International Journal on Emerging Technologies (Special Issue on ICRIET-2016) **7**(2): 257-260(2016)

ISSN No. (Print) : 0975-8364
ISSN No. (Online) : 2249-3255

Nutrients Detection in the Soil: Review Paper

Ashwini A. Chitragar, Sneha M. Vasi, Sujata Naduvinamani, Akshata J. Katigar and Taradevi I. Hulasogi
Department of Instrumentation Technology,
B V Bhoomaraddi College of Engineering and Technology, Hubli, INDIA

(Corresponding author: Ashwini A. Chitragar)
(Received 28 September, 2016 Accepted 29 October, 2016)
(Published by Research Trend, Website: www.researchtrend.net)

ABSTRACT: This paper focuses on analysing the content of micro nutrient and macro nutrient present in soil. Soil plays a vital role in the field of agriculture. The amount of nutrients available to the roots of the plant is the main factor limiting the yield of crops. Depending on these oil type, climate and crop grown during previous years the fertilizer requirements vary within a field and throughout the year. The Macro nutrients (Nitrogen, Phosphorous and Potassium) and Micro nutrients (Iron, Zinc, and Copper) are essential for healthy plant growth. Macro nutrients are needed in large amount and micro nutrients are needed in smaller amounts. Both micro and macro nutrients are naturally obtained by the roots from the soil. There are different concepts of soil pH detection techniques and technologies. Soil pH is a key parameter for crop productivity. Soil pH affects the soils physical, chemical and biological properties and thus plant growth. Soil pH is a measure of hydronium ion (H+) concentration traditionally tested in labs to decide how much fertilizer to apply to the field. In addition, they are used to monitor the impact of past fertility practices on changes in a field's nutrient status. Sensing all the above parameters is possible with the optical diffuse reflectance sensing, electrochemical sensing and electro conductivity sensing. Adding today's technology towards agricultural fields a Real time Embedded based soil analyser can be developed with quick and reliable automated system which is used to analyse various soil nutrients with the help of pH value. As per the availability of nutrients, recommendations of cultivating the particular crop and proper fertilizer will be given.

Key words: Soil Nutrient Detection, Nitrogen, Phosphorus, Potassium, Micro Nutrient and Macro Nutrients in soil.

I. INTRODUCTION

The soil macro nutrients, Nitrogen (N), Phosphorous (P) and Potassium (K) are essential elements for crop growth. The application of commercial N, P and K fertilizers has contributed to a tremendous increase in yields of agricultural crops that feed the world's population. However, excessive use of these fertilizers has been cited as a source of contamination of surface and ground water. Ideally, application rates should be adjusted based on estimates of the requirements for optimum production at each location because there is high spatial variability of N, P and K within individual agricultural fields.

Healthy soil forms the foundation of the food system in India. A healthy soil produces healthy crops. Maintaining a healthy soil demands care and effort from farmers. In the recent years, a declining trend of total factor productivity and compound growth rates of major crop and low nutrient use efficiency have been observed primarily due to deterioration of soil health.

The main reason of soil health deterioration are a) Wide nutrient gap between nutrient demand and supply, b) High nutrient turnover in soil- plant system coupled with low and imbalanced fertilizer use, c) Decline in organic matter status, d) Emerging deficiency of secondary micro nutrients, e) Nutrient leaching and fixation problems, f) Soil pollution and soil acidity etc. Deficiencies in micro and secondary nutrients in soil lead to mineral deficiency disorders. Therefore, to enhance sustainable production, timely testing of soil nutrients and prevention and soil degradation through improved soil health is important.

This paper describes the use of wireless sensor network technology to determine the level of soil nutrients. Since no proven economic method has been yet devised to effectively and efficiently allocates chemicals to meet crop needs, significant energy waste occurs in application of agriculture chemicals.

Consequently chemicals and fertilizers are applied in uniform amount irrespective of local changes in soil chemical condition. Wireless sensor networks are widely used in agriculture to increase the productivity and monitor various physical and chemical properties of the soil. Various types of sensors are used which performs various tasks like water monitoring, soil moisture monitoring, monitoring of soil chemical level and climate change effects. The sensor networks in this paper senses the soil chemical condition in real time and as per the measured deficit or excess chemical condition, appropriate amount of fertilizer and compost are applied to the soil.

II. LITERATURE SURVEY

Throughout the 1990's interest in soil quality and understanding its importance has come to the forefront of environmental sustainability. The terms soil quality, soil degradation, soil health, soil resilience are being used more frequently and with greater urgency in connection with strategies to protect our global environment. The need to improve our quality of life and protect many scarce natural resources are forcing society to recognise the importance of there soil resource. However, soil quality and land management both have direct influence on water and atmospheric quality and by extension to human and animal health. While seemingly a straight forward concept, soil quality has been difficult to define and more difficult to quantify.

