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ORGANIC MATTER DYNAMICS IN TEAK AND EUCALYPT PLANTATIONS

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ABSTRACT

Soil organic matter, a key component of soil, releases nitrogen, phosphorus, sulphur and other elements during its decomposition and it has beneficial effects on the physical, chemical and biological properties of soils. Clearfelling, slash burning and plantation activities can lead to positive or negative changes in organic matter content of soils. This project was initiated to evaluate organic matter changes along linear sequences in teak and eucalypt plantations in relation to natural forest.

Five sequences. Thora and Karulai for teak ***(Tectona grandis),*** Kadasseri and Tirunelli for eucalypts ***(Eucalyptus tereticornis*** and ***E. grandis)*** and Kollathirumed for teak, eucalypt and albizia ***(Albizia falcataria)*** intermixed were selected Soil samples were taken along the sequence at 0, 200, 400, 600, 800, 1000, 1200,1400, 1600, 1800, 2000, 2200, 2400, 2600 and 2800m starting from natural forest. At every sampling locale, fixing a tree as central point, **15** surface samples (0-20cm) within a radius of 10m and one sample each from ***0-20 ,***20-40, and 40-60cm layers of a central pit were taken Altogether 1350 samples were analysed for organic carbon (OC) according to Walkley and Black method. Analysis of variance was done for each sequence to ascertain the variation within OC values of 15 locales and that within 15 surface samples of each locale.

F-values are significant fox the locales in all the sequences. The nonsignificance of F-values and the relatively low coefficients of variation for surface samples suggest that the OC values at each locale can be pooled. Least significant difference test shows that for the Thora, Karulai, Kadasseri, Tirunelli and Kollathirumed sequences 3, 13, 10, 1 and 3 locales have lower and 5, 0, 0, 1 and 7 locales have higher levels of OC compared to natural forest.

At Thora, OC values in teak plantations remain close to that of natural forest and plantation activities have not caused any drastic change in OC content of soils. A decline in OC levels occurs in teak plantations of Karulai sequence and this is attributable to plantation operations in the early stages of second rotation. Eucalypt plantations at Kadasseri have relatively lower contents of OC than that of natural forest and the trend at Tirunelli is opposite. At Tirunelli, well-established root systems of seedling trees and the addition of branches, twigs and leaves after coppicing promote accumulation of OC. Compared to natural forest, higher levels of OC occurs in teak, eucalypt and albizia plantations of Kollathirumed.

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Key words : Soil organic matter, organic carbon in plantations. teak, eucalypt, albizia.

INTRODUCTION

Soil Organic Matter (OM) includes plant and animal residues at various stages of decomposition. During the decomposition of OM, there is gradual release of nitrogen, phosphorus, sulphur and other elements. Kyuma et al. (1969), Mikhaylova (1970) and Palaniappan (1975) show that the amount of nitrogen released is closely related to the OM content in soil. Both the quantity of organic phosphorus and rate of mineralisation are positively correlated with the amounts of organic carbon and nitrogen in soils (Jackmann 1955, Purushothaman 1964). Further, application of OM increases soluble phosphate content of soils (Brams 1973, Singh and Hariram 1977). Waksman and Iyer (1932) show that calcium, magnesium and potassium are bound to OM and Nishita et al. (1956) observe that the uptake of potassium increases in pot culture experiment as the concentration of OM increases. OM is a reservoir of sulphur (Evans and Rost 1945) and reports ofLeela (1967) and Virmani and Kanwar (1971) indicate close correlation between OM and total as well as organic sulphur. OM is an important pool of micronutrients. Many of the micronutrients are sparingly soluble and in the absence of OM it is impossible for crops to obtain enough of these, even though only microquantities are required (Allison 1973). Thomas (1975) observes that aluminium content in soils decreases with increase in OM. Singh and Lal (1976) report that certain organic acids possess growth-promoting properties and they also observe that some compounds serve as chelating agents while others are fungitoxic.

Besides being a storehouse of various nutrients, OM has beneficial effects on the physical, chemical and biological properties of soils. McHenry and Russell (1944, cited in Singh and Lal 1976) note that OM upon decomposition furnishes microbially produced slimes and mucilages which act as cementing agents. Soil structure improves with increasing levels of OM (Cecconi and Bacetti 1955) and studies of Korschens and Greilich (1981) and Tsutsumi (1958) show close relationship between OM and aggregation and particle as well as bulk densities of soils. Permeability of soils is also increased by the addition of OM(Biswas and Ali 1969, Salter and Haworth 1961). OM influences buffer and exchange capacities of soils (Kalisz and Stone 1980) and Sanchez (1976) reports that in many highly weathered tropical soils, maintenance of cation exchange capacity is almost equivalent to maintenance of OM. Richer the variety of microorganisms, more satisfactory the working of OM cycle and the shift in the microorganisms in response to different cropping sequences has a bearing on the biological activity of soil in decomposing organic matter, solubilising unavailable nutrients and making them available to plants (Drift 1959). Voss-Lagerlund (1976) reports that microbial breakdown of OM is important to the maintenance of fertility and productivity of forest ecosystems.

