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Mineralization of Carbon and Nitrogen During Composting

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Abstract

Mineralization of carbon and nitrogen during composting was investigated in an experiment with cowdung slurry and Trichoderma spp. viz. T.viride and T. harzianum at college of Agriculture, Yavatmal during the year 2012-13. The contents of moisture and temperature were very high in the beginning hereafter reduction in temperature was noticed throughout the decomposition period. The mineralization of nitrogen at initial period of decomposition was low upto 120 days and afterwards it was substantially increased upto maturity of compost. The significantly lowest carbon content was recorded in teak leaf litter and bamboo leaf litter compost due to addition of cow dung slurry @10% and decomposing culture @ 1 kg/ t. The activities of bioagents found maximum in teak leaf litter due to initial biochemical composition and nitrogen supplied by cow dung slurry.

Keywords: Mineralization, carbon, nitrogen, leaf litter.

Introduction

Now a day forests are being destroyed all over at a faster rate that was never before through various malpractices and illegal means. This is of course a matter of research how to maintain the fertility status of these forest soils and decreasing mineralization of the major nutrients. The risk of carbon and nitrogen immobilization by decomposing material and its adverse effect on vegetative growth and reproductive potential of the forest plants is a matter of concern. The rate of decomposition of added tree biomass, the nature and abundance of humus and nutrient released in soil are influenced by the chemical composition of the tree biomass, climate, soil characteristics and activity of micro-organism. The rate of decomposition of tree biomass is higher in species having maximum ash, nitrogen content, lowest C/N ratio and lignin content[1]. Beneficial soil microbes such as *Trichoderma viride* and *Trichoderma harzianum* are being investigated for its suitability in increasing the fertility status of the forest soils. Therefore the present studies were undertaken to study the periodical changes in carbon and nitrogen during decomposition of teak and bamboo leaf litter and effect of cow dung slurry (CDS) with bioagents *T.viride* and *T. harzianum*.

Material and Methods

An experiment Teak and bamboo leaf litter, cow dung was collected and available at site and decomposing culture *Trichoderma* viz., *T.viride* and *T. harzianum* was used as bioagents.

The experiment on compost preparation was conducted at Agronomy farm, College of Agriculture, Yavatmal with eight treatments and three replication in a randomized block design with combination of bamboo and teak leaf litter with and without CDS along with two bioagents *T.viride* and *T. harzianum*. The treatments were T_1- Teak leaf litter, T_2-Bamboo leaf litter, T_3-Teak leaf litter +CDS@10%+ decomposing culture@1kgt^{-1}, T_4-Bamboo leaf litter +CDS@10%+ decomposing culture@1kgt^{-1}, T_5-Teak leaf litter +decomposing culture@1kgt^{-1}, T_6-Bamboo leaf litter +decomposing culture@1kgt^{-1}, T_7- Teak leaf litter + CDS @ 10%, T_8- Bamboo leaf litter + CDS @ 10%.

The compost pits of size 1x1x1 m were filled treatment wise with teak and bamboo leaf litter separately. In each pit leaf litter was evenly spread up forming a layer of 15 cm thickness. Then fresh CDS with and without decomposing culture as per treatments wise was thoroughly mixed in a bucket containing 10 litters of water. The mixture was evenly sprinkled on the layer of leaf litter, In this way each pit was completely filled about 1 feet above ground and covered with cow dung and soil slurry and moisture content in each were maintained to 60 per cent as to check the moisture loss from pits. The compost samples were analyzed periodically (30, 60, 90, 120, 150, 180, 210 and 240 days) for organic carbon and total nitrogen by the standard methods.

