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STUDY ON NITROGEN CONTENT IN SOIL USING SPECTROSCOPY

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Abstract -Nitrogen plays an important role in Agriculture. Measurement of Soil properties must be needed for precision agriculture. Soil contains both macro nutrients and micro nutrients. Nitrogen, Phosphorus, Potassium are macro nutrients which are essential for entire plant growth. Nitrogen is essential for plant leaf growth. Excess amount of fertilizers in soil will lead to infertility and also changes the soil property. So, the nutrient measurement in soil is essential for agriculture. The methods available for nitrogen measurement in soil are Kjeldhal method, Dumas combustion which are used as reference method. These chemical methods are time consuming. Satellite sensors, digital cameras, spectroradiometers are used to find the nitrogen content. However these methods are non-destructive, it has some drawbacks where as it is a high cost instrument. In this paper, discussed about estimating nitrogen content in the soil using Mid-infrared Spectroscopy, Near-infrared Spectroscopy, VNIR Reflectance Spectroscopy, imaging spectroscopy, Visible and Ultra- violet spectroscopy. These spectroscopy methods are rapid, high precision and low cost.

Key Words:Nitrogen, Spectroscopy, Principle component Analysis, Partial Least Square.

1.INTRODUCTION

Soil is the main source to provide nutrients for plant. Nitrogen is a part of chlorophyll which gives green color to the plant. Phosphorous is responsible for photosynthesis and also used to store and transform the energy to various parts of plant. Potassium regulates the CO2 uptake. Addition of nitrogen in soil changes the properties of the soil. It also affects the ground water and environment. Nitrogen releases the green house gas (i.e., Nitrous oxide) which creates environmental pollution. It will lead to affect human health, like bladder cancer, gastric cancer. Because of such reasons, nutrient level must be measured and controlled [1].

Near-infrared sensor used to find nitrogen content in the soil. Using this method, nitrogen can be predicted quickly, non-destructive and non-polluting. In NIR sensor, wavelengths are characterized by Principal Component Analysis and Genetic Algorithm used to find nitrogen, phosphorous, potassium, organic matter and Ph of the soil. Here, the soil is analysed using BPNN (Back Propagation Neural Network) and PLS (Partial Least Square) method. Finally concluded that BPNN is superior method than PLS. The soil water content and particle size may affect the accuracy [2].

VNIR Spectroscopy is used to estimate organic carbon, total nitrogen, activity of carbon and physical and chemical property of the soil. It has been found that the signals in the VNIR region are weaker than the Mid-infrared region. PLS regression technique is used to find the soil properties. If the data's are highly dimensional and highly correlated, this method is much better [3].

Imaging Spectroscopy is used to estimate soil properties. It is easy technique to find nutrients in large domain. Soil erosion, soil genesis, formation, deposition, soil contamination, salinity, soil mapping and classification, soil swelling and soil water content are predicted using imaging spectroscopy. In Imaging Spectroscopy provides the data's to and users as real. It gives some ideas for implementing IS technology in remote sensing and soil science [4].

The spectroscopy techniques are almost depends on chemometric tools. The Partial Least Square is applied for both NIR and MIR. It has been found that Diffuse reflectance near-infrared spectroscopy is shows better performance than attenuated total reflectance spectroscopy in mid-infrared region. Here the effect of particle size of soil and temperature drying in NIR Spectroscopy data is did not identified. Using NIR and MIR, phosphorous and potassium are estimated. Prediction of total nitrogen in the soil is limited [5].

UV spectroscopy used for finding the primary nutrients like nitrogen, phosphorous and potassium. The peak absorption at the wavelength gives concentration of the primary nutrients [6].

To find the accuracy of NIR spectroscopy, while measuring the critical point. While measuring the soil nutrient, the decompositions are not used (small amount of numeric value or zero). Mostly used soil samples were inorganic type. Here used principles are principle component analysis algorithm (PCA) and partial least square (PLS). These principles help to predict the soil components and also perform deviation, even hazardous, leading to erroneous conclusion. Measure chemical components and physical parameters (eg. texture). The agriculture mostly depend on type of agriculture plant and soil materials like biological samples and also depend on land structure and place. Explain the model performance parameters may or may not use to express the uncertainty of the future prediction used soil for analysis. Explain the soil properties with help of non-Gaussian. And suggest improving the use of NIR based soil component analysis [7].

