International Journal of Ecology and Environmental Sciences
www.ecologyjournal.in
Online ISSN: 2664-7133, Print ISSN: 2664-7125
Received: 30-05-2021, Accepted: 14-06-2021, Published: 30-06-2021
Volume 3, Issue 2, 2021, Page No. 271-274

Evaluation of soil in the area of Roorkee and Haridwar

Bharti Pathak[1], S B Sharma[2]
[1] Research Scholar, Department of Microbiology, Faculty of Science, Motherhood University, Roorkee, Uttarakhand, India
[2] Professor and Dean, Faculty of Science, Motherhood University, Roorkee, Uttarakhand, India

Abstract
Soil is a complex organization being made up of some six constituents' namely inorganic matter, organic matter, soil organisms, soil moisture, and soil solution and soil air. Roughly, the soil contains 50-60% mineral matter, 25-35% water, 15-25% air and little percentage of organic matter. We found that Soil pH was acidic to neutral in winter and rainy season. Soil was acidic in summer season.

Keywords: Soil, pH, winter, simmer, season, acidic, neutral

Introduction

Soil is a complex organization being made up of some six constituents' namely inorganic matter, organic matter, soil organisms, soil moisture, and soil solution and soil air. Roughly, the soil contains 50-60% mineral matter, 25-35% water, 15-25% air and little percentage of organic matter (Chatwal, *et al*., 2005) [11]. Soil is a highly complex biological system that is influenced by correlated physical-chemical and environmental parameters, and it presents a varied habitat for a diverse range of soil microorganisms (Pietramellara, *et al*., 2002; Campos, *et al*., 2012) [37, 9]. The soil quality analysis includes an analysis of parameters and processes which effects on soil to operate efficiently as a component of a sound ecosystem (Smita, *et al.*, 2015) [46]. Lal, (1996) [26] and Shepherd, *et al*., (2000) [42] examined that land use changes in tropical ecosystems could cause significant modifications in soil properties. Heavy metal contamination of soil due to various anthropogenic activities has become a major cause of concern throughout the world. Although metals such as Cr, Cu and Co etc. are essential for plant metabolism, but at levels exceeding food and fodder safety levels, they pose sever health risk (Katnoria, *et al*., 2011; Wang, *et al*., 2012) [23, 51]. Heavy metal contents of soils are dependent on the soil physico-chemical properties, cropping practices, availability and species of metal in soil, solubility of metals in soil and type of plant (Sinha, *et al*, 2006; Dheri, *et al*., 2007) [45, 15]. Human activities through industrial, agricultural, traffic, domestic, mining and other anthropogenic processes have contributed to elevated and toxic levels of these metals when compared to those contributed from geogenic or lithological processes (Pam, *et al*., 2013) [35]. Severe deterioration in land use type of soil quality may lead to a permanent degradation of land productivity (Kang, 1986: Nardi, *et al.*, 1996: Islam, 2000) [22, 31, 17]. Land use pattern plays a vital role in governing the nutrient dynamics and fertility of soils (Venkatesh, *et al*., 2003).

Materials and methods

Experimental site

The experiments were conducted in Uttarakhand i.e. Haridwar and Roorkee for two years (2018-2020) from three land use sites 1. Industrial area 2. Agricultural area 3. Natural Forest area

Sampling period

Samples will be collected at different time intervals from different land use areas of Roorkee and Haridwar for consecutive years 2017-2018 & 2018-19.

Sampling frequency

First sample of soil and groundwater will be collected in the month of February, second sample of soil will be collected in the month of June, third sample of the soil will be collected in the month of October and the fourth sample in the month of February from different sites of Roorkee and Haridwar for one year (2018-2019).

Collection of soil samples

The soil samples will be collected at depth 0-15cm, using screw-auger. 21 points subsamples will be taken randomly from each site and mixed thoroughly to form composite samples (approx. 3kg soil) each. The soils will be put into plastic bags, labeled and immediately transported to the laboratory for analysis (Subra, 2001; Okonkwo, 2010) [48]. Each soil sample was divided into two parts; the first part was sent to be analyzed for soil physical and chemical properties. The second part of the soil sample was isolated to obtain pure soil bacterial and fungal cultures at the Environmental laboratory of College of Forestry, SHUATS, Prayagraj.