Results and Discussion

Carbon Mineralization: Inoculation of bamboo and teak leaf litter leaf litter with *T.viride* and *T. harzianum* and addition of starter cow dung continuously reduced the organic carbon content at 30, 60, 90, 120, 150, 180, 210, 240 days of decomposition period of leaf litter. The maximum reduction in carbon content of teak (40.8 to 23.5per cent) and bamboo (30.5 to 16.0 per cent) leaf litter were recorded in treatment T_3 and T_4 respectively. In microbes alone treatments recorded

mineralization 42.5 per cent in teak (T_5) and 30.6 per cent in bamboo (T_6) in the beginning and found decreased up to 28.9 per cent in teak (T_5) and 20.5 per cent in bamboo (T_6) in the period of 240 days. The increase in N accelerated the CO_2 evolution. The CO_2 release increase with incubation period also correlates with the findings of Maharudrappa *et al*.[2]. Carbon of the leaf litter was mineralized to the tune of 42.8 in the beginning to the extent 28.6 per cent indicated higher mineralization at 240 days in teak while in bamboo leaf litter mineralization was only 30.9 per cent in the beginning and restricted to 22.2 per cent with T7 and T8 treatments respectively.

It is observed from table-1 that both bioagents and CDS contributed for the decomposition and helped in decreasing mineralization per centage of the leaf litter. After 90 to 120 days of decomposition of litter mineralization process found decreased in all the treatment which correlates the time factor as contributor for composting process. Amongst the individual role of inoculating culture and starter CDS, the role of inoculating culture was more pronounced than the starter. However, their combined effect was more pronounced. Gawade recorded the similar influencing result of microinoculant on decomposition of agricultural wastes than CDS[3].

The maximum reduction in organic carbon content was recorded up to 150 days after inoculation (DAI) in teak and up to 240 DAI in bamboo leaf litter. The water soluble carbohydrates decreased with decomposition process and which indicated that easily biodegradable carbon diminished much faster than resistant carbon material. Thereafter the reduction in organic carbon content was lowered. Similar results reported by Manna *et al*.[4] and Sun *et.al*.[5].

Nitrogen Mineralization: The improvements in total nitrogen content in teak and bamboo leaf litter compost were recorded during whole incubation period table-2. The rate of increase in total nitrogen content at initial period to 150 days was lowered in both teak (1.50 per cent) and bamboo leaf litter (0.74 per cent) compost whereas; it was increase after this period to 240 days (1.68 per cent and 0.95 per cent) respectively. Combined effect of the CDS and microbial culture resulted increased from 1.36 per cent to 1.68 per cent in teak while comparatively less mineralization found in bamboo 0.62 per cent in the beginning and 0.95 per cent after 240 days of composting (T_3 and T_4). In microbes alone treatments recorded mineralization 1.33 per cent in teak and 0.57 per cent in bamboo in the beginning and increased up to 1.55 per cent in teak and 0.83 per cent in bamboo in the period of 240 days (T_5 and T_6). Mineralization to the tune of 1.31 in the beginning to the extent 1.52 per cent after 240 days in teak while in bamboo it was 0.57 per cent in the beginning and increased to 0.81 per cent (T_7 and T_8).

Conclusion

The rate of decomposition of leaves and twigs are correlated to the number of days of decomposition. Hence, in the present study it has been noticed that N are positively related with decomposition rate[6]. During the decomposition process carbon is used as a energy source by decomposer, while nitrogen is assimilated in cell protein and other components. Thus, higher initial nitrogen promotes decomposition[7]. Gross mineralizations of N continue to increase with time which was always higher in slurry with bioagents. Similar observations were also reported by Tiwari and Trehan[8,9]. Enhanced microbial mineralization of organic matter universally augmented available nitrogen (NH_4^+ and NO_3^-) in soil. This was also supported by Saha *et al*.[10]. The present study show that soil microbial activity during the process of decomposition of organic matter is dependent on the availability of easily degradable carbon rather than mineral nitrogen.

Table-1
Organic carbon (%) content during composting of leaf litter

Treatment	Period in Days							
	30	**60**	**90**	**120**	**150**	**180**	**210**	**240**
T_1	43.3	42.5	40.9	39.0	36.9	34.2	31.3	29.0
T_2	31.9	31.5	30.5	28.8	27.0	25.3	25.7	23.4
T_3	40.8	39.0	37.1	34.1	31.1	28.7	26.7	23.5
T_4	30.5	30.0	27.5	25.6	22.9	20.2	19.1	16.0
T_5	42.5	41.3	39.6	36.6	34.0	31.9	30.4	28.9
T_6	30.6	30.2	29.2	27.5	25.6	23.6	21.8	20.5
T_7	42.8	42.2	40.4	37.1	34.9	32.8	30.7	28.6
T_8	30.9	30.7	29.9	28.4	26.6	24.9	23.4	22.2
F test	Sig.	Sig.	Sig.	Sig.	Sig.	Sig.	Sig.	Sig.
S. E. (m) ±	0.12	0.08	0.07	0.23	0.04	0.05	0.05	0.07
C.D. (0.05)	0.37	0.23	0.21	0.69	0.13	0.14	0.15	0.23

