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Eco-friendly management of brown spot and yield of rice

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Abstract: **:** A study was undertaken to assess different tree leaf biomass for controlling brown spot of rice under field conditions at the Bangladesh Agricultural University, Mymensingh during the aman season of 2009. Leaf biomasses of five indigenous trees at various levels were incorporated in the 1 m^2 plots before ten days of final land preparation. All the leaf biomass except Pitraj showed considerably positive effect in controlling brown spot and increasing grain yield of rice over control. Among the treatments Mahogany and Neem @ 300g per plot were found more effective in reducing the percent disease index and severity with significant increase in grain yield than the other treatments. However, Mahogany leaf biomass appeared to be the best in respect of antifungal action and increasing yield of rice.

Key words: Rice; brown spot; tree leaf biomass.

Introduction

Brown spot caused by the fungus *Bipolaris oryzae* (Breda de Hann) Shoemaker is one of the most devastating diseases of rice (Fazlu and Schroeder, 1966). Strategies for brown spot control are limited since cultivars with an adequate level of resistance are not available (Lee, 1992). Therefore, the management strategies recommended are fungicide application and balanced plant nutrition (Ou, 1985; Razende *et al*. 2009). Chemical control is very destructive as it destroys ecological balance and causes resurgence of the pathogen infestation. Successful control of the disease by different tree biomass which had no adverse effect on the environment. On the other hand, crop cultivation reduces soil organic matter and adversely affect on soil quality. Soil compaction the main reason for low soil organic matter, which restricts plant root development and limit plant growth (Asady and Smuker 1989; Unger and Kasper, 1994). To develop more efficient system to improve soil nutrient dynamics, a well synchronized balance must be established between specific crop demands as supply of nutrients from decomposition.

In agroforest system (AFS), the main input of nutrients is achieved through biomass decomposition, by which element that are essential for plant development and are associated to plant tissues not readily available to crops of commercial interest are released. That is why environment friendly management with leaf biomass is very effective method which reduces the chemicals and considered as one of the best strategy for preserving the nature without disturbing its components. Keeping in view of the above, the present investigation was undertaken to study the effect of tree leaf biomass on brown leaf spot of rice.

Materials and Methods

Host The experiment was conducted in the field laboratory, Department of Agroforestry, Bangladesh Agricultural University, Mymensingh during July to November, 2009. A modern variety of rice cv. BR 11 (Mukta) was used as the test crop. The unit plot size was 1m × 1m. The spacing between blocks was 100 cm and the plots were separated from each other by 40 cm space. Leaf biomass of five trees viz. Mahogony (*Swietenia macrophylla*), Neem (*Azadirachta indica*), Arjun (*Terminalia arjuna*), Kalo Jam (*Syzigium cumini*) and Pitraj (*Aphanamixis polystichya*) each with three different doses were used in the experiment. The treatments were, T_1 = Mahogany 100g leaf biomass, T_2 = Mahogany 150g leaf biomass, T_3 = Mahogany 300g leaf biomass, T_4 = Neem 100g leaf biomass, T_5 = Neem 150g leaf biomass, T_6 = Neem 300g leaf biomass, T_7= Arjun 100g leaf biomass, T_8 = Arjun 150g leaf biomass, T_9 = Arjun 300g leaf biomass, T_{10} = Jam 100g leaf biomass, T_{11} = Jam 150g leaf biomass, T_{12} = Jam 300g leaf biomass, T_{13} = Pitraj 100g leaf biomass, T_{14} = Pitraj 150g leaf biomass, T_{15} = Pitraj 300g leaf biomass, T_{16} = Control (without leaf biomass) + Recommended Dose of NPK Fertilizers (BRRI, 1999). The whole amount of various tree leaf biomasses were incorporated in experimental plots before ten days of final land preparation. Recommended dose of all fertilizers except urea were applied in control plots during final land preparation. Forty days old seedlings were transplanted in the field. The occurrences of brown spot were recorded from randomly selected 5 hills of each plot. The plants were graded using the following scoring scale (0-9) of IRRI (1988) as presented in Fig 1.