The usual practice for establishing teak and eucalypt plantations in Kerala is to clearfell a natural forest or mature stand, burn the area and then plant with the required species. Changes may occur in OM content of soils due to plantation activities and this project was initiated to evaluate OM changes along linear sequences in teak and eucalypt plantations in relation to natural forest.

REVIEW OF LITERATURE

Effect of clearfelling on *soil* organic matter content

The clearing of natural vegetation has short and long- term effects on OM status of a site. Investigations of Dryness and Youngberg (1957) and Shibata et al. (1951) indicate that denudation results in increased oxidation of OM. In clearfelled areas, Trimble and Tripp (1949) find that all the OM disappears and even after 50 years its content is low. After clearing a forest in Ghana, OM content of the topsoil decreases by 57% after three years of exposure, whereas under shade the decrease is only 27% (Cunningham 1963). Jaiyebo and Moore (1964) note that OM in the 0-l0cm layer decreases from 4.4% under bush fallow to 1 4% when the soil has been kept bare for six years. To maintain OM in the surface soil at a level comparable to that under secondary forests, 16 tons of plant materials are to be applied/ha/yr (Juo and Lal 1977). In Kerala, Thomas (1964) observes that OM and nitrogen are leached to greater depths in deforested areas compared to natural forest. However, there is no serious depletion of nutrients during the course of two years after deforestation. Chaly and Koshy (1967) in their studies on the effect of deforestation on OM, nitrogen and potash status of some forest soils of Kerala, show that OM in the surface layer is reduced substantially with intensity of denudation.

Effect of slash burning on soil organic matter content

Fire burns OM,heats up the topsoil and changes the physicochemical properties of soils some of which may be conducive to growth and development of plants whereas others may be detrimental (Banerjee and Sumerchand 1981). The practice of burning at the end of a long dry season leads to destruction of 70% OM in the surface 7.5cm of the soil (Youngberg 1953). Vukicevic and Milosevic (1960) find that after fires, OM content decreases but after 10years it increases. A small but significant increase in OM content following burning is noted by Nye and Greenland (1964). Viro (1974) shows that burning causes marked decrease in C:N ratio and due to leaching of bases initial OM level is reached only after 55 years.

Effect of plantations on soil organic matter content

Jenny et al. (1949) report that the time required to reach near equilibrium accumulation of OM is less than a decade in tropical soils, 30–60 years under ***Quercus californica*** and 100-200 years under ***Pinus ponderosa.*** Due to clearance and subsequent cultivation 9% OM is lost per annum (Kowal and Tinker 1959) snd significant drop in OM content occurs in the first and second rotation coniferous and broadleaved plantations compared to indigenops forests in Kenya (Robinson 1967). Cornforth (1970) observes that in Trinidad, ***Pinus caribaea*** established after clearing tropical evergreen forests reduced 74% of the organic reserves. Jose and Koshy (1972) studying the morphological and physical characteristics of Nilambur soils in natural forest and teak plantations of 1, 15,30, 60 and 120 years report that only the natural forest and the oldest teak plantation have distinct surface horizons rich in OM. Singhal et al. (1975) find that eucalypts when raised in sal zone change the rate of litter return which decreases the OM status hitherto occurring under natural sal. Lundgren, (1978), while studying the natural and plantation soils in Tanzanian Highlands reports that the effect of man-made forests on soil varies considerably and soils under natural forests are always richer in OM than those under plantations.

MATERIALS AND METHODS

Five sequences were selected with two each representing teak ***(Tectona grandis)*** and eucalypts ***(Eucalyptus tereticornis*** and ***E. grandis)*** and one teak, eucalypt and albizia ***(Albizia falcataria)*** intermixed. The sequences were Thora and Karulai for teak, Kadasseri and Tirunelli for eucalypts and Kollathirumed for teak, eucalypt and albizia intermixed (Fig. **1)**. The natural forests at Thora, Kadasseri, Karulai and Tirunelli are South Indian Moist Deciduous and that at I<ollathirumed is West Coast Tropical Evergreen. Elevation, drainage and year of plantations for the five sequences are given in Fig. 2 and Table **1.**

