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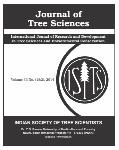

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Effect of Teak Leaf Litter Addition on Nitrogen Mineralization in Soil During Litter Decomposition Under *Abelmoschus moschatus*

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ABSTRACT

The field investigation was conducted in the year 2016-17 at Agroforestry Research Farm, College of Agriculture, Nagpur. The experiment was laid out in Randomized Block Design (RBD) with ten treatments consisting of various levels of teak leaf litter combined with cow dung and bio-decomposer which were replicated thrice. Application of teak leaf litter @ 5 t ha^{-1} + cow dung slurry @ 50% of teak leaf litter + bio – decomposer during 30, 60 and 90 DAS recorded maximum NH_4N : 35.08 mg Kg^{-1}, 51.07 mg Kg^{-1}, 43.72 mg Kg^{-1} and NO_3N : 24.59 mg Kg^{-1}, 35.81 mg Kg^{-1}, 23.10 mg Kg^{-1} respectively.

Key Words:

Abelmoschus moschatus, Cow Dung, Nitrogen mineralization, Teak Leaf Litter

INTRODUCTION

Leaf litter is an important component of tree cropping system. This is because it builds up the forest floor and creates a layer of nutrient and litter on the soil. It is a major source of soil organic matter as it returns nutrients back to the soil through nutrient recycling. It reduces nutrient loss through leaching and erosion. It is well established that litter decomposition is positively associated with soil and litter nutrient concentrations (Wood et al. 2006). Litter fall is a fundamental process in nutrient cycling and it is the main means of transfer of organic matter and mineral elements from vegetation to the soil surface (Regina et al. 1999). Plant litter decomposition is the process of biological disintegration of litter during which mineralization of complex organic compounds into simple inorganic forms. It includes leaching, break up by fauna, transformation of organic matter by micro organisms and transfer of organic and mineral compounds to the soil (Loranger et al. 2002). Teak (*Tectona grandis*) trees affect soil properties through several pathways. These trees alter inputs to the soil system by increasing capture of wet fall and dry fall and by adding to soil nitrogen via nitrogen mineralization. The present study was conducted to study the effect of teak leaf litter addition on nitrogen mineralization in soil during litter decomposition.

MATERIAL AND METHODS

The field investigation on effect of teak leaf litter addition on nitrogen mineralization in soil was conducted in the year 2016-17 at Agroforestry Research Farm, College of Agriculture, Nagpur. The experiment was laid out in Randomized Block Design (RBD) and the treatments were replicated thrice. The ten treatments consist of various levels of teak leaf litter combined with cow dung and bio-decomposer. The experimental site where experiment was conducted is a teak plantation of year 1991. The teak was planted at 2 m distance (tree to tree) and 12 m row to row spacing. Teak leaf litter required for the experiment was obtained from teak plantation of Agroforestry research farm. During late winter *i.e.* in the month of February litter fall of teak starts. The teak leaf litter was collected from surface and was dumped in pit where it was crushed. The teak leaf litter samples were then analyzed for nutrient content. From the result it was observed that C:N ratio of teak leaf litter is 30.40 which is narrower. Anonymus (2011) concluded that, understanding C:N ratios of crop residues and other material applied to the soil is important to manage soil cover and crop nutrient recycling, providing quality habitat for soil micro organisms.

The soil under experimental area is light textured soil with good drainage. In order to study the nitrogen mineralization soil samples up to 0-15 cm depth were collected at 30, 60 and 90 DAS (Days after sowing) of *Abelmoschus moschatus*. Standard procedures were applied for analysis of soil samples.