Table-2
Total nitrogen content during composting of leaf litter (%)

Treatment	Period in days							
	30	**60**	**90**	**120**	**150**	**180**	**210**	**240**
T_1	1.29	1.30	1.31	1.33	1.35	1.38	1.43	1.49
T_2	0.56	0.57	0.58	0.60	0.62	0.65	0.75	0.81
T_3	1.36	1.40	1.44	1.47	1.50	1.56	1.62	1.68
T_4	0.62	0.68	0.67	0.71	0.74	0.81	0.87	0.95
T_5	1.33	1.34	1.35	1.36	1.38	1.43	1.49	1.55
T_6	0.57	0.58	0.60	0.62	0.66	0.71	0.78	0.83
T_7	1.31	1.31	1.33	1.34	1.36	1.42	1.48	1.52
T_8	0.57	0.58	0.59	0.61	0.64	0.70	0.76	0.81
F test	Sig.	Sig.	Sig.	Sig.	Sig.	Sig.	Sig.	Sig.
S. E. (m) ±	0.006	0.005	0.007	0.006	0.005	0.025	0.039	0.01
C.D. (0.05)	0.019	0.016	0.021	0.020	0.015	0.0745	0.118	0.023

References

1. Mukhopadhyay N., Gupta S.K. and Banerjee S.K., Forms and distribution of humic acid and fulvic acid component in soil under deciduous and coniferous forest., *J. Indian Soc. Soil Sci,.* **37 (1)**, 477-480 **(1982)**

2. Maharudrappa A., Srinivasamurthy C. A., Nagaraja M. S., Siddaramappa R. and Anand H. S. Decomposition rates of litter and nutrient release pattern in tropical soil. *J. Indian Soc. Soil Sci.* **48 (1)**, 92-97. **(2000)**

3. Gawade G.S., Studies on cellulolytic fungi in decomposition and enrichment of agricultural wastes. *M. Sc. (Agri)Thesis (Unpub.), Dr. PDKV. Akola*., 1-42 **(2001)**

4. Mann M.C., Ganguly T.K. and Ghosh B.N., Evaluation of compost maturity and mineral enrichment quality through simple chemical parameters., *J. Indian Soc. Soil Sci.,* **48 (4)**, 781-786 **(2000)**

5. Sun S., Liu J. and Chang S.X., Temperature Sensitivity of soil carbon and nitrogen mineralization : Impacts of nitrogen species and land use type, *Plant and Soil* **372,** 1-2, 597-608 **(2013)**

6. Swift M.J., Heal D.W. and Anderson J.M., Decomposition in terrestrial Ecosystems, *Blackwell Scientific Publications Oxford*, 40-56 **(1979)**

7. Satchell J.E. and Lowe D.G., Selection of leaf litter by Lumbricus leraestris process in soil biology (Eds. O. Graff and J. E. Satchell, North Holland, Amsterdam), 102-119 **(1997)**

8. Tiwari V.N., Pathak A.N. and Lehri L.L., Effect of cattle dung and rock phosphate on composting of wool waste, *Biological wastes*, **27(3)**, 237-241 **(1989)**

9. Trehan S.R., Mineralization of nitrogen from cattle slurry decomposing in soil, *J. Indian Soc.Soil Sci.,* **48(3),** 463-468 **(2000)**

10. Saha N., Das A.C. and Mukherjee D., Effect of decomposition of organic matter on the activities of microrganisms and availability of Nitrogen, Phosphorous and Sulphur in soil, *Journal of Indian Society of Soil Science*, **43(2),** 210-215 **(1995)**