

## MIXED LEAF LITTER DECOMPOSITION IN DIARA LAND OF GANGA BASIN AT BHAGALPUR, BIHAR

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### Introduction

Micro-organisms of the soil are very diverse in their composition and functional manifestation. Most abundant groups of microorganisms in terrestrial soils are bacteria and fungi which are the main primary decomposers (Clark and Paul, 1970). The decomposition of plant litter (Dickinson and Pugh, 1974) in both the systems, aquatic as well as terrestrial (Anderson and Mac Fadyan, 1976; Swift *et al.*, 1979) have been studied. The decomposition constant (K) has been examined in many ecosystem with low and high production rates and over a wide range of environmental conditions (Meentemeyer, 1978; Melillo *et al.*, 1982). As such in the present work the qualitative and quantitative characterisation of litter decomposition in diara land has been made. The vegetation of diara land consist of cultivated crops as well as wild species. In India litter decomposition has been studied by Jain (1963), Singh (1969), Shukla (1976), Singh (1978) and Srivastava (1981). But no work has been done on litter decomposition in such a system as diara land, where annual occurrence of flood destruct the existing vegetation and after recession of flood water, nuded land appears on the Ganga river bed, Diara land is situated at 86° 45' 58" E Longitude and 25° 15' N Latitude and is located on the southern side of the Ganga basin.

### Materials and Methods

Litter production value was very low in the month of October and November, just after the flood. It increased after December, so the experiment was carried out from the month of January to the first half of July. The total study period of litter decomposition could not be more than six months as after that the nylon bags on the soil get destroyed due to heavy rainfall and occurrence of flood.

Decomposition study of mixed leaf litter of various plant species like *Zea mays*, *Triticum aestivum*, *Trichosanthus dioica*, *Cicer arietinum*, *Cynodon dactylon*, *Cyperus rotundus*, *Lippia geminata* etc. were performed by estimation of weight loss in the field.

*Estimation of weight loss* : The progressive weight loss of litter followed for six months from January 1986 to July 1986, fortnightly in diara land by nylon bag technique (Bocook *et al.*, 1960; Witkamp, 1963; Gosz *et al.*, 1972; Weigert and McGinnis, 1975).

Firstly fallen leaves of various plant species were collected and mixed together. 6 g of air dried mixed leaf litter samples were kept in each of 30, 1 mm<sup>2</sup> nylon mesh bags (8x8 cm in size) and then closed them firmly with metal clips. The nylon bags

were placed over the soil surface covered with soil of the land. During the sampling months 3 bags were removed randomly and brought to the laboratory. The samples were oven dried at 80 °C for 48 hrs to constant weight for dry weight values.

*Turnover of organic matter*: After litter has placed on to diara floor it decays by the action of decomposers and the abiotic environment. The rate at which litter decays under study conditions can be expressed as a constant K. In case when litter is confined in mesh bags the measuring of weight loss is a special loss with eventually no addition of litter, the input is zero or  $L=0$ , Olson (1963) was assumed this as an exponential decay and represented it by the equation.

$$\frac{X_t}{X_0} = e^{-Kt}$$

Where, X is weight remaining at time t,  $X_0$  is initial weight, e is base of natural logarithm and K is the decomposition constant. Turnover time is expressed as the reciprocal of turnover rate,  $1/K$ .

The data obtained during experimentation were processed for analysis of variance.

### Results and Discussion

Monthly and progressive weight loss of mixed leaf litter for six months has been presented in Table 1. It was denoted that the weight of litter reduced greatly in the early rainy season. From the progressive weight loss of the litter, it appeared that 81.7% of the total litter had disappeared of which 58.3%, 35% and 20% were in the early rainy, summer and late winter season, respectively.

Analysis of variance between wet and dry weight of litter was significant at 1% level ( $P < 0.001$ ) and the variance ratio (F) was 35.9956 (Table 2).

Exponential decay parameter for mixed leaf litter has been shown in Table 1. Decomposition constant (K) of mixed leaf litter was 3.39.

In nylon bag technique the litter was placed at a time only. It disappeared at a fast rate because of rich microbial activity on the litter substrate. The fast disappearance rate of litter (Table 1) during rainy season might be due to accelerated growth of microbial population as well as to the activities to decompose the material in the presence of sufficient moisture and optimum temperature, while it was moderate in winter season and at a very slow rate in summer season (Singh, 1978; Datta Munshi *et al.*, 1987). The value of decay constant in temperate ecosystem was very low in the tropical ecosystem. It was due to the temperature and moisture content which do not favour the process. In a temperate ecosystem the value of decay constant was as high as 5.0 (Swift *et al.*, 1979), due to high rainfall and optimum temperature. In the present study decay constant was 3.39 which was comparable with the values of *Savanna* 3.0 (Swift *et al.*, 1979) and *Zyzyphus* 3.32 (Singh, 1978). The K value of *Shorea* plantation 2.37 and *Savanna* 2.74 were estimated by Singh (1978) and that of *Shorea robusta* stand 2.52 by Datta Munshi *et al.* (1987). All these values were low in comparison to the obtained present value 3.39. It seems higher lignin content in tree plants (Anon., 1976) resists decomposition in comparison to herbaceous vegetation on diara land.

