www.ThePharmaJournal.com

The Pharma Innovation

ISSN (E): 2277-7695
ISSN (P): 2349-8242
NAAS Rating: 5.23
TPI 2023; 12(1): 394-400

www.thepharmajournal.com
Received: 14-10-2022
Accepted: 17-11-2022

Jayaprakash SM
Department of Soil Science and Agricultural Chemistry, ZAHRS, KSNUAHS, Shivamogga, Karnataka, India

Faijalahmadmulla
Department of Soil Science and Agricultural Chemistry, KSNUAHS, Shivamogga, Karnataka, India

Pruthvi Raj HM
Department of Soil Science and Agricultural Chemistry, ZAHRS, KSNUAHS, Shivamogga, Karnataka, India

Thippeshappa GN
Professor and Head, Department of Soil Science and Agricultural Chemistry, KSNUAHS, Shivamogga, Karnataka, India

Chaitanya HS
Scientist, Department of Horticulture, KVK, Brahmavar, Udupi, Karnataka, India

Naveen NE
Scientist, Department of Agronomy, KVK, Brahmavar, Udupi, Karnataka, India

Lakshman
Associate Director of Research, ZAHRS, Brahmavar, KSNUAHS, Shivamogga, Karnataka, India

Corresponding Author:
Jayaprakash SM
Department of Soil Science and Agricultural Chemistry, ZAHRS, KSNUAHS, Shivamogga, Karnataka, India

Status of major nutrients under arecanut based cropping systems in the coastal region of Udupi district

Jayaprakash SM, Faijalahmadmulla, Pruthvi Raj HM, Thippeshappa GN, Chaitanya HS, Naveen NE and Lakshman

DOI: https://doi.org/10.22271/tpi.2023.v12.i1e.18030

Abstract
A GPS based soil survey was carried out in the farmer's field in three Taluks of Udupi district *viz*., Udupi, Kundapura and Karkala taluks during the period of 2019 to 2021 in order to knowthe "Status of major nutrients under arecanut based cropping systems in the coastal region of Udupi district" by using Arc GIS 10.4 software. Surface soil samples were collected from soils under arecanut based cropping systems in Udupi district and were analysed for electro-chemical and chemical properties. Study revealed that soils are extremely acidic to strongly acidic range with soil pH ranged from 4.03 to 6.60, organic carbon status is medium to high with normal electrical conductivity. Analytical results showed that available nitrogen and potassium status were found low to medium, whereas, available phosphorus status was medium to high. The exchangeable calcium and magnesium were found to deficient in soils under arecanut based cropping systems, whereas soils were low in available sulphur.

Keywords: Arecanut, macronutrients, GPS and Arc GIS

Introduction
The arecanut (*Areca catechu* L), which belongs to family palmaceace is one of the most profitable commercial plantation crops grown in humid tropics of India. The area under arecanut cultivation in Udupi district has increased, the total area of arecanut cultivation in Udupi was about 21,365 hectares. As such crop like arecanut is perennial in nature and their productivity is affected by many reasons, out of which soil nutrient imbalance is one of the important productivity constraints. Available macronutrient status in soil helps in determining the soils potential to supply nutrients for crop growth. Soil testing provides information regarding nutrient availability in soils which forms the basis for the fertilizer recommendations for maximizing the crop yields. In order to provide a base line data and information on available nutrients status, the present study was undertaken to determine the major nutrients like available nitrogen, available phosphorus, available potassium, exchangeable calcium, exchangeable magnesium and available sulphur of the selected Udupi, Kundapura and Karkala taluks in Udupi district that would focus on adopting appropriate cultural and nutritional management practices to keep the plants healthy and productive.

Material and Methods
Study area
Udupi district situated between the foothills of the Western Ghats in the East and the Arabian Sea in the West. The region lies between 13° 34' N latitude and 74° 75' E longitudes, covering an area of 3,582 sq. km. The district is roughly 88 kilometers long and 100 kilometers broad at its widest point. It includes three distinct natural regions: a coastal region with a 98-kilometer-long coastal belt, a midland plain topography, the Malnad region and the Ghats. Udupi district has varied climatic zones. The mean temperature ranges from 22° C (72 °F) in winter to 37° C (99 °F) in summer. The annual precipitation of Udupi district is 4119 mm per annum. District is blessed with high rainfall from the south-west monsoon (June to September).