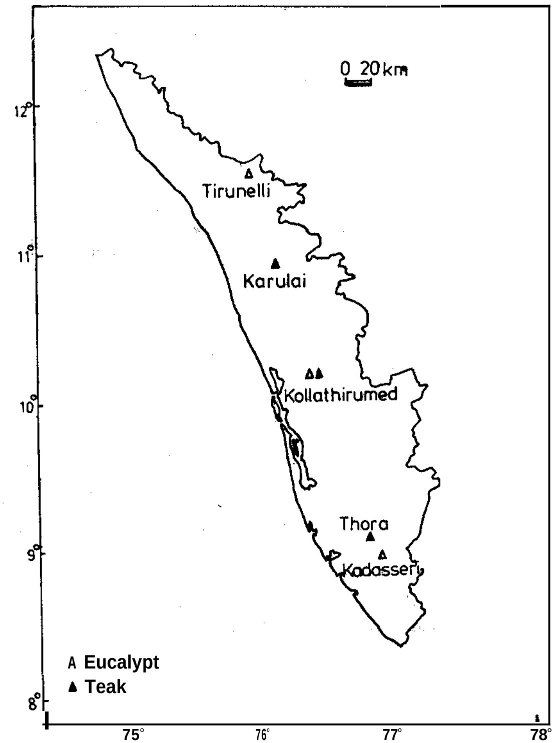

FIG. 1 LOCATION OF STUDY AREA

Soil samples were taken along, the sequences at 0, 200, 400, 600, 800, 1000, 1200, 1400, 1600, 1800, 2000, 2200, 2400, 2600 and 2800m starting from natural forest (Table 1). As most of the feeding roots were concentrated in the top 0–60cm of soil, depth-wise sampling was restricted to 60cm. At every sampling locale, fixing one tree as central point, a pit was dug near the tree and one sample each was taken from 0–20, 20-40 and 40-60cm layers. Sampling pattern for the surface samples (0–20cm) is shown in Fig. **3.** Fifteen surface samples were taken within a radius. of 10m from the tree, one from 0–2, two from 2–4, three from 4-6, four from 6-8 and five from 8-10m radii. Thus there were 18 samples from one locale and 270 samples from a sequence. Altogether there were 1350 samples from the five sequences.

Soil samples were air–dried and passed through 2-mm sieve. Organic carbon (OC), analysis was done according to Walkley and Black method (Allison 1965). OM content is obtained by multiplying OC value with 1.732, assuming that carbon. constitutes 58% of OM.

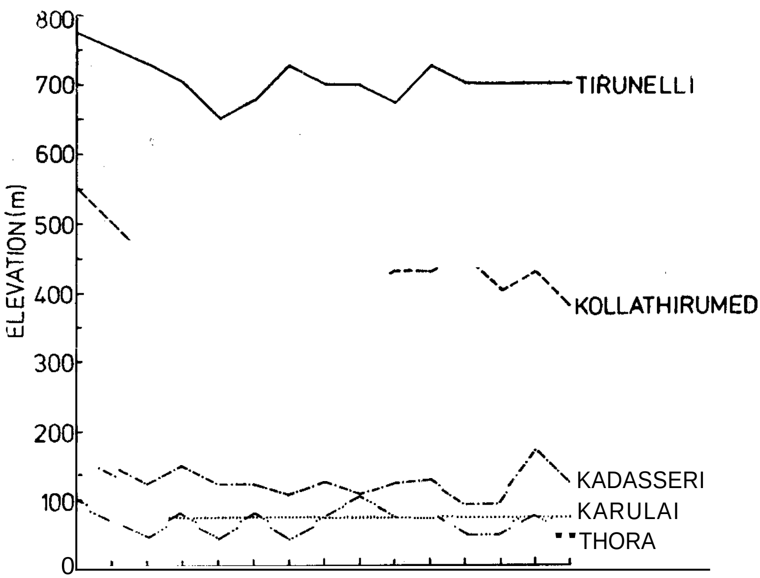

Table 1. Description of different sequences

Sequence	Range & Division	Site parameters	Detail of locales*	
Thora	Mannarappara, Konni	Hilly 50-100m, well drained, teak	1	natural forest
			2-5	1980
			6-9	1975
			10 & 11	1973
			12	1971
			13-15	1970
Karulai	Karulai, Nilambur	Level. 80m, well drained, teak	1	natural forest
			2-15	1974
Kadasseri	Pathanapuram, Punalur	Hilly, 125-150m, well drained, eucalypt	1	natural forest
			2-4	1981
			5-12	1979
			13-15	1977
Tirunelli	Begur, Wynad	Hilly, 650-775m, well drained, eucalypt	1	natural forest
			2-5	1914;
			6-8 & 12	1971, 1981 coppice
			9-11	1972
			13	1970, 1980 coppice
			14 & 15	1969, 1979 coppice
Kollathirumed	Kollathirumed, Vazhachal	Hilly, 375-550m, well drained, teak-eucalypt-albizia intermixed	1	natural forest
			2 & 4	1981 teak
			3	1967 eucalypt
			5	1979 teak
			6-9	1979 albizia
			10-14	1980 teak
			15	1980 albizia

* Sampling locales 1 to 15 are at 0, 200, 400, 600, 800, 1000, 1200, 1400, 1600 1800, 2000, 2200, 2400, 2600 and 2800m respectively.

