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Research Article

RATES OF LEAFLITTER DECOMPOSITION IN WESTERN GHATS ECOSYSTEM, TAMILNADU

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Abstract- The experiment was conducted to study the Leaf litter decomposition of Western Ghats ecosystem. The study was carried out in the major two types of forest namely tropical dry deciduous forest and tropical moist deciduous forest, which are major ecosystem in the foot hills of Nilgiri biosphere reserve, Tamil Nadu. The rate of leaf litter decomposition was studied using nylon bag buried technique. Rate of decomposition was estimated at soil surface and soil subsurface level. The overall decomposition study results explained that tropical dry deciduous forest recorded the highest rate of decomposition rate in both surface and surface soil. It was observed that in tropical moist deciduous forest composition of leaf litter was highly resistant to degradation.

Keywords- Decomposition, Leaf litter, Tropical dry deciduous, Tropical moist deciduous

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Introduction

Decomposition is a complex and often prolonged process, the rate constants varying with the nature of the substrate and the characteristics of the environment [11]. The importance of the forest floor as an integral part of the ecosystem has been recognized for a long time. One of the most important actions occurring there is "decomposition", a term broadly used to refer to any changes in biochemistry, outer shell and mass. Litter decomposition acting as a significant function in carbon cycling in global ecosystems [2].

Litter decomposition involves (mass loss) involves two simultaneous and fundamental sets of processes, the concomitant mineralization and humification of lignin, cellulose and other compounds by a succession of microorganisms and the leaching downward in the soil of soluble compounds whose Carbon and nitrogen are progressively mineralized or immobilized. These processes are controlled by abiotic factors, such as climate, and by biotic factors, such as litter chemical composition and soil organisms. Chemical changes during litter decomposition are illustrated. This study was designed to investigate the rate of decomposition per cent in the two major forest types namely tropical dry deciduous forest and tropical moist deciduous forest present in the foot hills of Nilgiri Biosphere Reserve, Tamil Nadu [6].

Material and Methods

Study area

The Nilgiri Biosphere Reserve was the first biosphere reserve in India established in the year 1986. It is located in the Western Ghats and includes 2 of the 10 bio geographic provinces of India. Wide ranges of ecosystems and species diversity are found in this region. Thus, it was a natural choice for the premier biosphere reserve of the country.

Tropical dry deciduous forest

The largest area of the country's forest land is occupied by tropical dry deciduous forests. The dry season is long and most of the trees remain leafless during that season. The forest trees are not dense, 10 to 15 m in height, and undergrowth is abundant. The forests are dominated by *Dalbergia paniculata, Terminalia chebula, Dillenia pentagyna, Pterocarpus marsupium, Diospyros melanoxylon, Anogeissus latifolia, Boswellia serrata, Chloroxylon swietenia, Bauhinia tomentosa, Hardwickia binata, Gyrocarpus jacquini, Zizyphus glabrata, Moringa tinctoria, Dendrocalamus strictus.*

Tropical moist deciduous forest

These cover an extensive area of the country receiving sufficiently high rainfall (100 to 200 cm) spread over most of the year. The dry periods are of short duration. Many plants of such forests show leaf-fall in hot summer. The forests are dominated by *Tectona grandis, Terminalia paniculata, Terminalia bellerica, Grewia tillifolia, Dalbergia latifolia, Lagerstroemia lanceolata, Adina cordifolia*, etc. Some other common associates are *Terminalia tomentosa, Dillenia pentagyna, Eugenia spp,* and *Boswellia serrata.* These forests produce some of the most important timbers of India [9].

Methodology

Leaf litter decomposition

The rate of litter decomposition was studied during the period of April 2015 to November 2015, using nylon bag buried technique [12]. Air dried leaves (100 g) were collected from experimental plots and taken in the nylon bags of 20 x 25 cm size and 2 mm aperture size. The leaf litter bags were randomly kept in the all three forest floor. A total of 21 bags will be placed per plot. At every month intervals, the litter bags will be retrieved from the field at the rate of three bags per plot. The litter samples will be cleaned free of extraneous materials, oven dried at 70^0 C for 48 hr and oven dry weight will be determined. The ratio of mass loss was

the calculated for the three forest types and expressed as percent loss of the original mass using the mass loss equation [14].

