A STUDY ON THE IDENTIFICATION AND ANALYSIS OF DIFFERENT MACRONUTRIENTS OF THE SOILTHROUGH ADVANCED TECHNIQUES

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ABSTRACT

Soil nutrients testing is helpful for identifying nutrients contents in the soil before applying fertilizer for quality and process control of agricultural produce and soil fertility. In thispaper we have reviewed different system for detection of various macronutrients of the soil. Nitrogen (N), Phosphorus (P) and Potassium (K) are the key nutrients which are mainly responsible for plant growth. Soil electrical conductivity, pH level, soil temperature also effect theproductivity of the crop.

Keywords: *Soil, Nitrogen, Phosphorus, Potassium, Temperature, Electrical Conductivity.*

I. Introduction

Agriculture is the backbone of Indian economy. In India, around 70% of the population earns its earnings from agriculture [2]. Soil fertility changes with every harvest and varying weather condition, this affects the nutrient contents of soil [5, 9]. Soil efficiency can be achieved by giving suitable amount of fertilizers to the soil. These fertilizers plays key role by giving essential soil nutrients to the crop land those are required for nourishing and growth of crop [3]. To increase crop production, excessive chemical fertilizers are added to the soil. This unnecessary addition of fertilizers causes an undesirable environmental impact, an unnecessary increase in the cost of production and decline in crop yield and crop response ratio [7, 8]. Hence soil nutrient detection is greatly necessary for proper plant growth and effective fertilization [4].

At present day soil analysis techniques are time intense and high price and carried out in laboratories. It is necessary to use a technique that has a fast response time and an away that allow real time, on-site soil nutrient analysis. A great need to modernize the conventional analysis of soil parameters in agricultural practices for the higher productivity and result. In situ monitoring of soil parameters is an emerging trend which may have the potential to transform agricultural practices to increase productivity [6]. Number of researcher has developed soil nutrients detection methods by using various methods, including Conductivity, optical, electrochemical but lots farmers suffer due to lack of knowledge and their own incapability to utilize these advanced methods. [1] Hence after taking review on all the conditions, we have decided to study a different system reported by researchers for the soil nutrients identification & analysis.

II. Literature Survey

Agni Biswas and Sarthak Prakash [1] presented the "Farming Technology for India Agriculture Based Sensorics and Indicative Systems"; in this paper authors intends to present methods to provide the farmer a tool that increase his information which will result in the output of his farm. For that author monitors Soil moisture levels, PH levels, Humidity and temperature of the soil and according to inputs from these variables pipe valve will be turn on & off.

After studying this [1] we think that rapid technological advances and timely policy interventions have not only helped to stop food crisis in India but also ensured steady increase in food production.

Chetan Dwarkani M et al [2] presented the "Smart Farming System Using Sensors for Agricultural Task Automation" in this paper author described advanced farming by linking a sensible sensing system and smart irrigation system through wireless communication technology. Their system include some physical parameters such as soil moisture content, nutrient content, and pH of the soil which plays a vital role in farming activities. Based on the detection of essential parameters

of the soil, the required quantity of green manure, compost, and water is splashed on the crops using a smart irrigation system.

In this paper [2] author describe moisture sensor content based sufficient amount of water was sprinkled by the irrigator system.

Akshay Sankpal and Krishna K. Warhade [3] presented the "review of optoelectronic detection methods for the analysis of soil nutrients" in this paper author reviewed sensing technology and other portable various methods which were useful in the determination of soil nutrients viz. NPK like electrochemical, mechanical, optical etc. mainly optical methods were studied for the determination of soil nutrients with the uses of optical LED's and VIR-NIR methods.

In this paper [3] author studied various methods which were used to determine soil nutrients and they found optical method is efficient and low power consumption.

Tamal Adhikary et al [4] presented the "Test Implementation of a Sensor Device for Measuring Soil Macronutrients" in this paper author developed a sensing system using high precision, wide spectral range Photo Diode (PD), low spectral-width Light Emitting Diode (LED), microcontroller, analog-to-digital converter (ADC) for detecting soil macronutrients. They have integrated a GPRS modem with sensing unit for remote data collection to a server. The test samples were carried out from different farmlands and the outcome were compared with those obtained by a color chart judgment after laboratory analysis.

After studying this paper [4] we found that the measurement using current sensing system is restricted by only three macronutrients of the soil and it requires soil solution, which needs to be prepared in a chemical laboratory.

D. Rupa et al [5] presented the " A Novel Approach for Soil Testing using Embedded System" in this paper author develop a testing system which can be used for soil analysis, which helps the farmers to grow and produce the proper crop. System detects the Nitrogen, Potassium, Phosphorous and PH of soil. Nitrate and phosphorous ISE were used to measure concentration of Nand K nutrient of soil.

After studying this paper [5] we found that proper soil test will help to the use of enough fertilizer according to the requirements of the crops, although taking benefit of the nutrients already presentin the soil.

Abdullah Na et al [6] presented the "An IOT Based System for Remote Monitoring of Soil Characteristics" in this paper the author used antimony electrode for pH measurement. For soil moisture content evaluation, the inverse relation between soil resistance and soil moisture has been used and related circuitry has been developed. The soil temperature sensor DS18B20 was used which worked on Dallas one wire protocol. The system was incorporated with Bluetooth for the transfer of data to a nearby cell phone. The whole system was developed on STM32Nucleo platform.

