Litter species richness and their decomposition role in variation of soil organic carbon across different tropical vegetal covers.

Sakthivel N. [1] *, S.F. Lesley Sounderraj*[2], Nancy Lesley[3]S.F.Wesley Sunderraj[4]
Corresponding Authors*: Sakthivel N, Department Of Zoology, Voorhees College, Vellore
S.F. Lesley Sounderraj. Department Of Zoology, Voorhees College, Vellore
Nancy Lesley. Presidency College Chennai .

ABSTRACT :

The major input of vegetative C to forest soil is represented by litter; hence changes in litter inputs are likely to have important consequence for soil C dynamics. The present study shows variation in soil organic carbon SOC and litter decomposition across litter diversity. Tropical vegetal cover in dominated by *Tectonagrandies*, *Bambusaarundinacea*, *Syzygiumcumini*, *Poongamiyapinnata* and *Ailanthus excels*, were used for the study. SOC was analyzed in the soils up to the depth of 1.25m at different intervals. Litterbag experiment was conducted to understand the process of decay rate in the five types of litter at three different depths, viz top 5 cm , 25 cm and 50 cm,physical fraction was done in the collected soil samples. SOC values from the five different types of vegetal cover showed significant difference. The annual litter fall was maximum in *Syzygiumcumini* followed by *Tectonagrandiee*, *Bambusaarundinacea*, ,*Poongamiyapinnata*and *Ailanthus excelsa* . Litterbag experiment showed that all the experimental points,leaf litter get decomposed with in a year on storage . The decomposition was faster in bags kept at the top layers of the soil compared to the subsequent layer. Comparatively there was an increase in SOC of samples from the experimental layer than adjacent layer indicating, that tropical soils shows the high rate of SOC sink potential. Physical fraction of SOC showed uniformity in the proportion of mobile and recalcitrant pools across soil profile of the different vegetal cover.

Keywords: SOC : Soil Organic Carbon, C: Carbon

INTRODUCTION :

Ecosystem are sustained by means of different biological, chemical and physical proceses. One of these basic process is the litter decomposition in ecosystem which transforms organic substances to the simple forms and perform nutrient cycles .In terrestrial system plant litter fall is a primary pathway for the return nutrients to the soil.

The major input of vegetative C to forest soil is represented by litter: hence changes in litter inputs are likely to have important consequences for soil C dynamics (Sayer et al., 2007.)

The balance between litter inputs and heterotrophic litter decomposition influence the amount of C stored in the forest floor. Further Nitrogen (N) Phosphorus(P) and Calcium (Ca) are released from plant litter during decomposition where they can become available for plant and microbial uptake.

The three main factors controlled the litter decomposition rates are temperature, moisture and litter quality .Among the soil faunal community, especially the influence of earthworms is increasingly being recognized as a possible fourth important factor (Dechaine et al,.2005).One of the basic factors that affect litter decomposition potential rate is the microbial activity, litter compound. Where substrate is available, soil microbial activity increase exponentially with soil temperature with microbial activity often doubling with a 10^{o}C increase the temperature (Kirschbaum 1995).

Therefore the mechanism of litter decompositions, translocation and stabilization into soil layers are fundamental process in the functioning of the ecosystem as they regulate the cycle of Soil organic matter (SOM), CO2 emission into atmosphere ,Carbon sequestration in to soil and mineralization (Maisto et al., 2011:Parras Alcantara et al ., 2015; Smolander et al,. 2008 ; Fioretto et al., 2005*).*

Litter decomposition after litter fall is a key process in the carbon (C) and nutrient cycling in terrestrial eco system. As climatic conditions drive the rate of litter decomposition at a global scale, litter decomposition is very fast in humid tropical forest and has a remarkable influence on the annual variability of C fluxes (Aerts 1997; Meentemeyer 1978).Although tropical forests are a

critical component of the global C cycle (Pan et al.2011), the driving factor of litter decomposition have been studied less thoroughly in the tropics than in other climate regions.

In this study we report an in situ investigation of variation in the rate of litter decomposition and SOC according to the litter diversity for the Southern dry tropical riverine forest of AmirthiForest range , Vellore.

Materials and Methods.

LITTER COLLECTION :

Leaf Litter samples were collected at month intervals for one year . At each time of sampling $1m^2$ quadrates were randomly laid on the forest floor under 10 different tree species. The litters that fell in those are were collected separately by species wise . At each site eight quadrate were laid. The leaves collected were dried in the open air (ambient temperature) and then oven dried at 75ºC to constant weight. Among eight quadrate litter samples of each each leaf species high three quadrate samples Carbon content was determined after keeping the dried samples in Muffle ferance at 200ºC overnight . Based on the rate of leaf litter fall dry weight and Carbon content of litter. Few litter species were selected for the Litter bag technique to study the movement of carbon, the same across different vegetal covers at different depths of soil in tropical forest of Amirthi forest (division in Vellore)

STUDY SITE DESCRIPTION.

The area chosen for the present study site lies between 12º.'41- 12º -43' N, 79º.02 E and 72º·43' 09.5 N, 79º03 30.1 ELocated Vellore forest division Tamil Nadu,India. at an elevation of 292 m – 364m above sea level. The study area of Southern Dry tropical riverine forest restricted to the river barks and perennial stream barks to a width of about one or two chains on either side. The soil is often coarse to fine grained sand with varying mixture of silt. They are light grey, greyish brown and reddish brown in color, slightly acidic with pH ranging from 6.0-6.5 and small variation at different depths.

It receives an average annual rainfall is 850mm to 971mm from September to December monthly average rain fall between 124.9mm to 176.9mm Rainfall is restricted to June- November. Minimum temperature recorded in winter is 29.5º C and maximum temperature recorded in summer is 45º C.Humidity levels are maximum during monsoon (June- October) and range from 67 % to 86 % and during summer 40 % to 63 % .

