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To Study the Effect of Leaf Nitrogen Concentrations over Plant Growth

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ABSTRACT: Nitrogen (N) Is fundamental element who plays a key role in the plant life cycle. It is the main plant needed mineral nutrient for chlorophyll production and other plant cell components (proteins, nucleic acids, amino acids). Plant N status affects the Crop yield. This result in the optimization of nitrogen fertilization has become the object of intense research had its environmental and economic impact.

This review paper focuses on reviewing current methods and techniques used to determine plant N status. By using spectroradiometers, reflectometers, imagery from satellite digital cameras and sensors, optical properties have been measured to estimate N in plants, such as crop leaf transmittance, canopy reflectance, chlorophyll, polyphenol fluorescence. High correlation has been found between optical parameters and plant Nitrogen status, and these techniques are new and not destructive. However, some drawbacks include chlorophyll saturation, soil and atmospheric interference and the high cost of instruments. Electrical properties of plant tissue have been used to estimate fruits quality water content in plants, as well as nutrient deficiency, which suggests that they have potential for use in plant Nitrogen determination.

KEYWORD: Plant Leaf; Chlorophyll; Spectral Reflectance; Crop Nitrogen; Remote Sensing; FieldSpec.

I. INTRODUCTION

Nitrogen (N) is an essential element for crop growth, development, and yield and is major nutrient element in agricultural production. Farm managers aim to identify crop nitrogen status and supply the appropriate amount of fertilizers for optimal yield and nitrogen use efficiency. Substantial amounts of nitrogen fertilizer are necessary for commercial plants production because of the large biomass produced by plants crops, but excessive amounts negatively affect cane quality and increase susceptibility to pests. Therefore, efficient estimation of plant nitrogen status and appropriate nitrogen fertilizer management are essential for plants production. The Scientist recommends fertilizer rates ranging between 60 and 120 kg N/ha, depending primary on soil type and plants variety. Scientist advices the growers to take leaf samples for nitrogen analysis to get information about the nutritional status of their crops and to correct any kind of nitrogen deficiency by fertilization. However, the methods used of estimating leaf nitrogen contents are laborious, costly and time consuming. Rapid and efficient method for estimating plants nitrogen concentration is therefore necessary.

The use of imaging spectroscopy techniques to estimate the nutrient status of growing crops could save time, and reduce the cost associated with sampling and analysis. Imaging spectroscopy is a technology that entails acquiring data in narrow (<10 nm) and contiguous spectral bands. These narrow spectral bands enable the detection of some spectral features that masked within the broader bands of multispectral scanner systems.

Researchers have evaluated the use of imaging spectroscopy techniques for estimating nitrogen status of some crops such as Corn, wheat, sorghum, Tomato, Potato and Brinjal by determining the appropriate combination of wavelengths to characterize nitrogen deficiency. Their work resulted in satisfactory results of leaf or canopy nitrogen estimates. In a study with plants under controlled conditions, it was found that there was

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a detectable nitrogen deficiency where the infrared/red ratios measured over plants plots with adequate nitrogen was significantly higher than those measured over nitrogen-deficient plots. A recent literature review indicated that no work has been done to estimate plants nitrogen at farmers' fields using spectroscopic data from handheld, airborne or space borne sensors. The aim of the present study was to evaluate the use of spectroscopic data to predict leaf nitrogen contents in plants.

II. RELATED WORK

Studies of the interrelationship between Nitrogen uptake, plant Nitrogen concentration and growth rate are central to an understanding of the role of Nitrogen within plants. It is widely accepted that improved information on the factors controlling the acquisition and utilization of Nitrogen by crops will help to identify the constraints to developing more effective strategies of N fertilization. These in result increase the efficiency of Nitrogen use to the benefit of the environment. However, there has confusion about the exact mechanisms controlling responses to Nitrogen, which appear to varies depends over relative availability of Nitrogen from internal reserves and from external sources of nitrate.

Valentina Ulissi et al. suggested that nitrogen is generally considered to be the second most important factor limiting growth in ecosystem and play a major role in determining productivity under conditions of adequate water supplies affecting over Tomato plant using SPAD chlorophyll meter readings [1].

John J. Troiano et. al. performed experiment on Lycopersicon esculentum (tomato) plants were grown in sand type under two different nitrogen nutrition levels of 28 mg/liter N0 3-N and 140 mg/liter N0 3-N) supplied in Hoagland's solution.after performing experiment he found that The stems and leaves were harvested immediately, after 48 hr fumigation Tissue analyses (Kjeldhal method) indicated that total Nitrogen content had increased following exposure to NO2[2].

