J. Agrofor. Environ. 2(1): 1-6, 2008 ISSN 1995-6983

Time of application of teak leaf litter and its effect on boro rice

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Abstract: A field experiment was conducted at Agronomy Field Laboratory, Department of Agronomy, Bangladesh Agricultural University, Mymensingh in the Boro season of 2008 in order to evaluate the time of application of teak leaf litter and its effects on bror rice. The experiment was conducted in a randomized complete block design with four replications. Five treatments viz. recommended fertilizer dose (RFD), teak leaf incorporated in the soil before 21 days of transplanting, teak leaf incorporated in the soil before 15 days of transplanting, teak leaf incorporated in the soil before 7 days of transplanting and teak leaf incorporated in the soil at the day of transplanting. The results indicated that different treatments significantly influenced the yield and yield contributing characters viz. plant height, total tillers hill^{-1}, effective tillers hill^{-1}, panicle length, number of grains panicle^{-1}, grain and straw yield, biological yield and harvest index of rice. Highest grain yield (5.24 t ha^{-1}) was recorded in RFD followed by leaf litter incorporated before 21 days (4.99 t ha^{-1}), 15 days (4.77 t ha^{-1}), 7 days (4.68 t ha^{-1}) of transplantation and at the day of transplantation (4.49 t ha^{-1}), respectively. Post harvest soil analysis showed that tree leaf litter release a significant amount of N, P, K and S. The organic matter of the post harvest soil increased considerably due to treatments as compared to initial soil.

Key words: Teak, leaf litter, Boro rice, BRRI dhan28

Introduction

Rice is cultivated primarily for the grain which forms an important part of the diet in many countries, especially in Asia. Rice is now cultivated in many localities throughout the world with favorable climatic conditions. More than 90% of the world rice produced is in Asia; while China and India being the largest producers (Reed, 1976). The demand for rice is constantly rising in Bangladesh with nearly 2.3 million people being added each year to its population of about 140 million.

Organic matter is an essential component of soils because it provides a carbon and energy source for soil microbes. Soil organic matter also improves tilth in the surface horizons, reduces crusting, increase the rate of water infiltration, reduces runoff and facilitates penetration of plant roots. Bio-fertilizer is used to improve the fertility of the land using biological wastes; hence the term bio-fertilizers, and biological wastes, do not contain any chemicals which are detrimental to the living soil. They are extremely beneficial in enriching the soil with those micro-organisms which produce organic nutrients for the soil and help combat diseases. So bio-fertilizer play an important role to improve soil fertility, suppress pathogenic soil organisms, degrade toxic organic chemicals, improve soil porosity, drainage and aeration, reduce compaction, improve the water holding capacity of soil, promote break up unproductive soil, increase the protein and mineral content of most crops. Aid in balancing soil pH, reducing soil erosion improves oxygen assimilation in plants.

Decomposition of tree leaf litter is an integral and significant part of biochemical nutrient cycling and food webs of floodplain agroforestry system. Decomposition refers to both the physical and chemical breakdown of litter and the mineralization of nutrients within leaf litter are converted into available form for uptake by vegetation and thereby exercising a critical control on vegetation productivity (Mitch and Gosselink, 1993; Groffman *et al*., 1996).

The fertility of the soil of our country is decreasing day by day because of vigorous use of chemical fertilizer. Organic fertilizer can play a vital role to overcome this problem. Teak, a native species of Southeast Asia, is one of the most widely introduced exotics in tropical countries. Present study is undertaken to observe the effect of time of incorporation of teak leaf litter on yield and yield contributing characters of rice and health status of post harvest soil.

Materials and Methods

The experiment was conducted at the Agronomy Farm, Department of Agronomy, Bangladesh Agricultural University, Mymensingh during January to May 2008. The experiment was conducted in Randomized Complete Block Design (RCBD) with four replications. There are five treatments viz. T_0 = recommended fertilizer dose, T_1 = teak leaf incorporated before 21 days of transplanting, T_2 = teak leaf incorporated before 15 days of transplanting, T_3 = teak leaf incorporated before 7 days of transplanting, T_4 = teak leaf added to the soil at the day of transplanting. Plant height, no. of total tillers hill^{-1}, no. of effective tillers hill^{-1}, no. of non effective tillers hill^{-1}, number of grains panicle^{-1}, 1000 grains weight, grain, straw yield, biological yield and harvest index etc. were recorded from each plot and converted as tha^{-1}. Soil pH, total nitrogen, available P, exchangeable K, and available S was determined using standard laboratory method for each. Data were analyzed using a computer package programme MSTAT-C, and mean differences were adjudged by Duncan's Multiple Range Test.