VEGETATION :

Vegetal cover spread across vast area of study sites are dominated by *Syzygiumcumini,Bambusaarundinacea,Ailanthus excelsa ,Poongamiyapinnata*and *Tectona grandies.*. Rest of the area occupied by a variety of trees such as *Mangiferainditca* , *Termindia arjuna* , *Meliodubia, Dexxusindica, Alangeumsalvifolium* , *Pterosperimumsuberfollum* , *Pterosperimumcancescens, Terminalia bellerica*etc .

Most of the vegetation is deciduous in nature.Foliage of canopy gets replaced every year. Herbaceous cover or floor cover begins to develop in the monsoon season (June) and is completed by January.Five types of vegetal cover were chosen to understand their influence on soil organic carbon.

LITTER COLLECTION:

Leaf Litter samples were collected at month intervals for one year. At each time of sampling $1m^2$ quadrates were randomly laid on the forest floor under 10different tree species. The litters that fell in those area were collected separately by specieswise. At each site eight quadrates were laid. The leaves collected were dried in open air (ambient temperature) and then ovendried at 75ºC to constant weight. Among eight quadrates litter samples of each litter species, three quadratesamples Carbon content was determined after keeping the dried samples in Muffle furance at 200ºCovernight . Based on the rate of litter fall dry weight and Carbon content, five litter species were selected for the Litter bag experiment to study the movement of carbon, the same across different vegetal covers at different depths of soil in tropical forest of Amirthi forest.

PHYSICA FRACTIONATION :

Physical fractionation of the soil samples was done following the method of Six e al.(2002). Briefly, the samples were screened for removal of roots and debris by passing thorough a 2mm sieve .Air dried samples (100g) were submerged in water for 30 mints and then subjected to wet- sieving . Samples were physically fractionated into two different pools,one ≥250-2000µm and the other ≤250µm by passing though250 µm size- sieve and SOC was estimated for the fractions. Fractionated sample ≥250-2000 µm was designated as the mobile pool (Pool 1) and the ≤ 250 µm size fraction was designated as the recalcitrant Pool (Pool 2). These designations were made on the basis of variation in the rate of SOC decomposition present in the two particle sizes. Similar references have been made earlier.(Arrouays ,D., et al (2006), Shrestha,B., (2007), Chevallier, T., (2004)).

SOIL SAMPLING AND ANALYSIS:

Soil samples were selected by composite sampling. Five points were identified for soil collection in each vegetal cover sites. Samples were taken as follows : Five samples at 2cm interval up to a depth of 12cm; two samples beyond 12cm and up to 20 cm at 4cm intervals; two samples beyond 20cm and up to 30 cm at 5 cm intervals; Three samples beyond 30 cm up to 60 cm at 10 intervals: Two samples beyond 60 cm and up to 90 cm at 15 cm intervals and two samples beyond 90 cm up to 1.30 cm at 20 cm intervals.

Soil samples from all the layers of five different points were pooled labeled as composite samples. Five composite samples per each vegetal cover with a distance of 5 km between any two were collected. Samples were brought to the laboratory in sealed bags; air-dried and process for SOC estimation. (Walkley, A. and Black,I.A 1934).

Litter decomposition rates are measured by four different technique, namely Mass balance, Tethered Leaves,Cohort layered Screen and Litterbags technique.

Litter bag preparation:

The litter bag approaches is widely used to study decomposition at the soil surface Fresh leaf litter is enclosed in the mesh bags placed on the ground and collected at periodic intervals for measurement of the mass remaining.

The litterbag used was made of tarpaulin sheet with 100 GSM thickness havingperforation different sizes on two sides were used. Litterbag consisted of a 0.5 mm mesh at the bottomand 2.0 mm at the top.The mesh size was assumedsmall enough to limit the physical loss of fresh litter from the bag,toreduce the intervention of invertebrates and to allow aerobic micro organism activity.

The size and content of the litterbag is also an important component of litterbag studies. The litterbag in the study was a square 20 X 20 cm bag. Leaves of each studied litter species were incubated individually. Three bags were kept for each type of leaf litter at three different depth. A total of 189 litterbags were filled with 50g of air dried litter (only leaves) collected from the floor of *S.cumini*,*B.arundinacea*,*T.grandies* ,*P. pinnata* and *A.excelsa*. These bags were placed at 5 cm, 15 cm and 25 cm depth with minimum possible disturbance. To understand the micro organism specificity towards litter; samples of Teak and Bamboo were interchanged between the two vegetal covers and kept at the same depth at different points.

Litter bag were collected carefully at the intervals of 90,220 and 320 days and the samples were carefully transported to the laboratory. Litter left in was carefully pick it up brushed out and cleared of foreign materials (Soil, roots and fauna), and washed with distilled water. Then the remaining litter in the bag was dried in open air and then oven dried at 75^0 C to constant weight before being weighted to determine the mass loss. The soil also weretaken every time form the vicinity of litter bags to observed variation in soil organic content.

LITTER MASS LOSS AND DECAY RATE CO EFFICIENT:

The rate of litter material loss was expressed as the percentage material remaining (%R) after a given time. Calculated as:

$$\% R = W(t_x)/W(t_1)x100$$

Where, $W(t_x)$ is the dry weight (g) of the leaf material after time(t_x),and $W(t_i)$ is the initial weight of the leaf material (Peterson & Cummins 1974). In the present study % R was calculated monthly as well as for the entire period.