In this paper [6] researcher has been considered soil pH, temperature, and moisture measurement. The system has developed on STM32 board with use of Bluetooth to communication with farmer's smart phone.

Dr. Neeta A. Doshi et al [7] presented the "Soil N-P-K Monitoring and Control System using FPGA: A Review" in this paper the percentage of Nitrogen, Phosphorus and Potassium by using sensor and monitoring is analyzed and FPGA system was proposed.

After studying this paper [7] we conclude NPK fertilizer does not reduce soil bulk density. This will be due to increased availability of N and K in the soil.

Laxmi C. Gavade et al [8] published the "N, P, K Detection & Control for Agriculture Applications using PIC Controller: A Review" in this paper author reviewed different detection of N, P and K contents, humidity of the soil by using different sensors and also monitor the temperature and sunlight in the farmland.

After reading this paper [8] we found that overall these techniques have verisimilar and all the process will take place using chemical laboratory to detect the presence of soil macro-nutrients, though separately measurements of the nutrients still remains an open challenge due to some factors such as expensive spectrometers and other sensor techniques.

Dharesh Vadalia et al [9] presented the "Real Time soil fertility analyzer and crop prediction" in this paper author determine the average percentage of basic soil nutrients Nitrogen, Phosphorous and Potassium with the help of pH meter and predict the suitable crops for the

particular soil type in real time. System was built on Arduino.

After studying this paper [9] we found that by using pH meter and EC sensor pH & electrical conductivity is measured in real time. The pH meter reading gives the approximate ratio of various nutrient content present in soil and in what proportion. This estimate of soil nutrient will decide the suitable crop for the farmland.

Deepa V. Ramane et al [10] presented the "Detection of NPK nutrients of soil using Fiber Optic Sensor": In this paper author has developed a fiber optic based color sensor to determine N, P, and K values with in the soil sample. For that colorimetric measurement of aqueous solution of soil has been used. The color detector relies on the principle of absorption of color by solution. It helps in deciding the N, P, K amounts as high, medium, low, or none. The sensor probes beside correct signal acquisition circuits were constructed to detect the deficient element of the soil. It was helpful in dispensing only needed amount of fertilizers in the soil.

After studying this [10] we found, optical fiber based color sensor was developed to detect the absence of the nutrients N, P or K in the soil. Optical NPK sensor is worked on the principle of iteration between incident light & soil surface properties.

III. Various Available Sensor Techniques

There are different types of sensors that may be used to detect various nutrients of soil. Soil micronutrients detections are usually performed by three steps: Soil sampling, sample pretreatment and chemical analysis. In real time, detection of NPK is carried out by three methods viz. Conductivity measurement, electrochemical measurement methods and Optical measurement method to analyze concentration of primary nutrients [10].

A] Conductivity Method

In this method, two or three electrodes of same / different material are used to dip in soil samples. Materials used may be steel, silver, platinum, antimony, graphite or copper [10]. An A.C. voltage is applied to electrodes in the sample. Reference electrode is attached to multimeter to get the current changes. The A.C. voltage leads to movements of ion that results variableness of current of soil sample. Use of A.C. voltage avoids neutralization of ions. Varied current offers varied conductivity. Variability between electrical conductivity and N, P, K Concentration is observed. [8]. According to concentration of NPK in soil, conductivity of electrode change. The change in conductivity is converted into electrical signal with the help of transducers for further interface with electronic control system.

B] Electrochemical Method

Electrochemical sensors constitute Ion Selective Electrode and Ion Selective Field Effective Transistor. It requires ion selective membranes, which are integrated with the reference electrode and enable the ion concentration response to be converted into electric potentials. Ion Selective Electrode (ISE) and Ion Selective Field Effective Transistor (ISFET) use different membranes, extraction solutions, and a multi-target system with coated wire field-effect transistor [10].

C] Optical Method

Optical NPK sensors concern with incident light and soil surface properties, the characteristics of the reflected light vary due to the soil physical and chemical properties [10]. Laser Induced Florescence Spectroscopy is optical technique in which analyte in the molecule absorbs radiation at UV and visible a wavelength. NIR is a spectro photometric method that deals with the interaction of near infrared radiation with the sample under analysis [8].These optical ways are reliable but time-consuming, high cost per test and not easily replicable, this resulted in the limitation of the number of soil samples tested for characterizing the spatial changeability of soil nutrients in a field or fields [10].

IV. Conclusion

An appropriate soil test will ensure a sufficient amount of fertilizer use to meet the requirements of the crop while considering the nutrients already present in the soil. We have studied various types of methods which are useful in the determination of soil nutrients found that chemical method required complex laboratory testing and this time consuming doesn't gives results in real time period.

Optical methods are studied for the

determination of soil nutrients which use optical LED's and VIR-NIR methods. Optical methods are efficient and having low power consumption. Electrochemical method responds to a particular ion in the solution according to logarithmic relationship between the ionic activity and electric potentials. There is limited soil nutrients lab-on-a-chip system available commercially. Hence more effective tools need to be invented to enhance the production from the soil and make easy the farmers struggle for survival.

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