J. Agrofor. Environ. 4 (2): 85-88, 2010 ISSN 1995-6983

Effect of tree leaf litter on the yield and yield contributing characteristics of T. aman rice cv.BR11

T.A. Khan, S.S.R.M.M.A. Sorwar, M.A. Mondol and J.M. Mazumdar
Department of Agroforestry, Bangladesh Agricultural University, Mymensingh-2202, E-mail: tofayelsst@yahoo.com

Abstract: The experiment was conducted in the Agroforestry Field Laboratory, Bangladesh Agricultural University, Mymensingh during the period from July to November 2009 to find out the response of different leaf litter on yield of rice (cv. BR11). The experiment included 15 different treatments i.e. T_0 (recommended fertilizers only), T_1 (100g Arjun leaf biomass), T_2 (150g Arjun leaf biomass), T_3 (300g Arjun leaf biomass), T_4 (100g Neem leaf biomass), T_5 (150g Neem leaf biomass), T_6 (300g Neem leaf biomass), T_7 (100g Pitraj leaf biomass), T_8 (150g Pitraj leaf biomass), T_9 (300g Pitraj leaf biomass), T_{10} (100g Mahogany leaf biomass), T_{11} (150g Mahogany leaf biomass), T_{12} (300g Mahogany leaf biomass), T_{13} (100g Eucalyptus leaf biomass), T_{14} (150g Eucalyptus leaf biomass) and T_{15} (300g Eucalyptus leaf biomass) replicated three times following RCBD. Results showed that the Neem (300g Neem leaf biomass) treatment gave the highest grain yield and that of Arjun was the lowest. There was no significant effect on 1000 grain weight. The highest grain yield (5.66 t ha^1) was recorded in the treatment T_6 (300g Neem leaf biomass) followed by mahogany (second highest) treatment. Among the tree leaf biomass, Neem and Mahogany treatments were found the best. Thus it appears that tree leaf biomass could successfully be used as an alternative to chemical fertilizers.

Key words: leaf biomass, grain yield, leaf litter.

Introduction

Bangladesh is a densely populated agro-based country. Rice is the principal crop which is grown in all three crops growing seasons, occupying about 80 per cent of total cropped area (IRRI, 1990). It is the staple food for 60 per cent of the world population. For crop production, the presence of organic matter in soil is important. A good soil should have an organic matter content of more than 3.5 per cent. But in Bangladesh, most of the soils have less than 1.7 per cent and some soils have even less than 1 per cent organic matter (Sattar, 2002). Now, it is well agreed that depleted soil fertility is a major constraints for higher crop production in Bangladesh and indeed, yield of several crops are declining in most soils (Bhuiyan, 1991).

Organic matter is called the life of the soil and plays an important role for sustainable soil fertility and crop productivity. It plays vital role to improve physical, chemical and biological properties of the soils and ultimately enhance the crop production. The greatest benefit from cycling and recycling of organic matter in soils is the overall improvement in soil environment. Organic matter acts as a reservoir of plant nutrients especially N, P, K and S and prevents leaching of the nutrients. Organic matter of Bangladesh soils is decreasing day by day. The ever decreasing organic matter content in our soils causes nutrient imbalance including micronutrient deficiency. Different tree leaf biomasses such as Arjun, Neem, Pitraj, Mahogany and Eucalyptus are the good sources of organic matter and can play a vital role in soil fertility improvement as well as supplying nutrients especially N, P, K and S. Tree leaf litter is a very important organic source of soil fertility improvement. The decomposition of leaf litters influence the amount of N availability for plant uptake. Leaf litter supplies the carbon, nitrogen, phosphorus, potassium and other nutrients in soil that are further considered as important indicators of soil productivity and the ecosystem health. Moreover, this leaf litter has been wastage by several ways. So, if we can utilize these materials as a source of organic matter for rice cultivation, then we can reduce the considerable amount of chemical fertilizer like urea.

Nutrient release in leaf litter decomposition is an important process in nutrient flux in an agroforestry system. Nutrients may be released from leaf litter by leaching or mineralization (Swift *et al*. 1979). Leaf litter plays a fundamental role in the nutrient turnover and in the transfer of energy between plants and soil, the source of the nutrient being accumulated in the upper most layers of the soil (Singh, 1978). Plant litter produced during senescence processes and plant residues left on site after harvest operations are the primary substrate for heterotrophic respiration in plant-soil ecosystems. Substrate quality, together with the physico-chemical environment and the decomposer community, is one of the three interacting factors regulating the rate of decomposition (Swift *et al*. 1979).