Soil samples collection
One fifty three surface soil samples were collected from three taluks of Udupi district (Udupi, Kundapura and Karkala). These surface soil samples were air dried, sieved and analyzed for soil reaction (pH), electrical conductivity (EC), soil organic carbon (OC) primary and secondary nutrient status by adopting standard procedures.

Soil analysis

Soil pH was determined for 1:2.5 soil: water suspension by using digital pH meter fitted with combined electrodes (Jackson, 1973) [3]. Soil organic carbon was estimated by wet oxidation method (Walkley and Black, 1934) [13]. Available nitrogen (N) by alkaline permanganate method (Subbaiah and Asija, 1956), available phosphorus (P_2O_5) by Brays and Kurtz method as described by Jackson (1973) [3], available potassium (K_2O) by neutral normal ammonium acetate method (Systronics flame photometer 128) (Jackson, 1973) [3]. Exchangeable calcium (Ca) and magnesium (Mg) were determined by adopting Versanate titration method (Jackson, 1973) [3]. The available sulphur (S) content was determined by turbidometric method using spectrophotometer at 420 nm after extracting with 0.15% $CaCl_2$ solution (Jackson. 1973) [3].

Statistical analysis

The correlation analysis of data was computed in relation to available major nutrients content with different physicochemical properties of the soils as suggested by Sundararaj, N. *et al.*, 1972 [10].

Preparation of maps

Maps of soil survey of farmers' field were generated based on x, y coordinates recorded in the farmers' field using GPS. Maps showing the spatial distribution of low, medium and high area for individual major nutrients and digitalized by using Arc GIS 10.4 software.

Results and discussion

Physicochemical properties of the soil

From the result (Table 1, 2 and 3), it was noticed that all soil samples collected from Udupi district were recorded the pH in the range of 5.04 to 6.65, 4.09 to 6.12 and 4.03 to 6.48 with mean and median of 5.59, 5.01, 4.81 and 5.52, 5.10, 4.64 with 0.41, 0.54, 0.53 as standard deviation in Udupi, Kundapura and Karkala taluk respectively, indicating the acid nature. Among the taluks of Udupi district soil acidity was more prominent in Karkala taluk followed by Kundapura and Udupi taluks. The acidic nature of these soils may be attributed to the high intensity of weathering coupled with intensive leaching of bases due to heavy rainfall. Similar results also reported by (Sathyanarayana and Biswas, 1970) [9]. Electrical conductivity of soils ranged from 0.079 to 0.606, 0.065 to 0.841 and 0.08 to 0.39 dSm^{-1} with mean and median of 0.367, 0.259, 0.190 and 0.36, 0.16, 0.08 $dSm^{-1}$with standard deviation of 0.14, 0.16, 0.08 in Udupi, Kundapura and Karkala taluk respectively, enlightening that soils were normal with respect to EC might be due to continues leaching of soluble salts with water through rain water from surface soil (Kabey and Shankar, 2013; Padhan *et al.*, 2016; Shivanna, 2008) [4, 7, 11]. Organic carbon content was found to be in the range of 3.3 to 17.3, 3.0 to 24.0and 3.2 to 17.3g kg^{-1} with mean and median of 9.1, 10.27, 9.7 and 8.5, 8.95, 9.45 g kg^{-1}in Udupi, Kundapura and Karkala taluks respectively, with standard deviation of 3.46, 4.14 and 3.53 g kg^{-1}. It was observed that low to high in OC status. These variations in organic carbon status were related to agricultural activities, namely crop management, particularly the use of FYM, fertilizers, green manure and plant residues Bhat and Mohapatra (1981) [2] observed similar findings.

