blight of rice cv. BRRI dhan40 in 2011 and 2012

Treatment (dose)	Brown spot						Bacterial Leaf blight					
	At 75 DAT		At 90 DAT		At 105 DAT		At 75 DAT		At 90 DAT		At 105 DAT	
	2011	2012	2011	2012	2011	2012	2011	2012	2011	2012	2011	2012
Garlic (1%)	6.00b (27.97)	7.50b (30.23)	10.50cd (41.67)	12.00c (44.83)	12.67d (58.36)	15.75c (54.35)	4.00a (0.00)	5.75a (-4.55)	7.00ab (15.97)	8.00b (15.79)	6.42b (33.61)	6.50b (39.53)
Garlic (2%)	5.33b (36.01)	-	8.67de (51.83)	-	10.17e (66.58)	-	4.00a (0.00)	-	6.00bc (27.97)	-	5.55bc (42.61)	-
Neem (1%)	6.67ab (19.93)	8.25b (23.26)	14.50b (19.44)	16.00b (26.44)	22.67b (25.50)	23.00b (33.33)	4.00a (0.00)	5.50a (0.00)	5.75bcd (30.97)	6.00cd (36.84)	5.33c (44.88)	5.50cd (48.84)
Neem (2%)	6.33ab (24.01)	-	12.00c (33.33)	-	16.60c (45.45)	-	3.50a (12.50)	-	5.33bcde (36.01)	-	5.00cd (48.30)	-
BAU-Biofungicide (2%)	5.33b (36.01)	7.00b (34.88)	6.33g (64.83)	7.75de (64.37)	4.00f (86.86)	6.00e (82.61)	3.67a (8.25)	5.50a (0.00)	4.00de (51.98)	5.00d (47.37)	3.00e (68.98)	3.25e (69.76)
BAU-Biofungicide (3%)	5.33b (36.01)	-	6.00g (66.67)	-	4.33f (85.77)	-	3.00a (25.00)	-	3.67e (55.94)	-	3.00e (68.98)	-
Bavistin DF (0.1%)	6.00b (27.97)	7.50b (30.23)	8.33ef (53.72)	9.00d (58.62)	10.00e (67.14)	11.75d (65.94)	4.00a (0.00)	6.00a (-9.09)	5.33bcde (36.01)	6.00cd (36.84)	4.75cd (50.88)	5.50cd (48.84)
Bavistin DF (0.05%)	7.00ab 15.97	8.50b (20.93)	10.67c (40.72)	11.00c (49.43)	12.67d (58.36)	14.25c (58.70)	4.00a (0.00)	5.25a (4.55)	5.67bcd (31.93)	7.00bc (26.32)	5.17c (46.54)	6.50b (39.53)
Potent 250 EC (0.1%)	5.00b (39.98)	6.75b (37.21)	6.00g (66.67)	7.00e (67.82)	3.33f (89.06)	5.25e (84.78)	3.67a (8.25)	5.50a (0.00)	4.67cde (43.94)	5.75cd (39.47)	4.00de (58.63)	5.00d (53.48)
Potent 250 EC (0.05%)	6.00b (27.97)	7.00b (34.88)	6.50fg (63.89)	7.50de (65.52)	4.00f (86.86)	6.00e (82.61)	4.00a (0.00)	6.00a (-9.09)	5.33bcde (36.01)	6.50c (31.58)	4.67cd (51.71)	6.00bc (44.19)
Control (water)	8.33a	10.75a	18.00a	21.75a	30.43a	34.50a	4.00a	5.50a	8.33a	9.50a	9.67a	10.75a

In a column, figures having same letter(s) do not differ significantly at 5% level of significance by DMRT
DAT = Days after Transplanting
Data represent the means of three replications
Data in parentheses indicate % disease severity reduction over control
(-) = Not tested in 2012

Table 2. Effect of extracts of Garlic and Neem; BAU-Biofungicide, Bavistin and Potent on germination(%) and vigour index at 14 days after sowing of harvested seeds of rice cv BRRI dhan40 following tray method during Aman season in 2011 and 2012