Nutrients like N, P and K are the key element for crop production. Among these nitrogen is most essential for crop specially rice. But it is costly item when it is derived from artificial sources. Green manuring with *Sesbania rostrata* can save a substantial amount of nitrogen. It has been reported that in rice production green manuring with *Sesbania rostrata* could save nearly 80 per cent of applied nitrogen (Bhuiyan, 1984; Rabindra *et al*. 1989; Thangaraju and Kannaaiyan, 1990). Another results showed that upland rice production with four N fixing tree species, rice yield was best with *Gliricidia sepium* followed by *Leucaena leucocephala, Cajanus cajan* and *Cassia siamea* (Rathert and Werasopon, 1992). Alley cropped with *Cassia siamea, Gliricidia sepium* and *Flemingia macrophylla*, the yield of maize were increased at an acceptable level; it also add nitrogen in the soil (Yamoah *et al*. 1986 b).

In the light of the above, the present piece of work was undertaken to observe the effect of tree leaf litter on the yield and yield contributing characteristics of T. aman rice cv.BR11.

Materials and Methods

The research was conducted at the Agroforestry Farm, Department of Agroforestry, Bangladesh Agricultural University, Mymensingh during July-November, 2009. The land is situated on agro-ecological zone of the Old Brahmaputra Floodplain (No. 9) and it characterized by non-calcareous soil dark grey floodplain parent material old brahmaputra river borne deposits, the land is moderately well drained with a silt loam texture. The relief of the land is flat and above flood level and sufficient sunshine is available throughout the experiment period. The p^H value of experimental soil ranged from 6.5 to 6.8. Rice cv. BR11 (Mukta), a modern variety of rice, was used as the test crop in this experiment. The variety was released from Bangladesh Rice Research Institute (BRRI) the cross between IR20 (IR532-E-576) and IR5 (IR5-47-2) rice. It grows well all over Bangladesh in aman season. BR11 prefers sandy loam to clay loam soil. Total growth duration of this variety ranges from 140 days from sowing to harvesting. It gives an average yield of 5.5 to 6.5 t ha^{-1} under proper management (BRRI, 1991). The experiment was conducted in a Randomized Complete Block Design (RCBD) with three replications. There were sixteen treatments. Each block was subdivided into sixteen unit plots. The treatments were randomly distributed to the unit plots in each block. The total numbers of plots were 48. The unit plot size was 1m x Im. The spacing between blocks was 100 cm and the plots were separated from each other by 40 cm space. Tree leaf biomasses like Arjun (*Terminalia arjuna*), Neem (*Azadirachta indica*), Pitraj (*Aphanamixis polystachya*), Mahogany (*Swietenia macrophylla*) and Eucalyptus (*Eucalyptus camaldulensis*) leaf biomasses were collected from the, Neem, Arjun, Pitraj, Eucalyptus and mahogany trees of Bangladesh Agricultural University Campus, Mymensingh. These leaf biomasses were chopped by hand and mixed uniformly with soil during final land preparation and then left to decompose for ten days. Fertilizers were applied in the controlled plot according to the recommended dose doses (Kg ha^{-1}): Urea; 180, TSP; 90, MOP; 40, Gypsum; 60, Zinc Sulphate; 10 (BRRI, 1999). The whole amount of various tree leaf biomasses such as Arjun, Neem, Pitraj, Mahogany and Eucalyptus leaves were incorporated in experimental plots before 15 days of final land preparation. Recommended dose of all fertilizers except urea were applied in control plots during final land preparation. Urea was applied top dressing in three equal installments i.e.15, 30 and 50 days after transplanting (DAT). Forty (40) days old seedlings of cv.BR11 seedlings were transplanted on 29 July 2009 with a hill to hill and line to line distance of 15 cm x 20 cm. Two or three healthy seedlings per hill were transplanted in all the plots. Necessary gap filling was done within 10 days of transplanting. Weeds were controlled by uprooting and removing from the field. Furadan (5G) was applied once with urea fertilizer during second installment of top dressing to control insect pests of rice. Crop was grown under rain fed condition. Prior to each top dressing, plots were weeding manually. The rice plants were harvested on 30 November 2009. The crop was harvested at its full maturity. The grain and straw were separated by hand threshing and plot wise weight of grain and straw were recorded in kg $plot^{-1}$. The grain and straw yields were expressed as t ha^{-1}. The weight of grains were recorded by an electrical balance and adjusted to 14% moisture level and expressed as t ha^{-1}. The data collected throughout the period of the experiment were computed and analyzed following the appropriate design of the experiment. The mean results were compared by Duncan's Multiple Range Test (DMRT) and ranking was indicated by letters (Zaman *et al.* 1982).

Results and Discussion

Effect of different leaf biomass along with recommended fertilizer levels was investigated on yield and yield contributing components of rice (cv. BR11).

