International Journal for Modern Trends in Science and Technology, 9(02): 227-232, 2023

ISSN: 2455-3778 online
DOI: https://doi.org/10.46501/IJMTST0902041
Available online at: http://www.ijmtst.com/vol9issue02.html

Physico–Chemical Properties of Bare Soil and Anthill Soil Samples Selected from Chikkamagaluru, Shivamogga, and Haveri Districts of Karnataka

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To Cite this Article
N. Nagaraja, S. Latha, and H.S. Jayanna. Physico–Chemical Properties of Bare Soil and Anthill Soil Samples Selected from Chikkamagaluru, Shivamogga, and Haveri Districts of Karnataka. International Journal for Modern Trends in Science and Technology 2023, 9(02), pp. 227-232. https://doi.org/10.46501/IJMTST0902041

Article Info
Received: 18 January 2022; Accepted: 20 February 2022; Published: 26 February 2023.

ABSTRACT

The physico-chemical properties of Bare soil and Anthill soil is based on the various parameters like pH, Electrical conductivity (EC), and available total primary macronutrients (N+P+K), status of Sulphur (S), status of Boran (B), organic carbon (OC) and available total micronutrients (Cu+Fe+Mn+Zn). Soil sample analysis of a region is a major factor in determining what types of plants grow in a certain area. Soil fertility is the inherent capacity of the soil to provide the essential plant nutrients in adequate amounts and in proper properties for the plant growth. Soil characterization of a region is an important aspect in relation to sustainable agricultural production.

The macronutrients and micronutrients are important soil elements that control its fertility and enhance the yield of crops. If we fail to supply the proper nutrients in the proper concentration, the plant function is affected.

The Chikkamgaluru, Shivamogga and Haveridistricts of Karnataka was selected for the study. The Bare soil and Anthill soil samples were collected randomly in Chikkamagaluru, Shivamogga and Haveri districts and compared for their physic-chemical properties. These results help farmers, researchers, agronomists and agriculture engineers for finding the processes related to soil, nature and nutrients status and help to improve the sustainable agriculture and horticulture production.

Keywords: pH, Electrical Conductivity, macronutrients, micronutrients, organic carbon.

INTRODUCTION

Soil is formed initially through disintegration and decomposition of rocks by physical and chemical process and is influenced by the activity and accumulated residues of numerous species of microscopic and macroscopic animals (Pujar et.al. 2012). The physical weathering process which brings about the disintegration of rocks into small fragments includes expansion and contraction caused by alternating heating and cooling. Stresses resulting from freezing and thawing of water and the penetration of roots and scouring or grinding by abrasive particles carried by moving ice or water and by the wind. The chemical processes tending to decompose the original minerals in the parent rocks include hydration, oxidation, reduction, solution, and dissociation, immobilization by

precipitation or removal of components by volatilization or leaching and various physicochemical exchanged reactions (kardol, et al. 2006). The loose products of these weathering processes are often transported by running water, glaciers or wind and deposited elsewhere in adequate amounts and in proper proportions for the plant growth. Soil characterization of a region is an important aspect in relation to sustainable agriculture production.

The soil profile differs from place to place and region to region particularly with respect to their color, depth, and composition (Sumithra, et al 2013).

The total available primary macro nutrients and micronutrients are important soil elements that control its fertility and enhances the yield of crops (Singh 2012). Anthill soils generally have high clay content and this enhances water storage capacity (Ali and Talukder 2008).

The research work was to analyse the Bare and Anthill soils of various selected places of Chikkamagaluru, Shivamogga and Haveri districts in terms of their physic-chemical parameters and arrive at a comparative assessment of the similarties and differences that exist due to regional topography and climate and the consesuation influence on favouredcrop type for harvest, their growth prospects and the final yield.

Chikkamagaluru is one of the district of Karnataka state in southern India. Spanning an area of 7.201 sq km. The five major rivers are tunga, Bhadra, Hemavathi, Nethravathi and Vedavati rivers flowing throughout the year. Coffee was first introduced into India through the Chikkamagaluru district when the first coffee crop was grown in the Baba BudanGiri Hills in 1670. It is a tourist heaven of Kemmannugundi, Kuduremukha, Manikadhar, Hebbe and Kallathigiri falls.

Shivamogga district is one of the district of Karnataka state in Southern India with a total area is 8465 Km^2. A major part of Shivamogga district lies in the malnad region of the Western Ghats and it is also known as "Gate way to Malnad " or malenaadahebbagilu in Kannada. Tunga and Bhara are two major rivers that flowing throughout the year. Shivamogga receives an average annual rainfall of 1813.9 mm with an average of 86 days in the year being rainy days.

