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DYNAMICS OF ORGANIC CARBON AND DIFFERENT FORMS OF NITROGEN UNDER FIRST AND SECOND ROTATION TEAK PLANTATIONS OF KERALA

Teak (*Tectona grandis* Linn. f.) is a tall tropical deciduous tree cultivated for its hard, durable and decay-resistant wood. It grows on a variety of soils, but requires good drainage. It is established on a plantation scale in Kerala since 1842 and the Forest Department has completed first rotation in several plantations, second in some and third rotation teak is planted in very few areas (Alexander *etaf.,* 1981). In Kerala, it is planted over an area of about 76,000 ha. The wood is used for ship-building, decorative plywood, furniture, carvings etc. Blanford (1S33) studying the soils under teak in Burma found that teak cropping led to serious soil erosion due to the removal of undergrowth. Kadambi (1945) reported that studies in erstwhile Mysore didn't indicate any soil deterioration in teak plantations. Seth and Yadav (1959) observed that sufficient quantitative data are lacking to prove or disprove the hypothesis of soil deterioration due to continuous teak planting. Jose and Koshy (1972) based on a study in Nilambur soils indicated that recuperation occurs in some of the soil properties, Alexander *et al.* (1981) studying the organic carbon and cation exchange capacity of soils under **first and** second rotation teak plantations held the view that soil parameters could not limit the growth of **teak.**

Many workers have reported the distribution of organic carbon and different forms of nitrogen and their variations with altitude (Nath and Deori, 1976; Palaniappan *et al.,* 1978; Rajamannar and Krishnamoorthy, 1978; Minhas and Bora, 1982). However, not much **work** has been conducted to find out the distribution of organic carbon and different forms of nitrogen in soils under first and second rotation teak in Kerala. Hence a study was undertaken.

The site of the study was Nedumkayam in Karulai range of Nilambur Forest Division with 80 m elevation and level topography. Teak plantations established in 1955 (first rotation) and 1965 (second rotation) were chosen and soil was sampled in 1982 taking two profile pits representing each rotation. Soil samples were collected from each profile for depths of 0–15, 15–50 and 50-100 cm separately. The profile descriptions are given in Table 1.

Soil samples were air-dried, passed through 2 mm seive and analysed for pH, organic carbon and total, available, ammoniacal and nitrate nitrogen following standard analytical procedures (Jackson, 1958).

In general, the **pH of** the soil slightly decreased with depth. The pH values for the 0-15, 1 5-50 and 50–100 cm layers were 6.1, 6.0 and 5.9 in the case of first rotation and 6.0, 5.9 and 5.8 for the second rotation teak (Table 2). The organic carbon content also decreased with depth in both the rotations.

Table 1

Profile characteristics of soils under first and second rotation teak

	I rotation
Site:	Nedumkayam
Profile I Depth (cm)	Level, 80 m elevation, well drained, good undergrowth of eupatorium *(Chromolaena odorata)*
0–15	Greyish brown (10 YR 5/2), loamy sand, granular abundant medium roots, slightly acid.
15-50	Dark Yellowish brown(10 YR 6/4), few mottles, loam, massive, firm, very fine rcots, medium acid.
50–100	Light reddish brown (10 YR 6/4), abundant mottles, loam, massive firm, very fine roots, medium acid.
Profile M Depth (cm)	Level, 80m elevation, well drained good, undergrowth of eupatorium about 200 m away from profile I.
0-15	Very dark grayish brown (10 YR 3/2), loamy sand, granular, firm abundant medium roots, slightly acid.
15-50	Yellowish brown (10 YR 5/6), very few mottles, loamy sand, blocky firm, very few fine roots, medium acid.
50–100	Yellowish red (5 YR 5/6), few mottles, loam, massive, firm very few very fine roots, medium acid.
	II rotation
Profile III Depth (cm)	Level, 80 m elevation, well drained, good undergrowth of eupatorium about 600 m away from profile II.
0-15	Light yellowish brown (110 YR 6/4), loamy sand, granular, firm, abundant coarse roots slightly acid.
15-50	Reddish brown (5 YR 4/4), abundant mottles, loamy sand, blocky very few fine roots, medium acid.
50-100	Yellowish red (5 YR 5/6), abundant mottles, loam, massive, very fine, practically no roots, medium acid.
Profile IV Depth (cm)	Level, 80 m elevation, well drained, good undergrowth of eupatorium, about 150 m away from profile III.
0–15	Dark yellowish brown (10 YR 3/4), loamy sand, granular, abundant medium roots, slightly acid.
15-50	Dark reddish grey (5 YR 4/2), very few mottles, loamy sand, blocky, firm, very few fine roots.
50–100	Yellowish red (5 YR 5/6), abundant mottles, loam, massive, very few very fine roots, medium acid.

In general soils under first rotation teak contained more organic matter compared to the soil under second rotation teak. The soil of second rotation is under teak for a period of 77 years after clearfelling the natural forest and it has undergone complete exposure to environmental factors twice, first at the time of clearfelling the natural forest and second at the time of final felling of the first rotation teak when it was 60 years old, whereas the first rotation soil is under teak only for a period of 27 years.