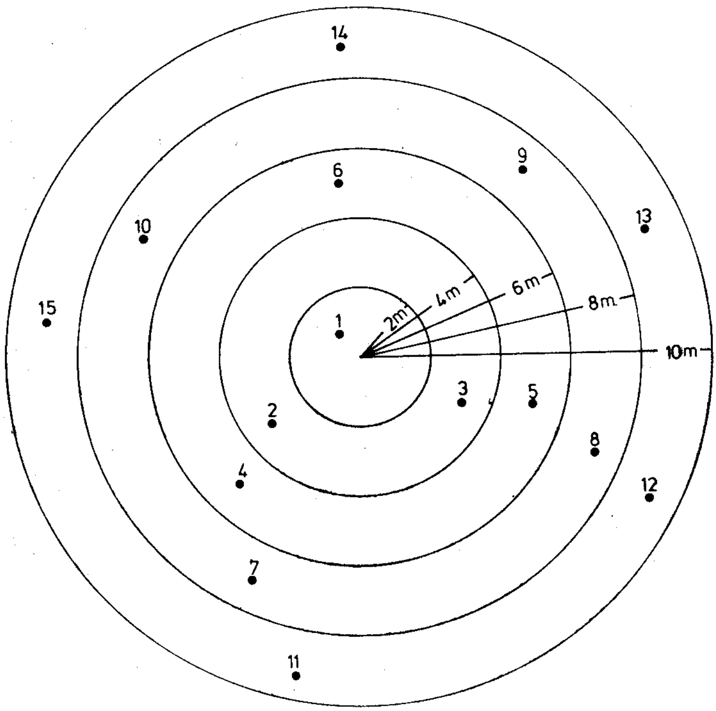

FIG 3 SAMPLING PATTERN OF THE SURFACE SAMPLES

RESULTS AND DISCUSSION

Tables 2-6 show the OC values (%) in the surface (0-20cm) and 0-20,20-40 and 40-60cm layers at various locales of the sequences. Figures 4 and 5 represent the distribution of OC in the surface samples and soil pits. Analysis of variance was done for each sequence to ascertain the variation within OC values of 15 locales and that within the 15 surface samples of each locale (Table 7). F–values are significant for the locales in all the sequences. The fact that F-values for surface samples are not significant suggest that the OC values at each locale can be pooled. The relatively low coefficients of variation also justify the propriety of this procedure (Tables 2-6).

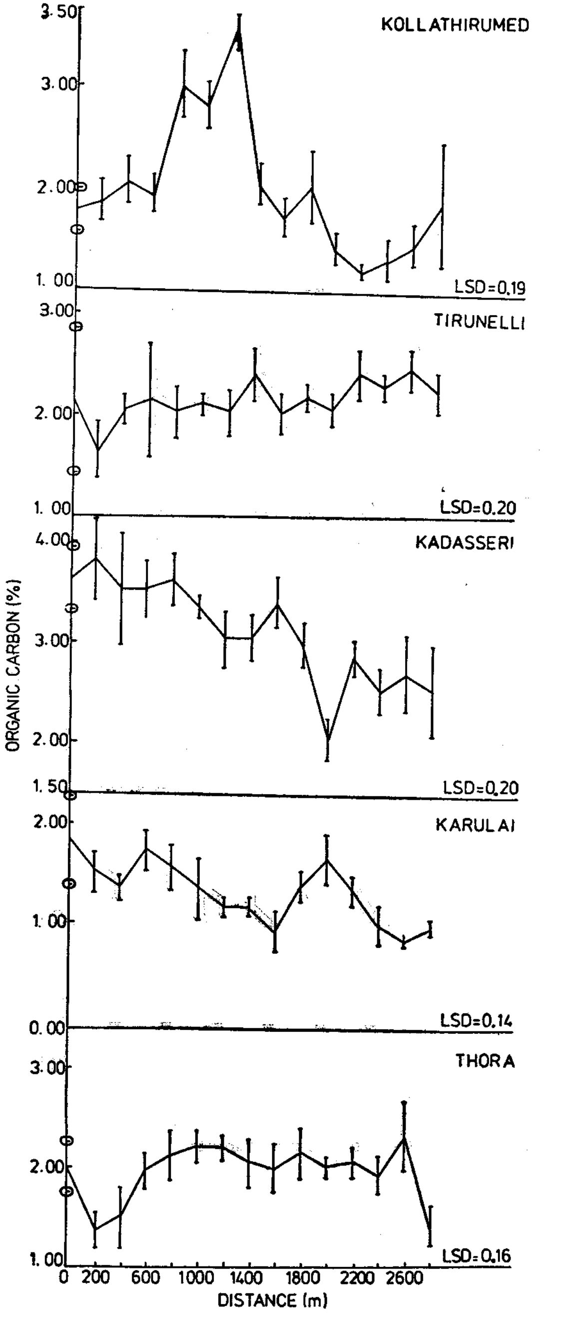

FIG. 4. DISTRIBUTION OF ORGANIC CARBON IN THE SURFACE SAMPLES (0-20 cm) OF THE 15 LOCALES (BAR DENOTES ±SD)

