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Effect of leaf biomass of different agroforest trees on the prevalence of insects and yield of rice cv. BR11

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Abstract: A field experiment was conducted at the Agroforestry field laboratory, Bangladesh Agricultural University, Mymensingh during the period from July to November 2006 to find out the effect of tree leaf biomass and inorganic fertilizers on the prevalence of insect pests and yield of rice cv. BR11. A total of 17 treatments comprises with the leaf biomass of rain tree (*Albizia saman*), kalokoroi (*Albizia lebbeck*), mahogoni (*Swietenia macrophylla*), eucalyptus (*Eucalyptus camuldulensis*), ipil-ipil (*Leucaena leucocephala*), minjiri (*Cassia siamea*) and akashmoni (*Acacia auriculiformis*) alone or in combination with different levels of fertilizers were accommodated in a Randomized Complete Block design with three replications.. The result showed that different treatments significantly influenced the yield and yield contributing components viz. plant height, panicle length, effective tillers hill^{-1}, filled spikelets panicle^{-1} and grain yield. The maximum (5.58 t ha^{-1}) yield was recorded in treatment B_{10} (Ipil-ipil + recommended fertilizer dose). This yield increase was 62.68% higher compared to lowest yield obtained in B_{13} (Akashmoni) and 37% higher than the control where only recommended fertilizer dose was used without leaf biomass. The highest prevalence of green leaf hopper (17.67), % damaged leaves (24.01) and % white head (29.11) was observed in the treatment B_{16} (10% higher of recommended fertilizer dose) where the lowest prevalence of green leaf hopper (5.33), % damaged leaves (9.31) was found in B_{12} (Minjiri + recommended fertilizer dose) and % white head (14.52) in B_{10}. There was no significant effect on the prevalence of brown plant hopper and rice bug. The study suggested that the use of ipil-ipil or minjiri leaf biomass with recommended fertilizer dose may produce better yield and minimize the insect prevalence in rice field.

Key word: Tree leaf biomass, Fertilizer, Yield, Insect Prevalence, Rice.

Introduction

Rice is the principal crop which is grown in all three the crop growing seasons, occupying about 80% of total cropped area. Unfortunately, the yield of rice in this country is 2.21 t ha^{-1} which is very low (BBS, 2004) compared to other rice growing countries like South Korea and Japan where the average yield is 7.00 and 6.22 t ha^{-1} respectively (FAO, 1999). A good soil should have an organic matter content more than 3.5 percent. But, in Bangladesh, most of the soils have less than 1.7 percent and some soils have ever less than 1 percent organic matter (Satter, 2002). Inorganic fertilizer inputs not only increase plant productivity but also increase the availability of insect resources and increase the number of insect individuals, possibly the number of insect species (Hurd *et al.* 1971; Prestidge 1982; Sedlacek *et al.* 1988; Siemann 1998). The continuous rice cropping also created favorable condition for certain kinds of insect pests. About 175 species of insect have been recorded as rice pest and of those 20-30 species are economically important (Miah and Karim, 1984). Stem borer, rice bug, leaf hopper and plant hopper are generally considered most damaging causes about 13% yield losses to Boro crops, 24% to Aus and 18% to Amon crops (BRRI, 1985). The estimated annual loss of rice in Bangladesh due to insect pest and diseases is 1.5-2.0 million tons (Siddique, 1992). The average loss due to insect pest's damage in Bangladesh is about 18% of the expected rice crop yield per year (Alam *et al.* 1993). Leaf biomass is a very important organic source of soil fertility improvement. The decomposition of leaf biomass supplies the carbon, nitrogen, phosphorous, potassium and other nutrients in the soil that are considered as important indicator of soil productivity and the ecosystem health. So, the use of tree leaf biomass as a source of organic matter for rice cultivation significantly reduces the considerable amount of chemical fertilizers. To meet up the demand of our increasing population, farmers are now encouraged and practicing agroforestry system which is environmentally sound and ecologically balanced. Thus there are ample scopes for utilization of tree leaf biomass in the farmers' crop field as green manure. Under such a production system, the prevalence of major insect pest and their effects on yield of rice is necessary to determine.