The plants showing a mean disease score 0 were designated as highly resistant, 1 were resistant, 2-3 were moderately resistant, 4-5 were tolerant, 6-7 were moderately susceptible and 8-9 were susceptible.

The disease index was estimated at dough stage using the following formulae: Percent disease index (PDI) =

$$\frac{\text{Sum of total scores}}{\text{Maximum grade} \times \text{Total number of plants assessed}} \times 100$$

Results and Discussion

The effect of leaf biomass on the percent disease index of brown spot of rice under field conditions is shown in Table 1. It was observed that in general all the treatments had substantial positive effect on the reduction of percent disease index over control except Pitraj 100g. Consequently, the least percent disease index was observed in treatment receiving leaf biomass of Mahogany 300g (38.32%) followed by Neen 300g (42.6%), Neem 150g (42.9%) and Arjun 100g (43.9%). The highest percent disease index was recorded in Pitraj 100g followed by Pitraj 150g and control treatment. Pitraj leaf biomass (150 and 300g) was least effective in reducing the percent disease index. Mahogany and Neem leaf biomass were the effective botanicals to control *Bipoloris oryzae*.

Antifungal property of *Azadirachta indica* was also examined by other workers (Qasem, 1996 and Awad et al. 1997) who reported that leaf biomass of A. indica was found to be effective against fungi and bacteria. Strong fungi toxicity of leaf biomass might be responsible for the presence of antifungal substances which after isolation may prove of great therapeutic value. Such isolated substances from higher plants have been demonstrated to possess systemic activity and was less phytotoxic as compared with synthetic fungicides (Fawcett and Spencer, 1990).

0 1 2 3 4 5 6 7 8 9

Fig. 1. Brown spot measuring scale (0-9)

Table 1. Effect of tree leaf biomass in reducing the severity of brown spot of rice

Treatments	Disease incidence (%)	Disease severity	Disease reaction
T_{1} Mahgoni (100g)	58.55 cdef	5.3 cdef	MS
T_{2} Mahgoni (150g)	58.99 cdef	5.3 cdef	MS
T_{3} Mahgoni (300g)	38.33 h	3.4 h	MR
T_{4} Neem (100g)	50.44 efg	4.5 efg	MS
T_{5} Neem (150g)	42.99 gh	3.8 gh	MS
T_{6} Neem (300g)	42.55 gh	3.7 gh	MS
T_{7} Arjun (100g)	43.88 gh	3.9 gh	MS
T_{8} Arjun (150g)	54.99 def	4.9 def	MS
T_{9} Arjun (300g)	49.22 fg	4.4 fg	MS
T_{10} Kalo Jaam (100g)	56.99 def	5.1 def	MS
T_{11} Kalo Jaam (150g)	60.44 cde	5.4 cde	MS
T_{12} Kalo Jaam (300g)	53.99 def	4.9 def	MS
T_{13} Pitraj (100g)	100.00a	9.2 a	HS
T_{14} Pitraj (150g)	84.66b	7.6 b	HS
T_{15} Pitraj (300g)	68.33c	6.2 c	MS
T_{16} Control (Only RDF)	90.32b	8.2 b	HS
Level of significance		0.01	-

RFD = Recommended fertilizer dose

The leaf biomass had considerably differential response to brown spot severity. The disease severity ranged from 3.4 to 9.2. However, the lowest severity (3.4) was obtained in the treatment Mahogany 300g which showed moderately resistant reaction while the highest severity (9.2) was obtained in the treatment Pitraj 100g followed by Control and Pitraj 150g and their disease reaction rated as highly susceptible to the disease. The second and third lowest disease severity was recorded in the treatments Neem 300g Neem 150g, respectively. Twelve treatments such as T6, T_7, T_5, T_4, T_9, T_8, T_{12}, T_{10}, T_1, T_2, T_{11} and T_{15}, were identified as moderately susceptible. The rest treatments Pitraj 100g and control were highly susceptible to the disease. The findings of the present study revealed that the treatments showed different types of reaction of rice under natural field conditions. The plants with same age and nursing within the same environment showed differences in lesion size, leaves yellowing and remained green. Variation in susceptibility to the disease severity of cereal crop have been identified by other investigators (Yousef *et al*. 1998; Uddin, 2004). Holanda *et al.* (2002) also found that rice grown on soil with low organic matter had high brown spot and leaf scald severity. NPK application through chemical fertilizer either in single or balanced form without organic manure increased the severity of disease (Mathew, 1996). Similar findings were observed by Singha *et al.* (2000) who reported that higher doses of N and P fertilizer made the rice plant susceptible to brown spot.