The available nitrogen content of soils were ranged from 149.63 to 262.81, 112.67 to 526.84 and 122 to 445.31 kg ha^{-1} with average values of 214.78, 262.34 and 231.19 kg ha^{-1} in Udupi, Kundapura and Karkala taluks with median of 224, 250.36, 219.52 and standard deviation of 34.59, 79.01, 76.25 respectively. Whereas available phosphorus varied from 1.82 to 54.01, 3.16 to 230.1 and 5.01 to 168.05 kg ha^{-1} with average value of 21.50, 65.64 and 50.44 kg ha^{-1} in Udupi, Kundapura and Karkala taluks with median of 18.22, 40.14, 36.06 kg ha^{-1} and standard deviation of 17.50, 59.07, 39.10 respectively. Similarly the available potassium content ranged from 41.68 to 381.09, 41.44 to 571.31 and 94.8 to 651.7 kg ha^{-1} with an average value 155.09, 242.03 and 294.56 kg ha^{-1} in Udupi, Kundapura and Karkala taluks with median of 132.82, 230.46, 281.55 kg ha^{-1} and standard deviation of 92.83, 144.91, 124.43 respectively. Acid soils with high rainfall for prolonged duration affected mineralization of organic matter and also leaching and runoff loss nitrate and ammonical nitrogen from the soil Mathew *et al.* (2009) [6] and rich soils with Fe and Al oxides and hydroxide fixed the available phosphorus by oxides and hydroxides of Fe and Al might be a possible reason for low availability of available phosphorus (Mahajan *et al.*, 2015) [5] and coarser texture of the soil and undulating topography together with heavy rainfall leading to higher leaching losses of available potassium Sanappa and Manjunath (2013) [8]. The available nitrogen were found 77.6 to 100 per cent low and 22.4 to 31.6 per cent among taluks of the Udupi district and available phosphorus ranged from 15 to 64.8 per cent low and 48.6 to 50 per cent medium and 31.7 to 35 per cent high among these taluks. With respect to available potassium, these were found 3.9 to 52.9 per cent low and 41.2 to 67.2 per cent medium and 5.9 to 28.9 per cent high (Table 4, Fig 1, 2, 3 & 4)

The data on exchangeable calcium, exchangeable magnesium and available sulphur are also presented in Table 1, 2 and 3. The exchangeable calcium was varied from 0.60 to 5.38, 0.20 to 5.88 and 1.10 to 4.38 cmol (p^+) kg^{-1} with an average value 2.34, 2.11 and 2.04 cmol (p^+) kg^{-1}, with the median of 2.1, 1.89, 1.89 cmol(p^+)kg^{-1} and 1.29, 1.03, 0.66 as standard deviation, whereas exchangeable magnesium ranged from 0.19 to 2.98, 0.09 to 4.97 and 0.01 to 2.89 cmol(p^+)kg^{-1} with an average value 1.21, 0.88 and 0.58 cmol(p^+)kg^{-1} with the median of 0.89, 0.59, 0.49 cmol(p^+)kg^{-1} and 1.12, 0.84, 0.43 as standard deviation, and available sulphur content varied from 5.08 to 33.98, 1.93 to 119.95 and 0.63 to 52.39 kg ha^{-1} with an average value 15.11, 19.43 and 6.94 kg ha^{-1}, with the median of 12.8, 14.86, 14.33 kg $ha^{-1}$and 8.18, 19.62, 9.13 as standard deviation in Udupi, Kundapura and Karkala taluks, respectively of Udupi district. Deficiency of exchangeable Ca and Mg in soils might be attributed to leaching loss of bases from soils due to heavy rainfall and coarse textured nature of soil. The H^+ and Al^{3+} ions were saturated with kaolinite clay mineral and negative correlation observed between the exchangeable calcium and magnesium with soil pH (Ananthanarayana, *et al.*, 1986) [1].

The deficiency of soil exchangeable calcium and magnesium ranged from 70.6 to 90.8 and 47 to 88.2 per cent among taluks of the Udupi district and overall 86.3 and 78.5 per cent deficiencies were observed, respectively. With respect to available sulphur 81.6 to 94.2 per cent of the soils were found deficit in the different taluks with mean of 84.3 per cent of soils were deficit in the Udupi district (Table 5 and fig 4).

Correlation coefficient (r) of the major nutrients with other physicochemical properties

Correlation coefficient (r) was observed between soil properties such as major nutrients and physicochemical properties presented in table 6.

Results indicated that soil pH showed a positively and significantly correlated with exch. calcium (r=0.393*) and magnesium (r=0.347*) and positively correlated with nitrogen (r=0.064), sulphur (r=0.246). Whereas it had negatively and highly significantly correlated with organic carbon (r=-0.812**) and negatively correlated with available phosphorus (r=-0.160) and available potassium (r=-0.241).