Table 1. Effect of tree leaf biomass on Plant height, Panicle length, number of effective tillers $hill^{-1}$ of rice cv.BR11

Treatment	Plant height (cm)	Panicle length (cm)	No. of effective tillers $hill^{-1}$
T_0	96.57 def	20.94 e	9.26 efg
T_1	87.39 h	18.36 gh	8.29 j
T_2	90.31 gh	18.25 h	8.30 ij
T_3	91.49 gh	18.61 fgh	7.87 j
T_4	102.49abc	21.11 c	9.80 cd
T_5	103.84 ab	22.78 b	11.46 b
T_6	104.19 a	24.33 a	11.97 a
T_7	94.39 fg	20.19 de	9.26 efgh
T_8	95.51 efg	19.19 efg	8.55 ghi
T_9	97.09 def	20.89 cd	8.22 j
T_{10}	101.07 abc	22.82 b	10.09 c
T_{11}	101.66 abc	21.59 c	9.51 de
T_{12}	101.56 abc	23.36 ab	12.12 a
T_{13}	98.62 cde	18.13 h	8.49 hi
T_{14}	98.21 cde	23.21 ab	10.03 c
T_{15}	99.59 bcd	23.32 ab	9.78 ef
Level of significance	**	**	**
CV (%)	4.46	5.68	3.22

In a column figure with the same letter do not differ significantly (as per DMRT), ** = Significant at P < 1% level of probability; (150g Neem leaf litter), T_6 (300g Neem leaf litter), T_7 (100g Pitraj leaf litter), T_8 (150g Pitraj leaf litter), T_9 (300g Pitraj leaf litter), T_{10} (100g Mahogany leaf litter), T_{11} (150g Mahogany leaf litter), T_{12} (300g Mahogany leaf litter), T_{13} (100g Eucalyptus leaf litter), T_{14} (150g Eucalyptus leaf litter), and T_{15} (300g Eucalyptus leaf litter).

Table2. Effect of tree leaf litter on numbers of grains panicle^{-1}, 1000 grain weight, yield of rice cv. BR11

Treatment	Numbers of Grains panicle^{-1}	1000 grain weight (gm)	Yield (t ha^{-1})
T_0	98.32 de	23.15	4.13 ef
T_1	93.851 fg	23.23	3.55 h
T_2	93.30 g	23.27	3.44 h
T_3	93.17 g	23.21	3.47 h
T_4	99.87 de	23.29	4.19 e
T_5	109.62 b	23.39	4.91 bc
T_6	115.29 a	23.40	5.66 a
T_7	96.59 defg	23.21	3.63 gh
T_8	96.26 efg	23.39	3.94 fg
T_9	100.04 d	23.29	3.46 gh
T_{10}	110.83 b	23.31	5.03 b
T_{11}	106.09 c	23.28	4.59 d
T_{12}	115.27 a	23.51	5.51 a
T_{13}	96.89 defg	23.44	3.53 h
T_{14}	108.51 bc	23.19	4.66 cd
T_{15}	105.29c	23.43	4.63 cd
Level of significance	**	NS	**
CV (%)	11.03	0.91	3.89

n a column figure with the same letter do not differ significantly (as per DMRT), ** = Significant at P < 1% level of probability; T_0 (recommended fertilizers only), T_1 (100g Arjun leaf litter), T_2 (150g Arjun leaf litter), T_3 (300g Arjun leaf litter), T_4 (100g Neem leaf litter), T_5 (150g Neem leaf litter), T_6 (300g Neem leaf litter), T_7 (100g Pitraj leaf litter), T_8 (150g Pitraj leaf litter), T_9 (300g Pitraj leaf litter), T_{10} (100g Mahogany leaf litter), T_{11} (150g Mahogany leaf litter), T_{12} (300g Mahogany leaf litter), T_{13} (100g Eucalyptus leaf litter), T_{14} (150g Eucalyptus leaf litter), and T_{15} (300g Eucalyptus leaf litter).

During the experimental period different leaf biomass with recommended fertilizer doses showed significant effect on yield and yield contributing components. It was found that leaf biomass and fertilizer combination had no significant effect on 1000-grain weight. However, the treatments had marked influence on plant height, panicle length, total number of effective tillers hill^{-1}, grains panicle^{-1} and grain yield. The highest plant height (104.19 cm), panicle length (24.33 cm) and total number of effective tillers hill^{-1} (12.12) was observed in the treatment T_6 (300g Neem leaf biomass) which was statistically identical with T_{12} (300g mahogany leaf biomass) treatment (Table 1). These results also in agreement with that of Apostol (1989) who reported that organic and inorganic fertilizer increased the productive tillers per hill of rice. The total number grain panicle^{-1} was also highest (115.27) in treatment T_{12} (300g mahogany leaf biomass) but statistically similar with T_6 (300g Neem leaf biomass). The lowest number of grain panicie^{-1} (93.17) was observed in T_3 (300g Arjun leaf biomass). Similarly, Akter *et al.* (1993) reported that the application of green manure with chemical fertilizer was found to produce significantly higher yield parameters than with chemical fertilizer only.

