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Research Article

VERTICAL DISTRIBUTION OF CHEMICAL PROPERTIES AND MACRO NUTRIENT STATUS IN NON TRADITIONAL ARECA GROWING SOIL PROFILES OF KARNATAKA

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ABSTRACT
Soils reaction in different soil profiles varied from medium acidic to strongly alkaline and ranged from 5.6 to 8.5 and 5.5 to 8.4 in both the depths, decreased with increasing depth. Cation exchange capacity in different soil profiles ranged from 9.00 (cmol (p^+) kg^{-1}) to 24.00 (cmol (p^+) kg^{-1}) it showed decreasing trend with increasing depth. Exchangeable calcium in profile bodies varied from 1.8 (cmol $(p^+)kg^{-1}$) to 4.2 (cmol (p^+) kg^{-1}). Exchangeable magnesium of soil profiles was in the range of 0.89 (cmol (p^+) kg^{-1}) to 3.5 (cmol (p^+) kg^{-1}). Available sulphur in different soil profiles was in the range of 8 ppm to 18.5 ppm and was highest in surface horizon. It gradually decreased with depth in all the soils.

***Key Words**: Cation Exchange Capacity and Soil Horizon*

INTRODUCTION
The Arecanut palm (*Areca catechu Linn*.) is one of the most profitable commercial plantation crop grown in humid tropics of India. It is native of Malayan Archipelago, Philippines and other East Indian Islands. In India, the crop is grown on an area of 2.68 lakh hectares with a production of 3.34 lakh tones (Anon., 2010). India is the largest producer and consumer of arecanut in the world. It is also being grown in Sri Lanka, Bangladesh, Malaysia, Indonesia and Philippines on a limited scale. In India traditionally arecanut is being grown in Karnataka, Kerala, Assam, West Bengal, Tamil Nadu and Maharashtra. About 89 per cent of the area under arecanut has spread in the states of Karnataka, Assam and Kerala. Karnataka is the leading state with 1,68,000 hactare area and an annual production of 2.24 lakh tones (Anon., 2010). Most of the traditional areca growing soils are acidic in nature while non- traditional areca growing soils are alkaline in nature. In Karnataka, the arecanut growing area is divided into two distinct tracts, viz. the 'malnad' and the 'maidan' tract. The 'malnad' tract experiences heavy rainfall of about 4,000 mm annually, most of it is received during June to September. This tract consists of coastal plains of Dakshina Kannada, Udupi, Shimoga and hilly terrains of Chikkamagalur districts. 'Maidan' tract consists of Chitradurga, Davanagere, Chikkamagalur and parts of Shimoga and considerable area is under arecanut cultivation in this tract, which forms the principal source of income for the farmers of these areas. The management of arecanut gardens and maintaining the fertility status of the soils is extremely difficult. It requires regular and careful attention. The balanced supply of nutrients is very much essential from the point of soil health and also to avoid disorders in the non-traditional belt of areca nut growing areas of Karnataka. The 'maidan' tract which receives less rainfall of about 1000 mm annually also requires irrigation specially during summer for exploiting potentiality of crop.

MATERIALS AND METHODS
The representative profile samples were collected from six different taluks , representing maidan areas from different depths as per morphological features. The profile samples were analysed for different physical and chemical properties and available nutrient status. In order to characterize profile samples for fertility status in non-traditional areca gardens of Karnataka, total 6 pedons were collected from 6 taluks *viz*., Chitradurga, Holelkere, Honnali, Changiriand, Bhadravathi and Tarikere. The representative profile

samples were dried, crushed in a wooden mortar and pestle and passed through 2 mm sieve. The samples were stored in clean polythene container and used for further laboratory analysis. For organic carbon estimation, the samples were finely grounded using agate pestle and mortar and made to pass through 0.2 mm sieve. The collected profile samples were dried under shade. The laboratory analysis of profile samples was conducted at the Zonal Agricultural Research Station, college of agriculture Shimoga, Karnataka during 2010. The following standard procedures were adopted for analysis of the nutrients in the laboratory- particle size analysis by Bouyoucos soil hydro meter method (Piper, 1966), organic carbon by Walkely and Black's wet oxidation method (1934), soil pH was determined by 1:2.5 soil : water suspension using digital pH meter (Jackson, 1973). Cation exchange capacity by ammonium in the lechate was quantified by kjeldhal distillation method (Jackson, 1973).