As in the case of organic carbon the content of total, available, ammoniacal and nitrate nitrogen decreased with depth and again, in general, their contents were relatively high in soils under first rotation teak probably due to the carbon-nitrogen ratio of the organic matter. The C:N ratio of the soils ranged from 7.49 to 8.91 and invariably the ratio was narrow for the deepest layer (50–100 cm) of the profile. The C:N ratio of the deeper layers of soils under the second rotation teak was narrower as compared to that of the soil under first rotation crop which also lends credence to the faster rate of decomposition of organic matter under second rotation teak. The available nitrogen content of the

Table 2

Characteristics of soils under first and second rotation teak

Profile No.	Depth (cm)	pH in water	Organic carbon %	Total N (ppm)	Available N (ppm)	Ammoniacal N (ppm)	Nitrate N (ppm)	C/N ratio
				I rotation				
I	0- 15	6.1	1.38	1661	168	21.3	12.7	8.31
	15– 50	6.0	0.97	1101	109	13.5	7.6	8.81
	50-100	5.8	0.50	640	61	7.4	4.0	7.81
II	0- 15	6.1	1.42	1679	172	22.1	13.1	8.46
	15– 50	60	0.99	1111	113	14.1	7.8	8.91
	50-100	5.9	0.54	646	62	7.8	4.4	8.36
Mean	0– 15	6.1	1.40	1670	170	21.7	12.9	8.39
	15- 50	6.0	0.98	1106	116	13.8	7,7	8.86
	50-100	5.9	0.52	643	62	.6	4.2	8.09
				II rotation				
III	0- 15	6.0	1.21	1490	155	19.6	11.7	8.12
	15- 50	5.9	0.84	1001	100	12.6	7.2	8 39
	50-100	5.8	0.47	629	61	7.5	4.0	7.49
IV	0- 15	6.0	1,27	1470	159	19.1	11.9	8.64
	15– 50	5.8	0.88	1003	103	12.3	7.3	8.78
	50-100	5.8	0.49	631	63	7.1	4.1	7.77
Mean	0– 15	6.0	1.24	1480	157	19.4	11.8	8.38
	15- 50	5.9	0.86	1002	102	12.5	7.3	8.59
	50-100	5.8	0.48	630	62	7.3	4.1	7,63

Table 3

Ratios of total N to different forms of N under first and second rotation teak

Profile	Depth (cm)	Ratio of		
		Total N/ available N	Total N/ ammoniacal N	Total N/ nitrate N
		I rotation		
I	0– 15	9.89	77.98	130.79
	15- 50	10.10	81.56	144.87
	50-100	10.49	86.49	160.00
i!	0– 15	9.76	75.98	128.10
	15- 50	9.83	78.79	142.40
	50–100	10.42	82.81	146.80
Mean	0– 15	9.83	76.98	129.45
	15- 50	9.97	80.18	143.64
	50-100	10.46	84.65	153.40
		II rotation		
'II	0- 15	9.61	76.02	127.35
	15- 50	10.01	79.44	139.03
	50-100	10.31	83.87	157.25
IV	0- 15	9.25	76.96	123.50
	15- 50	9.74	81.53	137.40
	50–100	10.04	88.86	153.90
Mean	0- 15	9.43	76.49	125.43
	15– 50	9.88	80.49	138.22
	50-100	10.18	86.37	155.58

soil, in general, was about 10% of total nitrogen and was highest in the topmost layer of the soil as in the case of total nitrogen. Soils under the first rotation teak retained more available nitrogen probably due to the relationship between total nitrogen and available nitrogen. The depthwise and rotationwise distribution of ammoniacal and nitrate nitrogen, was similar to that of total and available nitrogen. The ratios of total N to available N, total N to ammoniacal N and total N to nitrate N (Table 3) were relatively high for deeper layers of soil in both the rotations indicating that the loss of available, ammoniacal and nitrate nitrogen is mora as compared to that of total nitrogen in these layers.

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കാടുവെട്ടിത്തെളിയിച്ച് തേക്ക് നട്ടുവളർത്തുന്നതുകൊണ്ട് മണ്ണിലെ ജൈവാംശത്തിന്റെയും വിവിധ രൂപത്തിലുള്ള പാക്യജനകത്തിന്റെയും അളവിൽവരുന്ന മാറ്റങ്ങൾ മനസ്സിലാക്കുന്നതിന് നിലമ്പൂർ വനവിഭാഗത്തിൽപ്പെട്ട ഒന്നാംവട്ട തേക്കിൽ തോട്ടങ്ങളിലെയും രണ്ടാംവട്ട തേക്കിൻതോട്ടങ്ങളിലെയും മണ്ണ് പഠനവിധേയമാക്കി. ജൈവാംശത്തിന്റെയും വിവിധ രൂപത്തിലുള്ള പാക്യജനകത്തിന്റെയും അളവ് രണ്ടാംവട്ട തേക്കിൻതോട്ടങ്ങളിലെ മണ്ണിൽ കുറവായിക്കണ്ടു.

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