Haveri district is exactly in the centre of Karnataka state being equi-distant from Bidar in the far north and Kollegala in the far south. The soil profile differs from place to place and region to region particularly with respect to their color, depth, and composition(Sumithra, et al. 2013).Haveri is famous for its eardamors garlands and Bydagi re chillies. Siddeshwara temple haveri, Galageshwara temple at GalagarattaMylaralingeshwara temple at Mylara rear Guttajs and KagineleMahasamsthana Kanaka Gurupeetha are major Tourism places in the district.

The average annual rainfall of the district was 768mm less by 3%compared to the normal rainfall of 792mm. Varada, Brahma, Kumadwathi and Tungabhadra all the four rivers flowing through Haveri district.

MATERIAL AND METHODS:

The study area covered six selected places like Birur of Chikkamagaluru district Ayanur, Rippenpete and Shivamogga of Shivamogga district and Ranebennur of Haveri district. These Bare and Anthill soil samples were collected from each place and composite soil samples were prepared the soil samples were air dried and processed to pass through 2mm sieve and analysed for the pH, EC, OC, and macronutrients were analysed as per methods standardized to agriculture Kendra, an institution of Agriculture to University of Agricultural Sciences, Bangalore situate at Navile, Shivamogga. Micronutrients were analysed by atomic absorption spectroscopy (AAS) technique in the soil test laboratory O.T. road Shivamogga.

RESULT AND DISCUSSION

Table 1: Bare soil samples

Variation of physic-chemical properties of Bare soil samples														
Sl no	sample	place	PH	EC dsm^{-1}	OC %	N $Kgha^{-1}$	P $Kgha^{-1}$	K $Kgha^{-1}$	S ppm	Z ppm	B ppm	Fe Ppm	Mn ppm	Cu Ppm
1	S 1	Birur	7.1	0.1	0.47	241.43	80.3	625	5.6	0.33	0.4	1.61	1.6	1.04
2	S 2	Birur	6.4	0.1	0.15	76.9	15.5	125.78	2.6	1.28	0.1	2.18	2.8	0.57
3	S 3	Birur	5.1	0.1	0.38	196.72	36.1	156.6	7.7	0.64	0.1	6.18	8.7	0.73

4	S 4	Ranebennur	5.6	0.1	0.29	148.44	3.7	99.7	25.4	1.19	0.2	3.20	1.8	0.40
5	S 5	Ranebennur	5.8	0.1	0.07	37.56	7.4	87.18	9.0	0.40	0.2	32.4	12.2	1.00
6	S 6	Ranebennur	6.0	0.1	0.46	236.07	22.8	322.7	17.2	0.47	0.4	10.81	7.6	1.08
7	S 7	Ayanur	5.7	0.1	0.44	227.13	28.0	246.5	4.3	0.2	6.04	32.4	12.2	1.00
8	S 8	Ayanur	5.5	0.1	0.40	207.46	41.2	85.65	7.7	0.2	7.27	0.44	9.5	0.22
9	S 9	Ayanur	4.9	0.1	0.57	295.09	110.50	133.60	6.4	0.2	6.42	23.46	7.70	0.52
10	S 10	Shimoga	4.4	0.1	0.65	338.01	595.1	72.28	7.7	0.2	7.49	34.66	9.2	0.22
11	S 11	Shimoga	4.6	0.1	0.47	245.01	52.30	154.15	4.30	0.3	4.67	21.34	6.5	0.44
12	S 12	Shimoga	5.2	0.1	0.45	230.70	22.10	80.03	6.00	0.2	2.16	5.64	6.8	1.33
13	S 13	Rippenpete	5.2	0.1	1.22	633.10	7.40	60.13	15.50	0.3	3.65	28.38	11.3	1.00
14	S 14	Rippenpete	5.8	0.1	1.15	593.75	4.40	275.75	8.20	0.7	0.47	23.92	11.9	1.48
15	S 15	Rippenpete	5.0	0.1	0.68	354.10	5.90	78.33	7.70	0.2	1.04	21.78	14.5	0.89