Table 1

*Rate of loss of mixed leaf litter in nylon bags placed on the Diara floor*

Period	Dry weight of litter (gm)	Loss of dry weight (gm)		Percentage loss of weight	
		Fortnightly	Progressive	Fortnightly	Progressive
15.1.1986	6.0±0.0	-	-	-	-
1.2.1986	5.4±0.2	0.6	0.6	10.0	10.0
15.2.1986	4.8±0.15	0.6	1.2	11.1	20.0
1.3.1986	4.3±0.3	0.5	1.7	10.4	28.3
15.3.1986	3.9±0.1	0.4	2.1	9.3	35.0
1.4.1986	3.6±0.2	0.3	2.4	7.7	40.0
15.4.1986	3.2±0.2	0.4	2.8	11.1	46.7
1.5.1986	2.8±0.1	0.4	3.2	12.5	53.3
15.5.1986	2.5±0.13	0.3	3.5	10.7	58.3
1.6.1986	2.2±0.1	0.3	3.8	12.0	63.3
15.6.1986	1.5±0.07	0.7	4.5	31.8	75.0
1.7.1986	1.1±0.08	0.4	4.9	26.6	81.7

Litter dry weight are means of three samples ±standard deviation.

Table 2

*ANOVA of month and dry weight of litter of Diara land*

Source of variation	d.f.	S.S.	M.S.S.	F
Month	6	24.405	4.0675	35.9956*
Error	5	0.565	0.113	
Total	11	24.97		

\*P&lt;0.001

Table 3

*Exponential decay parameter*

Stand	Turnover rate (K)		Turnover time (K) days
	10 <sup>-2</sup> /day	year	
Mixed litter	0.93	3.39	107

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## SUMMARY

Monthly and progressive data of weight loss of mixed leaf litter kept in nylon bags on the floor showing maximum decomposition during rainy season 58.3 per cent. The turnover required to decompose the residual leaf litter was 107 days. Analysis of variance between months dry weight of litter was found significant ( $P < 0.001$ ) and the variance ratio (F) was 35.9956. Decomposition constant (K) of mixed leaf litter was 3.39.

भागलपुर, बिहार में गंगा पात्र की दियारा भूमियों में मिश्र पर्णास्तरण का विघटन  
एच०के० वर्मा

सारांश

दियारा भूमि स्तर पर नाइलोन की थैलियों में रखा मिश्र पर्णास्तरण के भार में मासिक और क्रमिक के अधिकतम विघटन वर्षा ऋतु में 58.3% होता पाया गया। अवशिष्ट पर्णास्तरण को विघटित होने में लगा समय 107 दिनों मासों और पर्णास्तरण के शुष्क भार में विचर विश्लेषण सार्थक ( $P < 0.001$ ) और विचरण अनुपात (एफ) 35.9956 पाया गया। मिश्र पर्णास्तरण का विघटन स्थिरांक (के) 3.39 रहा।

## References

- Anon. (1976). *The Wealth of India*. CSIR, New Delhi, X : 146.
- Anderson, J.M. and A. Mac Fadyan (Eds.) (1976). *The role of terrestrial and aquatic organisms in the decomposition process*. Blackwell Scientific Publication, Oxford. 474.
- Bocook, K.L., C.J. Gilbert, C.K. Capstick, D.C. Twinn, J.S. Waid and M.J. Woodman (1960). Change in the leaf litter when placed on the surface of soils with contrasting humus type. *J. Soil Sci.* 11: 1-9.
- Clark, F.E. and E.A. Paul (1970). The microflora of grassland. *Advances in Agronomy*, 22: 375-435.
- Datta Munshi, J., A. Hussain and H.K. Verma (1987). Litter dynamics in *Shorea robusta* stand in deciduous forest of Monghyr (Bihar). *Environ. and Ecol.*, 5 (2) : 374-377.
- Dickinson, C.H. and G.J.H. Pugh (Eds.) (1972). *Decomposition of plant litter*, Academic Press, London. 241-246, and 775.
- Gosz, J.R., G.E. Likens and F.H. Bormann (1972). Nutrient content of litter fall on the Hubbard Brook experimental forest, New Hampshire, *Ecol.*, 53: 769-787.
- Jain, N.K. (1963). The effect of decomposition of nature leaves and litter of Sal (*Shorea robusta*) on granitic and lateritic soil. *Proc. Nat. Aca. Sci., India*, 33: 148-152.
- Meentemeyer, V. (1978). Macroclimate and lignin control of litter decomposition rates. *Ecol.*, 59: 472.
- Melillo, J.N., J.D. Amber and J.F. Muratore (1982). Nitrogen and lignin control of hardwood leaf litter decomposition dynamics. *Ecol.*, 63 : 621-626.
- Olson, J.S. (1963). Energy storage and the balance of producers and decomposers in ecological systems. *Ecol.*, 44: 322-331.
- Shukla, A.N. (1976). Fungal decomposition of sal leaf litter in Chakia forest of Varanasi. *Dissertation*, BHU, Varanasi, India.
- Singh, K.P. (1969). Studies in decomposition of leaf litter of important trees of tropical deciduous forest at Varanasi, *Trop. Ecol.*, 10: 292-311.
- Singh, A.K. (1978). Comparison of primary production and energetics of Savanna and Teak (*Tectona grandis* L.) plantation of Chandraprabha region. *Ph.D. Thesis*, BHU, Varanasi, India.
- Srivastava, A.K. (1981). Studies on microbial decomposition of leaf litter of Tropical dry deciduous forest. *Ph.D. Thesis*, BHU, Varanasi, India.
- Swift, M.J., O.W. Heal and J.M. Anderson (1979). *Decomposition in terrestrial ecosystem*. Blackwell Scientific Publications, Oxford, 372.
- Weigert, R.G. and J.T. Mc Ginnis (1975). Annual production and disappearance of detritus on three South Carolina Old fields, *Ecol.*, 56: 129-140.
- Witkamp, M. (1963). Microbial population of leaf litter under different Woodland condition, *Plant and Soil* 9: 179-185.