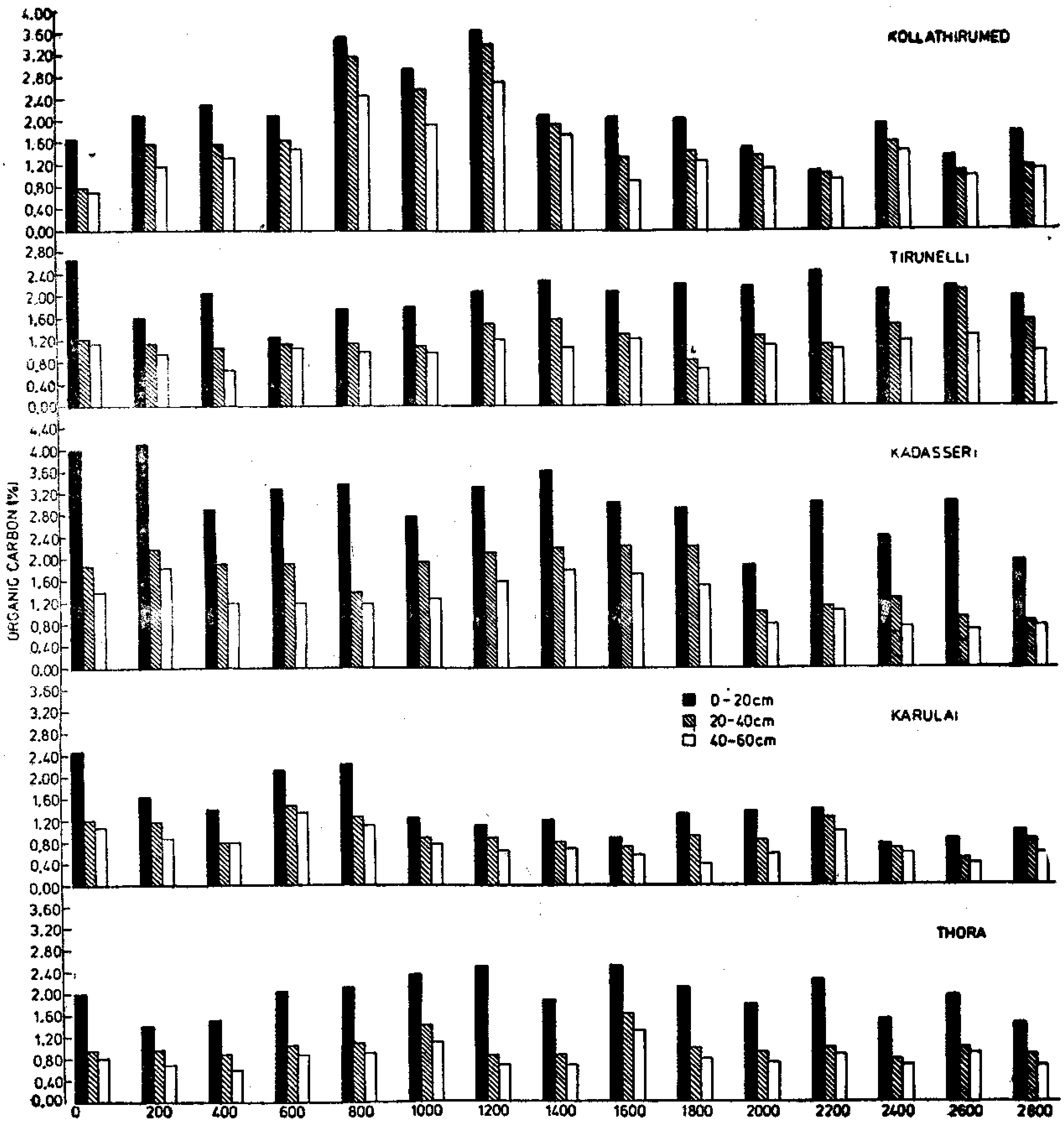

FIG. 5 DISTRIBUTION OF ORGANIC CARBON IN THE SOIL PITS OF THE 15 LOCALES

Table 2. Distribution of organic carbon in the Thora sequence

Distance from natural forest (m)	Organic carbon (%)				
	Surface samples n = 15		Soil pit		
	mean	cv	0-20cm	20-40cm	40-60cm
0	1.93	13	2.01	0.94	0.81
200	1.38	13	1.41	0.95	0.68
400	1.50	20	1.50	0.87	0.60
600	1.98	9	2.06	1.05	0.86
800	2.12	11	2.13	1.07	0.93
1000	2.20	8	2.36	1.43	1.13
1200	2.19	6	2.49	0.86	0.66
1400	2.06	12	1.88	0.87	0.69
1600	1.99	12	2.51	1.63	1.31
1800	2.15	12	2.12	0.98	0.81
2000	2.01	5	1.79	0.93	0.71
2200	2.06	7	2.25	0.98	0.86
2400	1.92	9	1.52	0.77	0.69
2600	2.30	16	1.97	0.99	0.90
2800	1.41	15	1.44	0.88	0.66