Treatment (dose)	Germination (%)		Germination failure (%)		Normal seedling (%)		Diseased seedling (%)		Vigour index	
	2011	2012	2011	2012	2011	2012	2011	2012	2011	2012
Garlic (1%)	91.00ab (+8.33)	90.00ab (+7.14)	5.00bc (-50.00)	5.00c (-48.29)	75.00ab (+15.97)	72.00c (+14.29)	10.00ab (-9.09)	11.00a (-5.74)	2207.97b (+18.79)	2170.13bc (+17.02)
Garlic (2%)	92.33ab (+9.92)	-	4.67c (-53.30)	-	77.33a (+19.58)	-	9.00bc (-18.18)	-	2265.75ab (+21.89)	-
Neem (1%)	92.00ab (+9.52)	91.00ab (+8.33)	5.00bc (-50.00)	5.00c (-48.29)	75.00ab (+15.97)	74.00bc (+17.46)	10.00ab (-9.09)	9.00b (-22.88)	2136.11bc (+14.92)	2107.2cd (+13.63)
Neem (2%)	93.00a (+10.71)	-	4.00cd (-60.00)	-	78.00a (+20.61)	-	9.00bc (-18.18)	-	2212.88b (+19.05)	-
BAU-Biofungicide (2%)	96.00a (+14.29)	95.00a (+13.10)	2.00e (-80.00)	3.00d (-68.98)	83.67a (+29.38)	82.00a (+30.16)	7.33d (-33.36)	7.00c (-40.02)	2560.28a (+37.74)	2551.75a (+37.61)
BAU-Biofungicide (3%)	96.00a (+14.29)	-	2.00e (-80.00)	-	84.00a (+29.89)	-	7.00d (-36.36)	-	2567.60a (+38.13)	-
Bavistin (0.1%)	92.00ab (+9.52)	90.67ab (+7.94)	4.00cd (-60.00)	5.33bc (-44.88)	77.67a (+20.10)	74.67bc (+18.52)	8.33cd (-24.27)	9.00b (-22.88)	2249.07ab (+21.00)	2210.63bc (+19.21)
Bavistin (0.05%)	90.00ab (+7.14)	88.33ab (+5.15)	6.00b (-40.00)	6.33b (-34.54)	74.00ab (+14.43)	70.00c (+11.11)	9.00bc (-18.18)	9.67bc (-17.14)	2103.45bc (+13.16)	2036.97cd (+9.85)
Potent 250 EC (0.1%)	95.00ab (+13.10)	94.00a (+11.90)	3.00de (-70.00)	3.00d (-68.98)	82.00a (+26.80)	81.67a (+29.63)	8.00cd (-27.27)	7.33c (-37.19)	2399.03ab (+29.07)	2400.53ab (+29.45)
Potent 250 EC (0.05%)	94.00ab (+11.90)	93.67a (+11.51)	3.00de (-70.00)	3.33d (-65.56)	81.00b (+25.25)	80.00ab (+26.98)	7.00d (-36.36)	7.67c (-34.28)	2316.87ab (+24.65)	2306.91abc (+24.40)
Control (water)	84.00b	84.00b	10.00a	9.67a	64.67ab	63.00d	11.00a	11.67a	1858.70c	1854.40d

In a column, figures having same letter(s) do not differ significantly at 5% level of significance by DMRT
Data represent the means of three replications
Data in parentheses indicate % increased (+) and % decreased (-) over control
DAS = Days after sowing
- = Not tested in 2012

Table 3. Benefit-Cost Ratio (BCR) analysis of foliar spray with two extracts of Garlic and Neem; BAU-Biofungicide, Bavistin and Potent in controlling diseases of rice in cv BRRI dhan40

Functions	Garlic clove (1%)	Neem leaf (1%)	BAU-Biofungicide (2%)	Bavistin (0.1%)	Potent (0.1%)	Control
Seed (Tk.)	750/-	750/-	750/-	750/-	750/-	750/-
Preparation of land (Tk.)	7200/-	7200/-	7200/-	7200/-	7200/-	7200/-
Seed bed preparation (Tk.)	400/-	400/-	400/-	400/-	400/-	400/-
Fertilizer cost (Tk.)	9990/-	9990/-	9990/-	9990/-	9990/-	9990/-
Lay out & Transplantation	5000/-	5000/-	5000/-	5000/-	5000/-	5000/-
Weeding and irrigation (Tk.)	5000/-	5000/-	5000/-	5000/-	5000/-	5000/-
Cost of treatments (Tk.)	2496/-	1696/-	3150/-	3705/-	2741/-	-
Insecticide cost (Tk.)	500/-	500/-	500/-	500/-	500/-	500/-
Harvest cost (Tk.)	3000/-	3000/-	3000/-	3000/-	3000/-	3000/-
Cost of processing (Tk.)	1000/-	1000/-	1000/-	1000/-	1000/-	1000/-
Transportation cost (Tk.)	500/-	500/-	500/-	500/-	500/-	500/-
Others cost (Tk.)	1000/-	1000/-	1000/-	1000/-	1000/-	1000/-
Total cost of cultivation (Tk.)	36836/-	36036/-	37490/-	38045/-	37081/-	34340/-
Yield (kg/ha)	5165	4915	5690	5450	5780	4560
Sell price (Tk/ha)	77475/-	73725/-	85350/-	81750/-	86700/-	68400/-
Profit (Tk/ha)	40639/-	37689/-	47860/-	43705/-	49619/-	34060/-
(%) return over control	19.32	10.65	40.52	28.32	45.68	-
Benefit-Cost ratio	2.10:1	2.04:1	2.28:1	2.15:1	2.34:1	1.99:1

Legends for costs: Labour: Tk. 200/labour; Seed: Tk. 30/kg; ploughing: Tk. 2400/ha (one time); Bavistin: Tk. 2500/kg; Potent: Tk.1850/litre; BAU Biofungicide: Tk. 50/kg; garlic clove: Tk. 64/kg; neem leaf : Tk. 40/kg; Urea: Tk. 20/kg, TSP: Tk. 24/kg, MP: Tk. 17/kg, Zypsum:Tk. 10/kg,, Zinc:Tk. 220/kg, and rice sell price: Tk. 15/kg.

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