Nitrogen mineralization (ammonical and nitrate –N) was estimated by the method described by Page (1982). The samples from the incubation flask was taken out after every 30 days of incubation for determination of N mineralization of crop residues. The samples were air dried and extracted with 2% KCl and these samples were distilled with MgO with boric acid indicator taken in beaker. The distillate was titrated for ammonical nitrogen with 0.005 N H_2SO_4. The stopper of round bottom flask was removed and Devarda's alloy was added in the flask and steam was released and distillate was collected in another beaker with boric acid indicator. Again that distillate was treated with 0.005 N H_2SO_4 and from that value nitrate nitrogen was estimated.

RESULT AND DISCUSSION

Addition of organic matter influence considerably the rate of decomposition as well as consequent chemical changes brought in soil. Organic C, N and P are major constituents of soil organic matter and need to be managed to reverse the trends of nearly a century of cultivation. Major portion of these nutrients are present in unavailable form which further becomes available to plants for their nutrition by certain microbial activities. There was positive impact of teak leaf litter on N mineralization in soil. At 30 days after sowing of *Abelmoschus moschatus* mineralization of ammonical nitrogen ranged from 31.80 mg kg^{-1} to 35.08 mg kg^{-1} and mineralization of nitrate nitrogen ranged from 22.50 mg kg^{-1} to 24.59 mg kg^{-1}. While at 60 days after sowing of *Abelmoschus moschatus* mineralization of ammonical nitrogen ranged from 46.31 mg kg^{-1} to 51.07 mg kg^{-1} and that of nitrate nitrogen ranged from 32.77 mg kg^{-1} to 35.81 mg kg^{-1}. Whereas, at 90 days after sowing of *Abelmoschus moschatus* mineralization of ammonical nitrogen ranged from 39.63 mg kg^{-1} to 43.72 mg kg^{-1} and mineralization of nitrate nitrogen ranged from 21.13 mg kg^{-1} to 23.10 mg kg^{1}. Treatment T_7 recorded higher value of ammonical nitrogen and nitrate nitrogen with application of teak leaf litter @ 5 t ha^{-1} + cow dung slurry @ 50% of teak leaf litter + bio – decomposer during 30, and 90 DAS

Nitrogen mineralization at 30 DAS

The data pertaining to mineralization of N at 30 day after sowing of *Abelmoschus moschatus* is presented in table 1 and depicted in fig. 1.There was positive impact of teak leaf litter on N mineralization in soil. Treatment T_7 recorded higher value of ammonical nitrogen and nitrate nitrogen with application of teak leaf litter @ 5 t ha^{-1} + cow dung slurry @ 50% of teak leaf litter + bio – decomposer (35.08 mg kg^{-1} NH_4-N and 24.59 mg kg^{-1} NO_3-N). While treatment T_8 recorded second next higher value of ammonical nitrogen (34.98 mg kg^{-1}) and nitrate nitrogen (24.30 mg kg^{-1}) with the application of teak leaf litter @ 5 t ha^{-1} + cow dung slurry @ 50% of teak leaf litter. Treatment T_6, T_8 and T_9found at par with treatment T_7 regarding formation of ammonical nitrogen. While treatment T_8, T_9 and T_{10}found at par with T_7 for nitrate nitrogen.

Table 1. Effect of teak leaf litter addition on Nitrogen mineralization (mg kg^{-1}) in soil at 30 DAS

	Treatments	NH_4 N	NO_3 N
T_1	Absolute control	31.80	22.50
T_2	Teak leaf litter @ 2.5 t ha^{-1}	33.12	23.40
T_3	Teak leaf litter @ 5 t ha^{-1}	33.60	23.11
T_4	Teak leaf litter @ 7.5 t ha^{-1}	33.92	23.56
T_5	Teak leaf litter @ 2.5 t ha^{-1} + cow dung slurry @ 50% of teak leaf litter + bio-decomposer	34.04	23.04
T_6	Teak leaf litter @ 2.5 t ha^{-1} + cow dung slurry @ 50% of teak leaf litter	34.50	22.35
T_7	Teak leaf litter @ 5 t ha^{-1} + cow dung slurry @ 50% of teak leaf litter + bio- decompose	35.08	24.59
T_8	Teak leaf litter @ 5 t ha^{-1} + cow dung slurry @ 50% of teak leaf litter	34.98	24.30
T_9	Teak leaf litter @ 7.5 t ha^{-1} + cow dung slurry @ 50% of teak leaf litter + bio- decomposer	34.42	24.03
T_{10}	Teak leaf litter @ 7.5 t ha^{-1} + cow dung slurry @ 50% of teak leaf litter	34.12	23.91
SE(m) ±		0.239	0.329
CD at 5%		0.717	0.987