Table 1: Parameters used for physio-chemical analysis of soil sample

Sl.no	Parameters	Methods	Units
1	Soil pH (1:2) soil water suspension (W/V)	pH meter (Jackson, 1958)	
2	Soil EC (dsm^{-1}) at 25ºC of 1:2 soil water suspension	Digital conductivity Meter Black (1965)	dSm^{-1}
3	Organic carbon %	Titrimetric method of Walkey and Black (1947)	$Kgha^{-1}$
4	Available nitrogen (kg ha^{-1})	Kjeldhal Method, (Subbiah and Asija, 1956)	$Kgha^{-1}$
5	Available phosphorus (kg ha^{-1})	Olsen spectrophotometer method (Olsen *et. al.*, 1954)	$Kgha^{-1}$
6	Available potassium (kg ha^{-1})	Flame Photometric Method (Toth and Price,1949)	$Kgha^{-1}$
7	Nickel	Atomic Absorber Spectrophotometer Black (1965) and Lindsay and Norvell (1978)	mg kg^{-1}
8	Zinc	Atomic Absorber Spectrophotometer Black (1965) and Lindsay and Norvell (1978)	mg kg^{-1}
9	Chromium	Atomic Absorber Spectrophotometer Black (1965) and Lindsay and Norvell (1978)	mg kg^{-1}
10	Cadmium	Atomic Absorber Spectrophotometer Black (1965) and Lindsay and Norvell (1978)	mg kg^{-1}

Heavy Metal Analysis

Flame Atomic Absorption Spectrometry will be used to determine concentrations of heavy metals in samples obtained both from acidic digestion and from sequential extraction.

Soil moisture

The soil moisture is expressed as per cent of moisture content; this pertains to the percentage of water in the soil on the oven dry weight basis. The occurrence, distribution and activity of fungi are highly influenced by moisture content. An optimum amount of moisture is required for the microbial activity and decomposition of the organic matter in the soil. Soil moisture content was determined by drying 100 g of fresh soil in a hot air oven at 105 - 110°C for overnight (Anon, 1977 and Gupta, 1999).

Soil pH

Soil pH measures the negative logarithm of the hydrogen ion activity of the soil solution. It is the measure of soil sodicity, acidity or neutrality. It is a simple but very important estimation for soils, since soil pH influences largely the availability of nutrients to crops. It also affects microbial population in soils. Most nutrient elements are available in the pH range of 5.5 to 6.5. The acid or alkaline reaction of a soil was measured by a number of methods and expressed in terms of pH units, each pH units represents a tenfold increase or decrease in relative acidity or alkalinity. The pH of the soil samples was measured with an electrical digital pH meter (Elico) in 1:5 (w/v) soil-water suspensions.

Soil temperature

It is the degree of heat or coldness; it is represented by degree Celsius (°C). The temperature of soil regulates or controls the rate of microbial reproduction and decomposition. The optimum temperature for this purpose may be between 24 and 35 °C. Soil temperature was recorded with a soil thermometer at the time of soil sampling by inserting the thermometer into the earth core.

Atmospheric temperature

It is the degree of heat or coldness; it is represented by degree Celsius (°C). The temperature is vital for several activities of the plants, trees and microorganisms in the environment. The atmospheric temperature was measured by using wet and dry bulb thermometer or digital hygrometer.

Electric conductivity

The electrical conductivity (EC) is a measure of the ionic transport in a solution between the anode and cathode. The EC is normally considered to be a measurement of the dissolved salts in a solution like, a metallic conductor, they obey Ohm's law. EC is commonly expressed in units of milli Siemens per cm (mS-cm'1). The EC of the soil samples were measured with an electrical digital EC meter (Elico) in 1:2 (w/v) soil-water suspensions. Soil electrical conductivity (EC) is a measurement that correlates with soil properties that affect crop productivity, including soil texture, cation exchange capacity (CEC), drainage conditions, organic matter level, salinity, and subsoil characteristics. Electric conductivity can be expressed in units of milli Siemens per cm (mS-cm"1).