Results

Plant height: N, P, K, S level influenced plant height significantly at all treatments of different time interval (Table 1). After harvest tallest plant (79.38 cm) was recorded under recommended fertilizer dose and the

second highest plant (77.63 cm) was produced in T_1 followed by T_2 (75.75 cm), T_3 (74.00 cm) and T_4 (71.50 cm) treatments, respectively.

Total tillers hill^{-1}: Total numbers of tillers hill^{-1} was significantly influenced by different time interval incorporation (Table 1). The highest number of tillers hill^{-1} (11.75) was obtained from recommended dose applied and gradually decreased as order of T_2 (9.75), T_3 (8.25) and T_4 (7.00) treatments, respectively. **Effective tillers hill^{-1}**: Treatments had significant effect on the production of effective tillers hill^{-1}. The highest number of affective tillers hill^{-1} (10.00) was obtained from RFD and in other treatments i. e, T_1 T_2 T_3 and T_4 number of effective tillers hill-1 were 8.25, 7.25, 6.50, 5.50, respectively (Table 1).

Non-effective tillers hill^{-1}: The effect of different time after interval application of leaf litter was not significant on the production of non-effective tiller hill^{-1}. The highest production of non-effective tiller in control plot, 15 days before, and 7 days before and the lowest in 21 days before and at the day of transplanting (Table 1).

Panicle length (cm): The panicle length of rice was influenced significantly by the incorporation of the leaf litter. The panicle length varied from 19.21 to 21.15 cm due to different treatments. Highest panicle length was found in RFD (21.15 cm) and among the different time of application highest panicle length (20.47 cm) was found in the treatment of 21 days before which was statistically similar with 15 days before. The lowest panicle length recorded in at the days of transplanting (Table 1).

Table 1. Effect of time of application of teak leaf litter on morphological characters of rice

Treatments	Plant height (cm)	Total tillers hill-1 (no.)	Effective tillers hill-1 (no.)	Non-effective tillers hill-1 (no.)	Panicle length (cm)	Grain/ panicle
T_0	79.38a	11.75a	10.00a	1.75	21.15a	68.38a
T_1	77.63b	9.75b	8.25b	1.50	20.47b	66.55b
T_2	75.75c	9.00bc	7.25bc	1.75	20.00c	65.95b
T_3	74.00d	8.25c	6.50cd	1.75	19.40d	65.22bc
T_4	71.50e	7.00d	5.50d	1.50	19.21d	64.31c
Level of significant	**	**	**	NS	**	**
CV (%)	1.24	5.37	8.86	38.73	1.07	1.36

In a column figures having the same letter(s) do not differ significantly,**Significant at 1% level of probability, CV = Coefficient of Variation, NS = Not significant

Grain panicle^{-1}: Time of application of teak leaf litter significantly influenced the number of grains panicle^{-1}. The highest number of grains panicle^{-1} (68.38) was obtained from control plot. The lowest number of grains panicle^{-1} (19.21) observed from at the days of transplanting. The second highest was recorded from before 21 days (66.55). Where total number of grains panicle^{-1} obtained from 15 days before and 7 days before was statistically similar (Table 1).

Yield

Grain yield: Time of application of teak leaf litter had significant effect on grain yield of rice. The highest grain yield (4.24 t/ha) was obtained from RFD and the lowest grain yield (3.49 t/ha) from at the days of transplanting. Second highest grain yield (3.99 t/ha) was recorded from T_1 and another two treatments was statically similar (Table 2).

Straw yield: The straw yield was markedly influenced by the application of tree leaf litter in different time after interval (Table 2). The highest straw yield (7.89 t/ha) obtained from control plot. Among three leaf litter which was applied in different time interval the highest return (7.60 t/ha) from before 21 days and 2nd highest (7.22 t/ha) from 15 days before and another (7 days before, at the days transplanting) treatment showed statistically similar effect.

Biological yield: The biological yield was affected by the incorporation of leaf litter on different time after interval. The highest biological yield was found 12.13 t/ha in control plot and the lowest yield 9.82 t/ha was found at the day of transplanting (Table 2).

Harvest index: Here the experiment showed non-significant effect (Table 2). Harvest index obtained from the different treatments varied from 34.30-35.54% where highest Harvest index found at the day of transplanting (35.54%). And the lowest was (34.30%) found before 15 days of transplanting.

