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Research Notes

CHANGES IN ORGANIC CARBON AND DIFFERENT FORMS OF NITROGEN UNDER FIRST AND SECOND ROTATION (COPPICED) EUCALYPT PLANTATIONS

Eucalypts *(Eucalyptus tereticornis* and *E. grandis)* were introduced in Kerala on a plantation scale since early 1950s. This is part of a programme based on the national policy for higher production of wood for domestic and commercial requirements. By 1976, the area under eucalypts was about 33,000 ha. In addition to these, Kerala Forest Development Corporation has drawn up a scheme to raise 45,000 ha of plantations over a period of 10 years by clearfelling the existing moist deciduous forests (Nair 1981). The plantations thus established will be subjected to final felling on completion of a period of 10 years. The rotation though fixed as 10 years initially, has been later reduced to seven years. In many areas at the time of final felling, the above ground parts are cut, leaving the root system intact in the soil. The emerging coppiced shoots are retained thus establishing a coppiced plantation.

Thomas (1964) and Chaty and Koshy (1967) reported leaching of organic matter and nitrogen to greater depths in deforested areas. Robinson (1967) found a significant successive drop in organic carbon and nutrients under first and second rotation exotic conifer plantations in Africa compared with indigenous forest. Works of Evans (1977) showed that there was no evidence of long term productivity decline arising from site degradation in short-rotation plantations. Lundgren (1978) after a thorough review on soil changes and yield declines in forest plantations, suggested that forest clearance and raising of fast-growing species ke eucalypts, conifers and teak were associated with pronounced deterioration in marginal soils. Studies of Alexander *et al.* (1981) on organic carbon and other soil properties of soil under uncoppiced as well as coppiced eucalypt plantations revealed that soil parameters are not the limiting factor for the growth of eucalypt in uncoppiced and coppiced plantations.

No serious effort has been made to study the effect of rotations of eucalypt (*Eucalyptus tereticomis)* on the organic carbon and different forms of soil nitrogen. Hence the present investigation was undertaken.

The site for the study was Kollathirumed area of Vazhachal Forest Division. A plantation established in 1977 (first rotation, uncoppiced) and another coppiced in 1977 (second rotation) weresampled in 1981. The plantations are in an adjacent area, established on rather similar parent material and topography (hilly). This provides ideal situations to assess the effect of rotation on soil characteristics. Two profile pits were exposed in each plantation and soil samples were collected from depths of 0–15, 15–50 and 50-100 cm separately. Profile descriptions are given in Table 1.

Table 1

Profile characteristics of soils under first rotation and second rotation (coppiced) eucalypt plantation

First rotation	
Site : Kollathirumedu	
Profile I	Hilly, mid–slope, 400 m asl, moderately well drained, good undergrowth of eupatorium *(Chromolacna odorata)*
Depth (cm)	
0–15	Reddish brown (5 YR 4/3), loamy sand, granular, friable, abundant medium roots, medium acid.
15-50	Yellowish red (5 YR 4/6), loam, blocky, few fine roots, slightly acid.
50-100	Yellowish red (5 YR 5/6), loam, blocky, practically no roots, slightly acid.
Profile II	Hilly, mid-slope, 400 m asl, well drained, good undergrowth of eupatorium, 200 m from profile I.
Depth (cm)	
0-15	Reddish brown (5 YR 5/3), loamy sand, granular, friable, abundant medium roots, medium acid.
15-50	Yellowish red (5 YR 5/6), loam, blocky, few fine roots, slightly acid.
50–100	Yellowish red (5 YR 4/6), loam, massive, no roots, slightly acid.
Second rotation (coppiced)	
Site : Kollathirumedu	
Profile III	Hilly, mid-slope, 400 m asl, well drained, thick undergrowth of eupatorium
Depth (cm)	
0-15	Dark reddish brown, (5YR 3/4) loam, granular, friable, abundant coarse roots, strongly acid
15-50	Light reddish brown (5 YR 6/4), loam, blocky, hard, few mottles, few medium to fine roots, strongiyacid
50-100	Reddish yellow (7.5 YR 7/6), loamy sand, massive, very hard, very few very fine roots, strongly acid
Profile IV	Hilly, mid slope, 400 m asl, well drained, thick undergrowth of eupatorium, 300 m from profile III
0-15	Dark reddish brown (5 YR 3/4), loam, granular, friable, abundant coarse roots, strongly acid
15-50	Reddish brown (5 YR 4/3), loam,b!ocky, hard, few mottles, few fine roots, strongly acid
50-100	Reddish yellow (7.5 YR 7/6), loamy sand, massive, very hard, no roots, strongly acid

Table 2

Characteristics of soils under first rotation and second rotation (coppiced) eucalypt plantation