Relative humidity

Humidity can be defined as, the amount of invisible water vapour present in the atmosphere in gaseous form. Relative humidity is expressed in percentage as ratio between the total capacity of the air to hold moisture under a given temperature and the amount of moisture, it actually carries. Relative humidity was measured using digital hygrometer.

Table 2: Physical parameter of soil sample

S. No	Parameters	Methods
1	Bulk Density (g/cc)	Muthuaval *et al.*1992
2	Soil color	Munsell chart Method
3	Particle Density (g/cc)	Relative density bottle method of Black (1965)
4	Pore space (%)	Muthuaval *et al.*1992
5	Soil texture	Bouyoucous Hydrometer Method, 1965

The results were analyzed statistically by Pearson's co-efficient correlation and ANOVA (one way) with the help of SPSS software. To test the difference between soil quality parameters and soil quality index of the different land use types, one-way analysis of variance (ANOVA) followed by Tukey HSD was performed using SPSS

Results

The physico-chemical parameters of agricultural soil samples in summer, rainy and winter seasons during the years 2018-19, and 2019-20, revealed that, the variations were observed between different seasons of both the years. Relative humidity was higher (85-90%) in rainy seasons, medium (61-63%) in summer seasons. Soil moisture was maximum (62%, 79% and 64%) in rainy, followed by winter (35%, 35% and 36%) and summer (24%, 22% and 24%) seasons.

Discussion

Soil pH was acidic to neutral (6.1, 5.1 and 6.7) in summer and rainy seasons and acidic in winter (6.3, 6.1 and 7.0) seasons. Electrical conductivity of soil was very low (between 0.4-0.43 $mS.cm^{-1}$) in winter, summer and rainy seasons. Soil organic carbon was very higher in winter (4.4 %, 4.3% and 4.15%), followed by rainy (3.1%, 3.4% and 2.31%) and in summer (2.6%, 2.8% and 2.1%)) seasons. The available phosphorous was very lower (2.2-2.9 $kg.ha^{-1}$) in winter, summer and rainy seasons, than the critical value (10.11-24.32 $kg.ha^{-1}$). Available potassium was lower (74.78-64.74 $kg.ha^{-1}$) in winter, summer and rainy seasons, than the critical value (108-280 kg.ha"1). Concentration of zinc was higher (0.95$kg.ha^{-1}$, 0.98 $kg.ha^{-1}$ and 1.0 $kg.ha^{-1}$) in rainy and winter (1.22 $kg.ha^{-1}$, 1.01 $kg.ha^{-1}$ and 1.0 $kg.ha^{-1}$) and medium (0.89 kg.ha"1, 0.85 kg.ha"1 and 0.98 kg.ha"1) in summer seasons, than the critical value (0.9-2.69 $kg.ha^{-1}$). Concentration of copper was very higher (2.13 $kg.ha^{-1}$, 2.18 $kg.ha^{-1}$ and 2.13 $kg.ha^{-1}$) in summer, winter (2.18 $kg.ha^{-1}$, 2.32 $kg.ha^{-1}$ and 1.18 $kg.ha^{-1}$) and very lowers (1.18 $kg.ha^{-1}$, 1.24 $kg.ha^{-1}$ and 1.19 $kg.ha^{-1}$) in rainy seasons, than the critical value (1.01 $kg.ha^{-1}$). Concentration of manganese was very higher in winter (12.7 $kg.ha^{-1}$, 12.8 $kg.ha^{-1}$ and 13.01 $kg.ha^{-1}$) followed by rainy (10.1 $kg.ha^{-1}$, 10.02 $kg.ha^{-1}$ and 12.00 $kg.ha^{-1}$) and summer (7.4 $kg.ha^{-1}$, 7.5 $kg.ha^{-1}$ and 6.15 $kg.ha^{-1}$) seasons, than the critical value (4.48 $kg.ha^{-1}$). Concentration of iron was higher in rainy (38.1 $kg.ha^{-1}$, 38.0 $kg.ha^{-1}$ and 40.2 $kg.ha^{-1}$), summer (28.21 $kg.ha^{-1}$, 28.11 $kg.ha^{-1}$ and 25.61 $kg.ha^{-1}$) and winter (22.98 $kg.ha^{-1}$, 22.88 $kg.ha^{-1}$ and 22.12 $kg.ha^{-1}$) seasons than the critical value (5.6-10.08 $kg\text{-}ha^{-1}$).