RESULTS AND DISCUSSION

Chitradurga

The pH of the soils decreased with depth and the values ranged from 7.40 to 7.90. The electrical conductivity ranged from 0.13 to 0.25 dSm^{-1}. The surface soil contained higher organic carbon than the lower layer, which, decreased from 12.9 g kg^{-1} (surface) to 8.6 g kg^{-1} (last layer). The exchangeable calcium and magnesium ranged from 4.20 to 3.80 and 1.21 to 0.89 cmol (p+) kg^{-1} respectively. Cation exchange capacity (CEC) values of the soil found to be (16.80 cmol (p+) kg^{-1}) in the surface layer and it decreased with depth to the lowest value of (13.00 cmol (p+) kg^{-1}) in the last layer.

Hollalkere

The soil pH and EC did not show definite trend with the depth which ranged from 7.60 to 8.00 and 0.16 to 0.21 dSm^{-1}. The organic carbon content was high (13.5 g kg^{-1}) in surface horizon and decreased with depth (8.1 g kg^{-1}) in the last layer. The exchangeable calcium and magnesium contents ranged from 5.5 to 2.79 and 1.41 to 1.10 cmol (p^+) kg^{-1}, respectively and decreasing trend was noticed with depth except for calcium which was same in both the depths 1.41 cmol (p+) kg^{-1}.The cation exchange capacity was highest (23.60 cmol (p^+) kg^{-1}) in the surface layer and gradually decreased with depth (19.10 cmol (p^+) kg^{-1}) in the last layer.

Honnali

The soils of Honnali profile were neutral to alkaline with pH values ranged from 7.80 to 7.50 which gradually decreased with depth. Electrical conductivity of soils ranged from 0.10 dSm^{-1} in the last layer to 0.32 dSm^{-1} in the 82-88cm layer.The organic carbon content of the surface horizon was highest (15.0 g kg^{-1}) and decreased with depth to (8.6 g kg^{-1}) in the last layer. The exchangeable calcium and magnesium contents ranged from 3.5 to 1.8 and 3.5 to 1.9 cmol (p^+) kg^{-1} respectively. Cation exchange capacity values decreased with increasing depth and ranged from 24.00 to 15.20 cmol (p^+) kg^{-1}.

Bhadravathi

The soils of Bhadravathi profile were found to be almost neutral with pH values ranged from 6.9 to 6.7 which gradually decreased with increasing depth. Electrical conductivity of soil increased with depth from 0.07 dSm^{-1} in the surface layer 0.17 dSm^{-1} in the penultimate layer. The organic carbon content of the surface horizon was highest (18.00 g kg^{-1}) and decreased with depth (14.30 g kg^{-1}). Exchangeable calcium and magnesium contents ranged from 3.00 to 3.82 and 1.10 to 1.0 cmol (p^+) kg^{-1} respectively. Exchangeable calcium content was decreased with depth whereas there is no definite trend in distribution of magnesium with the depth.There is a decrease in cation exchange capacity with depth and with a value of 14.00 cmol (p+) kg^{-1} in the surface layer to 8.0 cmol (p+) kg-^{1} in the last respectively.

Tarikere

The pH of the soils decreased with depth that ranged from 7.4 to 7.9 and pH values showed alkaline in reaction with decreasing trend as the depth increases. Electrical conductivity was found to ranged from 0.12 to 0.21 dSm^{-1}. The organic carbon content of the surface horizon was highest (15.8 g kg^{-1}) and decreased with depth of (5.3 g kg^{-1}) in the last layer. Exchangeable calcium and magnesium contents ranged from 5.80 to 2.50 and 3.20 to 1.21 cmol (p^+) kg^{-1} respectively. The cation exchange capacity was found to decrease with depth ranging from 16.00 to 14.10 cmol (p^+) kg^{-1}

Channagiri

The pH of the soils found to be 7.8 to 8.0 which gradually decreased with depth. Electrical conductivity decreased from 0.21 dSm^{-1} in surface layer to 0.20 dSm^{-1} in fourth layer. The organic carbon content was highest in surface horizon (16.80 g kg^{-1}) and decreased with depth (10.10 g kg^{-1}). Exchangeable calcium and magnesium contents ranged from 3.93 to 2.10 and 2.21 to1.10 cmol (p^+) kg^{-1} respectively. The cation exchange capacity also ranged from 18.5 0 to 9.00 cmol (p^+) kg^{-1} and no definite trend was observed with the different depths of profile.