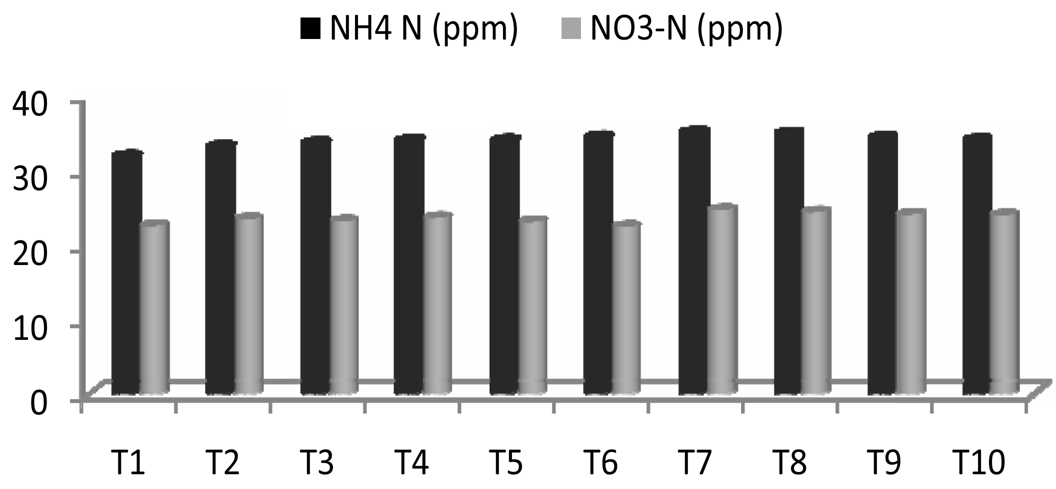

Fig. 1. Effect of teak leaf litter on N mineralization at 30 DAS

Nitrogen mineralization at 60 DAS

The data pertaining to mineralization of N at 60 day after sowing of *Abelmoschus moschatus* is presented in table 2 and depicted in fig.2. Treatment T_7 recorded higher value of ammonical nitrogen and nitrate nitrogen with application of teak leaf litter @ 5 t ha^{-1} + cow dung @ 50% of teak leaf litter + bio-decomposer (51.07 mg kg^{-1} NH_4-N and 35.81 mg kg^{-1} NO_3N). While treatment T_8 recorded second next higher value of ammonical nitrogen (50.94 mg kg^{-1}) and nitrate nitrogen (35.39 mg kg^{-1}) with the application of teak leaf litter @ 5 t ha^{-1} + cow dung slurry @ 50% of teak leaf litter. Regarding formation of ammonical nitrogen it was observed that, treatment T_6, T_8 and T_9 were at par with T_7. T_6 found statistically significant over other treatments. Treatment T_8, T_9 and T_{10} were found at par with T_7 for recording significant nitrate nitrogen content in soil.