Organic carbon showed positively correlated with available phosphorus (r=0.316) and available potassium (r=0.151). Whereas it had negatively correlated with available nitrogen (r=-0.148), exchange able calcium (r=-0.297), exchangeable magnesium (r=-0.117) and available sulphur (r=-0.184).

Available nitrogen showed positively correlated with available potassium (r=0.185), exchangeable calcium (r=0.104), available sulphur (r=0.060); whereasit had negatively correlated with available phosphorus (r=-0.242), exchangeable magnesium (r=-0.003).

A positively correlation was observed between available phosphorus with available potassium (r=0.093), exchangeable magnesium (r=0.003), available sulphur (r=0.032); and negatively correlation was observed with exchangeable calcium (r=-0.357). Similarly, available potassium showed positive correlation with available sulphur (r=0.112), and negative correlated with exchangeable calcium (r=-0.227) and magnesium (r=-0.250).

Exchangeable calcium showed a positive and significantly correlated with exchangeable magnesium (r=0.344*) and positively correlated with available sulphur (r=0.221).Whereas it had negatively correlated with DTPA iron (r=-0.280), zinc (r=-0.306), copper (r=-0.326) and manganese (r=-0.150). Similarly, exchangeable magnesium had a positively correlation with available sulphur (r=0.020) and negatively correlation with DTPA iron (r=-0.206), zinc (r=-0.213), copper (r=-0.253) and manganese (r=-0.093). Similarly, available sulphur had a negative correlation with DTPA iron (r=-0.119), zinc (r=-0.256), copper (r=-0.258) and manganese (r=-0.151).

Table 1: Descriptive statistics of analytical results of soils under arecanut based cropping systems in Udupi taluk.

Sl No.	Parameter	Units	Maximum	Minimum	Mean	Median	S. D.
1.	pH		6.65	5.04	5.59	5.52	0.41
2	EC	(dSm^{-1})	0.60	0.07	0.36	0.36	0.14
3.	OC	(g kg^{-1})	17.3	3.30	9.10	8.50	3.46
4.	Av. N	($kg\ ha^{-1}$)	262.81	149.63	214.78	224	34.59
5.	Av. P		54.01	1.82	21.49	18.22	17.50
6.	Av. K		381.09	41.68	155.09	132.82	92.83
7.	Exch. Ca	(cmol (p+) kg^{-1})	5.38	0.60	2.34	2.10	1.29
8.	Exch. Mg		2.98	0.19	1.21	0.89	1.12
9.	Av. S	($kg\ ha^{-1}$)	33.98	5.08	15.11	12.81	8.18

Table 2: Descriptive statistics of analytical results of soils under arecanut based cropping systems in Kundapura taluk.

Sl No.	Parameter	Units	Maximum	Minimum	Mean	Median	S. D.
1.	pH		6.12	4.09	5.01	5.10	0.54
2	EC	(dSm^{-1})	0.84	0.06	0.25	0.22	0.16
3.	OC	(g kg^{-1})	24.00	3.00	10.27	8.95	4.14
4.	Av. N	($kg\ ha^{-1}$)	526.84	112.67	262.34	250.36	79.01
5.	Av. P		230.10	3.16	65.64	40.14	59.07
6.	Av. K		571.31	41.44	242.03	230.46	144.91
7.	Exch. Ca	(cmol (p+) kg^{-1})	5.88	0.20	2.11	1.89	1.03
8.	Exch. Mg		0.09	4.97	0.88	0.59	0.84
9.	Av. S	($kg\ ha^{-1}$)	119.95	1.93	19.43	14.86	19.62

Table 3: Descriptive statistics of analytical results of soils under arecanut based cropping systems in Karkalla taluk.

Sl No.	Parameter	Units	Maximum	Minimum	Mean	Median	S. D.
1.	pH		6.48	4.03	4.81	4.64	0.53
2	EC	(dSm^{-1})	0.39	0.08	0.19	0.18	0.08
3.	OC	(g kg^{-1})	17.30	3.20	9.70	9.45	3.53
4.	Av. N	($kg\ ha^{-1}$)	445.31	122.00	231.19	219.52	76.25
5.	Av. P		168.05	5.01	50.44	36.06	39.10
6.	Av. K		651.70	94.8	294.56	281.55	124.43
7.	Exch. Ca	(cmol (p+) kg^{-1})	4.38	1.10	2.04	1.89	0.66
8.	Exch. Mg		2.89	0.01	0.58	0.49	0.43
9.	Av. S	($kg\ ha^{-1}$)	52.39	0.63	6.94	14.33	9.13