Table 2: Anthill soil samples

Variation of physico-chemical properties of Anthill soil samples														
Sl no	sample	place	PH	EC dsm^{-1}	OC %	N $Kgha^{-1}$	P $Kgha^{-1}$	K $Kgha^{-1}$	S Ppm	Z Ppm	B ppm	Fe ppm	Mn ppm	Cu Ppm
1	S 1	Birur	7.5	0.1	0.55	286.14	39.8	625	3.90	0.2	0.36	1.34	1.30	0.96
2	S 2	Birur	6.6	0.1	0.26	132.34	15.5	370.48	4.70	0.2	1.23	1.93	3.50	0.68
3	S 3	Birur	7.1	0.1	0.37	336.22	50.1	246.08	8.20	0.1	0.38	1.48	6.40	0.64
4	S 4	Ranebennur	5.2	0.1	0.65	200.30	11.0	125.43	17.20	0.4	0.31	15.86	14.50	2.14
5	S 5	Ranebennur	5.9	0.1	0.39	377.35	2.90	256.30	16.30	0.3	0.73	10.68	7.80	0.67
6	S 6	Ranebennur	5.7	0.1	0.73	315.55	15.5	171.70	16.80	0.5	0.24	13.11	10.70	1.54
7	S 7	Ayanur	5.2	0.1	0.61	395.24	45.7	364.93	4.30	0.3	0.38	26.16	6.10	0.80
8	S 8	Ayanur	5.6	0.1	0.76	257.53	8.80	105.7	8.20	0.3	1.35	14.46	12.30	0.82
9	S 9	Ayanur	5.3	0.1	0.50	246.80	44.9	323.6	4.30	0.2	5.00	13.29	13.20	0.40
10	S 10	Shimoga	4.0	0.1	0.48	246.80	4.97	66.6	5.20	0.2	3.17	36.02	8.30	0.43
11	S 11	Shimoga	4.8	0.1	0.35	178.84	15.50	117.78	7.70	0.2	7.98	17.23	12.20	0.63
12	S 12	Shimoga	5.8	0.1	0.99	513.29	2.9	86.80	7.70	0.2	5.57	4.00	6.00	1.11
13	S 13	Rippenpete	5.2	0.1	1.19	613.42	2.9	83.78	13.80	0.3	2.87	22.10	15.40	0.75
14	S 14	Rippenpete	5.1	0.1	1.45	751.13	13.3	311.10	6.90	0.3	0.31	16.76	14.60	1.01
15	S 15	Rippenpete	5.0	0.1	0.86	447.10	10.3	323.05	20.20	0.2	0.47	10.06	11.80	0.48

Table 3: Variation of Average values of Physico-chemical properties of Bare soil samples

Sl no	Sample no	place	pH	EC dsm^{-1}	OC	N $Kgha^{-1}$	P_2O_5 $Kgha^{-1}$	K_2O $Kgha^{-1}$	S ppm	B ppm	Zn ppm	Fe ppm	Mn ppm	Cu ppm
1	S1-S3	Birur	6.2	0.1	0.33	171.7	43.97	302.46	5.3	0.75	0.2	3.32	4.37	0.78
2	S4-S6	Ranebennur	5.8	0.1	0.28	140.69	11.30	169.86	17.2	0.69	0.27	7.13	6.37	0.65
3	S7-S9	Ayanur	5.4	0.1	0.47	243.23	59.9	376.69	6.14	6.58	0.2	18.78	9.8	0.58
4	S10-S12	Shivamogga	4.8	0.1	0.52	271.24	223.17	102.16	6.0	4.78	0.24	20.54	7.5	0.67
5	S13-S15	Rippenpete	5.1	0.1	1.02	526.99	13.77	138.07	10.47	4.47	0.40	24.69	12.57	1.13

Table 4: Variation of Average values of Physico-chemical properties of Anthill soil samples

Sl no	Sample no	place	pH	EC dsm^{-1}	OC %	N $Kgha^{-1}$	P_2O_5 $Kgha^{-1}$	K_2O $Kgha^{-1}$	S ppm	B ppm	Zn ppm	Fe ppm	Mn ppm	Cu ppm
1	S1-S3	Birur	7.06	0.1	0.39	203.87	35.13	413.85	5.6	0.65	0.16	1.58	3.73	0.76
2	S4-S6	Ranebennur	5.06	0.1	0.59	314.62	9.8	184.47	16.76	0.42	0.4	13.21	11.0	1.45
3	S7-S9	Ayanur	5.36	0.1	0.62	302.99	33.13	258.74	5.6	2.24	0.26	19.97	10.53	0.67
4	S10-S12	Shivamogga	4.86	0.1	0.60	312.97	7.79	90.39	6.86	5.57	0.20	19.08	8.83	0.71
5	S13-S15	Rippenpete	5.10	0.1	1.16	603.88	8.83	239.31	13.63	1.21	0.26	16.30	13.93	0.74

Soil pH and Electrical conductivity

The soil pH was analyzed far the Bare and Anthill soils collected from different of selected places of the selected area. The results of the average values of bare soil of pH in the table 1. The bare soil pH varied from 4.8 to 6.2 and the average values of Anthill soil of pH were represented in table 2. The Anthill soil pH varied from 4.86 to 7.06. The data represented to the bare soil and Anthill soil samples of Birur had a maximum value of pH and Shivamogga had a minimum value of pH.