The mean relative decomposition rate (RDR) was computed by using the formula:

$$RDR=(g\ g^{-1}\ day^{-1})=\ln (W_1-W_0)/(t_1-t_0)$$

Where, W_0=mass of litter present at the time t_0; W_1=mass of litter present at time t_1; t_1-t_0 =sampling interval (days)

(Table.1) Test of significance of difference between the species litter with respect wet weight, dry weight and carbon weight (ANOVA)

Species		N	Mean	Std. Deviation	ANOVA F-TEST	Significance P-value
Total wet weight	*Tamarindus indica*	5	920.9000	713.83331	8.524	0.000***
	Pongamia pinnata	4	947.5000	386.41299		
	Ziziphus mauritiana	4	520.3750	265.31043		
	Syzygium cumini	4	2072.0250	1390.79559		
	Bambusa arundinacea	4	1572.4000	1217.06569		
	Tectona grandis	4	2223.6750	607.58884		
	Ailanthus excelsa	12	253.2500	142.41776		
	Albizia lebbeck	6	329.5667	294.82688		
	Dalbergia lanceolaria	6	209.5833	119.63824		
	Wrightia tinctoria	5	257.7000	114.88113		
	Total	54	768.7185	876.27753		
Total dry weight	*Tamarindus indica*	5	495.0580	377.54231	8.084	0.000***
	Pongamia pinnata	4	482.3750	186.02112		
	Ziziphus mauritiana	4	250.7250	132.94085		
	Syzygium cumini	4	1051.9000	681.44137		
	Bambusa arundinacea	4	849.7750	633.04327		
	Tectona grandis	4	1086.1500	338.35454		
	Ailanthus excelsa	12	134.3917	82.87444		
	Albizia lebbeck	6	164.2833	144.59258		
	Dalbergia lanceolaria	6	99.2000	60.73151		
	Wrightia tinctoria	5	213.4000	95.68963		
	Total	54	400.3628	441.94201		
Total carbon weight	*Tamarindus indica*	5	199.8260	159.76556	9.085	0.000***
	Pongamia pinnata	4	139.6500	23.42940		
	Ziziphus mauritiana	4	88.1750	41.63591		
	Syzygium cumini	4	500.6750	308.23672		
	Bambusa arundinacea	4	242.4500	162.55499		
	Tectona grandis	4	449.5825	128.71196		
	Ailanthus excelsa	12	55.2333	37.27315		
	Albizia lebbeck	6	58.1667	48.85631		
	Dalbergia lanceolaria	6	42.0000	23.18776		
	Wrightia tinctoria	4	108.1000	41.44659		
	Total	53	158.0653	180.97735		

RESULT:

LITTER COLLECTION:

Values of the litter fall were different in different species. Litter fall data (table-1) showed significant ($P \leq 0.001$) differences between the types of vegetal cover and different periods of litter collection. There was gradual increase in the litter fall values in the five different species namely. *Tectona grandee*, *Ailanthus excelsa* by *Syzygium cumini*, *Poongamiya pinnata*, and *Bambusa arundinacea* respectively. Annual leaf litter addition was maximum in *Syzygiumcumini*, followed by *Tectona grandee and Bambusa arundinacea.* It clearly revealed the deciduous nature of these species.

Foliage of canopy gets replaced every year. Herbaceous cover or floor cover begins to develop in the month of November and its completed by April in *Albezialebbeck* ,*Dalbergiyalancerlaria* and *Wrightiatinctoria* where as other species like

*.Tamrindusindica ,Pongamiyapinnata , Ziziphusmauritiana ,Syzygiumcumini,Bambusaarundinacea*and *Tectona grandee* shows herbaceous cover in the month of January to May .

LITTER BAG:

Litter bag experiment shows near completion in the decomposition of litter kept in and 320 days intervals there is a difference in a decomposition of litter kept at different depths. Influence of plant trait variations could be seen in the rate of decomposition. (Table-2)

The dry matter loss in leaf of all five litter species and two interchanged site experiments at different sampling intervals (90,220 &320 days), were analyzed of to access the decomposition rate. Difference decomposition of litter for different types of leaf materials at different depths in the soil were found to be significant ($P \leq 0.001$) . The one kept at the top of the soil got decomposed to a maximum extent in 320 days. (99 to 87 %) and 97.2 to 88 % in *T.grandee* and *A.excels* respectively in all the depths. were as in *S.cumini*, shows high percentage of weight loss (82 %) in top layer and weight was reduced in middle and bottom layers . At the end of 90 and 220 days of experimental intervals the mass remaining and loss percentage of litter in three different species shows high rate in the top layers (5 cm depths) and reduced the percentage in decomposition in increasing depths at 25 cm and 50 cm depths, In *T. grandee*, *A. excels* followed by *S. cumini*, *P .pinnata*, and *B.arundinacea* respectively.

At the site where litter bags were exchanged between vegetal covers (*B. arundinacea* litter *T. grandee* and vice versa), The decomposition rate was less, but at time progressed was almost similar (at 320 days) to previous experiment (Table -2)

(Table-2) Mass remaining and loss(%) of five types of litter in five different site covers at three different depths(cm), after 90,220 and 320 days (n=3)

SPECIES	LITTER	90			220			320		
		TOP[5CM]	25(CM)	50(CM)	TOP(CM)	25(CM)	50(CM)	TOP(CM)	25(CM)	50(CM)
Ailanthus excelsa	Remained	26	49.2	77.8	17.5	75.4	92.5	2.8	8.8	12
	Decomposed	74	40.8	22.2	82.5	24.6	7.5	97.2	91.2	88
Pongamia pinnata	Remained	69.1	74.4	95.2	44	64	70	33.2	45.2	59.3
	Decomposed	30.9	14.6	4.8	56	36	30	66.8	54.8	41.7
Bambusa arundinacea	Remained	77.4	84.4	91.3	44	54	64	24	44	56
	Decomposed	32.6	15.6	8.7	56	46	36	76	54	44
Tectona grandis	Remained	19.8	75.3	91.3	11.6	46.5	69.6	1	8	13
	Decomposed	80.2	24.7	9.7	88.4	43.5	30.4	99	92	87
Syzygium cumini	Remained	37.5	79	91.1	26	39	82	18	64	77
	Decomposed	62.5	21	8.9	74	61	18	82	36	23
B.arundinacea litter in *T. grandis* site	Remained	72	74	82	68	74	64	44	36	38
	Decomposed	28	26	18	32	26	36	56	64	62
T.grandis litter in *B.arundinacea* site	Remained	84	80	78	76	68	72	30	22	20
	Decomposed	16	20	22	24	32	28	70	78	80

LITTER MASS LOSS AND DECAY RATE CO EFFICIENT:

The relative decomposition rate (g g-1 d-1) for decomposing leaf litter of five tree species at various depth in different days given In Table 3) The result shows 0.034 -0.047,in 90 days, 0.009-0.02in 220 days and 0.0139- 0.0143 in 320days in *A.excelsa*, 0.017-0.38,0.015-0.018,0.012- 0.013 in *P.pinnata*, 0.024-0.039,0.016-0.018,0.011-0.014 in *B.aurndinace*a,0.025- 0.049,0.16-0.020, 0.014-0.014 in*T.grandee*and 0.024-0.046, 0.013-0.020 , 0.010-0.014 in *S.cumini*, in three different days intervals.