Materials and Methods

The experiment was carried out at the Agroforestry Farm, Department of Agroforestry, Bangladesh Agricultural University, Mymensingh during aman season of 2006. The experimental area experiences a sub tropical climate and belonged to Old Brahmaputra Floodplain (AEZ 9). It is characterized by non-calcareous dark grey flood plain soil having p^H value from 6.5 to 6.8. The soil texture is silty with average organic matter content of 1.14%, total nitrogen 0.085% and C / N ratio 13:5 (FAO, 1988). The tested rice variety was BR11 (Mukta). The leaf biomass of raintree, kalokoroi, mahogoni, eucalyptus, ipil-ipil, minjiri and akashmoni were used alone or in combination with different levels of inorganic fertilizers (recommended dose, 10% higher and 10% lower of recommended dose) as treatments. The experiment was carried out in RCBD with three replications. The leaf biomass was incorporated in the plots @ 5 t ha^{-1} before 15 days of transplanting and recommended dose of fertilizers according to BRRI (1999) was Urea-TSP-MP-Gypsum-$ZnSO_4$ @ 180-100-70-60-10 kg ha^{-1}. The leaf biomass were collected from locally grown tress and dried prior to incorporation according to the treatments and then left to decompose. Thirty five days old seedlings were transplanted with 15 X 25 cm spacing. No fungicide and pesticide were used to control pest diseases. Five major insect species were undertaken into consideration. Sweep net sampling is the most common method of sampling leafhopper adults. In each plot, 5 sweeps were made in cross-section. The collected sample was stored in a jar and counted in the laboratory, To assess rice bug prevalence morning time was chosen because they are not active at that time. By choosing 4 different sites in each plot the number of bugs was recorded. The prevalence of leaf folder was assessed based on the percentage of leaves infested. For this, 5 hills were selected randomly in each plot and numbers of leaf folder infested leaves were recorded. The percent of leaf folder damaged leaves were calculated by the following formula:

$$\%\,damaged\ leaves = \frac{No.of\ damaged\ leaves\ per\ five\,hills}{Total\ no.of\ leaves\ per\ five\,hills} \times 100$$

The prevalence of stem borer was determined based on the percentage of white head. Five hills were selected randomly in each plot and numbers of white heads were recorded. The damage is assessed using the following formula:

$$\%\,white\,head = \frac{No.of\ white\,heads}{Total\ no.\ panicles\,observed} \times \frac{No.of\ \inf ested\ hills}{Total\ no.of\ hills\,observed} \times 100$$

The crop was harvested at its full maturity. The plants of individual treatment as tagged previously were separately harvested and threshed. Data were taken on plant height, no. effective tillers hill^{-1}, panicle length, filled spikelets panicle^{-1}, 1000-grain weight and grain yield. The data collected throughout the period of the experiment were computed and analyzed following the appropriate design of the experiment. Duncan's multiple range tests (DMRT) were done in order to show the significant differences between the treatment means (Gomez and Gomez, 1984).

Results and Discussion

Effect of leaf biomass on the prevalence of major insect pests: Use of different leaf biomass markedly influenced the prevalence of different insect pests (Table 1). The lowest prevalence of green leaf hopper was found in treatment B_{12} (5.3) while the highest prevalence was (17.7) in B_{16}. The highest percentage of the damaged leaves (24.01%) and white head (29.11%) was also recorded in B_{16}, whereas the lowest prevalence was found in the treatment B_{12} (9.31%) and B_{10} (14.52%), respectively. The prevalence of brown plant hopper and rice bug was insignificant (Table 1). The result was partially backed up by Surekha *et al.* (2003) who observed that white head damage by stem borer was 14.2 to 31.3% in 1999 and 16.8 to 29.7% in 2000 during wet season. Application of excessive inorganic fertilizers stimulates early vegetative growth leading to mutual shading. This mutual shading reduced the photosynthetic activity and thus resulted in an unfavorable N / carbohydrate balance and plant becomes succulent causing higher number of pest attack (Ito and Sakamoto, 1942) which supported the higher incidence of pests recorded in the present investigation. Higher incidence of pests observed in the inorganic fertilized treatments in the present study was supported by Prasad *et al*. (2004) who recorded highest incidence of leaf folder and yellow stem borer at 200 kg N ha^{-1}.

Table 1. Effect of tree leaf biomass on Green leaf hopper, Brown plant hopper, Rice bug, White head(%) and Leaf damage(%) of rice (cv. BR11)

