Agricultural Soil Analysis: Electric Conductivity and pH

***Dr. Dhirendra Kumar Singh**

Abstract

Soil analysis is necessary to know the nutrient value of the soil. A number of parameters are considered to determine the quality of soil. In this work we have considered Electric conductivity and pH of the soil of selected agricultural fields of Shahpura Panchayat samiti of Jaipur district, to know the health of the soil of particular area to facilitate the judicious use of fertilizers to increase the productivity.

Key Words:-Soil analysis, pH, Electric conductivity, Agricultural field, Nutrient

Introduction

The soil analysis is a process by which macro and micro nutrients such as P, K, Ca, Mg, Na, S, Mn, Cu and Zn are chemically extracted from the soil and measured for their availability" content within the soil sample. The soil analysis is generally done to increase the knowledge of nutrients especially available in experimental soil. This also reduces the environmental impacts due to soil amendments as well as increases the efficiency of resource inputs such as fertilisers and water. Besides this it helps to predict the nutritional values needed for crop production and to evaluate the fertility status of soils of a country or a state or a district. By knowing the nutrition status of the soil a farmer can apply only the required nutrient to make soil fertile and productive. A number of criteria are used for soil analysis; in this study we considered electric conductivity and pH of the soil.

Methodology

Procedure to Take Soil Samples

First of all the test area/plot/soil unit is determined. This is followed by making a traverse over the soil unit .Site is cleaned with spade from where soil sample is to be collected. Spade is inserted into soil at one place, and then Standing on the opposite side, again the spade is inserted into soil. A lump of soil is removed and a pit of 'V' shape is formed with its depth should be 0-6" or 0-9" or 0-12"depth that is normal depth of tillage. Soil slice of ½ inch thick from both the exposed surface of the pit from top to bottom is taken out, also termed furrow-slice. By using the spade soil sample is collected in a polyethylene bucket. Furrow-slices are collected from 8-10 or sometimes 20-30 sites. Sites are

selected at random in a zigzag/or criss-cross manner by Distributing the sites throughout the entire soil unit by avoiding the prohibited samples and local problem soils. The information is generally furnished in two sheets of thick paper with the sample. One sheet is folded and kept inside the bag. Another sheet is folded and attached to the bag.

Electric Conductivity and pH of Soil

The electric conductivity and pH of the soil is determined to fix the nutritional status of the soil. By knowing this it will be easier for farmers to make a judicious selection of fertilizers.

Electric conductivity

Soil electrical conductivity (EC) is a metric of the salt content in the soil, it is an important indicator of soil health. It will affect crop yield and quality, plant nutrient availability, and the activity of soil microbes .

Soil EC is the electrical conductivity of a solution within a unit distance and represents the content of soluble salts , also known as salinity/ ion concentration. It is an index to measure soil water-soluble salt. Soil water-soluble salt is an important indicator of mineral nutrients in the topsoil to determine whether salt ions in soil limit crop growth. The soluble salt ions mainly come from irrigation water and fertilizer solutions. Within a certain range, the conductivity increases with the concentration of the liquid and decreases with the decrease of the concentration, often expressed in millisieverts/centimeter (mS/cm) or dS/m.

There are several common methods for testing soil EC value:

Handheld EC meter: A handheld EC meter is a simple and easy-to-use tool that measures the EC value of soil extract. The meter is equipped with a probe that is inserted into the soil extract, and the reading is displayed on a digital screen.

Laboratory analysis: Soil samples can be sent to a laboratory for analysis, where the EC value is measured using conductivity meter. This method provides accurate results, but it can be time-consuming and expensive.

Soluble salt test strips: Soluble salt test strips are paper strips that are dipped into a soil extract. The color of the strip changes based on the EC value of the soil extract, and the result can be compared to a color chart to determine the EC value.

Electrical resistivity imaging (ERI): ERI is a geophysical method that uses electrodes to measure the electrical resistivity of soil. By measuring the resistivity, the EC value of the soil can be estimated.

Soil moisture sensor: Soil moisture sensors are commonly used in smart agriculture to help farmers in real-time and remotely monitor soil EC and ensure optimal plant growth.

Table 1: Electric Conductivity and Salinity Classes

Electric Conductivity	Salinity classes
0-2.0	Non saline
1.2-4.0	Slightly saline
4.1-8.0	Moderately saline
8.1-16.0	Strongly saline
More than 16.1	Very strongly saline

Soil pH:

The soil pH determines that a soil is acidic, neutral, basic or alkaline. The acidity, neutrality or alkalinity of a soil is measured in terms of hydrogen ion activity of the soil water system. The negative logarithm of the H ion activity is called pH and thus pH of a soil is a measure of only the intensity of activity and not the amount of the acid present. The pH range normally found in soils varies from 3 to 9. Mathematically pH is represented as, $\log 1/H = - \log H^+$

Potentiometric Method:

This method is based on the measurement of potential, developed across an indicator or the glass electrode on account of the difference activity of H^+ ions in and out of the electrode, i.e., in the bathing solution. The potential difference between the glass electrode and calomel electrode is expressed in pH units.

