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Soil Synthesis and Identification of Nitrogen percentage in Soil using Machine learning algorithms and Augmented Reality – A Typical review

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Abstract

Soil nitrogen is the one of the primary nutrient plays a major role in achieving high crop yield. This paper mainly synthesizes importance of knowing percentage of nitrogen present in the soil, conventional laboratory testing methods, limitations of traditional techniques used and importance of nitrogen, rate of consumption during different stages of cultivation to achieve high yield, suitable soil for specific yield, potential. This paper also focused on the soil classification based on soil color approach, Machine learning algorithms, novel approaches used for nitrogen application to specific crop when consumption by the crop is more, the environmental effects due to excess use of nitrogen fertilizers and the research gaps., use of cutting edge technologies like augmented reality in future agriculture.

Key words : About four key words or phrases in alphabetical order, separated by commas.

1. INTRODUCTION

The word 'soil' comes from 'Solum' word , consists of mineral particles, organic matter, water, air & living organisms called earth's crust hold the plant to grow [1]. Soil is crucial component in food production, quality of environment, sustainable soil management resources will generate large benefits like Biodiversity, food security and nutrition management, climate change adaption, water quality and quantity and Economic growth. Cultural system confirms adequate level of soil fertility and this practice was disturbed with excessive use of chemical fertilizers, pesticides and ample tillage to meet the world people hunger with limited land availability [18]. To ensure and improve agriculture productivity with desired nutrient supply, the nutrients present in the soil has to be monitored continuously. Soil fertility can be improved with conservation methods by retaining the residue on the surface of soil that decrease soil disturbance, and increase aggregation of soil, water infiltration and availability of nutrients [4].

Functionality of soil determined by soil quality and assessments depends on many aspects like process of static and chemical, physical changes and biological factors are need to be defined and these aspects are considered in determining soil management and environmental scenario [20]. It includes identification of land arable, diversification of crop, restoration of organic matter and rationalization soil input [5]. Soil classification is based on the soil fertility in olden day, but in modern days soil properties- color, texture and structure are also taken into consideration and in determining soil type [19].

According to "Indian Council of Agriculture Research (ICAR)" Indian soils are classified based on their character and nature as per USDA soil taxonomy Figure 1.

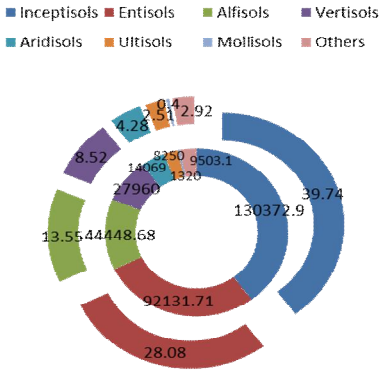

Figure 1: ICAR classification of Indian soils as per USDA Taxonomy

ICAR has Classified the soils based on their color, genesis, composition and location into: (1) Alluvial Soils, (2). Black Soils, (3). Red and Yellow Soils, (4). Laterite Soils. (5). Arid Soils, (6). Saline Soils, (7). Peaty Soils, (8). Forest Soils.

1.1 Alluvial Soils: These soils differ from sandy loam to clay in nature and light gray to ash gray in color.

1.2 Black Soil: these soils are clayey and water proof. Have different characters in different weather conditions like swell and sticky in wet conditions, shrikes in dried conditions and

helps the crops to sustain in dried weather conditions due to slow absorption and loss moisture. These soils contain lime, iron magnesia and alumina and the color of this soil vary from deep black – grey [21].

1.3 Red and Yellow soils: Red and Yellow soils with fine texture are fertile and with rough texture are poor in fertile.[23] And the soils are in reddish color due to extensive diffusion of iron in crystalline and metamorphic rocks, become yellow when it happened in a hydrate form. [24] These soils contain less percentage of nitrogen, phosphorous and humus.[25]

1.4 Laterite Soils: these soils are result of intensive leaching due to high temperature and heavy rain fall. [26] These soils contain iron oxide and aluminium compounds, and with very less percentage of organic matter, nitrogen, phosphate and calcium. [27] Soils are looks in red colour [22].

1.5 Arid Soils: these soils are sandy in structure and contain high percentage of soil by evaporation of salt water due to low moisture, high temperature and humus. [28] These soils colour is varies from red to brown and contain low humus and organic matter. [29]

1.6 Salin/Usara Soils: These soils are vary from sandy to loamy, these soils are low in nitrogen and calcium and rich in proportion of sodium, potassium and magnesium. [30]

1.7 Peaty soils: These soils are rich in humus and organic content. These soils black in colour [17].

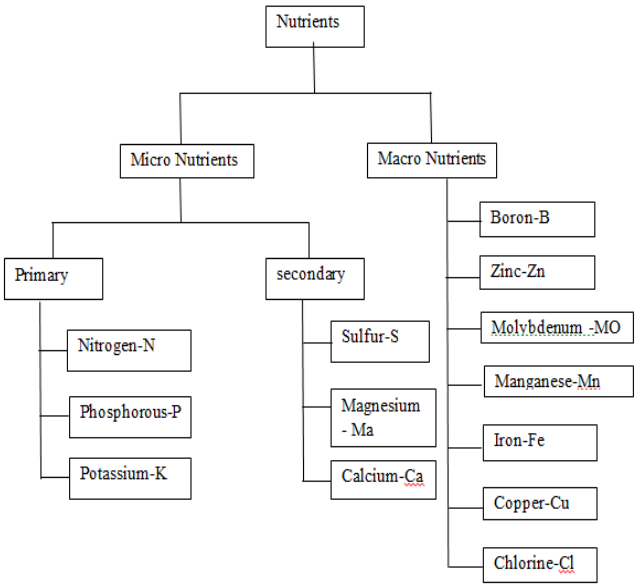

Figure 2: classification Soil nutrients

1.8 Essential nutrients exist in the soil:

Soil nutrients are classified as macro and micro nutrients [7]. Figure 2 details existing nutrients