References

1. Singh AK, Bordoloi LJ. Comparative Study of Soil Fertility Status under Horticulture Based Land Use Systems in Two Different Altitudes of Nagaland. Journal of the Indian Society of Soil Science, 2014:62(1):75-79.
2. Alok Kumar Srivastava, Kulandaivelu Velmourougane Bhattachary. Impacts of agro-climates and land use systems on culturable microbial population in soils of the Indo-Gangetic Plains, India.Current Science,2014:107:9.
3. Arun Nagendran N, Deivendran S, Prabavathi S. Diversity of Soil Microbes under Different Ecosystem Landuse Patterns. Journal of Applied & Environmental Microbiology,2014:2(4):90-96.
4. Bai J, Ouyang H, Xiao R. Spatial variability of soil carbon, nitrogen, and phosphorus content and storage in an alpine wetland in the Qinghai-Tibet Plateau, China. Australian Journal of Soil Research,2010:48(8):730–736.
5. Baruah TC. Soil fertility constraint in N.E. India and their impact on crop production: Proceedings- Summer School on Acid Soils for Increasing Crop Productivity Sustainable Agricultural Development. National Bureau of Soil Survey and Land Use Planning, Jorhat, Assam, 2002, 13-20.
6. Bhattacharyya PN, Jha DK. Seasonal and Depth-wise variation in Microfungal Population Numbers in Nameri forest soil, Assam, Northeast India. Mycosphere, 2011:2(4):297–305. Biological Science Volume 13 Issue 3 Version 1.
7. Black CA. Methods of Soil Analysis, Am. Soc, Agron. madison, Wisconsin, U.S.A, 1965, 2.
8. Bouyoucos G. The hydrometer as a new method for the mechanical analysis of soils. Soil Sci,1927:23:343-352.
9. Campos AC, Etchevers JB, Oleschko KL, Hidalgo CM. Soil Microbial biomass and nitrogen mineralization rates along an altitudinal gradient on the Cofre de Perote volcano (Mexico): the importance of landscape position and land use. Land Degrad. Develop, 2012. DOI: 10.1002/ldr.2185.
10. Ceccherini MT, Ascher J, Pietramellara G, Mocali S, Viti C, Nannipieri P. The effect of pharmaceutical waste-fungal biomass, treated to degrade DNA, on the composition of eubacterial and ammonia oxidizing populations of soil. Biology and Fertility of Soils,2007:44:299-306.
11. Chatwal, Sharma. A text book of environmental studies, I edition, Himalaya publishing house, 2005, 281.
12. Chenithung, Tsangloa T, Sharma YK, Sharma SK. Fertility status and soil acidity under different land use systems in wokha district of Nagaland. Journal of Indian Society of Soil Science, 2014:62(4):414-418.
13. Datta M, Gupta RK. Utilization of press mud as amendment of acid soil in Nagaland. Journal of Indian Society of Soil Science,1983:31:511-516.
14. Decaens T, Jimenez JJ, Gioia C, Measey GJ, Lavelle P. The value of soil animals for conservation biology. European Journal of Soil Biology,2006:42:S23-S38.
15. Dheri GS, Brar MS, Malhi SS. Heavy-metal concentration of sewage-contaminated water and its impact on underground water, soil, and crop plants in alluvial soils of northwestern India. Communications in Soil Science and Plant Analysis,2007:38:1353–1370.
16. Hernot J, Robertson G. Vegetation removal in two soils of the humid tropics: Effect on microbial biomass. Soil Biol. Biochem,1994:15:93-99.
17. Islam KR, Weil RR. Land use effects on soil quality in a tropical forest ecosystem of Bangladesh. Agriculture, Ecosystems & Environment,2000:79:9–16.
18. Jackson ML. Soil Chemical Analysis. Constable, London, 1958.
19. Jain RK, Kapur M, Labana S, Lal B, Sarma PM, Bhattacharya D, Thakur IS. Microbial diversity: Application of micro-organisms for the degradation of xenobiotics. *Current Science,*2005:89(1):101-112.
20. James EBG, Hyde KD. Methods for the study of Mangrove Marine Fungi, In: *Mangrove* Microbiology, Role of Microorganisms in Nutrient cycling of Mangrove soils and waters," Ed by A. D. Agate, C. V. Subramanian and H. Vannuccie,1998,9-27.
21. Julia F, Jackie A. Monitoring and assessing soil bioremediation (Enumeration of soil microorganisms). Publisher: Springer berlin Heidelberg. Soil Biology,2005:5:261-280.
22. Kang BT, Juo ASR. Effect of forest clearing on soil chemical properties and crop performance. In: Lal, R., Sanchez, P.A., Cummings, Jr., R.W. (Eds.), Land Clearing and Development in the Tropics. Belkema, Rotterdam, 1986, 383–394.
23. Katnoria JK, Arora S, Bhardwaj R, Nagpal A. Evaluation of genotoxic potential of industrial waste contaminated soil