Treatments	Green leaf hopper	Brown plant hopper	Rice bug	White head (%)	Leaf damage (%)
B_0 (Control) (RFD)	13.00 b-e	4.30	1.70	25.66 b	19.37 bc
B_1 (Raintree)	10.30 b-g	3.70	2.70	21.42 efg	17.36 cde
B_2 (Raintree +RFD)	14.30 ab	4.30	1.30	18.34 h	14.92 e
B_3 (Kalokoroi)	9.30 d-h	4.00	2.70	23.11 cde	22.20 a
B_4 (Kalokoroi+RFD)	11.30 b-f	3.30	1.30	20.60 fg	15.10 e
B_5 (Mahogoni)	11.30 b-f	4.30	2.00	25.11 bc	18.38 cd
B_6 (Mahogoni+RFD)	6.70 ghi	4.00	2.00	17.45 hi	14.85 e
B_7 (Eucalyptus)	13.30 bcd	4.70	2.70	22.77 def	21.79 ab
B_8 (Eucalyptus+RFD)	9.70 d-g	4.00	1.70	20.38 g	17.53 cde
B_9 (Ipil-ipil)	8.30 f-i	5.00	2.00	22.29 efg	17.62 cde
B_{10} (Ipil-ipil+RFD)	5.70 hi	3.30	1.70	14.52 j	19.89 f
B_{11} (Minjiri)	9.00 e-i	4.30	2.00	20.74 fg	14.93 e
B_{12} (Minjiri+RFD)	5.30 i	4.00	1.70	16.25 ij	9.31 f
B_{13} (Akashmoni)	14.00 abc	4.70	2.00	24.51 bcd	21.93 ab
B_{14} (Akashmoni+RFD)	14.30 ab	4.70	2.30	20.84 fg	16.27 de
B_{15} (10% low RFD)	10.00 c-g	5.30	1.70	25.44 b	18.08 cd
B_{16} (10% high RFD)	17.70 a	4.70	2.00	29.11 a	24.01 a
Level of significance	0.01	NS	NS	0.01	0.01

Effect of leaf biomass on yield and yield contributing components of rice

The study clearly indicated that the yield contributing characters was significantly influenced due to different treatments. The highest plant height (104.64 cm) was found in B_{10} and lowest plant height (88.47 cm) in B_{13}. Highest panicle length was observed in treatment B_{10} (24.16 cm) where the lowest in B_3 (18.02 cm). The treatment B_{12} produced highest number of effective tillers hill^{-1} (12.07) and filled spikelets panicle^{-1}

(115.54) where the treatment B_5 produced lowest number of effective tillers hill^{-1} (7.91) and filled spikelets panicle^{-1} (93.12). The maximum (5.58 t ha^{-1}) grain yield was recorded in the treatment B_{10} which was statistically similar with treatment B_{12}. On the other hand, the lowest grain yield was found in the treatment B_{13} (Table 2). Akter *et al*. (1993) reported that the application of green manure with chemical fertilizers produce significantly higher yield than the chemical fertilizer alone. The highest yield (5.58 t ha^{-1}) obtained in B_{10} (Ipil Ipil leaf biomass + recommended fertilizer dose) treatment is in agreement with that of Akter *et al*. (1993). Jeyaraman and Purushothaman (1988) also reported that 10 t ipil ipil green manure with 50 and 75 kg ha^{-1} N gave grain yields of 4.3 and 4.8 t ha^{-1}, respectively compared with 2.8 t with no N, 3.61 t with green manure alone and 4.3 t with 100 kg N ha^{-1}. Nahar *et al*. (1996) also observed that green manuring with *Leucaena leucocephala* produced highest yield of 4.36 t ha^{-1} whereas fertilized plots (100 kg N ha^{-1}) produced 4.12 t ha^{-1} grain yield of rice.

Table 2. Effect of tree leaf biomass on yield and yield contributing characters of rice (cv. BR11)

Treatments	Plant height (cm)	Panicle length (cm)	No. of effective tillers hill^{-1}	Filled spikelets / panicle	1000 grain weight (gm)	Yield (t ha^{-1})
B_0 (Control) (RFD)	96.45 def	21.24 c	9.25 efg	99.32 de	23.15	4.07 ef
B_1 (Raintree)	90.60 gh	19.66 ef	8.82 fghi	97.41 def	23.27	3.58 gh
B_2 (Raintree +RFD)	104.33 ab	22.82 b	11.19 b	110.85 b	23.52	4.86 bc
B_3 (Kalokoroi)	98.37 cde	18.02 h	8.67 hi	96.71 defg	23.45	3.52 h
B_4 (Kalokoroi+RFD)	101.16 abc	22.91 b	10.17 c	110.83 b	23.22	5.00 b
B_5 (Mahogoni)	91.68 gh	18.90 fgh	7.91 j	93.12 g	23.21	3.47 h
B_6 (Mahogoni+RFD)	99.87 bcd	23.30 ab	9.29 ef	105.33 c	23.42	4.68 cd
B_7 (Eucalyptus)	90.91gh	18.15 h	8.33 ij	93.40 g	23.57	3.47 h
B_8 (Eucalyptus+RFD)	101.17 abc	21.77 c	9.63 de	107.00 c	23.16	4.53 d
B_9 (Ipil-ipil)	93.37 fg	20.08 de	9.17 efgh	96.48 defg	23.42	3.71 gh
B_{10} (Ipil-ipil+RFD)	104.64 a	24.16 a	11.89 a	115.21 a	23.31	5.58 a
B_{11} (Minjiri)	96.22 def	20.89 cd	8.11 j	100.01 d	23.40	3.59 gh
B_{12} (Minjiri+RFD)	101.88 abc	23.16 ab	12.07 a	115.54 a	23.60	5.50 a
B_{13} (Akashmoni)	88.47 h	18.53 gh	8.08 j	94.22 fg	23.23	3.43 h
B_{14} (Akashmoni+RFD)	99.31cde	23.17 ab	10.22 c	107.48 bc	23.28	4.66 cd
B_{15} (10% low RFD)	95.05 efg	19.60 efg	8.71ghi	96.08 efg	23.36	3.82 fg
B_{16} (10% high RFD)	102.26 abc	21.32 c	9.84 cd	99.77 de	23.28	4.14 e
Level of significance	0.01	0.01	0.01	0.01	NS	0.01