(Table- 3) Relative decomposition rate (g g^{-1} d^{-1}) for decomposing leaf litter of five tree species at various depths in different days.

SPECIES	DAYS								
	90			220			320		
	TOP 5[CM]	25(CM)	50(CM)	TOP5(CM)	25(CM)	50(CM)	TOP 5(CM)	25(CM)	50(CM)
A.excelsa	0.047	0.041	0.034	0.02	0.014	0.009	0.0143	0.0141	0.0139
P. pinnata	0.038	0.03	0.017	0.018	0.016	0.015	0.013	0.013	0.012
B.arundinacea	0.039	0.031	0.024	0.018	0.017	0.016	0.014	0.012	0.011
T.grandis	0.049	0.036	0.025	0.02	0.017	0.016	0.014	0.014	0.014
S.cumini	0.046	0.034	0.024	0.02	0.019	0.013	0.014	0.011	0.01
B.arundinacea litter in *T. grandis* site	0.037	0.037	0.036	0.032	0.016	0.015	0.016	0.013	0.013
T.grandis litter in *B.arundinacea* site	0.031	0.033	0.034	0.014	0.016	0.015	0.013	0.014	0.014

(Table-4) The correlation between percent weight loss of leaf litter and time elapsed shows significant positive correlation (P≤ 0.05) except *A.excelsa* and *S.cumini* though positively correlated are not significant.

(Table-4) Correlation between decomposition and sampling interval.

S.No.	Species	Correlation coefficient (R)	Significant Value
1.	*Ailanthus excelsa*	.545	.129
2.	*Poongamiyapinnata*	.821**	.007
3.	*Bambusaarundinacea*	.827**	.006
4.	*Tectona grandies*	.674**	.046
5.	*Syzygiumcumini*	.274	.475
6.	*B.arundinacea* litter in *T. grandies* site	.890**	.001
7.	*T.grandies* litter in *B. arundinacea* site	.889**	.001

SOIL ORGANIC CARBON VALUES:

SOC values from the five different vegetal cover types of Southern Dry tropical Riverian forest of Amirthi forest shows significant differences (Table- 5). Difference across soil depths and between types of vegetal cover were found to be significant (P≤ 0.001). SOC content is high in top layers from 0 cm up to the depth of 16 cm at 2 cm intervals. SOC is 34.8 ± 0.68 – 14.7 ± 0.05, 27.5 ± 0.23 - 23.6 ± 0.22, 17.9 ± 0.15- 9.5 ± 0.06, 14.4 ± 0.19-10.4 ± 0.3 and 11.4±0.08 – 7.14± 0.06 for *T.grandee, P.pinnata, S.cumini, B.aurndinacea* and*A.excelsa* respectively .Soil Organic Carbon decreases with increasing the depth from 20cm up to the

depth of 60 cm at 10 cm interval , The decrease is gradual at deeper layers from 60 cm up to 125 cm the SOC is 4.6 ± 0.08, 1.8 ± 0.28, 0.6 ± 0.05, 1.5 ± 0.03 and 0.9 ± 0.04 in the same order of the species.

(Table.5) Test of significance (ANOVA) of difference in the Soil Organic Carbon Content between the species for various depths as well between the depths of various vegetal covers.

S.No.	Depth cm	*B.arundinacea*	*A.excelsa*	*S.cumini*	*T.grandies*	*P. pinnata*	ANOVA F Test P Value
		n Mean ±SE	n Mean ±SE	n Mean ±SE	n Mean ±SE	n Mean ±SE	
1	0-2	14.4 ± 0.19	11.4 ± 0.08	17.9 ± 0.15	34..8 ± 0.68	27.5 ± 0.23	781.07 ***
2	2-4	11.6 ± 0.10	11.1 ± 0.05	12.0 ± 0.40	30.3 ± 0.15	24.7 ± 0.24	4015.5 ***
3	4-8	11.1 ± 0.11	10.4 ± 0.08	11.2 ± 0.05	25.6 ± 0.18	23.0 ± 0.28	1947.7 ***
4	8-10	10.5 ± 0.15	9.3 ± 0.08	11.0 ± 0.20	24.2 ± 0.05	22.8 ± 0.35	1325.5 ***
5	10-12	10.7 ± 0.10	8.5 ± 0.07	10.4 ± 0.13	24.3 ± 0.15	22.6 ± 0.23	2459.5 ***
6	12-16	10.4 ± 0.13	7.14 ± 0.06	9.5 ± 0.06	14.4 ± 0.14	23.6 ± 0.22	2055.05 ***
7	16-20	9.2 ± 0.10	6.02 ± 0.03	8.3 ± 0.10	14.7 ± 0.05	20.5 ± 0.19	2715.04 ***
8	20-25	8.4 ± 0.10	5.14 ± 0.05	5.6 ± 0.08	14.2 ± 0.06	20.1 ± 0.12	4988.7 ***
9	25-30	8.1 ± 0.12	4.2 ± 0.08	5.4 ± 0.04	13.1 ± 0.16	18.0 ± 0.04	3309.7 ***
10	30-40	7.5 ± 0.10	3.7 ± 0.06	4.1 ± 0.03	11.5 ± 0.07	17.5 ± 0.05	1935.7 ***
11	40-50	5.1±0.08	3.9 ± 0.08	3.3 ± 0.10	9.1 ± 0.05	14.3 ± 0.05	3357.03 ***
12	50-60	4.6 ± 0.12	3.4 ± 0.07	2.8 ± 0.05	8.6 ± 0.04	13.2 ± 0.12	2272.5 ***
13	60-75	3.4 ± 0.05	2.1 ± 0.03	2.2 ± 0.03	7.5 ± 0.05	11.0 ± 0.05	4524.3 ***
14	75-95	2.6 ± 0.07	1.8 ± 0.03	1.8 ± 0.03	6.6 ± 0.07	9.6 ± 0.16	1539.7
15	95-110	2.1 ± 0.06	1.2 ± 0.03	0.6 ± 0.05	5.2 ± 0.08	7.6 ± 0.05	2276.6 ***
16	110-125	1.5 ± 0.03	0.9 ± 0.04	0.3 ± 0.04	4.6 ± 0.08	1.8 ± 0.28	143.48 ***
ANOVA F. Value		1203.8	3193.8	2864.25	2179.7	1308.4	