F. Rodriguez-Moreno et al. Studies have evaluated such possible conditions to improve the effectiveness of indices to estimate the nitrogen concentration to process the spectral signatures using dimension reduction techniques. The leaves spectral signatures recorded with help of ASD-FieldSpec3 spectroradiometer and Kjeldahl method used to determine the nitrogen concentrations [3].

Edrees Mahmoud et al. conducted The experiment work was carrying out in 2013 at Field Experimental Station of Mendel University this study is obtaining a successful model for optimizing Nitrogen doses without reducing wheat yield . The preliminary results showed that spectrums are sensitive in case to changes of crop parameters. The reflectance of plants stand under good nutritional condition clearly increased in the visible and increased in near-infrared region [4].

Dennis L. Wright et al. performed Experiments was conducted in Minidoka County, Idaho(42º N, 113º W) during seasons of spring and summer(2002 and 2003).the test result shows various vegetation indices from remotely sensed imagery to identify suitable vegetation indices apply for crop stress determination in a high yielding wheat cultivar[5].

Adán Mercado Luna et al. Conducted This study in a greenhouse in Amazcala, Mexico. it performs Five concentrations of nitrogen were analyzed using Steiner nutrient solution in different range of 0, 4, 8, 12 and 16 mEq / L, using as a basis the. The results showed that the increase in the concentration of nitrogen has a strong effect on plant growth [6]

Muhammad Naveed Tahir et al. performed experiment of hyperspectral remote sensing on ground-based used to determining particular spectral wavelength/combinations of wavelength and spectral vegetation indices used to estimate leaf Nitrogen contents of field-grown corn at different growth stages in wide range of Nitrogen fertilization rates [7].

Gilles Lemaire et al. conducted study on importance of crop Nitrogen status determined some diagnostic tools in order to decide the rate and the timing of N fertilizer applications. this Theory depends on Nitrogen uptake and this allocation allows the determination of Nitrogen Nutrition Index, based on the determination of the critical Nitrogen dilution curve for each crop species considered[8].

Ines Cechin et al. studied an increase in nitrogen availability results in higher leaf nitrogen content. This result shows positive correlation between leaf nitrogen content and photosynthesis for many species Up to 75% of leaf nitrogen is found in the chloroplasts .most of it invested in ribulose bisphosphate carboxilase alone. This shows nitrogen supplying over Effect found on photosynthesis and growth of sunflower plants grown in the greenhouse [9].

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Prajakta Patane et al. conducted study to use Normalized Difference Vegetation Index (NDVI) which It uses visible and near infrared bands of electromagnetic spectrum for observing target contain live green vegetation and get Chlorophyll content. Also get Nitrogen status indirectly [10].
Biljana Bojovic et al. Performed This experiment on winter wheat (Triticum aestivum) in year of 2002 and 2003 on agricultural field located in Kragujevac Research Center. This result found as Physiological investigations of relation between chlorophyll content and nitrogen on wheat cultivars .[11].
S.J. Imamsaheb et al. conducted study on Impact of fertigation and drip irrigation on yield, quality, growth and economic returns in different vegetable crops and found that nitrogen uptake varies over productions of crop as compared to other methods used [12].
Anu Varughese et al. conducted research over Brinjal and Tomato are crops having major scope for increasing the production. After experiment it found that Nitrogen is important element to the plants and at the same time these costly fertilizers. Hence Application of these fertilizers used through drip ensures proper utilization and find results in better yield [13].
R. N. Sahoo et al. Found that levels of chlorophyll and nitrogen provide the indicators of productivity of plants, stress and the nutrients availability. Thus compared to direct field techniques, remote sensing techniques have been shown to be time variant, non-destructive and provide some spatial estimates for quantifying and monitoring vegetation attributes [14].
Poonsak Miphokasap et al. performed experiment on plots, which total area of 0.27 ha were designed. This found Reflectance spectra were measured over the sugarcane canopy using a field Spectroradiometer. This can explain the nitrogen variations in sugarcane with combined cultivars [15].
R.A. Khavari-Nejad et al. conducted this experiment in Falaat Company area, Tehran, Iran. After experiment it found that Nitrogen (N) and phosphorus (P) are two essential nutritional elements to crops which improve their growth, yield and product quality .The result in Effects of Nitrate Deficiencies on Certain Biochemical Metabolites in Tomato [16].
Tomas Ayala-Silva et al. carried out experiment on Five wheat seeds were planted into 1.5 · 1.5 · 1.5 cm area. after found that In wheat plants the deficiency of an essential element may drastically affect appearance and production growth and yield[17].
Duli Zhaoa et al. Performed experiment was conducted in growing season at the Mississippi Agricultural and Forestry Experiment Station in year 2001.the result shows the Nitrogen deficiency effects on growth, photosynthesis, reflectance properties of sorghum [18].
Y. Cohen et al. Performed experiment over in the spring growing seasons (year 2006 and 2007) on two commercial potatoes grown area. Desiree in Kibbutz Ruhama, Israel .this study focuses on Abstract Relationships between leaf spectral reflectance at range of 400–900 nm and nitrogen levels in potato petioles and leaves [19].
Rafael F. Munoz-Huerta et al. conducted a study on various plants and found that Plants absorb nitrogen as a mineral nutrient mainly from soil is nitrogen , and it can be may come in the form of nitrate ($NO3^-$) and ammonium ($NH4^+$) and by absorbing nitrogen in plants shows certain advantage and disadvantage[20].