Table 4: Categorization of soil major nutrients under arecanut based cropping systems is soils of Udupi district

	Taluk Categorization	Udupi (17)	Kundapura (60)	Karkala (76)	Udupi District (153)
Available N (Kg ha^{-1})	Low (<280)	17 (100)	41 (68.4)	59 (77.6)	117 (77.2)
	Medium (280-560)	-	19 (31.6)	17 (22.4)	35 (22.8)
	High (>560)	-	-	-	-
Available P_2O_5 (Kg ha^{-1})	Low (<22.9)	11 (64.8)	9 (15)	15 (19.7)	35 (22.8)
	Medium (22.9-56)	6 (35.2)	30 (50)	37 (48.6)	76 (49.7)
	High (>56)	-	21 (35)	24 (31.7)	42 (27.5)
Available K_2O (Kg ha^{-1})	Low (<141)	9 (52.9)	18 (30)	3 (3.9)	30 (19.6)
	Medium (141-336)	7 (41.2)	27 (45)	51 (67.2)	85 (55.6)
	High (>336)	1 (5.9)	15 (25)	22 (28.9)	38 (24.8)

Table 5: Categorization of secondary nutrients under arecanut based cropping systems in soils of Udupi district

	Taluk Categorization	Udupi(17)	Kundapura (60)	Karkala (76)	Udupi District (153)
Exch. Ca (cmol(p+) kg^{-1})	Deficiency (<2.8)	12 (70.6)	50 (83.3)	69 (90.8)	132 (86.3)
	Sufficiency (>2.8)	5 (29.4)	10 (16.7)	7 (9.2)	21 (13.7)
Exch. Mg (cmol(p+) kg^{-1})	Deficiency (<0.8)	8 (47)	41 (68.4)	67 (88.2)	121 (78.5)
	Sufficiency (>0.8)	9 (53)	19 (31.6)	9 (11.8)	33 (21.5)
Available S (kg ha^{-1})	Low (<10)	16 (94.2)	49 (81.6)	65 (85.6)	129 (84.3)
	Medium (10-20)	1(5.8)	6 (10)	9 (11.8)	17 (11.1)
	High (>20)	-	5 (8.4)	2 (2.6)	7 (4.6)

Table 6: Co relation b/w soil physicochemical properties with major nutrients of udupi district

	pH	OC	N	P	K	Ca	Mg	S
pH	1.000							
OC	-0.812**	1.000						
N	0.064	-0.148	1.000					
P	-0.160	0.316	-0.242	1.000				
K	-0.241	0.151	0.185	0.093	1.000			
Ca	0.393*	-0.297	0.104	-0.357	-0.227	1.000		
Mg	0.347*	-0.117	-0.003	0.003	-0.250	0.344*	1.000	
S	0.246	-0.184	0.060	0.032	0.112	0.221	0.020	1.000

*Significant at 5%=(0.329) ** Significant at 1%=(0.424)

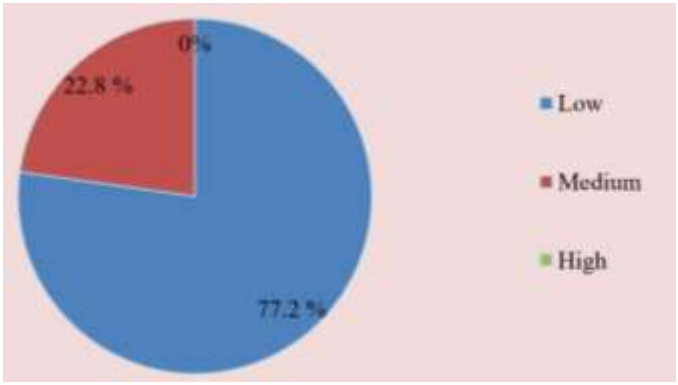


Fig 1: Percentage of available nitrogen status of soils under arecanut based cropping systems in Udupi district, coastal Karnataka