Available nitrogen, phosphorus, potassium and sulphur contents of soil profiles

The status on available major and secondary nutrients viz., nitrogen, phosphorus, potassium, calcium, magnesium and sulphur in soil pedons of non-traditional different areca gardens is presented in Table. 1

Chitradurga

Available nitrogen content of soil was medium (540.25 kg ha^{-1}) in the surface horizon and gradually decreased 187.81 kg ha^{-1} in the last layer. Available phosphorus content of soil gradually decreased with depth from 30.00 kg ha^{-1} in the surface layer to 25.30 kg ha^{-1} in the penultimate layer. Available potassium was high in all depths but decreased from 492.00 kg ha^{-1} in surface layer to 290.00 kg ha^{-1}in the last layer. Available sulphur ranged from 18.5 ppm to 15.0 ppm and was highest in surface layer and did not show any definite trend with depth.

Holalkere

Available nitrogen content of soil was medium (538.18 kg ha^{-1}) in the surface horizon and gradually decreased to (137.18 kg ha^{-1}) in the last layer. Available phosphorus content of soil gradually decreased with depth from (35.00 kg ha^{-1}) in the surface layer to (20.00 kg ha^{-1}) in the penultimate layer. Available potassium was high in all depths but decreased from (610.00 kg ha^{-1}) in surface layer to (339.00 kg ha^{-1}) in the last layer. Available sulphur ranged from 17 ppm to 14 ppm and was highest in surface layer it did not show any definite trend with depth.

Honnali

Available nitrogen content of soil was medium in the surface horizon (440.18 kg ha^{-1}) and medium in immediate subsequent layer with lowest value of (200.20 kg ha^{-1}) in the last layer. Available phosphorus content of soil gradually decreased with depth from (18.00 kg ha^{-1}) in the surface layer to (14.10 kg ha^{-1}) in the penultimate layer. Available potassium was high in all depths but decreased from (300.00 kg ha^{-1}) in surface layer to (190.28 kg ha^{-1}) in the last layer. Available sulphur ranged from 13.00 ppm to 9.10 ppm and was highest in surface layer but did not show any definite trend with depth.

Bhadravathi

Available nitrogen content of the profile studied was high in surface layer (581.36 kg ha^{-1}) and immediate layer (560.46 kg ha^{-1}) and it was medium in subsequent layers and lowest nitrogen was observed (400.25 kg ha^{-1}) in the penultimate layer. Available phosphorus content of soil gradually decreased with depth from (18.10 kg ha^{-1}) in the surface layer to (14.00 kg ha^{-1}) in the penultimate layer. The phosphorus content was lowest and decreased with depth. Available potassium was highest (300.2 0 kg ha^{-1}) in surface layer to (230.00 kg ha^{-1}) in the last layer. Available sulphur ranged from 9.00 ppm to 8.0 ppm and was highest in surface layer which did not show any definite trend with depth.

Tarikere

Available nitrogen content of soil was high (612.25 kg ha^{-1}) in the surface horizon and gradually decreased to (280.19 kg ha^{-1}) in the last layer. Available phosphorus content of soil was medium which decreased with depth from (26.80 kg ha^{-1}) in the surface layer to (17.00 kg ha^{-1}) in the penultimate layer. Available potassium was highest (430 kg ha^{-1}) in surface layer to (300.20 kg ha^{-1}) in the last layer. Available sulphur ranged from 11.25 ppm to 8.20 ppm which was highest in surface layer and did not show any definite trend with depth.