Soil is a mixture of weathered rock fragments, minerals and organic matter that are on the earth's surface. It provides a "Home" to countless microorganisms, invertebrates, and plant roots. Its depth varies from a few inches to several feet. Soil provides nutrients, water and physical support for the plants. It is also a source of air for plant roots. Roots located in the soil are nature's primary recyclers which turn dead cells and tissue into nutrients, energy, carbon dioxide and water to fuel new life. Soil is a valuable resource as a foundation of plant growth. Some farmers and other land managers have soil analysed for nutrient levels. Generally, soil tests have increases to high levels in the last several decades. As mentioned earlier, some soils are natively high in certain nutrients.

The essential plant nutrients include carbon and oxygen which are observed from the air, where as other nutrients including hydrogen are typically obtained from the soil.

Micro nutrient concentrations are generally higher in the surface soil and decreases with soil depth. In spite of the high concentration of most micro nutrients in soils, only a small fraction is available to plants. Micro nutrients, also known as trace elements, are required in micro quantities but there lack can cause serious crop production and animal health problem. Crops vary considerably in their response to various micro nutrients. Micro nutrient deficiencies are more common in humid tropical regions, as well as in humid temperature regions, because of intense leaching associated with high precipitation. Deficiency symptoms for most micro nutrients appear on the younger leaves at the top of the plant, where as toxicity symptoms generally appear on the older leaves of the plant.

The micro nutrients are Boron (B), Chlorine (Cl), Copper(Cu), Iron(Fe), Manganese(Mn), Molybdenum and Zinc (Zn).These plant food elements are used in very small amounts, but they are just as important to plant development. Boron: It is essential for the movement and metabolism of sugar in the plant and synthesis of plant harmonic and nucleic acids. It also functions in the lignin formation of cell walls. Chlorine: It is necessary for osmosis and ionic balance; it also plays a role in photosynthesis. Copper: It is a formation of cell walls. Involved in the photosynthesis respiration and processes within the plant involving nitrogen. Iron: It is involved in photosynthesis, respiration and chlorophyll formation and many enzymatic reactions. Manganese: It is a component of enzymes and is also involved in photosynthesis and root growth. It is involved in nitrogen fixation. Molybdenum: It is involved in nitrogen fixation and nitrification. Zinc: It is a component of organic complexes and DNA proteins. It is an important enzyme for protein synthesis. Zinc is evolved in the growth of harmonic production and seed development.

The Macro nutrients are essential elements used by plants in relatively large amount for plant growth is called macro nutrients. The major macro nutrients are Nitrogen (N), Phosphorous (P), Potassium (K). Calcium (Ca), Magnesium (Mg) and Sulphur (S) are also macro nutrients. All six nutrients are important constituents in soil that promote plant growth. Concentrations of these macro nutrients in the soil are generally determined before the site is distributed. In addition to macro nutrients, there are various trace elements that are necessary for plant growth. These trace elements are needed in smaller quantities than macro nutrients. If the trace element is required for plant growth it is called micro nutrients. These include Aluminium, Arsenic, Boron, Cadmium, Chlorine, Copper and others. Nitrogen: It is an important for a growth because it is a major part of all amino acids, which are the building blocks of all proteins, including the enzymes which control virtually all biological processes. A good supply of nitrogen stimulates root growth and development, as well as the uptake of other nutrients. Phosphorous: It enhances many aspects of plant physiology, including the fundamental processes of photosynthesis, nitrogen fixation, flowering, fruiting and maturation.

In plant, it is present mainly as a structural component of the nucleic acid, deoxyribonucleic acid (DNA) and ribose nucleic acid (RNA). It is present in both organic and inorganic forms, both of which are readily translocated within the plant. All energy transfers in the cell are critically dependent on phosphorous. Phosphorous is concentrated at the most actively growing points of a plant and stored within seeds in anticipation of their germination. Phosphorous is available to plants in limited quantities in most soils because it is released very slowly from insoluble phosphates and is rapidly fixed once again. Potassium: It occurs in all parts of plants in substantial amounts. Potassium is important in leaves and at growing points. It is outstanding among the nutrient elements for its mobility and solubility within plant tissue. Potassium regulates the opening and closing of the stomata by a potassium ion pump. Calcium: Calcium in plants occurs chiefly in the leaves, with the lower concentration in seeds, fruits and roots. A major function is as the constituent of cell walls. The nutrients involved in photosynthesis and plant structure. Magnesium: It is the constituent of the chlorophyll molecule. When deficient is translocated from older to younger tissues, so that signs of deficiency appear on the oldest first and then spread progressively to younger tissue. Sulphur: It is structural component of some amino acids and vitamins and is essential in the manufacturing of chloroplast. Symptoms of deficiency includes yellowing of leafs and stunted growth.

The soil pH measurement is also one of the important parameter for the measurement of nutrients in the soil. It is used to measure the acidity or alkalinity of soil. The pH values for the different nutrients are different.

