Biospectra : ISSN: 0973-7057, Vol. 17(2), September, 2022, pp. 157-160 30(AS).
An International Biannual Refereed Journal of Life Sciences **Animal Science**

ISSN : 0973-7057

Int. Database Index: 616 www.mjl.clarivate.com

Interrelationship between the Potential of Hydrogen Ion Concentration and Electrical Conductivity distribution of various agricultural land and their soil quality in Dhanbad, Jharkhand.

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Received : 28th June, 2022 ; Revised : 29th July, 2022

Abstract- This study investigated the relationship between the potential concentration of hydrogen ions and electrical conductivity. Six samples were taken from different places of Dhanbad from Bastacola (mining area) and Palani (agricultural area) districts of Baliapur Dhanbad. Soil pH is important in determining its amount as a source of H^+ and OH^-. Electrical conductivity can help to determine other physical parameters such as soil structure, porosity, and bulk density. Non-specific ions such as Nitrate, Potassium, Sodium, Chloride, sulphate, and Ammonium help in various ways in the management of agricultural commodities, the types of crops we grow, and the way we work on soil management.

Key words: pH, Electrical conductivity, soil texture, Bulk Density, non-specific ions

INTRODUCTION

Soil is a huge part of the natural environment and has a significant role in providing the nutrients to the plants. Soil quality is related to the capacity of the soil to sustain plant growth and function. Soil quality is determined by many factors such as the physical, chemical, biological, and ecological properties of the soil. It is formed in the process of pedongensis. Changing the quality of the soil depends directly on the production of crops. One of the most important parameters of the soil body is pH and electrical conductivity, as they indicate soil health. pH and EC analysis process are simple and non-expensive method. pH indicates basic, acidity and neutrality nature which depend on the ability of hydrogen ion concentration in a soil water solution. Therefore, the soil water solution is a reflection of the concentration of soil ions, which does indicate non- specific ions, while water is formed when nuclear oxygen and two hydrogen ions form in a liquid state. Hydrogen atom with positive load (H^+) and ion hydroxyl with negative load (HO^-). Soil pH, therefore, help to determines the fate of substance in the soil environment. pH helps in implication for the recycling and availability of nutrient available to plant for their growth & crop production, distribution of pollutants in soil environment and bioremediation process for contaminants soil. Functional role of soil pH in soil biogeochemistry for the remediation of contaminated and exploited soil. Control of translocation and transformation of pollutants in surroundings.[1]

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The ion of water can be correctly expressed by the ionization constant KW.[2]

Define as the following: Kw= $[H^+]$ $[OH^-]$

Kw= 10^{-14}eq…..1

Any substance with a pH value below 7 is considered acidic, above 7 is alkaline, and anything equal to 7 is considered neutral.

This indicates that the lower the soil pH, remains the higher the rate of solubility of ions in the soil goes.[3] As a result, plant production is interrupted due to ionic runoff. The lower the pH of the soil, water solution is, the higher the concentration of hydrogen ions and the higher the concentration of hydroxyl ions will be.

The most favourable pH level for farmland ranges from 6 to 7, as most plants readily absorb nutrients within this nominal range (USDA Natural Resource Conservation Service). The increase and decrease of the aqueous solution of the soil play a reciprocal relationship with the electrical conductivity. EC is also one of the most important physical parameters, correlating the concentration of chemical parameters, such as nitrates, potassium, sodium, chloride, sulphate and ammonium (Natural Resource Conservation Service). And an increase or decrease in pH will vary with electrical conductivity. If the result of a low pH disperses the ionic batch, it does not reach the crops, leaching nutrients that hinder productivity.

The electrical conductivity of the soil water solution represents the amount of salt concentration.[4] Electrical conductivity also helps in knowing the condition of soil texture, porosity and bulk density, which indirectly helps in controlling crop production.[5] This research primarily focuses to know present status of soil quality and it will help to increases the primary productivity of mining agricultural lands by analysis pH and electrical conductivity of soil, as these parameters are easy to analyse and less expensive to determine the quality. Dhanbad is known for mining activities due to huge mining operation of pollution increase and indirectly harm the soil quality agricultural land degraded into bare land. This study will focus on increasing agricultural production, control the concentration of nutrient and provide financial assistance to farmer. soil characteristics play significant role to farmers attempting to increase or decrease efficiency of fertilizers as per crops types and their production.[6] Standard levels of pH, EC values are essential for optimal plant growth and culture yield, because nutrients are freely available to be absorbed by plants. Testing the pH and EC of the soil help to determine which plants are best suited for a particular area.[7]

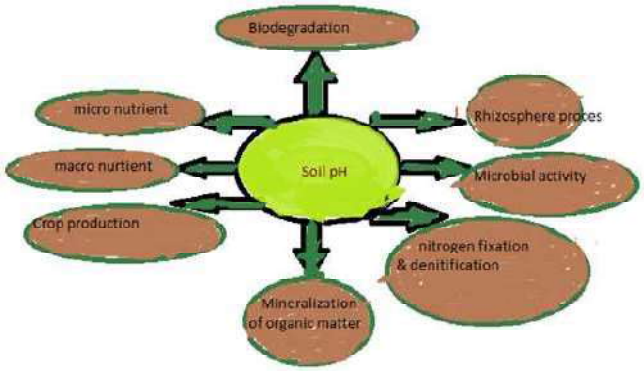


Fig. 1- Some biogeochemical processes and their relations with soil pH[1]

MATERIALS & METHODS

Study Area

Dhanbad district is located in the eastern part of the state of Jharkhand. It lies between 23°37' 50.15" and 24°03' 32.36" north latitude and 86°06' 30.90" at 86°49' 37.32" east longitude. It has a subtropical climate from March to May as summer, rainy season from June to September and winter from December to February.