Table 3. Distribution of organic carbon in the Karulai sequence

Distance from natural forest	Organic carbon (%)				
	Surface samples n=15		Soil pit		
	mean	CV	0-20cm	20-40cm	40-60cm
0	1.89	24	2.47	1.19	1.08
200	1.57	13	1.63	1.17	0.87
400	1.41	8	1.41	0.79	0.80
600	1.79	11	2.12	1.45	1.86
800	1.59	14	2.23	1.26	1.11
1000	1.38	22	1.24	0.89	0.78
1200	1.19	8	1.13	0.87	0.67
1400	1.18	9	1.20	0.80,	0.67
1600	0.96	22	0.86	0.72	0.55
1800	1.41	11	1.33	0.91	0.39
2006	1.67	14	1.35	0.85	0.60
2200	1.39	8	1.42	1.24	1.01
2400	1.07	18	0.77	0.68	0.60'
2000	0.86	6	0.85	0.49	0.40
2800	0.99	8	1.00	0.85	0.6

Table 4. Distribution of organic carbon in the Kadasseri sequence

Distance from natural forest (m)	Organic carbon (Oh)				
	Surface samples n=15		Soil pit		
	mean	cv	0–20cm	20-40cm	40-60cm
0	3 61	8	4.01	1.89	1.41
200	3.80	11	4.1 2	2.21	1.84
400	3.50	16	2.93	1.91	1.19
600	3.51	8	3.34	1.91	1.19
800	3.58	7	3.42	1.42	1.19
1000	3.33	3	3.22	1.94	1.28
1200	3.02	10	3.31	2.1 1	1.58
1400	3,04	7	3.64	2.21	1.80
1600	3.36	8	3.06	2.25	1.91
1800	2.96	7	2.93	2.23	1.51
2900	2.04	9	1.86	1.04	0.80
2200	2.84	6	2.92	1.10	1.06
2400	2.50	9	2.38	1.28	0.74
2600	2.67	14	2.38	0.94	0.68
2800	2.50	18	1.96	0.84	0.76

Table 5. Distribution of organic carbon in the Tirunelli sequence

Distance from natural forest (m)	Organic carbon (%)				
	Surface samples n = l5		Soil pit		
	mean	cv	0-20cm	20-40cm	40-60cm
0	2.18	32	2.70	1.24	1.16
200	1.66	16	1.63	1.16	0.96
400	2.05	7	2.07	1.09	0.67
600	2.14	25	1.26	1.17	1.10
800	2.05	12	1.81	1.15	0.97
1000	2.12	5	1.85	1.11	0.98
1208	2.05	11	2.11	1.54	1.23
1400	2.34	10	2.32	1.62	1.08
1600	2.02	10	2.13	1.32	1.23
1800	2.17	6	2.25	0.83	0.70
2000	2.05	8	2.21	1.29	1.11
2200	2.34	11	2.46	1.11	1.04
2400	2.28	5	2.10	1.46	1.19
2600	2.46	8	2.20	2.10	1.27
2800	2.23	9	1.99	1.57	098

Table 6. Distribution of organic carbon in the ,Kollathirumed sequence

Distance from natural forest	Organic carbon (%)				
	Surface samples n=15		Soil pit		
(m)	mean	cv	0-20cm	20–40cm	40–60cm
0	1.80	10	1.67	0.79	0.71
200	1.87	11	2.14	1.58	1.20
400	2.09	10	2.32	1.62	1.36
600	1.95	9	2.10	1.67	1.54
800	3.04	11	3.54	3.21	2.47
1000	2.83	8	2.97	2.59	1.96
1200	3.59	3	3.66	3.40	2.71
1400	2.09	10	2.10	1.97	1.78
1600	175	11	2.06	1.36	0.92
1800	2.06	17	2.04		1.26
2000	1.46	11	1.54	1.38	1.13
2200	1,26	3	1.09	1.03	0.90
2400	2.36	9	1.90	1.20	1.03
2600	1.51	13	1.37	1.09	1.01
2800	1.88	32	1.81	1.17	1.12'

Table **7.** Analysis of variance for the organic carbon content of surface samples in the 15 locales of each sequence.