III. METHODOLOGY

Valentina Ulissi et al. conducted a VIS-NIR Non-Destructive Spectroscopy method over a Tomato plants for determining Nitrogen concentration available in Tomato leaves. John J. Troiano et al. Carried out the tomato plants observation on different plants were exposed to low NO 2 concentrations in two separate experiments and observed different growth. F. Rodriguez-Moreno et al. performed for the spectral signatures dimensions reduced in the search of an index by using PCA versus ICA methods.
Edrees Mahmoud et al. performed canopy reflectance method over a wheat crop and processing Spectral Acquisition software ASD RS3 Version 6 was used to process and analyse recorded spectral curves. Dennis L. Wright et al. applied four different rates of N (0, 72,180, and 234 kg Nitrogen) were incorporated at planting and each rate was replicated twice except the 0 Nitrogen control and estimate canopy reflectance parameter.
Muhammad Naveed Tahir et al. studied The effects of different Nitrogen application on corn leaf Nitrogen were analyzed statistically at five different growth stages by Duncan's Multiple Range tests and comparing the means of each treatment using at a 0.05 probability by using SPSS 16. Gilled Lemaire et al. uses a Tissue analysis methods used Nitrogen Nutrition's Index(NNI) to determine as the ratio between the actual crop Nitrogen uptake (Na) and the critical Nitrogen uptake .Prajakta Patane et al. conducted extraction of Chlorophyll this extract analyzed using

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spectrophotometric method. it includes reflectance ,absorb and Transmittance of light which gives the chlorophyll content. Anu Varughese et al. used the Fertigation technique of supplying dissolved fertilizers to crops through an irrigation system. Poonsal Miphokasap et al. develop a estimation model that explain the nitrogen variations found in sugarcane with combined cultivars and getting reflectance spectra were measured over sugarcane canopy using a field spectroradiometer. Tomas Ayaka-Silva et al. conducted chlorophyll concentrations were determined using Minolta chlorophyll meter and estimate nitrogen content in wheat. Rafael F. Munoz-Huerta et al. performed Tissue analysis in which two methods Dumas Combustions and Kjeldahi Digestions are used overplants to estimate nitrogen contents.

IV. RESULT AND DISCUSSION

Valentina Ulissi et al. found that portable VIS-NIR spectrophotometer used to study the estimation efficiency of the N concentration of tomato leaves higher than SPAD chlorophyll meter readings. John J. Troiano et al shows that supplying NO3-N solutions effect the growth of Tomato plants . Edrees Mahmoud et al. found that results show that increase of nitrogen doses effect down reflectance in spectrum of visible spectral range (400–700 nm) and reflectance higher in near infrared spectral range (720 – 1000 nm). Adan Mercado Luna et al. come on the result of Greater seedling growth was observed with nitrogen treatment. Muhammad Naveed Tahir et al. shows that this identify different spectral vegetation indices for real-time monitoring of Nitrogen status of corn crop leaf at different growth stages showed that after nitrogen supply leaf size is very responsive .The leaf size is a result of cell production and cell expansion.
Prajakta Patane et al. found that chlorophyll and Nitrogen have relationship between Nutrient supplies to plants. Poonsak Miphokasap et al. experiment found that field spectroscopy data explants explain most of the nitrogen variations in plant canopy. Tomas Ayala-Silva et al. concluded that a Nutrient deficiency symptom has been found that as compared to Nitrogen supplied to plants. Duli Zhaoa et al. found that after performing experiment observed that Nitrogen deficiency effects on growth, photosynthesis and reflectance properties of sorghum.

V. CONCLUSION

Monitoring of Nitrogen levels in plants are more essential for plant growth thus field experiment showed a sensitivity of spectral measurement to nitrogen application have in different levels of different plants. The used Crop stand under good nutrition condition seen that higher spectral reflectance in the visible region and lower in the near-infrared region as compared to the control variants without providing Nitrogen fertilizing. After statistical evaluation of spectral data made a comparison with the results of leaf structure and nutrition analysis to relative spectral vegetation indices with the agronomic important crop characteristics.

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