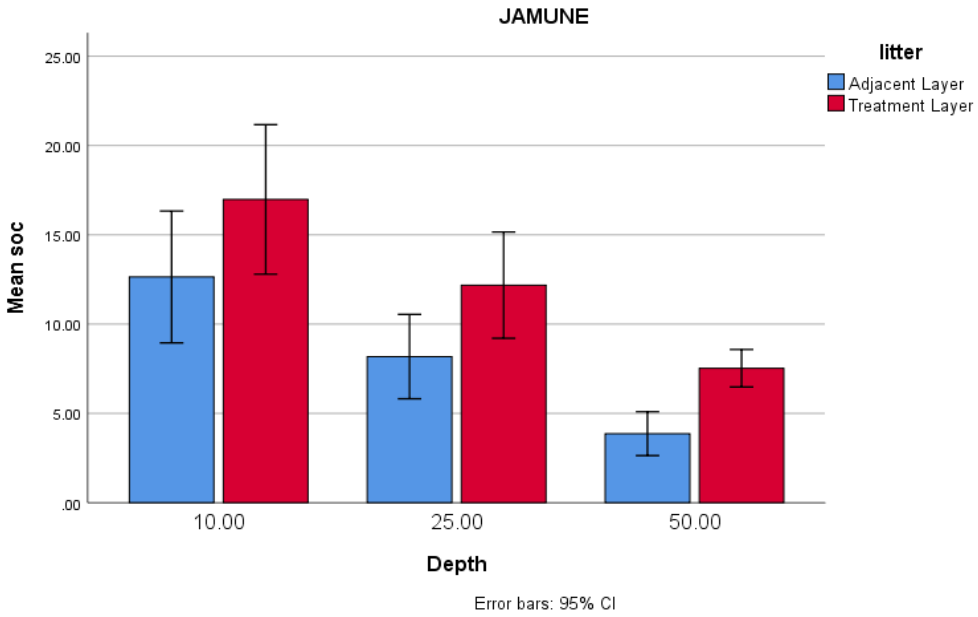
SOC POOLS:

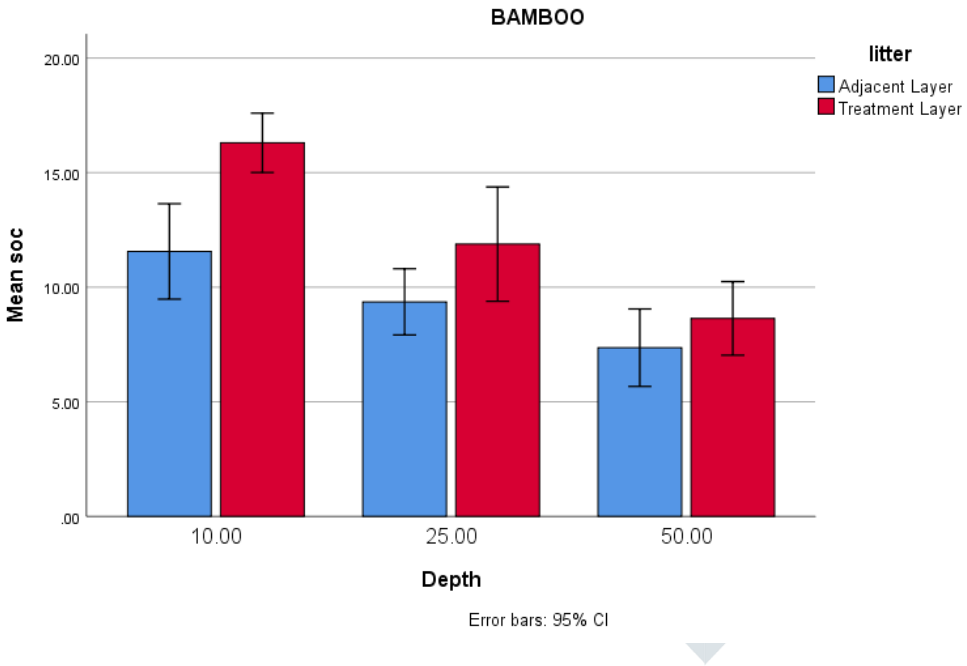
Proportion of physical fractioned two pools of soil samples from the town vegetal covers remained almost some (6- 18% for Pool 1and 94-82% for fool 2) at different depths (Table -6) SOC content of soil from the Litter-bag experiment was increased in the range of 9- 27% (Fig -1) than adjacent layer.