Mass loss (%) = $X_t g/X_0 g \times 100$

Where

X_0= The original amount of leaf litter

X_t= the amount of litter remaining at time't'

Results and Discussion

The leaf litter bags (100 g) were kept for the decomposition studies from April 2015 to November 2015 and observations were made at monthly intervals. The decomposition study was carried out at two different depths viz., soil surface (0-15 cm) and soil subsurface (15-30 cm)

Soil surface (0-15 cm)

The leaf litter bags (100 g) were randomly placed at soil surface (0-15 cm) in field condition and observed for weight loss which was eventually computed as decomposition loss and the results were presented in [Table-1]. The rate of decomposition was observed to be the highest two forest types during the month of May, 2015, however it was found to be the lowest during the month November, 2015.

Table-1 *Rate of leaf litter decomposition (Per cent)at soil surface (0-15 cm)*

S. No	Forest type	April 2015 Initial weight (g)	May 2015	June 2015	Jul 2015	Aug 2015	Sep 2015	Oct 2015	Nov 2015 (Final weight)	Rate of Decomposition (percent)
1.	Tropical dry deciduous forest	100	82.63	73.62	67.18	56.38	43.35	27.46	22.34	77.66
2.	Tropical moist deciduous forest	100	89.36	78.12	73.69	59.71	55.91	42.51	36.83	63.17

Among the two forest types, rate of decomposition was significantly higher in tropical dry deciduous forest (77.66 per cent) and lower in tropical moist deciduous forest (63.17 per cent). The results explained that the reduction in weight of leaf litter at the end of the study period was in the order: tropical dry deciduous forest (22.34 g) > tropical moist deciduous forest (36.83 g). It was observed that in tropical moist deciduous forest composition of leaf litter was highly resistant to degradation.

Soil sub surface (15-30 cm)

Under field condition leaflitter decomposition using leaf litter bag technique placed at 15-30 cm depth [Table-2]. The highest rate of decomposition was observed in tropical dry deciduous forest (80.52 per cent) as compared to tropical moist deciduous forest (77.65 per cent).

Table-2 *Estimation of decomposition per cent at soil sub surface (15-30 cm)*

S. No	Forest type	April 2015 Initial weight (g)	May 2015	June 2015	July 2015	Aug 2015	Sep 2015	Oct 2015	Nov 2015 (Final weight)	Rate of Decomposition (percent)
1.	Tropical	100	74.10	56.45	45.90	37.63	30.58	27.67	19.48	80.52
2.	Tropical	100	80.24	71.46	63.13	51.41	39.84	28.42	22.35	77.65

Comparison of leaf litter decomposition percentage

The decomposition per cent of leaf litter at surface and sub surface soil were studied and compared in [Table-3].Compared to surface soil at sub surface soil, the rate of decomposition was the highest in tropical dry deciduous forest (80.52 >77.65 per cent), tropical moist deciduous forest (77.65 > 63.17 per cent).

Table-3 *Comparative assessment of leaf litter decomposition*

S.No	Forest types	Decomposition (%)	
		Soil surface	Soil sub surface
1.	Tropical dry deciduous forest	77.66	80.52
2.	Tropical moist deciduous forest	63.17	77.65

In surface soil the rate of decomposition was in the following order: tropical dry deciduous forest (77.66 per cent) > tropical moist deciduous forest (63.17 per cent). In sub surface soil the decomposition rate was in the following order: tropical dry deciduous forest (80.52 per cent) > tropical moist deciduous forest (77.65 per cent). The overall decomposition study results explained that tropical dry deciduous forest recorded the highest rate of decomposition rate in both surface and surface soil.

Decomposition of leaf litter

Decomposition is an integrative process that reflects climate and microclimate conditions, litter chemistry and soil activity. Forest floor varies in the quantity of plant debris and this variation attributes to spatial heterogeneity of soil biota in forest ecosystems, because forest debris provides them with food and shelter[15]. Soil biota plays an integral role in the decomposition processes. Recently, soil fauna has been shown to play an important role in plant litter decomposition in tropical forests [7]. Leaf litter decomposition was carried out at varying soil depths viz., surface and subsurface. Decomposition percentage at surface level in tropical dry deciduous forest and tropical moist deciduous forest was 77.66 and 63.17 percent. High rate of decomposition was observed in the tropical dry deciduous forest (80.52 %) compared to tropical moist deciduous forest (77.65 %). The study revealed that percent reduction in leaf litter was found to be at higher level. (surface 77.66 per cent, subsurface 80.52 percent). The rate of decomposition was found to be higher at soil subsurface (15 cm) than at soil surface. This could be due to the maximum microbial activity at sub surface zone [10]. The plant litter can influence the activity of soil microbes and fauna by providing them with a food source and habitat [3].