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Conclusion

Profile samples were moderately acidic to strongly alkaline in reaction.and in profiles studied pH tended to decreased with depth. The majority of profiles were medium to high in available nitrogen and low to medium with respect to available phosphorus. The available potassium was medium to high in all the surface and sub-surface soil profiles. The morphological studies of the profiles showed that the soils of all the taluks (non- traditional belt) are well drained and hence the incidence of diseases is least compared to traditional areas. . The results are in confirmation with the observations of Khadikar *et al.* (and Bhat and Mohapatra (1971). Similar findings were also observed by Madiratta *et al.* (1985) in Areca gardens of orissa. The higher contents of organic matter at the surface are due to management factor like application of FYM and green manures at regular intervals by the growers

Table 1:Depth wise distribution of available Nitrogen, phosphorus, Potassium and sulphur of non-traditional areca belt

S.I. No.	Name of the Taluks	Depth (cm)	N (kg ha^{-1})	P_2O_5 (kg ha^{-1})	K_2O (kg ha^{-1})	S (ppm)
1	Chitradurga	0-25	540.25	30.0	492.0	18.50
		25-55	476.75	28.0	450.0	15.50
		55-85	391.14	26.5	310.0	16.50
		85-105	187.81	25.3	290.0	15.00
2	Holalkere	0-35	538.18	35.0	610.0	17.00
		35-60	451.81	30.0	485.0	15.50
		60-80	201.12	21.0	400.0	15.00
		85-100	137.18	20.0	339.0	14.00
3	Honnali	0-36	440.18	18.00	30010	13.00
		36-62	381.16	16.23	250.18	12.20
		62-82	312.17	15.73	238.11	10.20
		82-88	300.87	15.10	210.26	9.80
		88-107	200.20	14.10	190.25	9.10
4	Bhadravathi	0-30	581.36	18.10	300.00	9.00
		30-60	560.46	17.60	250.00	8.70
		60-85	410.25	16.10	241.00	8.20
		85-105	400.25	14.00	230.00	8.00
5	Tarikere	0-35	612.25	26.80	430.20	11.25
		35-55	548.48	21.60	380.30	10.91
		55-80	512.28	18.70	312.30	9.80
		80-105	280.18	17.00	300.20	8.20
6	Channgiri	0-30	640.78	20.00	261.30	12.78
		30-60	600.28	18.70	240.10	11.16
		60-80	528.18	17.80	212.80	10.16
		80-90	412.61	16.20	180.21	10.00

Table 2: Chemical Properties of profile samples under non -traditional areca growing soils of Karnataka

Sl No.	Name of the Taluks	Depth in (cm)	pH	EC (dS m^{-1})	OC (g kg^{-1})	Exchangable Bases (c mol(p^+) kg^{-1})		CEC (c mol(p^+)kg^{-1})
						Ca^{2+}	Mg^{2+}	
1	Chitradurga	0-25	7.90	0.13	12.90	4.20	1.21	16.00
		25-55	7.50	0.15	10.00	4.00	1.00	15.80
		55-85	7.40	0.25	9.10	4.10	1.00	14.70
		85-105	7.40	0.25	8.60	3.80	0.89	13.00
2	Holalkere	0-35	8.00	0.16	13.50	5.50	1.41	23.60
		35-60	7.90	0.18	11.20	3.60	1.41	22.80
		60-80	8.00	0.12	9.80	2.81	1.20	20.80
		85-100	7.60	0.21	8.10	2.79	1.10	19.10
3	Honnali	0-36	7.80	0.30	15.00	3.50	3.50	24.00
		36-62	7.80	0.28	14.10	2.50	2.50	20.00
		62-82	7.70	0.26	11.20	2.20	2.20	18.60
		82-88	7.00	0.32	9.00	1.90	1.90	17.10
		88-107	7.50	0.10	8.60	1.80	2.21	15.20
4	Bhadravathi	0-30	6.90	0.07	18.00	3.82	1.10	14.00
		30-60	6.90	0.13	16.50	3.40	1.00	13.60
		60-85	6.80	0.05	15.60	3.10	1.16	12.10
		85-105	6.70	0.17	14.30	3.00	1.12	8.00
5	Tarikere	0-35	7.90	0.12	15.80	5.80	3.20	16.00
		35-55	7.60	0.16	13.80	3.90	2.61	14.80
		55-80	7.40	0.09	12.10	3.50	1.31	14.60
		80-105	7.40	0.21	10.80	2.50	1.21	14.10
6	Channgiri	0-30	8.00	0.2 1	16.80	3.93	2.21	18.50
		30-60	7.90	0.20	15.80	3.17	1.91	15.90
		60-80	7.80	0.20	13.10	3.80	2.40	14.00
		80-90	7.8	0.22	10.10	2..10	1.10	9.00

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