The Government of india running many schemes to monitor soil health like Soil Health Card (SHE) started in 2015, under this scheme all the states follows distinctive principles for analyzing the soil to identify fertility related restrictions and also do the site specific fertilizer Suggestions[7]. This will process will done once in a three years after observing the soil regularity. Under this scheme nitrogen fertility status is shown in Figure 3

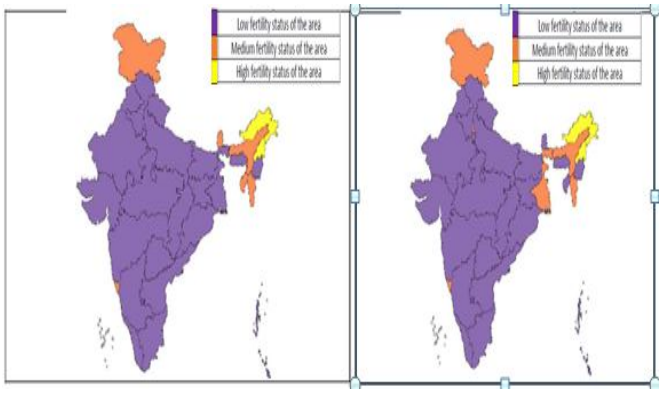

Figure 3: nitrogen fertility status under Soil Health Card (SHE)

Nitrogen is essential nutrient in rice yield [6]. Production of rice have increased the application of nitrogen fertilizer, and insufficient nutrient present in the soil be identified by leaf chlorophyll and decreased biomass and reduction in yield and quality [10]. Plants intake mineral form of nitrogen. Nitrogen available in form of Ammonium (NH+4) & Nitrate (NO-3) [12].

Excessive application of nitrogen Usage of nitrogen will leave high level nitrogen this will contaminate water and effect the environmental pollution due to leaching. [31] Excessive usage of fertilizers may also affect the quality of crop. [32] Supply high level of nitrogen to the leafy vegetables may cause human diseases [16]. The main aim of introducing novel farming methods in adequate supply of nitrogen is for environment – friendly and cost effective [13]. Tissue analysis is used for determination of nitrogen but is time consuming[14]. Chlorophyll and polyphenols have been used in determining the Nitrogen level in plant. [33]

Determination of N Status in crop based on the transmittance properties of leaves and also canopy reflectance measurements [15]. Determination of N with chlorophyll fluorescence can come across restrictions with chlorophyll methods. Determination of N status estimated with the value of canopy reflectance f a particular area. [34]

Table1: Anatomy of Plant N-Sensing techniques

Methods		**Advantages**	**Disadvantages**
Tissue analysis	Kjeldahl digestion digestion	To estimate total N contents (protein, amino acids, nucleic acids, *etc*.).	Invasive and destructive. Time-consuming. Toxic reagents used. Sample preprocessing requirements.
	Dumas combustion	No nitrate & nitrite depletion.	It may cause damage. Loss of nitrogen because of process burning Nitrogen

					partially. Preliminary processing needs.
Optical meters	Leaf level	Transmittance	SPAD	Relation between Status of Nitrogen & chlorophyll presence in the leaf. Easily movable.	Excess application of fertilizer to crops because of saturation point of leaf chlorophyll. And low reactivity N stress for identification at earliest stages.
		Fluorescence	Dualex	Incorrect signal from uncovered soil can be get rid of. Differentiate multiple N treatments under sunlight shadow. Easily movable.	Still they are unable to use remote sensors. Instead, fluorescence sensors will be used for observing sizable area of crop in the coming years.
			Multiplex	To identify N deficiency.	
	Canopy level	Ground-based	Passive sensors: Field Spec. CropScan LI 1800.	Identify sizable crop field area than leaf level meters.	It requires calibration. And dependence on sunlight.
			Digital Cameras	It Don't require sophisticated instruments.	It is sunlight dependent. Even though recent researchers described the use of fuzzy logic controllers decreasing the effects of sunlight, and most of research focused on assessment of crop N status and more analyses need to be done
			Active sensors: GreenSeeker Yara N-Sensor CropCircle	There is no sun-light dependency. Yara records more biomass per unit of surface of soil, calculate & record wide waveband. GreenSeeker reports variation in crop canopy & close to N saturation.	Equipment cost. Saturation due to the biomass increasing. GreenSeeker measures only two wavelengths. Yara did not detect plant N status. GreenSeeker reaches saturation earlier than CropScan when measuring crop N status during growth stage.
		Satellite-mounted	QuickBird	With this whole field analysis can be done.	High cost imagery. Weather conditions.
Sap and electrical meters			Nitrate test strips	High association among status of N and plant sap nitrate concentration. It is low-cost and easily movable. Rapid measurements.	Nitrate varies with exposer of light. Requires Plant sap dilution. Destructive. other forms of N.
			Nitrate ISE	Assessment of N in form of nitrate ions in plant sap due to great association among N and sap nitrate concentration. A broad operative range than nitrate strips.	Reactivity with ions, chloride, bicarbonate & nitrite. Concentration, sampling procedures, Calibration is needed.
			Electrical impedance spectroscopy	Electrical properties of plant tissue can be calculated Directly.	Invasive. Polarization effects of electrode. Some studies are focusing on sensing of plant nutrient.

2.CONCLUSION

To reduce the environmental and economic effect, balancing N – fertilizer is major concern. Tissue analysis methods used to determine plant n Status. And plant optical properties need to be used in addition to determining N Status to identify excessive usage of Nitrogen, overall optical analysis for N-status estimation need to be improved.

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