Profile No.	Depth (cm)	PH in water	Organic carbon %	Total N (ppm)	Available N (ppm)	Ammoniacal N (ppm)	Nitrate N (ppm)	C/N ratio
			First rotation					
I	0- 15	5 9	2.70	1806	181	21.7	12.1	14.95
	15- 50	6.0	1.79	1391	137	16.4	8.7	12.87
	50-100	6.1	1.03	907	75	10.5	5.4	11.36
II	0- 15	5.9	2.54	1797	177	21.3	11.7	14.13
	15- 50	6.1	1.71	1401	132	16.0	8.9	12 21
	50-100	6 2	0.99	901	71	10.1	5.3	10.99
Mean	0- 15	5.9	2.62	1802	179	21.5	11.9	14.54
	15- 50	6 1	1.75	1396	135	16.2	8,8	12.54
	50-100	6.2	1.01	904	73	10.3	5.4	11.17
			Second rotation (coppiced)					
III	0- 15	5.5	1.51	1510	149	19.1	10.7	10.00
	15– 50	5.3	0.87	1001	98	16.1	7.3	8.69
	50-100	5.0	0.61	790	77	14.7	6.4	7.72
IV	0- 15	5.5	1.61	1579	151	19.7	10.9	10.20
	15– 50	5.4	0.90	1037	99	15.9	7.6	8.68
	50-100	5.1	0.67	788	73	15.0	6.0	8.50
Mean	0- 15	5.5	1.56	1545	150	19.4	10.8	10.10
	15- 50	5.4	0.89	1019	99	16.0	7.5	8 69
	50–100	5.1	0.64	789	75	14.9	6.2	8.11

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).

Table 2 shows that pH of the soil ranged from 5.9 to 6.2 in first rotation (uncoppiced) and 5.1 to 5.5 in second rotation (coppiced) plantations. In second rotation plantation, the soil is exposed to the action of environmental factors such as sunlight, rainfall etc. This leads to enhanced leaching of bases resulting in higher acidity. The organic carbon decreased with depth. In first rotation, the values for organic carbon for 0–15, 15–50 and 50-100 cm depths were 2.62, 1.75 and 1.01 per cent whereas the corresponding values for second rotation were 1.56, 0.89 and 0.64

Table 3

Ratios of total N to different forms of N under first rotation and second rotation (coppiced) eucalypt plantation

Profile No,	Depth (cm)	Ratio of		
		Total N/ available N	Total N/ ammoniacal N	Total N/ nitrate N
		First rotation		
I	0- 15	9.97	83.23	149,26
	15- 50	10,15	84.82	159.89
	50-100	12.09	85,38	167.96
II	0– 15	10.15	84.37	153.59
	15- 50	10,61	87.56	157.42
	50-100	12.69	89.21	170.00
Mean	0- 15	10.07	83.81	151.43
	15- 50	10,34	86.17	158.64
	50-100	12.38	87.77	167.41
		Second rotation (coppiced)		
II	0- 15	10.13	79.06	141.12
	15- 50	10.21	62.17	137.12
	50-100	10.26	53.74	123.44
IV	0- 15	10.46	80.15	144.86
	15- 50	10.47	65.22	136.45
	50-100	10.79	52.53	131.33
Mean	0- 15	10.30	79.64	143.06
	15- 50	10.30	63.69	135.87
	50-100	10.52	52.95	127.26

per cent indicating that, in general, soil under first rotation retained more organic carbon. The soilsof first rotation was under natural forest till 1976 whereas the soils under second rotation were exposed to environmental factors for a long period of time. The latter was subjected to clearfelling of natural forests and final felling of first rotation crop 14 and 4 years before respectively. Obviously, the oxidation of organic matter has taken place at a faster rate in soils under the second rotation.

Total as well as different forms of N decreased with increasing depth, similar to organic carbon. As regards their contents, they are more in soils under the first rotation crop. This is due to the close relationship between organic carbon and nitrogen in soil. The C:N ratio decreased with depth from 14,54 to 11.17 in the

case of first rotation soil and 10.10 to 8.11 in second rotation soil. The narrow C:N ratio of the second rotation soil also indicates the faster rate of mineralisation that has taken place in this soil,

The ratios of total N to available N, total N to ammoniacal N and total N to nitrate N increased with increasing depth in soils under first rotation while it decreased with depth in the case of second rotation (Table 3).

Probably the increased mineralisation of organic matter observed in the second rotation would have resulted in the differential accumulation of different forms of nitrogen in deeper Sayers of soil.

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വാഴച്ചാൽ വനഡിവിഷനിലെ കൊല്ലത്തിരുമേട്ടിലുള്ള ഒന്നാംവട്ട യൂക്കാലി തോട്ടവും രണ്ടാംവട്ട യൂക്കാലി തോട്ടവും തമ്മിൽ ഒരു finofonna^ojomo നടത്തി. രണ്ടാംവട്ട യൂക്കാലി തോട്ടത്തിലെ മണ്ണിൽ പാകൃജനകത്തിന്റെയും കാർബണിന്റെയും അംശം കുറവായിക്കണ്ടു. രണ്ടാംവട്ട യൂക്കാലിത്തോട്ടത്തിലെ മണ്ണിലുള്ള ജൈവാംശം കൂടുതൽ വേഗത്തിൽ നഷ്ടപ്പെടുന്നതായി മനസ്സിലായി.

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