extracts of Amritsar, India. J. Environ. Biol,2011:32:363-367.
24. Kowalchuk GA, Stephen JR. Ammoniaoxidizing bacteria: A model for molecular microbial ecology. Annual Review of Microbiology,2001:55:485-529.
25. Kumud Das, Ramesh Nath, Padum Azad. Soil Microbial Diversity of Dibru-Saikhowa Biosphere Reserve Forest of Assam, India. Global Journal of Science Frontier Research, 2013.
26. Lal R. Deforestation and land-use effects on soil degradation and rehabilitation in Western Nigeria. I. Soil physical and hydrological properties. Land Degrad. Develop,1996:7:19-45.
27. Lindsay, Norvell. "Development of a DTPA Soil Test for Zinc, Iron, Manganese, and Copper," Soil Science Society of America Journal,1978:42:3:1978:421-428.
28. Lynch JM. Interactions between biological process, cultivation and soil structure. Plant and soil,1984:76:307-318.
29. Muralidharudu Y, Sammi Reddy KI, Mandal BN, Subba Rao A, Singh KN, Sonekar S. GIS based soil fertility maps of different states of India. All India Coordinated Project on Soil Test Crop Response Correlation, Indian Institute of Soil Science, Bhopal, 2011, 1-224.
30. Ngoye E, Machiwa JF. The influence of land-use patterns in the Ruvu river watershed on water quality in the river system. Physics and Chemistry of the Earth A, B, C, 2004:29, 15–18, 1161–1166.
31. Nardi S, Cocheri G, Dell'Agnola G. Biological activity of humus. In: Piccolo, A. (Ed.), Humic Substances in Terrestrial Ecosystems. Elsevier Amsterdam, 1996, 361–406.
32. Nyberg K, Schnurer A, Sundh I, Jarvis A, Hallin S. Ammonia-oxidizing communities in agricultural soil incubated with organic waste residues. Biology and Fertility of Soils,2006:42:315-323.
33. Olsen. Estimation of available Phosphorus in soils by extraction with sodium bicarbonate U. S. Deptt. Agr. Circ., 1954, 939.
34. Olson RK, Schoeneberger MM, Aschmann SG. An ecological foundation for Temperate Agroforestry. In: North American Agroforestry, An Integrated Science and Practice, Eds. H. E. Garrett, W. J. Rietveld and R. F. Fisher, Wisconsin, USA: American Society of Agronomy, Madison, 2000, 31-61.
35. Pam AA, Ato RS, Offem JO. Contribution of Automobile Mechanic Sites to Heavy Metals in Soil: A case study of North Bank Mechanic village, Makurdi, Benue State, Central Nigeria. Journal of Chemical, Biological and Physical Sciences,2013:3(3):2337-2347.
36. Petevino Chase, Singh OP. Soil Nutrients and Fertility in Three Traditional Land Use Systems of Khonoma, Nagaland, India. Resources and Environment,2014,4(4):181-189.
37. Pietramellara G, Ascher J, Ceccherini MT, Renella GC. Soil as a biological system. Annals of Microbiology, 2002:52:119–131.
38. Prasad RN, Pritam, Barooah RC, Ram M. Soil Fertility Management in NE Hill Region. Technical Bulletin No. 9, ICAR Research Complex for NEH Region, Shillong, 1981.
39. Rathore SS, Kurana Karan K, Prakash B. Alder based farming system –A traditional farming practices in Nagaland for amelioration of Jhum land. Indian Journal of Traditional Knowledge,2010:9:677-686.