The pH of the soil provides information regarding the potency of toxic substances present (Baruah 1999). The electrical conductivity of all Bare and Anthill soil samples found to be constant is 0.1 dsm^{-1}. On the basis of limits suggested by muhret. al (1995). Used for judging salinity of soils. All bare and anthill soil samples of study area comes under low conductivity group. The electrical conductivity may be ascribed to the leading of salts to lower horizons (Singh 2012).

Organic Carbon (OC)

Organic carbon represents the carbon contents in the soil sample. This carbon is present in the soil in the form of organic matter, formed by the action decomposition process of plant and animals materials with the microorganisms. The result obtained from this study reveals that the organic carbon content of the average values of Bare soil range from 0.28% to 1.02% (table 2) and 0.39% to 1.16% (table 1) respectively. The organic carbon content of both bare and anthill soil samples is low in Birur of the chikkamagaluru district (< 0. 5%). The average values of organic carbon content of the bare and anthill soil samples of Rippenpete of Shivamogga district had maximum value (>1 %). The deficiency in organic carbon may due to hyperthermic temperature and good aeration in the soil, water increases the rate of oxidating of organic matter (Singh and Mishra, 2012).

Nitrogen (N)

Nitrogen is an important macronutrient which plays a critical role in the determination of the nutrient status of the soil. The nitrogen content present in the soil is due to the continuous addition of residual content of plant and animals on the soil after decomposition. The data represented in table-1Shows the average values available nitrogen content in the bare soil samples varied from 140.69 kgm^{-1} to 526.99 kgm^{-1} with an average of 270.77 kgm^{-1} on the basis of the ratings suggested by subsiah and Asija 1956.

The average values of available nitrogen content in the anthill soil samples varied from 203.87 $kgha^{-1}$ to 603.88 $kgha^{-1}$ (table 2). The minimum amount of available nitrogen of bare and anthill soil samples of Birur of chikkamagaluru district and is due to low amount of organic carbon and maximum amount of nitrogen found in Rippenpete of Shivamoggadistrict and is due to high amount of organic carbon in the bare and anthill soil samples. The presence of nitrogen in the soil is enhanced plant growth quality of yield seed and fruit production.

Phosphorous (P_2O_5)

Available phosphorous is an important macro nutrients which requires a large amount of growth and development of plants. In soil, phosphorus content is present in the form of phosphorous pentaoxide which is easily associated by the plants. The obtained results in the study indicate that, the mean value of the available phosphorous content of bare soil samples varied from 11.30 $kgha^{-1}$ to 225.17 $kgha^{-1}$ (table 1) and the mean value of the available phosphorous content of anthill soil samples varied from 7.79 $kgha^{-1}$ to 35.13 $kgha^{-1}$ (table 2). According to observations of singh and Rathore (2013) soils of higher topography have higher phosphorous content from the soils of lower topography. In our present study lower topographic soil of Ranebennur had lower phosphorous content compare to higher topographic soil of Shivamogga. The phosphorous improves root development, rapid growth and encourage blooming.

Potassium (P_2O_5)

Potassium is an important macronutrients which is present in sedimentary and metamorphic rocks and also about 98% of potassium content in the soil is present in the form minerals. The potassium content present in the soil depends on the favorable soil environment with the pressure of organic matter Muhar et.al. 1963. The potassium is used to build protiens. In this current study, the results of available potassium content in the bare soil samples of selected places varied from 102.16 $kgha^{-1}$ to 376.69 $kgha^{-1}$. It is also observed that high potassium content was present bar soil sample of Ayanur of Shivamogga district and low potassium content was present in bare soil sample of shivamogga of shivamogga district.

The data tabulated in (table 2) shows the average value of available potassium status of anthill soil samples varying between 90.39 $kgha^{-1}$ to 413.85 $kgha^{-1}$. The minimum potassium content is found in Shivamogga of Shivamogga district and maximum potassium content was found in Birurof Chikkamagaluru district.