Dhanbad received more rain thanks to the mining aid of aerosol clouds due to rainfall the normal data of the Dhanbad I.M.D the observatory indicates 1306 mm of rain. The soil of Dhanbad district is the product of the remaining rock. Due to high temperature and heavy rainfall, most types of lateritic soil are formed from Archean metamorphic complex and rocks of lower Gondwana (DEIAA, Dhanbad). The regional three samples are taken from agricultural land and rest three sample take from mining area different regions of Dhanbad district. The purpose of sampling is to analyse the correlation between potential hydrogen ion concentration and electrical conductivity.

Fig. 2- Map show sampling area (Baliapur & Jharia)

Sample Collection Method

Soil samples were taken by dividing the field into different homogeneous sections depending on the observation. Debris were removed from the surface of each sampling area. The auger was driven a V-shaped depth of 15 cm. A sample was taken from the center of the sample plots and every half inch at the four corners. At a sampling point, we were taken five samples they were mixed well to draw a circle by taking samples from the plot divided into four parts a quarter part taken for soil quality status analysis.[8]

Methodology

pH

Weigh 10gm of soil sample into a 50 ml of beaker. Add 25 ml of distilled water and mix well with a glass rod and leave it for 30 min. Calibrate the instrument using a buffer solution, after calibration pour the soil water solution sample for pH analysis.

EC

Weigh 10 gm of the soil sample into a 50 ml beaker. Add 25 ml of distilled water and mix well with a glass rod and leave for 30 minutes. Calibrate the instrument using buffer solution. after calibration pour the soil water solution sample for electrical conductivity analysis.

RESULTS

The results after analysis of the samples is given as under. The all soil samples is analysed by mini soil testing lab developed IISS Bhopal and the pH value shown in the table are in log value.

Table 1- Minimum and Maximum value of pH and EC are given in log value given below:

Minimum value pH (ln value)	0.7419
Maximum value of pH (ln value)	0.8169
Mean value of pH (ln value)	0.7753
Minimum value of EC (µS) (ln value)	0.04
Maximum value of EC (µS)(ln value)	0.39
Mean value of EC (µS) (ln value)	0.19333
Regression value of pH and EC	-0.988

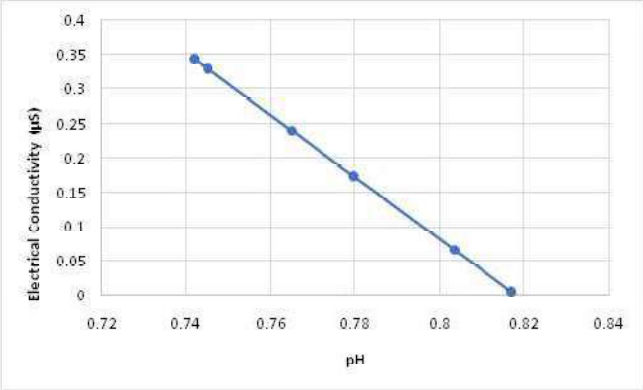
Table 2- pH value in log and Derived value of EC given below:

S.N	pH (x)	Ec (y)
1	0.7419	0.343
2	0.7451	0.329
3	0.7649	0.24
4	0.7796	0.174
5	0.8034	0.067
6	0.8169	0.006

Table 3- Show different range of pH suitable for different types of crops

Crop	Normal Growth pH Range	Recommended pH Range
Alfalfa	6.5-7.5	6.6-7.0
Barley	6.3-7.0	6.3-6.5
Clovers	5.8-7.0	5.8-6.2
Corn	5.8-7.0	5.8-6.2
Grasses	5.8-7.0	5.8-6.2
Oats	5.8-7.0	5.8-6.2
Soyabeans	6.5-7.5	6.6-7.0
Wheat	6.3-7.0	6.3-6.5

Source: Northeast Region Certified Crop Adviser (NRCCA) Study Resource



Graph 1- Show relationship between electrical conductivity (Y- axis) and potential of hydrogen ion concentration (X-axis)

Electrical conductivity= 0.6941 log pH + 0.0318 (r= -0.988)--------- eq. (2)

The regression equation of electrical conductivity shows that their significantnegative co-relationship between the potential of hydrogen ion concentration and electrical conductivity in the experimental soil sample.

DISCUSSION

The pH value of a particular sample ranges from log 0.741 to 0.8169 nature of soil quality. The electrical conductivity between 0.04 µS to 0.39 µS of the sample indicates a poor availability of nutrients and is not good for both agricultural purposes and for the survival of microorganisms. A low pH indicates high concentrations of hydrogen ions. Although high and low values of electrical conductivity indicate the availability of non-specific ions, we can say that the solubility of macro and micronutrients depends on the pH level of the soil.[9] It describes the quality of the nutrient index in the soil and helps to determine what types of crops can be planted. Soil pH is negatively

correlated with the electrical conductivity of the soil as there are many other factors such as soil minerals, porosity, soil texture, soil moisture and soil temperature which also affects the electricity conductivity varies from different soil qualities.[3,9]

CONCLUSION

There is significant negative relationship between pH and EC of various agricultural lands. The value of r = -0.9430. It indicates the poor abilities of nutrients available to soil after remedial process for such as after adding vermicomposting we can use it for the plantation of crops and boost economic.

ACKNOWLEDGEMENT

We would like to show gratitude to Dr. Rupam Mallik, Assistant Professor, University Department of Zoology, B.B.M.K. University Dhanbad for her cooperation and support.

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