Table 2. Effect of tree leaf biomass on yield and yield contributing components of rice

Treatments	No. of effective tillers hill^{-1}	Numbers of Grains panicle^{-1}	Yield (t ha^{-1})
T_{1} Mahgoni (100g)	10.11 c	110.89 b	4.56 d
T_{2} Mahgoni (150g)	9.61 de	105.97 c	4.98 b
T_{3} Mahgoni (300g)	12.01 a	115.35 a	5.61 a
T_{4} Neem (100g)	9.81 cd	99.74 de	4.11 e
T_{5} Neem (150g)	11.45 b	109.72 b	4.94 bc
T_{6} Neem (300g)	12.00 a	115.29 a	5.50 a
T_{7} Arjun (100g)	9.25 efgh	96.70 defg	3.45 h
T_{8} Arjun (150g)	8.61 ghi	96.28 efg	3.61 gh
T_{9} Arjun (300g)	8.17 j	100.10 d	3.89 fg
T_{10} Kalo Jaam (100g)	8.61 hi	96.85 defg	4.14 ef
T_{11} Kalo Jaam (150g)	10.02 c	108.44 bc	4.66 cd
T_{12} Kalo Jaam (300g)	9.85 ef	105.30 c	4.65 cd
T_{13} Pitraj (100g)	8.25 j	93.89 fg	3.44 h
T_{14} Pitraj (150g)	8.26 ij	93.22 g	3.46 h
T_{15} Pitraj (300g)	7.86 j	93.20 g	3.55 h
T_{16} Control (Only RDF)	9.24 efg	98.32 de	3.42 h
Level of significance	0.01	0.01	0.01

RFD = Recommended fertilizer dose

The number of effective tillers, grains panicle^{-1} and grain yield (t ha^{-1}) were influenced by incorporation of tree leaf biomass (Table 2). The number of effective tillers, grains panicle^{-1} and yield were significantly higher in soil amended with Mahogany 300g compared with other treatments. Number of effective tiller and grains panicle^{-1} was increased by 29.98 and 17.32% in Mahogany 300g treatment than control. The number of effective tillers and grains panicle^{-1} ranged from 9.24-12.01and 93.20-115.35, respectively. There was a slight difference in number of effective tillers and grains panicle^{-1} between Mahogany 300g and Neem 300g treatments. Neem 300g ranked second in position in those two components of yield. No significant difference was detected between the Mahogany 300g and Neem 300g in two important components of yield contributing characters.

Maximum grain yield was obtained in soil amended with Mahogany 300g (5.61 ton/ha) followed by Neem 300g. Next treatments were Mahogany 150g and Neem 150g in increasing yield of rice against the disease. Soil amended with Mahogany 100g, Neem 100g, Jam 100g, Jam 150g and Jam 300g showed intermediate yield (ton/ha). Minimum grain yield was recorded in control (3.42 ton/ha). In the present study, it was demonstrated that soil amended with Mahogany 300g and Neem 300g leaf biomass were effective in reducing the disease parameters. Mahogany 300g and Neem 300g were found to be efficient in enhancing rice resistance to pathogen and improving yield of rice. Several workers had reported the effectiveness of leaf biomass and green manure in controlling the percent disease index and severity of different diseases and increasing yield of rice (Meena and Muthusamy, 1999; Holanda *et al.* 2002; Uddin, 2004).

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