The number of grains panicle^{-1} of rice cv. BR11 was significantly influenced by the different treatments. Table 2 showed that the grains panicle^{-1} ranged from 93.17 to 115.29 and the highest number (115.29) was obtained in the treatment T_6. The treatment of T_{12} was produced the second highest grains panicle^{-1}. The lowest number (93.17) of grains panicle^{-1} was obtained in the treatment T_3 which was statistically similar with T_1 T_2 and T_{13}. In control plot number of grain panicle^{-1} was 98.32. Weight of 1000 grains showed that was not significantly influenced by the different treatments (Table 2). The highest weight of 1000 grains (23.51g) was obtained in treatment T_{12} and the second highest was obtained from the treatment of T_{13} (23.44g). The lowest weight of 1000 grains (23.19g) was observed in the treatment T_{14}. In control plot T_0 weight of 1000 grains was recorded 23.15g. The effect of tree leaf biomass on the grain yield, of rice (cv. BR11) was revealed a significant variation due to the different treatments. Grain yield varied from 3.44 t ha^{-1} to 5.66 t ha^{-1}.

The highest yield (5.66 t ha^{-1}) was obtained from T_6 (300g Neem leaf biomass) treatment which was statistically similar with T_{12} (300g mahogany leaf biomass) treatment, almost similar results were reported by Jeyaraman and Purushothaman (1988). They mentioned that 10 t Ipil-ipil green manure combined 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} which was also similar with Zoysa *et al.* 1990 and Nahar *et al.* 1996.

From the overall result of the present study, it can be concluded that the combination of different leaf biomass with recommended fertilizer dose maximizing the rice yield and 300g Neem leaf biomass and 300g Mahogany leaf biomass were found the best.

References

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

Apostol, E. D. F. 1989. Influence of mirasol organic and x-rice liquid fertilizer in combination with inorganic fertilizer on IR66 and BPIR12 rice varieties. Malabeu, Metro, Manila, Phillipines. P. 73.

BBS (Bangladesh Bureau of Statistics), 2007. The year book of Agricultural statistics of Bangladesh. Stat. Div. Minis. Planning, Govt. Peoples Rep. Bangladesh, Dhaka. pp.136.

Bhuiyan, N. I. 1991. Integrated nutrient management for suitable rice based cropping system. In: Proc. Workshop on experiences with modern rice cultivation. BARC, Dhaka. pp. 94-109.

Bhuiyan, S. I. 1984. Trip Report. BRRI-BWDB-IRRI collaborative research project on irrigation and water management in Bangladesh. pp. 1-11.

BRRI (Bangladesh Rice Research Institute). 1991. Adhunic Dhaner Chash 6th (revised) Edn. Booklet. No. 5. BRRI, Joydebpur, Gazipur. Rice Abst. 18 (4): 278.

IRRI, 1990. Standard Evaluation system for Rice. Internationnal Rice Research Institute, Laguna, Philippines. pp. 48.

Nahar, K., Haider, J. and Karim, 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.

Rabindra, B., Naidu, B. S., Devi, T. G. and Gowda, N. S. 1989. *Sesbania rostrata* a lower cost source of N for rice. Int. Rice Res. Newsl. 14 (2): 29.

Rathert, G. and Werasopon, O. 1992. Nutrient value of nitrogen fixing tree species for upland rice in Thailand. Nitrogen Fixing Tree Research Reports. pp. 81-84.

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

Singh, K. P. 1978. Litter production and nutrient turnover in deciduous forest of Varanasi, Trop. Ecol. 47: 655-665.

Swift, M. J., Heal, O. W. and Anderson, J. M. 1979. Decomposition in terrestrial ecosystems. University of California, USA. p. 372.

Thangaraju, M. and Kannaaiyan, S. 1990. Influence of Azolla, Sesbania and urea super granule on rice yield and nitrogen uptake. Rice Res. Newsl. 15 (1): 4.

Yamoah, C. F., Agboola, A. A. and Wilson, G. F. 1986b. Nutrient competition and maize performance in alley cropping systems. Agrof. Sys. 4: 247254.

Zaman, S. M. S., Rahim, K. and Howlader, M. 1982. Simple Lessons from Biometry. Bangladesh Rice Research Institute. Publication No. 54. p. 88

Zoysa, A. K. N., Keerthisinghe, G. and Upasena, S. H. 1990. Effect of *Leucaena leucocephala* (Aum.) dewit as green manure on nitrogen uptake and yield of rice. Biol. Fert. Soil. 9 (1): 68-72.