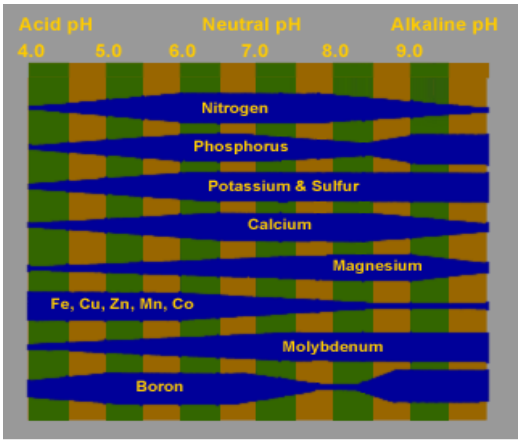

Fig. 1. pH values for different nutrients in soil.

III. METHODOLOGY

There are various types of sensors to measure mechanical, physical and chemical soil properties. We focus on sensors for measuring macro nutrients, micro nutrients and pH level in soil. Although many sensing technologies are available most of the soil nutrients sensors described in the literature involves one of two measurement methods.

Spectroscope: Optical diffuse reflectance sensing in visible and near infrared (NIR) wavelength ranges is one approach to rapidly quantify soil properties for site specific crop management (SSCM). Such optical methods have investigated by many researches due to attractive advantages over electrochemical technology, such as non-destructive measurement and no need to take soil sample. In principle, diffuse reflectance spectroscope is based on interaction between incident light and the soil surface properties such that the characteristics of reflected light vary due to the soil physical and chemical properties. Laser induced fluorescence spectroscope (LIFS) or near infrared spectroscope (NIR) technique or UV spectroscope is very widely used for experimental as well as commercial purpose. These optical methods are reliable but time consuming, complex and high cost per test. This resulted in the limitations of the number of soil samples are tested foe characterizing the spatial availability of the soil nutrients in a field or fields.

Electrochemical sensing: Most of the electrochemical methods used to determine soil nutrients levels are based on use of an ion selective electrodes (ISE), with glass or polymers membrane, or ion selective field effect transistor (ISFET). The ISFET has the some theoretical basics as ISE that is both ISE's and ISFET's respond selectively to a particular ion in the solution according to logarithmic relationship between the ionic activity and electric potentials. The ISE's and ISFET's require recognition elements that is ion selective membranes, which are integrated with the reference electrode and enable the chemical response (ion concentration) to be converted into a signal (electric potentials). Due to an increase demand for the measurement of new ions and tremendous advances in the electronic technologies require for producing a multiple channel ISFET's, numerous ion selective membranes have been developed in many areas of applied analytical chemistry. E.g. In the analysis of chemical or environmental samples. Ion selective membranes are available for sensing most of important nutrients NO_3, K, NA, CA, MG and CL.

IV. CONCLUSION

Growing concern about environmental pollution by excessive use of fertilizers lead to increases in needs to monitor soil nutrients required for crop growth. The sensor network technology will help the farmers to know the soil requirements which will help them take better decisions and preventive measures at the right time.

This will lead to tremendous improvement in the crop productivity. This, intern, will save there time, labour, money and make effective use of resources.

IV. CONCLUSION

Growing concern about environmental pollution by excessive use of fertilizers lead to increases in needs to monitor soil nutrients required for crop growth. The sensor network technology will help the farmers to know the soil requirements which will help them take better decisions and preventive measures at the right time. This will lead to tremendous improvement in the crop productivity. This, intern, will save there time, labour, money and make effective use of resources.

REFERENCES

[1].http://www.dpi.nsw.gov.au/content/agriculture/resources/soils/improvement/plant-nutrients
[2]. https://content.ces.ncsu.edu/extension-gardener-handbook/1-soils-and-plant-nutrients
[3]. http://soils.wisc.edu/facstaff/barak/soilscience326/macronut.htm
[4]. https://soilsmatter.wordpress.com/2014/07/11/macronutrien ts-versus-micronutrients/
[5]. http://eldoradochemical.com/fertiliz1.htm
[6] http://www.cropnutrition.com/efu-soil-ph
[7] http://www.jonathangreen.com/importance-soil-ph.html
[8]http://vlab.amrita.edu/?sub=2&brch=294&sim=1550&cnt=1
[9] http://www.farmwest.com/node/942
[10] http://www.finegardening.com/four-things-you-need-know-aout-soil-ph
[9] http://www.jove.com/science-education/10077/soil-nutrient analysis-nitrogen-phosphorus-and-potassium
[11]http://www.tankonyvtar.hu/en/tartalom/tamop425/0010_1A_Book_angol_02_tapanyaggazdalkodas/ch06s03.html
[12] http://link.springer.com/chapter/10.1007%2F978-3-642-27281-3_39