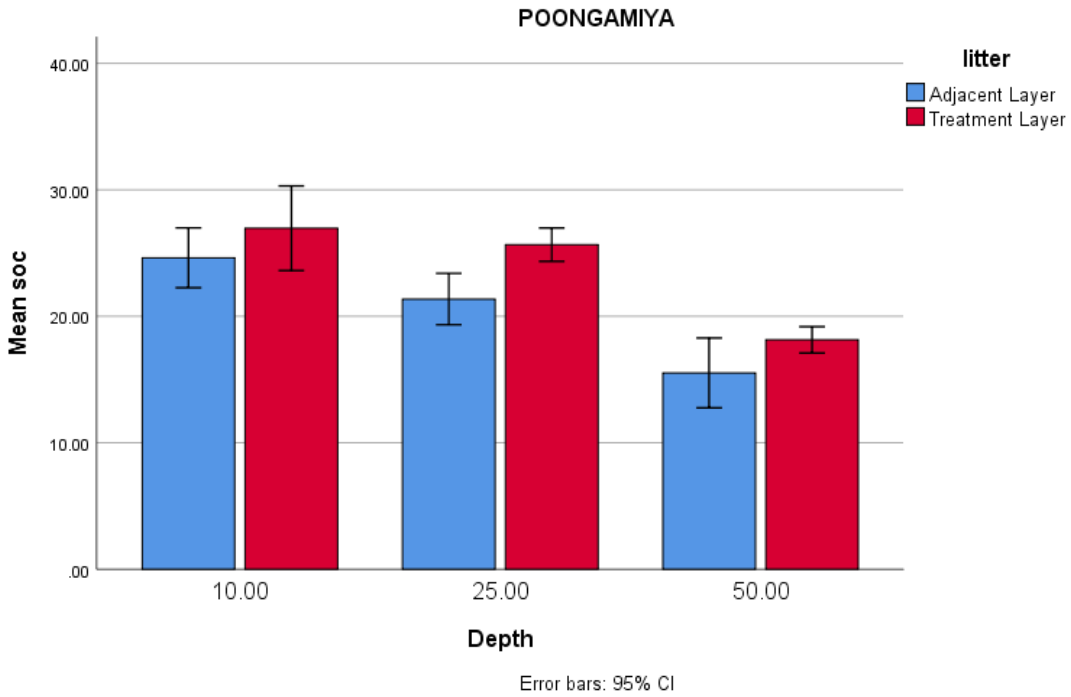
(Table- 6) SOC Content (g kg^{-1})in Pool-1 (≥ 250-2000µm) and Pool-2 (≤ 250 µm) of Four different vegetal covers soils with different depths (Mean ± SE)

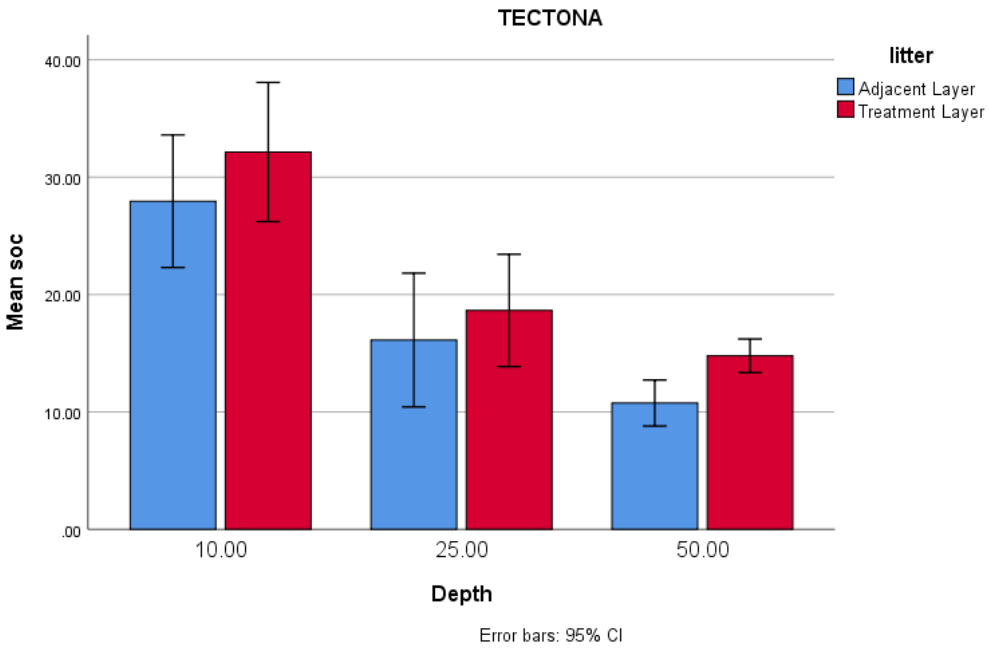
Depth in cm	*B.aurndinacea*		*S.cumini*		*T.grandee*		*P.pinnata*	
	Pool-1	Pool-2	Pool-1	Pool-2	Pool-1	Pool-2	Pool-1	Pool-2
0-2	3.2 ± 0.05	11.4 ±0.13	1.84 ±0.07	16.06 ±0.12	4.6 ±0.14	30.2 ± 0.06	3.7 ± 0.06	24.8 ± 0.02
2-4	2.41 ± 0.02	10.09±0.12	1.43±0.4	10.75±0.09	4.2±0.03	26.9±0.2	2.66±0.13	22.04±0.15
4-8	1.20±0.15	9.98±0.03	1.9±0.12	9.33±0.07	4.5±0.14	21.17±0.1	3.04±0.15	21.20±0.02
8-10	1.03±0.05	10.17±0.09	1.55±0.02	9.05±0.04	2.7±0.04	21.5±0.08	2.4±0.06	20.66±0.13
10-12	1.0±0.06	11.05±0.08	1.36±0.12	9.59±0.03	3.1±0.17	20.49±0.15	2.8±0.01	20.4±0.05
12-16	1.55±0.02	9.01±0.12	2.24±0.5	6.26.±0.07	1.35±0.19	13.05±0.13	2.3±0.04	21.2±0.15
16-20	1.74±0.06	8.76±0.1	2.83±0.11	5.47±0.04	1.0±0.06	13.7±0.13	3.01±0.12	17.26±0.12
20-25	2.7±0.08	5.70±0.14	2.1±0.03	3.69±0.14	3.1±0.04	11.14±0.05	4.1±0.05	16.53±0.12
25-30	3.5±0.01	4.6±0.01	2.1±0.06	3.43±0.1	2.6±0.14	10.67±0.05	2.9±0.4	16.09±0.11
30-40	1.74±0.1	1.26±0.02	1.3±0.02	2.70±0.08	2.2±0.02	8.09±0.18	5.2±0.01	12.31±0.11
40-50	1.19±0.15	4.16±0.03	1.3±0.01	2.0±0.11	2.0±0.05	7.10±0.03	4.1±0.12	11.10±0.04
60-75	0.74 ± 0.06	6.01±0.2	2.81±0.12	4.01±0.03	1.62±0.04	6.01±0.14	4.38±0.04	7.25±0.08
90-110	0.44 ± 0.05	3.69±0.04	0.7±0.4	2.24±0.5	0.7±0.5	4.35±0.02	3.4±0.11	6.13±0.03
110-130	0.48 ± 0.05	4.15±0.02	0.14±0.1	0.55±0.4	0.26±0.12	4.15±0.01	2.7±0.15	4.98±0.09