Source of variation	Degrees of freedom	Sum of squares	Mean squares	F
Thora				
Locales	14	17.66	1.261	25.33**
Surface samples	14	0.34	0.024	0.49ns
Locales X Surface samples	196	9.76	0.050	
Total	224	27.76		
Karulai				
Locales	14	20.74	1.482	40.07**
Surface samples	14	0.33	0.023	0.63ns
Locales X Surface samples	196	7.25	0.037	
Total	224	28.32		
Kadasseri				
Locales	14	53.64	3.831	49.31**
Surface samples	14	0.75	0.054	0.69ns
Locales X Surface samples	196	15.23	0.078	
Total	224	73.62		
Tirunelli				
Locales	14	8.19	0.585	7.20**
Surface samples	14	0.64	0.046	0.56ns
Locales X Surface samples	196	15.94	0.081	
Total	224	24.77		
Kollathirumed				
Locales	14	83.56	5.969	82.59**
Surface samples	14	0.50	0.036	0.50ns
Locales X Surface samples	196	14.17	0.072	
Total	224	98.23		

** F values are significant at P = 0.01; ns = nonsignificant.

Distribution of organic carbon in the Thora sequence

In natural forest, mean OC value of surface samples is 1-93 (LSD = 0.16). The values for 1980, 1975,1973, I971 and 1970 plantations are 1.75, 2.11, 2.08, 2.06 and 1.88 tespectively. OC contents at 200,400, 800,1000, 1200, 1800, 2600 and 2800m locales are significantly different from that of natural forest. The OC contents at 200, 400 and 2800m are less than natural forest while those at 800, 1000, 1200, 1800 and 2600m are greater.

In soil pits, OC values decrease with depth. For natural forest, it decreases from 2.01 in the 0-20 to 0.94 in the 20-40 and to 0.81 in the 40-60cm layers. The percent decrease of OC contents in the subsurface layers of natural forest is 53 in the 20–40 and 60 in the 40-60cm layers. The mean OC values of the samples in the 0–20, 20-40 and 40-60cm layers of soil pits in plantations are 1.96, 1.02 and 0.82 and the percent decrease is 48 and 58 in the deeper layers.

Elevation of this sequence ranges from 50 to 100m and hardly any anthropic pressure exists except at the periphery. The locales at 200 to 800m have 1980 teak plantations. OC values decrease in the first two and increase in the latter two locales. The values remain almost steady from 1000 to 2600m where 1975, 1973, 1971 and 1970 teak plantations occur. There is a decrease at 2800m and this is mainly ascribable to disturbances by the tribal colony adjacent to it. The overall similarity of OC contents in the 20-40 and 40-60cm layers is also notable. In general OC contents of plantations remain close to that of natural forest and plantation activities have not caused any drastic change in OC content of soils.

Distribution of organic carbon in the Karulai sequence

OC content of surface samples in the natural forest is 1.89 (LSD = 0.14). This value ranges from 0.88 to 1.79 in the plantations and the mean of 14 locales is 1.32 $\pm$ 0.32. OC values at 200,400, 800 to 2800m distances are significantly different and less than that of natural forest.

In the soil pits, OC content decreases with depth. In the natural forest, the value decreases from 2.47 in 0–20 to 1.19 in 20-40 and 1.08 in the 40–60cm layers. The mean OC values of the samples in the three layers are 1.32, 0.93 and 0.74. Percent decrease of OC content in the 20-40 layers is 52 and 30 in the natural forest and plantations respectively and the corresponding values are 56 and 44 in the 40-60cm layers.

Elevation is 80m and this sequence has 1974 second rotation teak. OC values of plantation locales are lower than that of natural forest and a clear-cut difference exists between the natural forest and plantations. The variations seen in the OC contents of various locales are partly attributable to the frequent fires and accumulation of ash. As the plantation activities are similar along the sequence and as all the locales have 1974 second rotation teak, the decline in OC is ascribable to plantation operations in the early stages of second rotation.

Distribution of organic carbon in the Kadasseri sequence

Mean OC value of surface samples in the natural forest is 3.61 (LSD = 0.20). It ranges from 3.50 to 3.80 in 1981, 2.04 to 3.58 in 1979 and 2.50 to 2.67 in 1977 plantations. OC values at 1000 to 2800m locales are significantly different and these values are less compared to natural forest

In soil pits, OC contents decrease with depth. It decreases from 4.01 in the 0-20 to 1.89 in the 20-43 and to 1.41 in the 40-60cm layers of soil pit in the natural forest. The mean OC values in the 0–20, 20-40 and 40-60cm layers of soil pits of plantations are 2.96, 1.67 and 1.25 respectively. The percent decrease of OC values in the natural forest and plantations in the 20-40cm layer is 53 and 44 respectively. It is 65 and 58 in the 40-60cm layers.

Elevation ranges from 125 to 150m and this sequence has 1981 eucalypt plantation at 200 to 600m, 1979 at 800 to 2200m and 1977 at 2400 to 2800m locales. In the area adjacent to natural forest, due to social pressures, eucalypt planting had to be discontinued. This could be the reason for the relatively higher OC values at 200, 400 and €00 m locales. At 2000m there is a sudden decrease which is not explainable. In general, plantations have lower levels of OC than natural forest. The 20-40 and 40-60cm layers do have fairly high levels of OC in comparison to the two teak sequences at Thora and Karulai.

