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Real Time Nitrogen Management – A Precision Approach for Enhancing Crop Productivity

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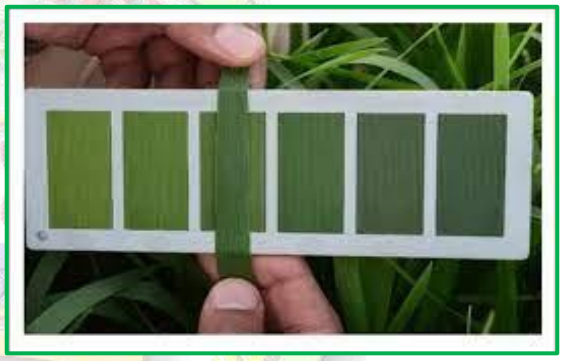
Agriculture must balance the need to feed a growing population with environmental and natural resource conservation. Nitrogen (N) is a necessary nutrient for plant growth and its presence in soil is an important measure of fertility. However, indiscriminate use of N fertilizers can cause nutritional imbalances and soil deterioration, highlighting the importance of accurate and effective N management. Real-time soil N assessments are essential for optimal management, as traditional sampling and analysis methods are time-consuming and error-prone. Accurate assessment of soil nitrogen is crucial for monitoring losses, establishing targeted fertilizer solutions, and improving crop output and efficiency.

Real Time N Management Tools

1.Leaf Colour Chart (LCC): It is cheap, basic and a simple-to-utilize alternative option to diagnose the relative leaf greenness of rice, maize, wheat crops etc as an indicator of crop N status in contrast with fast and moderately costly chlorophyll meter. The LCCs utilized in Asia are regularly a tough plastic strip around 7 cm wide and 13 to 20 cm long, consisting of four to six panels with colour ranging from yellowish green to dark green. Farmers monitor the leaf colour of field crops at 7 to 10 days stretches and apply N fertilizer under situation of leaves becoming more yellowish green than the critical LCC panel of the particular crop and variety.



Leaf colour chart

2.Green Seeker: NDVI (Normalized Difference in Vegetative Index) Sensor or Green Seeker: NDVI is a handheld device which uses light emitting diodes to generate red and near infrared light which are used to calculate NDVI values. Working Principle: Green Seeker calculates NDVI using red and NIR (Near Infra-Red) light. It is based on simple principle that red light is absorbed by plant chlorophyll as an energy source during photosynthesis. Therefore, healthy plants absorbs more red light and reflect larger amounts of NIR than those that are unhealthy and thus gives higher NDVI value. NDVI is calculated using the equation:

NDVI = NIRreflected– Redreflected /NIRreflected + Redreflected

Green Seeker is an excellent indicator of biomass (amount of living plant tissue) and is used to accurately project yield potential.

3. Nutrient Expert® (NE): Nutrient Expert® is a computer based, easy to use, interactive decision support software for site specific nutrient management (SSNM) especially for wheat and smallholder farmers designed and developed by International Plant Nutrition Institute (IPNI), USA.

4. SPAD meter: The SPAD 502 (Soil Plant Analysis Development) meter or chlorophyll meter is a portable diagnostic tool used for monitoring crop N status in situ in the field. It assesses the N content of the leaf by measuring relative greenness within few seconds. The SPAD readings are calculated based on two transmission values: the transmission of red light at 650 nm, which is absorbed by chlorophyll and the transmission of infrared light at 940 nm, at which no chlorophyll absorption occurs. The portion of light is absorbed by leaf and the leftover is transmitted and converts into electrical signal by a silicon photodiode detector. The amount of light in photodiode detector is inversely proportional to the amount of chlorophyll in the path of the light. Leaf chlorophyll content in SPAD meter is displayed in arbitrary units (0–99.9). The relationship between SPAD readings and leaf N content per leaf area is influenced by climatic factors and leaf characteristics, which shall be considered while using a chlorophyll meter to guide N management in fields (Xiong et al. 2015). Ata-ul-karim et al. (2016) found that there is a positive correlation between N concentration and SPAD values and nitrogen fertilizer doses in rice.

5. RapidSCAN sensor: he RapidSCAN CS-45 sensor (Holland Scientific Inc., Lincoln, Nebraska, USA) is a recently developed active crop canopy sensor and it is a lightweight as well as convenient portable sensor with built-in global positioning system and red edge (RE) band along with red and near infrared bands. Another advantage of the RapidSCAN sensor is that the sensor data collection is not influenced by measurement height in the range of 0.3 to 3m (Lu et al. 2017). It provides NDVI and normalized difference red edge (NDRE) as two default vegetation indices (VI) in addition to the R, RE and NIR wave band reffectance. Besides NDVI and NDRE, many different VIs can be calculated. Lu et al. (2017) found that this sensor can be used for predicting rice N status indicators at different growth stages.

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