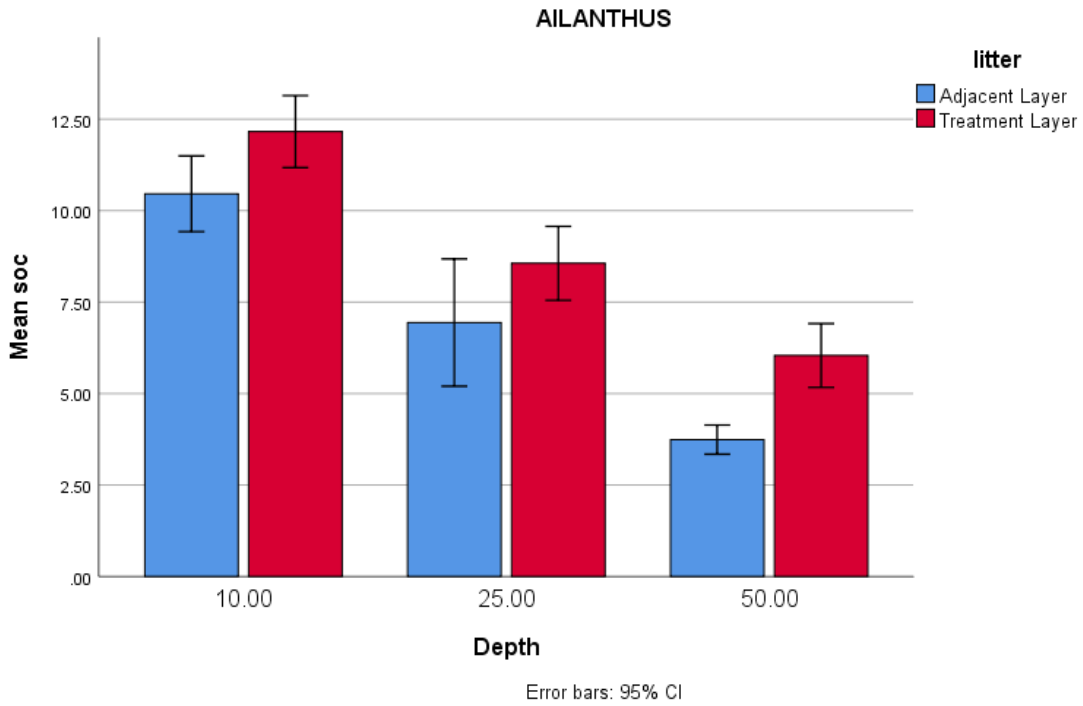
(Fig-1) SOC quantity in showed difference between subsequent layer and adjacent layers.






POONGAMIYA
litter
Adjacent Layer
Treatment Layer
Mean soc
40.00
30.00
20.00
10.00
.00
10.00
25.00
50.00
Depth
Error bars: 95% CI


TECTONA
litter
Adjacent Layer
Treatment Layer
Mean soc
40.00
30.00
20.00
10.00
.00
10.00
25.00
50.00
Depth
Error bars: 95% CI



Physical fraction of soils collected from the litter bag experiment showed a small increase in the range of 10-20% and 5-10%for Pool-1 and 2 respectively.

DISCUSSION:

The rise in SOC values is negligible in comparison with quantity of litter added annually, indicating that most of the litter that falls gets decomposed. This also shows that SOC present in the top layers of the soil does not come from the fresh litter alone. It is from the cumulative accumulation of undecomposed (Partially decomposed left over litter of previous years. Thisresults reveals that SOC gets soaked in to the lower layers.Additioncoming from the decomposition of fresh litter is less.

At all the experimental points leaf- litter gets decomposed within a year. An earlier study Brown,S., and Lugo, A.E., (1982). reported that the turn over time of litter in tropical forest is less than one year. Our results are in conformity with this report .SOC results shows positive correlation between the quality of litter and amount of SOC present in the top layers, indicating that the pattern of decomposition of litter is different for the types of vegetal cover. There is a significant difference in the down ward movement of SOC in the five types of the vegetal cover. This confirm that SOC in the tropical soils depends on the type of vegetal covers.

The differences in the quantities and movement of SOC seen across the soil of the study area indicates that their sink potential is high, Due to the difference in the quantities and movement of the soil organic carbon, litter bag experiment is conducted to validate this observation. The rate of decomposition and subsequent changes in the quantity of SOC seen in this soils indicates that additional inputs (Though the quantity in the bag small) can be easily taken in.

The litter bag experiment show the ability of tropical soil to take up extra carbon and also the understanding for the mechanics of movement of SOC in the tropics.The SOC present the top 0-20cm of the soil moves almost passively .The soil organic carbon (SOC %) in the soil (Treatment layer) of litter bag study was comparatively increase at the significant level ($P \leq 0.05$)with adjacent layer of five different stands . The litter bag experiment showed some ‘site effect ie more rapid decomposition when litter was placed beneath the parent vegetationrather than beneath other species. This is a result conformity with result of (Ayres et al., 2009; Perez et al., 2013. Wang et al., 2013) The proportion of Pools 1and 2 remained the same across the profile. There was a decrease in socdeeper layers, but proportion of the recalcitrant Pool remained almost same.

ACKNOWLEDGEMENT:

We are grateful to the State Forest Department, Tamil Nadu and Chief Conservator of Forest, Vellore Forest Division granting permission to carry out this study, which is the Part of Ph.D., program. We sincerely thank the Principal, Voorhees College, Vellore and Head of the Department – Dept of Zoology for facilities and encouragement provided during this study. We also thank Range forest officer and frontline staffs of the Amirthi Zoological Park for their constant field supports.