Sulphur content (S)

Table 1 shows the value of availablesulphur content of Bare soil samples is varied from 5.3 ppm to 17.2ppm. In our present study also revealed that all the anthill soil samples have medium sulphur content Ayanur of Shivamogga district and Birur of Chikkamagalur district has minimum sulphur content. Ranebennur of Haveri district has maximum sulphur content (table 2).

Boran(B)

The data tabulated in table 1 shows the average values of available boran status of bare soil samples varied from 0.69 ppm to 6.56 ppm. The minimum boran status is found in Ranebennur of Haveri district and maximum boran status is found in Ayanur of Shivamogga district in our present study also revealed that the average value of anthill soil samples varied from 0.42ppm to 5.57ppm. The minimum and maximum boran status is found in Ranebennur of Haveri district and Shivamogga of Shivamogga district respectively.

Zinc content (Zn)

As table 1 farther elucidates the available zinc stauts of bare soil samples; which average values varies from 0.2ppm to 0.40 ppm and table 2 represented the average values of zinc status of anthill soil samples which varies from 0.16ppm to 0.26 ppm all the soil samples have high zinc content. The average values of Zn content revealed that Birur of Chikkamagalur district has minimum zinc content and Ranebennur of Haveri district has Maximum zinc content (table 1). Zinc is an important trace element which plays a major role in the growth and development of plants by promoting the production of growth hormones.

Iron (Fe)

Iron is very important micronutrients which plays an important role in synthesis and maintaince of chlorophyll pigment in plants and also involved in protein synthesis (Parkpean,et al 1986 and Partpien et al. 1988).

The obtained results revealed that iron content of bare soil samples the average values varies between 1ppm to 211.69ppm (table 1). Birur of Chikkamagalur district has minimum value of iron content (< 4.5ppm) and maximum value of iron content found in Rippenpete of Shivamogga district. Table 2Futherelucidiates the available iron status of anthill soil samples from 1.58 ppm to 19.08ppm. Birur of Chikkaamagalur district low value of iron content and Shivamogga of Shivamogga district has high value of iron content.(Shivaprasad 1998).

Manganese (Mn)

Manganese is an important micronutrient present in the soils which are utilized by the plants in trace amounts. Manganese also plays a important role in the process of photosynthesis. The data represented in (table 1) shows the available manganese status of bare soil samples vary from 4.37 ppm to 12.57ppm and table 2 shows the available manganese status of anthill soil samples and is varied from 3.73 ppm to 13.93ppm. Minimum and maximum values of manganese status of both bare and anthill. Soil samples was found in Birur of Chikkmagalur district and Rippenpete of Shivamogga of Shivamogga district respectively.

Copper (Cu)

Copper is an important micronutrient present in the soil, which is needed by the plant in a minute quantity. It plays an important role in the chlorophyll formation and also plays a key role in several metabolic processes. Table 2 shows the available copper content and is found to vary the average values of copper content of bare soil samples from 0.58ppm to 1.13ppm. This data shows the lower value of copper content was found in Ayanur of Shivamogga district and higher value of copper content also found in Rippenpete of Shivamogga district. Table 2 shows the average value of anthill soil samples of copper content it varies from 0.67 ppm to 1.45ppm. This present data indicates that all the anthill soil samples have high copper content. Ayanur of Shivamogga district has a minimum value of copper content and Ranebennur of Haveri district has maximum value of copper content (table 2).

CONCLUSIONS

From this study we draw the following conclusions

1. The bare and anthill soil samples of Birur of Chikkamgalur district belonging to the dry region had low organic carbon compare to wet region of rippenpete of Shivamogga district.
2. The bare and anthill soil samples of Rippenpete of Shivamoggadisytrict formed high amount of nitrogen.
3. The bare soil samples of Shivamogga of Shivamogga district shows high amount of phosphorous content but anthill soil samples shows low amount of phosphorous.
4. Highest amount of potassium was found in anthill soil samples of Birur of chikkamagalur district and lower potassium of bare soil samples was found in Shivamogga of Shivamogga district.
5. The pH, EC, S, B, Zn, Fe, Mn and Cu of all bare and anthill soil samples of selected places of chikkamagalur, Shivamogga and Haveri districts are with permissible limits and therefore the bare and anthill soil samples seems to be suitable for quality of yield, sead and fruit production for both agricultural and horticultural crops.

Conflict of interest statement

Authors declare that they do not have any conflict of interest.

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