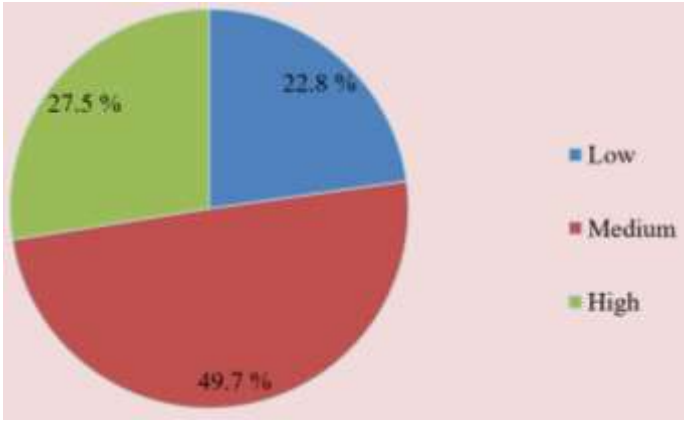


Fig 2: Percentage of available phosphorus status of soils under arecanut based cropping systems in Udupi district, coastal Karnataka

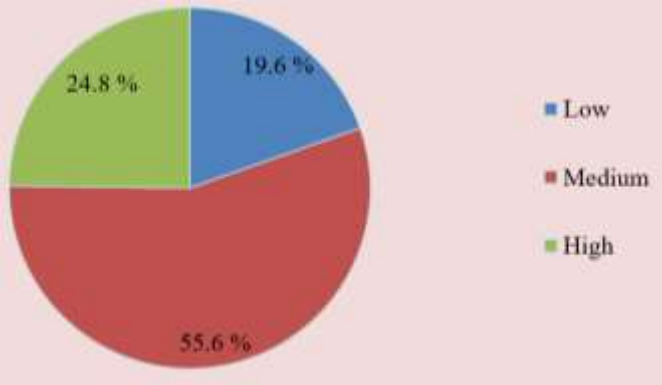
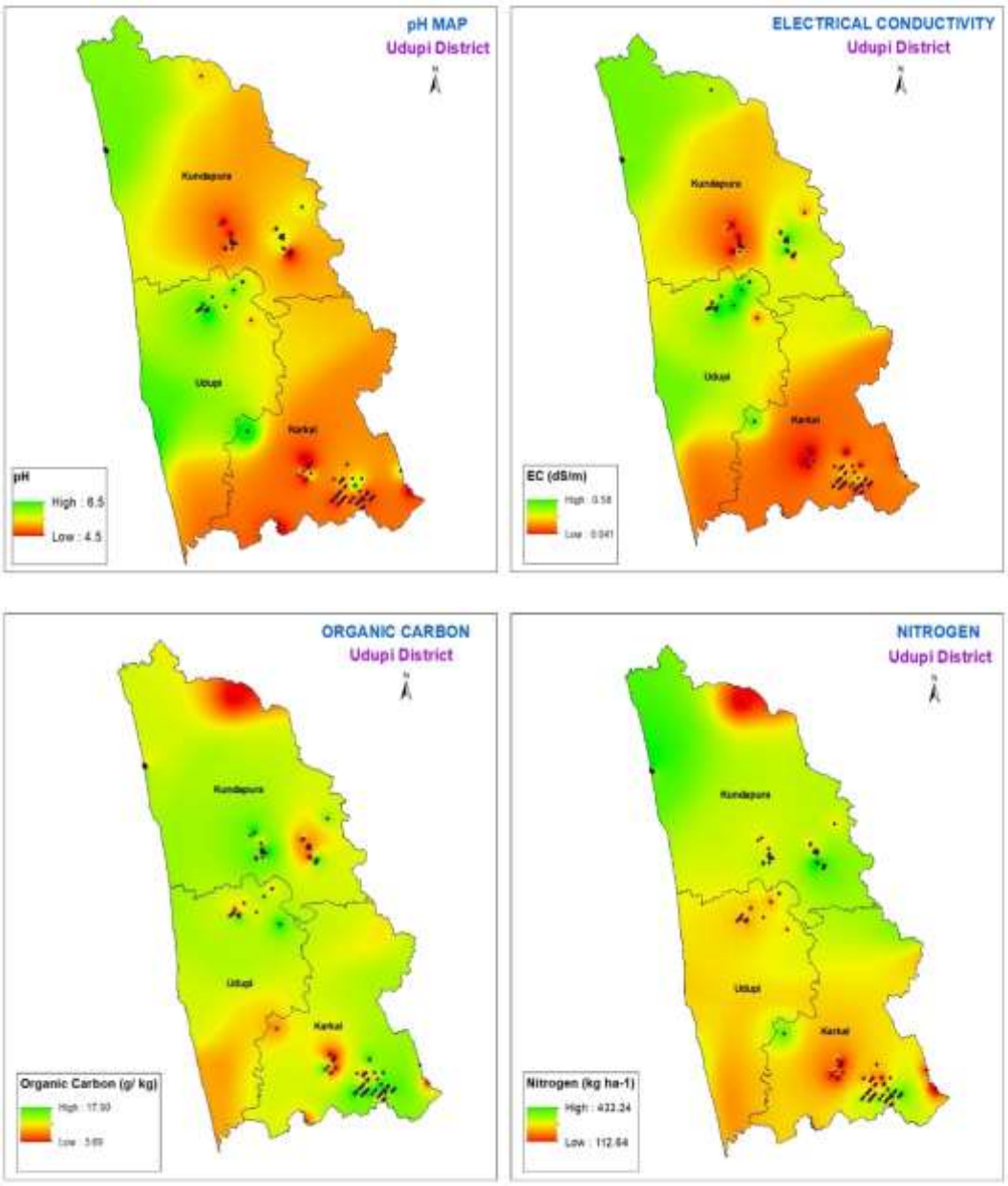