REFERENCE:

- **Aerts, R. (1997).** Climate leaf litter chemistry and leaf litter decomposition in terrestrial ecosystem: a triangular relationship. Oikos 79: 439-449
- **Attignon, S.E., D. Weibel, T.Lachat ., B. Sinsip,P. Nagel and R. Peveling , (2004).** Leaf litter breakdown in natural and plantation forests of the Lama forest reserve in Benin. Applied Soil Ecology 27: 109-124.
- **Arrouays,D ., Saby, N., Walter, C., Lemercier, B. and Schuvartz, C.,** Relationships between particle-size and organic carbon in French arable topsoils. Soil use Manage., 2006, 22,48-51.
- **Berg.B.andH.Staaf. (1980).** Decomposition rates and chemical changes in decomposing needle litter of scots pine, II. Influence of chemical composition. In: **T. Person (ed.)** Structure and function of northen coniferous forest , Ecological Bulletins 32: 373-390.
- **Bernhard – Reversat, F. (1982).** Measuring litter decomposition in a tropical forest ecosystem: Comparison of some methods. International Journal of Ecology and Environmental Science 8: 63-71.
- **Bernhard – Reversat, F .and D. Schwarts.(1992) .**Change in lignin content during litter decomposition in tropical forest soil (Congo): Comparison of exotic plantation and native stands. CompeteRendu de l Academic des sciences 325: 427-432.
- **Bernhard – Reversat , F ., J.J . Loumeto and J.P Laclau (2001).** litter fall, Litter quality and decomposition changes with Eucalypt hybrid and plantation age. PP,22-29.
  In:F. Bernhard – Reversat (ed) Effect of Exotic tree plantation on plant Diversity and Biological soil fertility in the Congo Savanna: With special Reference to Eucalypts center for Inter-national Forestry Research, Bogor, Indonesia.
- **Binkley D. (2002).** Ten –Year decomposition in loblolly pine Forest, Canadian Journal of Forest Research 32 (12): 2231-2235.
- **Cleveland, C.C, S.C Reed and A.R. Townsend (2006).** Nutrient regulation of organic matter decomposition in a tropical rain forest. Ecology 87: 492-503.
- **Chevallier, T., Blanchart, E., Albrecht, A. and Feller, C,** the physical protection of soil organic carbon storage in a vertisol under pasture and market gardening (Martinique, West Indies). Agric. Ecol.Environ., 2004, 103,375-387.
- **Goma –Tchimbakala, J. and Bernhard –Reverest.F(2006)**. Comparison of litter dynamics in three plantations of an indigenous timber- tree species(*Terminalia superba*) and a natural tropical forest in Mayombe , Congo.Forest Ecology and Management 229: 304- 313.
- **Hanson.P.J., Swanston.C.W and Garten.C.T.(2005).** Reconciling chang in Oi-hCarbon $^{-14}$ with mass loss for an oak Forest. Soil Society of America Journal 69: 1492- 1502.
- **Harmon ME, Lajtha .K(1999).** Analysis of detritus and organic horizons for mineral and organic constituents. In: Robertson GP, Bledsoe CS. Coleman DC, Sollins P. (Eds) Standard soil methods for long –term ecological research: Oxford University Press, New York, PP.143-165.
- **Kaspari, M., M.N. Garcia, K.E Harms, M. Santana, S.J. Wright and J.B Yavitt (2008).** Multiple nutrients limit litter decomposition in a tropical forest. Ecology Letters 11: 35-43.
- **Loranger,G., J.F. Ponge, D, Imbert f and P. Lavelle. (2002)**. Leaf decomposition in two semi- evergreen tropical forests: Influence of litter quality. Biology and Fertility of soils 35: 247- 252.
- **Mc Claugherty , C. and B.Berg (1987) .** Cellulose,lignin and nitrogen levels as rate regulating factors in late stages of forest litter decomposition. Pedobiologia 30: 101-112.
- **Meentemeyer, V (1978).** Macroclimate and lignin control of litter decomposition rates Ecology 59: 465-472.
- **Musvoto .C., B.M. Cambell and A.Kirchmann. (2000).** Decomposition and nutrient release from mango and miambo woodland litter in Zimbabwe. Soil Biology and Biochemistry 32: 1111-1119.
- **Pan, Y., R. A. Birdsey , J. Fang , R.Houghton , P.E. Kauppi, W.A. Kurz., O.L.Phillips, A.Shvidenko, S.L.Lewis , J.G. Canadell , P.Ciais , R.B. Jackson, S.W. Pacala , A.D . Mc Guire, Shilong Piao, A. Rautianianen, S.Sitch&D.Hayes.(2011).** A large and persistent Carbon sink in the worlds Forest science 333: 988-993.

- **Rayan, M.G., J.M Melillo and A. Riccia (1990).** A Comparison of methods for determining proximate carbon fractions of methods for forest litter. Canadian Journal of Forest Research 20: 166-171.
- **Shrestha,B.M., Singh, B.R., Sitaula , B.K., Lal, R and Bajracharya .R M.,** Soil aggregate – and particle associated organic carbon under different land uses in Nepal. Soil Sci .Soc.Am. J., 2007, 71.1194-1203.
- **Six,j., Callewaert, P., Degryze,S., Morries ,S.,J Gregorich, E,G., Paul,E,A and Paustrian** , K., Measuring and understanding carbon storage in afforested soils by physical fractionation. Soil Sci., Soc Am.J., 2002, 66,1981-1987.
- **Songwe, N.C., F.W. Fastoum and D.V.V Okali (1988).** Litter fall and productivity in a tropical rainforest, Southern Bukundu Forest Reser, Cameroon. Journal of Tropical Ecology 4: 25-37.
- **Tian, G., B.T. Kang &L.Brussard . (1992).** Biological effects of plant residues with contrasting chemical composition under humid tropical condtions – decomposition and nutrients release. Soil Biology and Biochemistry 24: 1051- 1060.