In a column figure with the same letter (s) do not differ significantly as per DMRT.
NS= Not-significant and RFD= Recommended fertilizer dose

References

Akter, M. S., Hasan, M. K. S., Adhikery, R. C. and Chowdhury, M.K.1993. Integrated management of *Sesbania rostrata* and Urea- nitrogen in rice under a rice- rice cropping system. Ann. Bangladesh Agric. 3 (2): 189-114.

Alam, S., Karim, A. N. M. R., Alam, M. S. and Nurullah, C. M. 1993. Importance of rice pest control transferable to farmer's fields. In: Proc. Workshop on Experience with Modern Rice Cultivation in Bangladesh, BRRI, Gazipur. Pp. 106-116.

BBS (Bangladesh Bureau of Statistics), 2004. Monthly Statistical Bulletin, June, 2004. Stat. Div. Ministry of Planning, Govt. Peoples Republic of Bangladesh.

BRRI, 1985. Annual Report for 1984. Bangladesh Rice Research Institute, Joydebpur, Gazipur, Bangladesh.

BRRI, 1999. Modern rice cultivation (Bengali Bulletin), Bangladesh Rice Research Institute, Gazipur. p26.

FAO. 1988. Land Resources Appraisal of Bangladesh Agricultural Development, Report 2. Agro-ecological Region of Bangladesh. Pp. 212-221.

FAO (Food and Agricultural Organization). 1999. Yearbook Production. FAO Statistics Division. 53: 72- 73.

Gomez, K. A. and Gomez, A.A. 1984. Statistical Procedure for Agricultural Research Institute.. John voiley and Sons, New York, Chickester Brisbane, Torento, Singapore. Pp. 139-240.

Hurd, L. E., Mellinger, M. V., Wolf, L. L. and McNaughton, S. J. 1971. Stability and diversity in three trophic levels in terrestrial successional ecosystems. Science. 173: 1134-1136.

Ito, S. and Sakamoto, S. 1942. Studies on rice blast-Report for 1941. Ministry of Agricultural and Forestry, Tokyo.

Miah, S. A. and Karim, A. N. M. R. 1984. Rice pest management technology, In: Proc. Workshop on

Experience with Modern Rice Cultivation in Bangladesh, BRRI, Gazipur. Pp.43-49.

Nahar, K., Haider, J. and Kanim, A. J. M. S. 1996. Effect of organic and inorganic nitrogen sources on rice performance and soil properties. Bangladesh. J. Bot. 25 (1): 73-78.

Prasad, B. R., Raju, N. B. T., Pasalu, I. C. and Babu, T. R. 2004. Influence of nitrogen and rice varieties on insect population build up and extent of damage. Annal Plant Protect. Sci. 12 (1): 217-218.

Prestidge, R. A. 1982. The influence of nitrogen fertilizer on the grassland Auchenorrhyncha (Homoptera). J. Appl. Ecol. 19: 735-749.

Satter, M. A. 2002. Build up organic matter in soil for sustainable agriculture. In: Panorama. The Independent. October, 25. p 10.

Sedlacek, J. D., Barrett, G. W. and Shaw, D. R. 1988. Effects of nutrient enrichment on the Auchenorrhyncha (Hornoptera) in contrasting grassland communities. J. Appl. Ecol. 25: 537-550.

Siddique, A. K. M. T. 1992. An overview of the ETL of rice pests and IPM scope in the content of rice production. Proc. of the workshop on experiences with modern rice cultivation in Bangladesh. BRRI, Gazipur. Pp: 33-45.

Siemann, E. 1998. Experimental tests of the effects of plant productivity and plant diversity on grassland arthropod diversity. Ecology. 79: 2057-2070.

Surekha, K., Kumari, A. P. P., Reddy, M. N., Satyanarayana, K. and StaCruz P.C. 2003. Nutrient cycling in agroecosystem. 67(2): 145-154.