Instruments

pH Meter, Physical Balance, Beaker, Glass Rod, etc.

Table 2: Measurment of Soil pH

Soil pH	Nature of Soil
Less than 5.0	Strongly acidic
5.5	Moderately acidic
6.0	Slightly acidic
6.5-7.5	neutral
7.5-8.5	Moderately alkaline
More than 8.5	Strongly alkaline

A Case Study

Electric conductivity and pH of the soil of selected agricultural fields of Shahpura Panchayat

samiti of Jaipur district was reviewed by the data obtained from the soil analysis lab situated in the Shahpura. It was found that Electric conductivity of the selected area was in the range of 0.09 to 0.46 and soil pH is in the range of7.56 to 8.32

Significance

Significance of Electric Conductivity

Soil EC that is too high or too low hinders the growth of crops. If the soluble salt content (EC value) in the substrate is too high, reverse osmosis pressure may be formed, which will replace the water in the root system and make the root tip brown or dry. Excessive EC value also increases the probability of root rot fungus. The low EC value indicates that the effective nutrients are insufficient.

Different plants have different suitable soil EC values according to the characteristics of fertilizer requirements and different growth stages. The optimal EC value for plant growth is usually between 0.8-1.8, and should not exceed 2.5.

Significance of Soil pH:

pH determination is an indispensable means for characterizing soil from the standard point of nutrient availability and physical condition, structure, permeability, etc.This also provides information on the potency of toxic substances present in the soil. It is indicative of the status of microbial communities and its net effect on the neutralization of organic residue and the immobilization of available nutrients. Once the soil pH is determined it provides the most rational basis for managing soil for selected agricultural crops. The pH measurement of soil in water and Potassium chloride systems provides information on the nature of charge discharge on soil colloids which will have a far recharging effect on nutrient measurement and reaction.

Remedial measures to improve Soil Electric Conductivity and pH

Soil Electric conductivity is affected by planting, irrigation, land use, fertilizer, manure, and compound fertilizer application, unalterable soil minerals, climate, and soil texture.

In modern times of agricultural practices, excessive irrigation and fertilization is a common. Soil salinity seriously affects the normal growth of crops, measuring the EC measurement can facilitate the farmers to carry out judicious use of water and fertilizer, for healthy growth of crops to increased production.

Agricultural fields that contain high alkaline soil with pH levels of 8 and above may find it hard to cultivate. This can be corrected by lowering a soil's alkalinity level with the help of Ammonium Sulphate and organic materials. This will lower the pH of soil. Similarly soil acidity can be reduced by adding lime to the highly acidic soil; this will increase the pH of soil.

The present study of selected agricultural fields of determines that soil is slightly alkaline as the pH range is and electric conductivity is indicative of non saline nature of the soil this indicates that there is no problem of salinity due to excesses irrigation and unbalanced use of fertilizes, however low

Electric conductivity indicates slight lack of nutrients which can be overcome by judicious use of fertilizes. The problem of slightly alkaline pH can be improved by the use of ammonium sulphate as well as adding more organic materials that are easily available in rural settings.

Acknowledgment:-Thank to the In charge, Soil Analysis Laboratory for providing data on the soil analysis parameters of agricultural fields of Shahpura.

***Associate Professor**
Department of Agricultural Biochemistry
B.B.D. Government College, Chimanpura,
Shahpura, Jaipur (Raj.)

References, Sources and further Readings

1. vlab.amrita.edu,. (2013). Soil Analysis-Determination of pH of Soil. Retrieved 22 May 2023, from vlab.amrita.edu/?sub=2&brch=193&sim=1549&cnt=1

   https://www.seeedstudio.com/blog/2022/07/15/soil-electrical-conductivity

2. Adviento-Borbe, M.A.A.; J.W. Doran; R. A. Drijber; and A. Dobermann. 2006. Soil electrical conductivity and water content affect nitrous oxide and carbon dioxide emissions in intensively managed soils. Journal of Environmental Quality, 35:1999- 2010.
3. Dahnke, W.C., and D.A. Whitney. 1988. Measurement of soil salinity. *In R*ecommended soil chemical test procedures for the North Central Region. Pages 32-34. Revision of North Central Regional Research Publication 221. North Dakota Agricultural Experiment Station Bulletin 499. Fargo, ND.
4. Maas, E.V., and G.J. Hoffman. 1977. Crop salt tolerance—current assessment. Journal of the Irrigation and Drainage Division, American Society of Civil Engineers, 103:115-134.
5. Patriquin, D.E., H. Blaikie., M.J. Patriquin., and C. Yang. 1993. On-farm measurements of pH, electrical conductivity, and nitrate in soil extracts for monitoring coupling and decoupling of nutrient cycles. Biological Agriculture and Horticulture. Volume 9, pages 231-272.
6. Smith, J.L., and J.W. Doran. 1996. Measurement and use of pH and electrical conductivity for soil quality analysis. *In* Methods for assessing soil quality, J.W. Doran and A.J. Jones (editors). Pages 169-185.Soil Science Society of America Special Publication 49. Madison, WI.