2. METHODLOGY

Artificially screening of soil sample was done for fine soil structure. Soil samples are divided into 3 equal groups. Each group was divided into 16 parts. In first group, nitrogen solution with different concentration of soil was prepared and stirred. In second group, soil sample was dried at 80º Celsius for 8 hours. In third group, soil sample was dried without any pre treatment. Using near infrared optical spectrum instrument spectral information of soil samples was collected. Acquisition range of spectral is 900nm to 1700 nm. This instrument gives

the light intensity reflection and absorption information from soil. The data was analysed under partial least square method, no information variable elimination method, competitive adoptive weighting method and partial least squares support vector machine method. The correlated coefficients of UVE and CARS are splendid. First group have low RMSECV values. Second group have highest precision. Third group have lowest precision. On the whole, first set have the best effect.

The sample was over dried and field moist. Oven dried samples are sieved (less than 2mm). Then the sieved sample was collected in glass bottomed cup for spectra collection illuminated by a halogen lamp. The moist sample was scanned to avoid the issues while handling. The scanning range was 350 to 2500. The average scans should be 30. After each sample scanning, the sample cup is rotated in 60º. The restricted spectra range in VNIR is 400-2500nm. The data's are collected for analysis using Partial least square (PLS).

UV spectroscopy used for finding the primary nutrients like nitrogen, phosphorous and potassium. Soil sample is prepared for different concentration. 150gm of soil sample is added with 350 ml of distilled water. Different chemical solutions were prepared by adding KCl, ZnNO3, Single Super Phosphate (SSP) and Urea. For Each added element, prepared 3 different solutions with different concentration as Sample 1: 100 gm of ion, Sample 2 : 200 gm of ion and Sample 3 : 400gm of ion. These soil samples were analyzed using Varian 100 Cary Spectrophotometer. Result is obtain using UV Scan software. UV Spectroscopy is used in optical method. The peak absorption at the wavelength gives concentration of the primary nutrients. Peak absorbance of Nitrogen is at 240nm wavelength. Peak absorbance of Potassium is at 200nm wavelength. Peak absorbance of Phosphorous is at 220nm wavelength.

To investigate the level of nitrogen content effect in a soil will done by pretreatment with help of Near Infrared sensor. Soil sample is divided into 16 groups and nitrogen was mixed different concentration in each group. Then it will be split into three groups for different pre-treatment. The first group of soil samples to be dried, pressed, sieved and ground. The next group of soil samples to be dried and ground. The last group of soil samples to be simply dried. The spectrum is analysed by Partial Least Square algorithm (PLS), Uninformative Variable Elimination (UVE), Competitive Adaptive Reweighted Algorithm (CARS). This paper (CO(NH2)2) was used to obtain solutions of nitrogen with 16 different concentrations. The result of this process gives best accuracy because of pre-treatment and near infrared sensor is high accuracy of predicting the nitrogen content in a soil.

Imaging Spectroscopy uses chromophoric soil phenomena. The success has been achieved under controlled laboratory conditions. This techniques causes more time for process. In Imaging Spectroscopy, it gives low information even though in multi spectra. If it is kept in air and space domains it creates problems. It is mostly used for limited soil analysis. In future, it gives high sensitive results.

Soil samples were taken as with low natural fertility and contrast in texture. Soil was sieved in 2mm to remove the impurities. Estimation of potassium and phosphorous availability is done through the extraction method with ion exchange resin. Nitrogen estimation is done in kjeldhal method. Development of the prediction models, evlovation of models predictive ability are the techniques used to find the soil properties. VNIR spectroscopy has a better performance than the MIR spectroscopy to estimate the phosphorous and potassium availability. Both spectroscopy techniques were limited for predicting nitrogen content in the soil.

3. CONCLUSIONS

In order to study and analyse soil nutrient content using Spectroscopes is very easy and low cost method. In all techniques, soil is dried and sieved to remove the impurities. PCA and PLS were mostly used for reducing the dimension. Based on the constructions of new uncorrelated factors from the original spectral data. Mostly Partial Least Square is used in all spectroscopy method. This method is used for the data's which are high amount and collinear matrix. This method is used to reduce the dimension and easy to analyse and visualize the data.

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