Fig 3: Percentage of available potassium status of soils under arecanut based cropping systems in Udupi district, coastal Karnataka



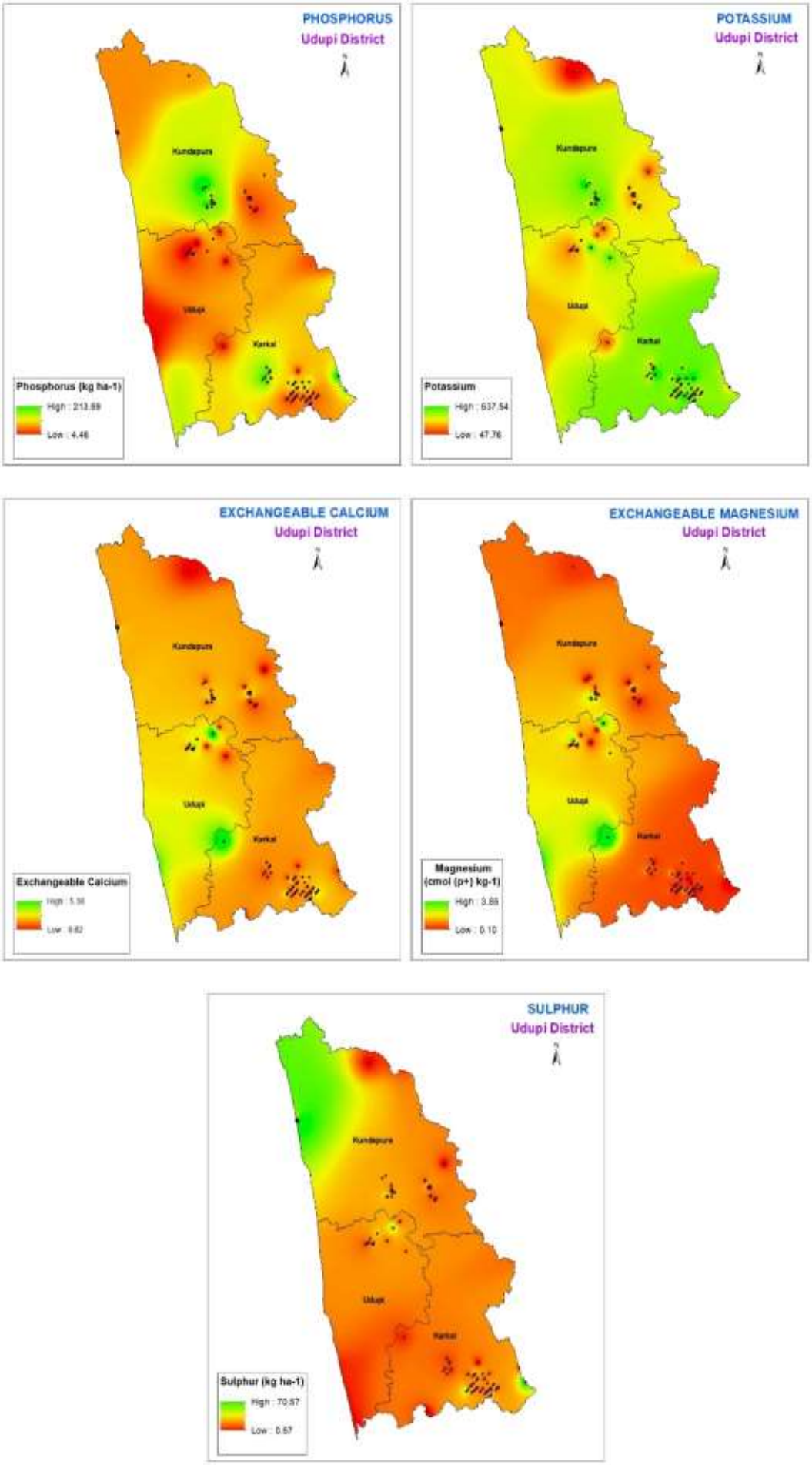


Fig 4: Mapping of soil major nutrients and secondary nutrients under arecanut based cropping systems is soils of Udupi district

Conclusion

The result indicates out of 153 soil samples collected from Udupi district, the pH was found to be acidic in nature and the soil organic carbon was low to high. The soils showed low to medium in available nitrogen status [Low (77.2%), Medium (22.8%) (Fig 1)], medium to high in available phosphorus [Medium (49.7%), High (27.5%), (Fig 2)], low to medium available potassium [Low (19.6%), Medium (55.6%) (Fig 3)], and medium to low available sulphur status [Low (84.3%), Medium (11.1%)].The exchangeable calcium (86.3%) and magnesium (78.5%) were found to be deficient.

Reference

1. Ananthanarayana R, Reddy MN, Mithyantha MS, Perur NG. Status of available secondary nutrients in acid soils of Karnataka. Journal of the Indian Society of Soil Science. 1986;34(3):614-616.
2. Bhat NT, Mohapatra AR. Scientific management for arecanut soils of Coastal Karnataka. Journal of the Indian Society of Soil Science. 1981;42(1):436-438.
3. Jackson ML. Soil Chemical Analysis. Prentice Hall of India Pvt. Ltd., New Delhi, c1973.
4. Kabeya MJ, Shankar AG. Effect of Different Levels of Zinc on Growth and Uptake Ability in Rice Zinc Contrast Lines (*Oryza Sativa* L.). Asian Journal of Plant Science and Research. 2013;3(3):112-116.