Table 2. Effect of teak leaf litter addition on Nitrogen mineralization (mg kg^{-1}) in soil at 60 DAS

	Treatments	NH_4-N	NO_3-N
T_1	Absolute control	46.30	32.77
T_2	Teak leaf litter @ 2.5 t ha^{-1}	48.22	34.08
T_3	Teak leaf litter @ 5 t ha^{-1}	48.92	33.65
T_4	Teak leaf litter @ 7.5 t ha^{-1}	49.38	34.31
T_5	Teak leaf litter @ 2.5 t ha^{-1} + cow dung slurry @ 50% of teak leaf litter + bio-decomposer	49.56	33.54
T_6	Teak leaf litter @ 2.5 t ha^{-1} + cow dung slurry @ 50% of teak leaf litter	50.23	32.55
T_7	Teak leaf litter @ 5 t ha^{-1} + cow dung slurry @ 50% of teak leaf litter + bio- decomposer	51.07	35.81
T_8	Teak leaf litter @ 5 t ha^{-1} + cow dung slurry @ 50% of teak leaf litter	50.94	35.39
T_9	Teak leaf litter @ 7.5 t ha^{-1} + cow dung slurry @ 50% of teak leaf litter + bio- decomposer	50.11	34.98
T_{10}	Teak leaf litter @ 7.5 t ha^{-1} + cow dung slurry @ 50% of teak leaf litter	49.67	34.81
SE(m) ±		0.347	0.479
CD at 5%		1.041	1.41

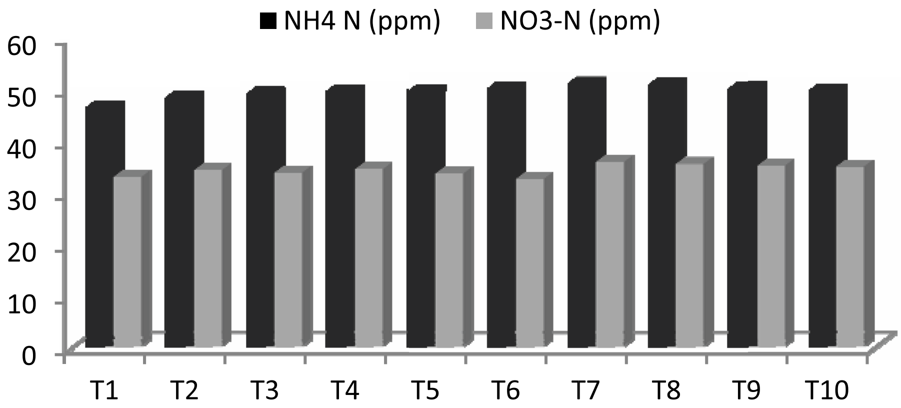

Fig. 2. Effect of teak leaf litter on N mineralization at 60 DAS

Nitrogen mineralization at 90 DAS

The data pertaining mineralization of N at 90 day after sowing of *Abelmoschus moschatus* is presented in table 3 and depicted in fig. 3. Treatment T_7 recorded higher value of ammonical nitrogen and nitrate nitrogen with application of teak leaf litter @ 5 t ha^{-1} + cow dung slurry @ 50% of teak leaf litter + bio-decomposer (43.72 mg kg^{-1} NH_4-N and 23.10 mg kg^{-1} NO_3-N). While treatment T_8 recorded second next higher value of ammonical nitrogen (43.60 mg kg^{-1}) and nitrate nitrogen (22.82 mg kg^{-1}). Treatment T_6, T_8 and T_9 recorded 42.99, 43.06 and 42.89 mg kg^{-1} ammonical nitrogen and were found at par with T_7. While, treatment T_8, T_9 and T_{10} were at par with T_7 by recording 22.82, 22.56 and 22.45 mg kg^{-1} nitrate nitrogen.