Table 2. Effect of time of application of teak leaf litter on yield contributing characters of rice

Treatments	1000-grain weight (gm)	Grain yield (t/ha)	Straw yield (t/ha)	Biological yield	Harvest index
T_0	23.30	5.24a	6.89a	12.13a	34.95
T_1	23.42	4.99b	6.60a	11.59b	34.43
T_2	23.30	4.77c	6.22b	10.99c	34.30
T_3	23.46	4.68c	5.83c	10.51d	35.01
T_4	23.55	4.49d	5.32d	9.82e	35.54
Level of significant	NS	***	**	**	NS
CV (%)	1.23	2.94	3.05	2.38	2.48

In a column figures having the same letter(s) do not differ significantly,**Significant at 1% level of probability, CV = Coefficient of Variation, NS = Not significant

Nutrient status of soil after harvesting of rice

pH: The pH level of different soils influenced due to different treatments. Results showed that there was a significant change in soil P^H due to different treatments compared to initial value. Initial soil P^H was 6.9 and due to application of leaf litter and fertilizer it changed from 7.0 to 7.9 pH (Table 3).

Total nitrogen: The N content in the soil was significantly improved. After harvesting of rice, total N content varied from 0.069to 160% where the initial soil sample bears 0.067%. The treatment of before 21 days showed the highest total N content (0.160%) and the lowest found in treatment where recommended fertilizer dose was used. The treatment of before 15 days was found the 2^{nd} heighest total N content (0.157%) which was statistically similar with the treatments of before 7 days and at the day of transplanting. In initial soil sample total nitrogen content was 0.067% (Table 3).

Available phosphorus: In this experiment the available P was significantly influenced due to the different treatments (Table 3). After harvesting of rice available P was found in 21 days before treatment which was released 4.73 ppm, 3.95 and 3.66 ppm found in 15 days before and 7 days before treatments. The lowest amount found in at the days of transplanting where the initial soil sample had 2.44 ppm P. Available P found in initial soil sample was 2.44 ppm .

Exchangeable potassium: It was found an increased rate of potassium content in soil where the teak leaf litter incorporated (Table 3). Exchangeable K in post harvest soils range from 0.181 to 0.278 me/100 g. The treatment of before 21 days was the highest exchangeable K 0.278 me/100 g which was statistically similar with before 15 days and 7 days. The recommended fertilizer dose was found the lowest exchangeable K (0.181 me/100g). It was 0.149 me/100 exchangeable potassium found in initial soil sample.

Available sulphur: Just before the incorporation of teak leaf litter in soil the sulphur status of soil was 4.44 ppm and after harvesting of rice it was found a significant influence of applying leaf litter. Highest 11.47 ppm S was found in T_1 which was statistically similar T_2 and T_3 treatment (Table 3).

Discussion

The leaf litter showed a significant positive effect in soil. Total N, available P, exchangeable K and available S was higher in the post harvest soil than initial status. Guan (1989) found that the available N and P content in soil sample taken from experimental plots with the application of organic material were significantly higher than recommended chemical fertilizer application. These results also in agreement with that of Maharudrappa *et al.* (2000) where litter application enhanced nutrient availability and rate of decomposition of leaf litter was as order of *Tectona grandis* > *Acacia auriculiformis* > *Eucalyptus hybrids* > *Casuarina equisetifolia.*

Time of application of teak leaf litter had significant effect on rice yield as well as positive residual effects on soil. Though highest yield obtained by using recommended fertilizer but it was only 5, 9, 11 and 14% higher than T_1, T_2, T_3 and T_4 treatments, respectively. In the recommended fertilizers treatment gave the best performance but residual effect in soil is

negative and also decreases the future productivity of soil. In contrast, using the teak leaf litter as organic manure produce similar grain yield (only 5-14% yield reduce) with RFD but it results a positive effects on soil as residual effect. These indicate teak leaf litter can be used as organic fertilizer instead of chemical fertilizer and application of leaf litter before transplantation is the better option than application during transplantation.

Table 3. Properties of post harvest soil as affected by different treatments and initial soil sample

Treatments	Total N (%)	Available P (ppm)	Exchangeable K (me/100g)	Available S (ppm)	pH
T_0	0.069	2.68	0.181	5.126	7.9
T_1	0.160	4.73	0.278	11.47	7.8
T_2	0.157	3.95	0.271	10.417	7.5
T_3	0.151	3.66	0.254	10.131	7.2
T_4	0.129	2.67	0.198	8.417	7.0
Initial soil sample	0.067	2.44	0.149	4.444	6.9

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