5. Mahajan GR, Manjunath BL, Latare AM, D'Souza R, Vishwakarma S, Singh NP. Fertility status of the unique coastal acid saline soils of Goa. Journal of the Indian Society of Soil Science. 2015;63(2):232-237.
6. Mathew DV, Patil PL, Dasog GS. Identification of soil fertility constraints of a pilot site in coastal agro ecosystem of Karnataka by geographic information systems technique. Karnataka Journal of Agricultural Sciences. 2009;22(1):77-80.
7. Padhan D, Sen A, Pal B. DTPA -Extractable Zinc in Rice Soils and its Availability to Rice. Current World Environment. 2016;11(2):662-669.
8. Sannappa B, Manjunath KG. Fertility status of soils in the selected regions of the western ghats of Karnataka, India. Scholars Academic Journal of Biosciences. 2013;1(5):200-208.
9. Sathyanarayana T, Biswas TD. Chemical and Mineralogical Studies of Associated Red and Black Soils. Mysore Journal of Agricultural Sciences. 1970;4:253-262.
10. Sundararaj N, Nagaraju S, Venkataramu MN, Jagannath MK. Design and analysis of field experiments, UAS, Hebbal, Bangalore. Systems. International Journal of Recent Scientific Research. 1972;5(9):1699-1702.
11. Shivanna M. Dynamics of potassium in hilly zone soils of Karnataka under paddy land use cover. Ph.D. Thesis submitted to Univ. Agric. Sci., Bangalore, c2008.
12. Subbaiah BU, Asija GL. Rapid procedure for the estimation of the available nitrogen in soil. Current Science. 1956;25(1):259-260.
13. Walkley AJ, Black CA. An examination of the method for determining soil organic matter and a proposed modification of the chromic acid titration method. Soil Science. 1934;37(1):29-38.