Table 3: Effect of teak leaf litter addition on Nitrogen mineralization (mg kg^{-1}) in soil at 90 DAS

	Treatments	NH_4-N	NO_3-N
T_1	Absolute control	39.63	21.13
T_2	Teak leaf litter @ 2.5 t ha^{-1}	41.27	21.98
T_3	Teak leaf litter @ 5 t ha^{-1}	41.87	21.71
T_4	Teak leaf litter @ 7.5 t ha^{-1}	42.27	22.13
T_5	Teak leaf litter @ 2.5 t ha^{-1} + cow dung slurry @ 50% of teak leaf litter + bio-decomposer	42.42	21.63
T_6	Teak leaf litter @ 2.5 t ha^{-1} + cow dung slurry @ 50% of teak leaf litter	42.99	20.99
T_7	Teak leaf litter @ 5 t ha^{-1} + scow dung slurry @ 50% of teak leaf litter + bio- decomposer	43.72	23.10
T_8	Teak leaf litter @ 5 t ha^{-1} + cow dung slurry @ 50% of teak leaf litter	43.60	22.82
T_9	Teak leaf litter @ 7.5 t ha^{-1} + cow dung slurry @ 50% of teak leaf litter + bio- decomposer	42.89	22.56
T_{10}	Teak leaf litter @ 7.5 t ha^{-1} + cow dung slurry @ 50% of teak leaf litter	42.52	22.45
SE(m) $\pm$		0.297	0.309
CD at 5%		0.891	0.949

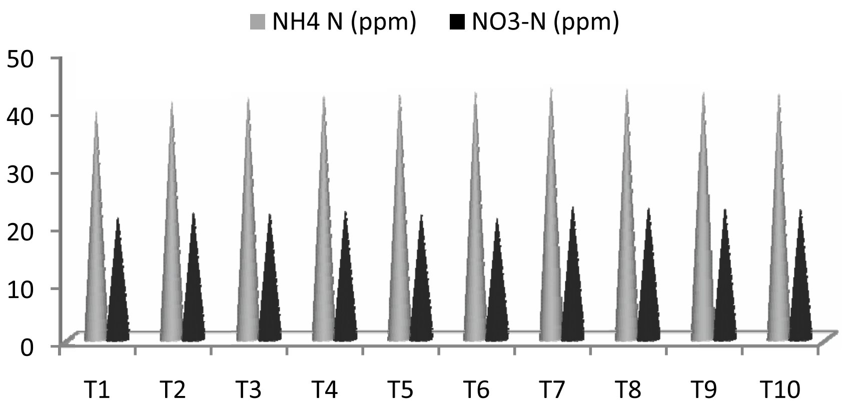

Fig. 3. Effect of teak leaf litter on N mineralization at 90 DAS

From the data depicted in fig.1, 2 and 3 it was observed that N mineralization was lowest during 30 DAS and increased upto 60 DAS. The mineralization of nitrogen was at peak at 60 DAS and there after it declined upto 90 DAS. The low mineralization of N at 30 DAS might be result of heavy uptake of N during early stage which decreased its content in the soil. Also there might be some immobilization of N as it was early phase of decomposition. During 60 DAS the ammonification might be in progress and hence showed high values of N mineralization.

These results are in close agreement with Roy et al. (2011) who found that, nitrogen immobilization in terms of ammonical nitrogen and nitrate nitrogen occurred upto 40th day. It was observed that mineralization was slower down during 90 DAS. Sarode (2006) also reported increasing trend of N mineralization on upto 90 days of incubation and then decreased at 120 days. The higher rate of N mineralization during early period and have also been reported by Pathak and Sorkan (1994). Nitrogen mineralization experiments, some of which involved the use of as a tracer, indicated that most nitrogen released after the addition of plant residues to soil is derived from the soil rather than from the added residues (Broadbent, 1948).

The results of present study, inferred that the combined application of teak leaf litter, cow dung and bio-decomposer are effective on N mineralization in soil In general, efficiency of the teak leaf litter was pronounced when it is combined with bio-decomposer. It is concluded that the application of 5 t ha^{-1} teak leaf litter+ cow dung @ 50% of teak leaf litter and bio-decomposer have positive impact on N mineralization in soil. It is clear from the results that, the application of teak leaf litter along with cow dung and bio-decomposer rather than application of only teak leaf litter succeed to extend significant impact on yield of *Abelmoschus moschatus*, available N, P and K in soil and N, P and K content in plant as well as seed..

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