40. Shaheen A, Naeem MA, Jilani G, Shafiq M. Integrated soil management in eroded land augments the crop yield and water-use efficiency. Acta Agriculturae Scandinavica Section B-Soil and Plant Science,2010:60:274-282.
41. Sharma YK. Physiochemical characteristics and nutrient status of hilly soils of Dimapur district of Nagaland. A journal of multidisciplinary advance research,2013:2(1):34-39.
42. Shepherd G, Bureh RJ, Gregory PJ. Land use affects the distribution of soil inorganic nitrogen in smallholder production systems in Kenya. Biol. Fert. Soils,2000:31:348-355.
43. Singh PK, Amenla Jamir. Comparative study of soil fertility status of direct seeded and transplanted rice under Kohima district of Nagaland. Journal of pharmacognosy and phytochemistry,2017:SP1:64-68.
44. Singh SK, Rai JPN. Soil microbial population and enzyme activity related to grazing pressure in Alpine meadows of Nanda Devi Biosphere Reserve. Jr. of Environ. Biol, 2004:25(1):103-107.
45. Sinha S, Gupta AK, Bhatt K, Pandey K, Rai UN, Singh KP. Distribution of metals in the edible plants grown at Jajmau, Kanpur (India) receiving treated tannery wastewater: Relation with physic chemical properties of soil. Environmental Monitoring and Assessment,2006:115:1–22.
46. Smita Tale, Ingole. A Review on Role of Physico-Chemical Properties in Soil Quality, Chem Sci Rev Lett.;2015:4(13):57-66.
47. Subbiah, Asija. A rapid procedure for the estimate of Available nitrogen in soil current sciences,1956:25:259-260.
48. Subra R. Soil microbiology (fourth edition of soil microorganisms and plant growth).P.O.Box, 699s, Enfiela, New Hampshire 03748.United State of America, 2001.
49. Toth, Price. Estimation of cation exchange capacity and exchangeable Ca, K and Na content of soil by flame photometer technique. Soil Sci.,1949:67:439-445.
50. Walkley Black A. A critical examination of a rapid method for determining organic carbon in soils - effect of variations in digestion conditions and of inorganic soil constituents. Soil Sci,1947:63:251-264.
51. Wang X, Chen T, Lei M, Song B, Wan X, Li Y. Selection of sugar cane varieties with a low heavy metal accumulation ability for the ecological remediation of contaminated farmland. J. Resour. Ecol,2012:3(4):373-378.
52. Webster EA, Hopkin DW, Chudek JA, Haslam SFI, Simek M, Picek T. The relationship between microbial carbon and resource quality of soil carbon. Journal of Environmental quality,2001:30:147-150.
53. Sharma YK, Anamika Sharma, Sharma SK. Physiochemical characteristics and soil fertility status of forest and rice land use system in Mokokchung district on Nagaland. Journal of Indian Society of Soil Science,2013:61(1):38-43.
54. Yao H, He Z, Wilson MJ, Campbell CD. Microbial biomass and community structure in a sequence of soils with increasing fertility and changing land use. Microbial Ecology,2000:40:223-237.