Real Time Nitrogen Management Under SSNM

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Introduction

Nitrogen is the most important nutrient for plant growth, yield, quality and environment. It is an essential component of amino acids, auxins, cytokinins, proteins, alkaloids, glucosinolates and various other food components. Adequate amount of nitrogen is required to support photosynthesis, since it is an integral part of chlorophyll molecuele. Crop plants can obtain much of their required N from the soil and organic sources, but the supply of N from these sources is seldom sufficient for supporting crop yield. Supplemental N from fertilizers is essential for higher yields and profit under field conditions.

Site Specific Nutrient Management is an approach for supplying the crop with nutrients at right time, right amount, right place and right manner. It aims at optimal use of nutrients by the crop from indigenous sources (soil, crop residue, manure, and irrigation water) and timely application of fertilizers at optimum doses. Feeding of crops with nutrients is done as and when needed by the crop. The goal of SSNM is to match nutrient supply from various sources with crop requirement and minimize nutrient losses from fields. For best effect, nutrients should be applied during the growing season to ensure that nutrients supply matches with the crop need at the critical growth stages.

What is real time nitrogen management?

Nitrogen can be lost from the soil plant system by leaching, runoff, denitrification or volatilization. The reason is that, there is lack of synchrony of plant nitrogen demand with nitrogen supply. An important part of SSNM is use of tools that can assess real N needs of crop plants. It can help us to apply N at optimum doses and achieve high nutrient use efficiency.

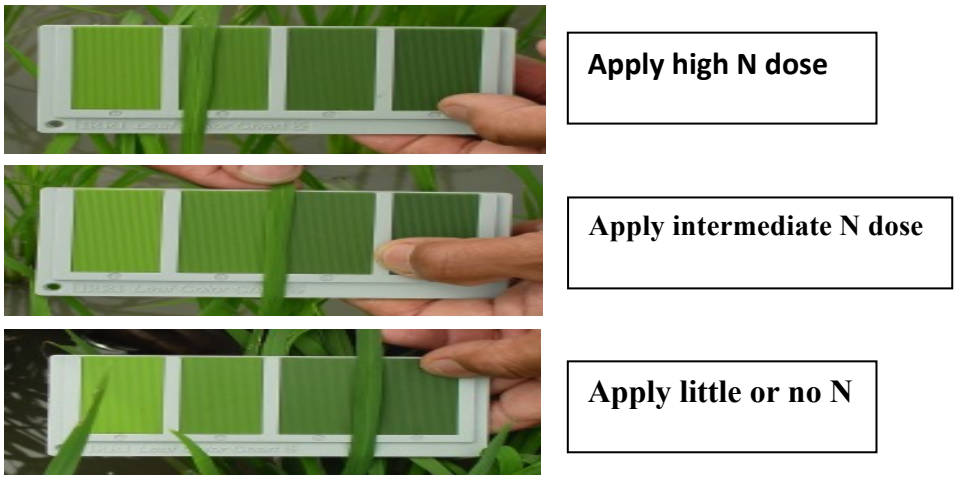
The various tools which are used for real time nitrogen management includes leaf colour chart, chlorophyll meter, optical sensors, remote sensing or use of GIS. The most commonly used tools are –

1. *Leaf colour chart method*

The Leaf Colour Chart (LCC) is used to determine the N fertilizer needs of rice crops. It was developed by International Rice Research Institute for N management in rice. LCC has four panels with colour ranging from yellow green to dark green. It determines the greenness of the rice leaf which in turn indicates its N content.

We use LCC by randomly selecting at least 10 disease free rice plants or hills in a field with uniform plant population. Then, select the topmost fully expanded leaf from each hill or plant and place the middle part of the leaf on a chart and compare the leaf colour with the colour panels of the LCC. Do not detach or destroy the leaf. If it is possible the same

person should take LCC readings at the same time of the day every time. LCC can be used to determine amount and timing of N fertilizer application in rice, wheat, maize and other crops. It is cheap and can easily be adopted by farmers.



(Source: Fairhurst & Witt, 2002. Rice: A practical guide to nutrient management)

Fig.1: Using the leaf colour chart (LCC) under field conditions

2. ***Chlorophyll meter or SPAD meter***

Chlorophyll meter or SPAD (Subsystem Positioning Aid Device) is used by researchers to estimate N status of crops. It works by emitting two frequencies of light, one at a wavelength of 660 nm (red) and one at 940 nm (infrared). Leaf chlorophyll absorbs red light but not infrared and the difference in absorption is measured by the meter and termed as "Optical Density Difference," i.e. ODD. ODD indicates the ratio of reflection vs. absorption. It can measure relative difference in crop N status and is also able to detect the onset of N stress before it is visible. Generally when SPAD value is less than the set critical reading than accordingly N fertilizer is applied.

(Source: Chlorophyll meter SPAD 502 plus, Indiamart.com)

Fig. 2: Use of Chlorophyll meter under field conditions

3. **Green Seeker sensor**

It is an integrated optical sensing and application system that measures crop status and variably applies the crop's nitrogen requirements. Yield potential for a crop is identified using a vegetative index known as NDVI (Normalized Differential Vegetative Index). The sensor uses light emitting diodes (LED) to emit light in two wavelengths i.e. red and near infrared

(NIR) light. The reflectance from the crop canopy is measured by a photodiode located at the front of the sensor head and calculates Normalized Differential Vegetative Index.

$$NDVI = \frac{\text{F NIR} - \text{F RED}}{\text{F NIR} + \text{F RED}}$$

NDVI value is related to the amount of plant material in the field and its greenness.

Where,

F NIR = Fraction of emitted near IR radiations reflected back from the sensed area

F RED = Fraction of emitted red radiations reflected back from the sensed area.

(Source: Handheld Green seeker, vantage–ro.com)

Fig. 3: Use of green seeker under field conditions

Conclusion

Site Specific Nutrient Management helps in saving of inputs, increase in fertilizer and other input use efficiency, aims at uniform crop stand with more yields and also ensures balanced application of fertilizers. Real time N management helps to estimate N status of plant and is used to improve N management by estimating the need of the crop for fertilizer before sowing and by distributing the fertilizer during the cropping season based on crop need. It also helps in maintaining the nutrient balance of the soil and minimising the nutrient losses. In addition, these nitrogen management practices have the ability to reduce agricultural non-point source pollution and to enhance economically sustainable crop production.

References

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