Distribution of organic carbon in the Tirunelli sequence

In the natural forest, mean OC value of surface samples is 2.18 (LSD -0.20) These values range from 1.66 to 2.14, 2.02 to 2.17, 2.05 to 2.34, 2.28 and 2.23 to 2.46 in 1975. 1972, 1971, 1970 and 1969 plantations. OC at 200 and **2600m** distance is significantly different from that at natural forest. The value at 2600m is greater and that at 200m is lower than that of natural forest.

In the soil pits, OC values decrease with depth. The value decreases from 2.70 in the surface to 1.24 in the 20-40 and to 1.16 in the 40-60cm layers in the natural forest. The average OC contents in the 0-20, 20-40 and and 40-60cm layers of soil pits in plantations are 2.03, 1.32 and 1.04 respectively. Percent decrease of OC contents in the 20-40cm of natural forest and plantations is 54 and **35.** These values in the 40-60cm layer are 57 and 49.

Elevation varies from 650-775m and the sequence has 1975 eucalypt at 200 to 800m, 1971 (1981 coppice) at 1000 to 1400 and 2200m, 1972 (1982 coppice) at 1600 to 2000m, 1970 (1980 coppice) at 2400 and 1969 (1979 coppice) at 2600 to 2800m locales. Excepting for the differences at 200 and 2600m, the deviation from natural forest is negligible in most locales. After coppicing, well-established root systems of seedling trees and addition of branches, twigs and leaves promote accumulation of OC. The trend of OC distribution in the surface samples is opposite to that of Kadasseri sequence with uncoppiced eucalypt plantations and it is mainly ascribable to coppiced eucalypt plantations of Tirunelli sequence.

Distribution of organic carbon in the Kollathirumed sequence

The mean OC value of surface samples is 1.80 (LSD = 0.19) in the natural forest. These values are 1.87-1.95, 1.26-2.35 and 3.04 in 1981, 1980 and 1979 teak, 2.09 in 1967 eucalypt and 1.88 and 1.75-3.59 in 1980 and 1979 albizia plantations. The mean values for teak, eucalypt and albizia plantations are 1.94, 2.09 and 2.57 respectively and these are greater than that of natural forest. OC values at 400, 800 to 1400 and 1800 to 2600m locales are significantly different from that of natural forest. The values at 400, 800, 1000, 1200, 1400, 1800 and 2400m locales are greater than natural forest while those at 2000, 2200 and 2600m are lower.

OC content decreases with depth in the soil pits. It decreases from 1.67 in the 0-20 to 0.79 in 20-40 and to 0.71 in the 40-60cm layers of natural forest. The mean OC values in the 0-20cm layer of teak, eucalypt and albizia are 1.97, 2.32 and 2.53 and in the 20-40cm. they are 1.58, 1.62 and 2.10. The corresponding values in the 40-60cm layer are 1.32, 1.36 and 1.70. Percent decrease of OC content in the 20-40cm layer of natural forest is 53 and it is 58 in the 40-60cm layer. In the case of teak, eucalypt and albizia plantations, percent decrease of OC in the 20-40cm layer is 20, 30 and 17 respectively and they are 33, 41 and 33 in the 40-60cm layer.

Elevation ranges from 375 to 550m and this sequence has 1981 teak at 200 and 600m, 1967 eucalypt at 400m, 1979 teak at 800m. 1979 albizia at 1000 to 1600m, 1980 teak at 1800 to 2600m and 1980 albizia at 2800m locales. Relatively higher levels of OC occurs in plantations compared to natural forest (2.12 and 1.80 respectively). When the OC values are differentiated in terms of tree crops, it is 1.94 for teak, 2.09 for eucalypt and 2.43 for albizia. The increase for albizia is expected because it is a leguminous crop which enhances nitrogen-fixation and OC accumulation in soils. The 20-40 and 40-60cm layer tend to have more OC which is in contrast to the trend seen in other sequences

CONCLUSION

At Thora , organic carbon (OC) values in teak plantations remain close to that of natural forest and plantation activities have not caused any drastic change in OC content of soils. A decline in OC levels occurs in teak plantations of Karulai sequence and this is attributable to plantation operations in the early stages of second rotation. Eucalypt plantations at Kadasseri have relatively lower contents of OC than that of natural forest and the trend at Tirunelli is opposite. At Tirunelli, well–established root systems of seedling trees and the addition of branches, twigs and leaves after coppicing promote accumulation of OC. Compared to natural forest, higher levels of OC occurs in teak, eucalypt and albizia plantations of Kollathirumed sequence and being leguminous, albizia enhances nitrogen-fixation as well as OC build-up in soils.

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