High rate of decomposition was observed in the summer season during the month of April and May. The highest decomposition of hill evergreen forest litter occurred in the late rainy season and early winter and the lowest rate in summer [4]. The highest rate of decomposition of detritus litter during spring and summer periods were reported in in hill evergreen forest [16]. The mass remaining in litter bags decreased linearly with time for all the species [13]. In deciduous forests, complete reduction of leaf litter was observed within the period ranging from 10 -12 months. In the present study complete reduction of leaf litter was observed in 8 months at both surface and subsurface level. The low decomposition percent was observed in the surface level in the tropical moist deciduous forest. This could be due to lignin and tannin contents of the litter. In tropics, the lignin: N ratio exerted the strongest influence on litter decomposition rates, because N reacts with lignin and forms recalcitrant products that are highly resistant to degradation[1]. Lignin could also be associated with other polymers like cellulose and hemicellulose, a complex cell wall that decomposes slowly [8].

Conclusions

This study established that decomposition rate vary with forest types and tree

species composition. Litter placed in sub-surface layer decomposed faster as compared to surface placed litter. Species having more nitrogen, phosphorus, ash and water-soluble compounds decomposes fast while those having more lignin, magnesium, cellulose and acid detergent fiber decompose slow. The study revealed that percent reduction in leaf litter was found to be higher level in at in tropical dry deciduous forest. (surface 77.66 per cent, subsurface 80.52 percent). This could be due to lignin and tannin content present in the litter tropical dry deciduous forest.

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Author Contributions
All authors are contributed substantially in conception, designing of the study, acquisition of data, analysis and interpretation of data.

Ethical approval:
This article does not contain any studies with human participants or animals performed by any of the authors.

Conflict of Interest: None declared

References
[1] Aerts R. (1997) *OIKO*, 79, 439–449.
[2] Aerts R. (2006) *J .Ecol*., 94,713–24.
[3] Bengtsson J., Lundkvist H., Saetre P., SohleniusandB. and Solbreck B. (1998) *Appl. Soil Ecol*., 9, 137–143.
[4] Boonyawat S. and C. Ngampongsai. (1974) *An analysis of accumulation and decomposition of litter fall in hill evergreen forest, Doi Pui, Chiangmai. Kasetsart Univ. Kogma Watershed Res. Bull.*, 17. 21 p.
[5] Coleman D.C. and Crossley D.A. (1996) *Fundamentals of Soil Ecology. Academic Press, New York, USA*.
[6] Champion H.G. and Seth S.K. (1968) *The Revised Survey of the Forest Types of India, Manager of Publications, New Delhi.*
[7] Gonza´lez G. and Seastedt T.R. (2001) *Ecology*, 82, 955–964.
[8] Meentemeyer V. (1978) *Ecology*, 59, 465-472.
[9] Prasad A.G.D., Nageeb, Sagheer A.A. (2012) *Journal of Environmental Biology,* 33.791-797
[10] Ruan. H., Yiqing L. and Zou. X. (2005) *International Symposium on Impacts of Soil Biodiversity on Biogeochemical*, 49, 529-538.
[11] Satchell J.E. (1974) *Litter-interface of animate/inanimate matter. In: Biology of plant litter decomposition, vol. 1, ed. by C. H. Dickinson and G. J. F. Pugh. Academic Press, London and New York.*pp. xiii-xliv.
[12] Shanks R.E and Olson J.S. (1961) *Sci.,* 134, 194-195.
[13] Sundarapandian S.M. and Swamy P.S. (1999) *Forest and Ecology Management*, 123, 231-244.
[14] Sylvia D., Fuhrmann J., Hartel P. and Zuberer D. (1999) *Principles and Applications of Soil Microbiology. Prentice Hall, New Jersey*, 550 pp.
[15] Wardle D.A. And Lavelle. P. (1997) *Linkage between soil biota, plant quality and decomposition. In: Cadisch, G., Giller, K.E. (Eds.), Driven by Nature: Plant Litter Quality and Decomposition. CAB International, London, UK*, pp. 107–124.
[16] Wiegert R.G. and McGinnis J.T. (1975) *Ecology*, 56, 129-140.