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Leaf Colour Chart for Synchronizing Nitrogen Supply with Actual Crop Demand in Paddy

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ARTICLE ID: 010

Introduction

Paddy is the most staple and nutritive food crop for world human population. Nitrogen (N) deserves a special status among the major nutrients and is the "mineral of life" for paddy. It is the most critical input that limits paddy productivity in irrigated ecosystem. There is no compromise on the need for the judicious use of N fertilizer for increasing paddy production despite the fact that the cost of N fertilizers increases year by year. Phasing of N application at critical developmental stages is more important for efficient utilization of applied N by paddy. Monitoring of plant N status is important in improving the balance between crop N demand and N supply from soil and applied fertilizer. Because leaf nitrogen content is closely related to photosynthetic rate and biomass production, it is a sensitive indicator of the dynamic changes in crop N demand within a growing season. The direct measure of leaf N concentration by laboratory procedures is time consuming and costly. Such procedures have limited use as a diagnostic tool for optimizing N topdressing because of the extensive time delay between sampling and obtaining results.

Farmers generally use leaf colour as a visual and subjective indicator for the crop's nitrogen status and need for N fertilizer application. Simple diagnostic tools as Leaf Colour Chart (LCC) and the SPAD (Soil and Plant Analysis Division) meter have been developed to monitor plant N status for fine tuning of N management. They allow farmers to adjust N applications in real time i.e. based on the present plant N status, which is closely related to the indigenous N supply and season specific climatic conditions that affect crop growth. The high price of SPAD meter limits its use by individual resource poor farmers. A very simple, quick and non destructive method of estimating leaf N status is by Leaf Colour Chart. It has

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been tested for real time N management in the farmers' fields in several countries including India.

Leaf Colour Chart

- The leaf color chart (LCC) is an innovative cost effective tool for real-time or crop-need-based N management in Paddy, Maize and Wheat.
- LCC is a visual and subjective indicator of plant nitrogen deficiency and is an inexpensive, easy to use and simple alternative to chlorophyll meter/ SPAD meter (soil plant analysis development).
- It measures leaf color intensity that is related to leaf N status.
- LCC is an ideal tool to optimize N use in Paddy/Maize at high yield levels, Irrespective of the source of N applied, viz. organic manure, biologically fixed N, or chemical fertilizers.

  Thus, it is an eco-friendly tool in the hands of farmers.
- Now, it is manufactured with 4 colors called Four Panel LCC & 6 colors called Six Panel LCC. Moreover, LCC is provided with water-proof laminated instruction sticker in the required regional language.

It is an inexpensive, simple, easy to use tool for measuring the leaf greenness, developed from a Japanese prototype and was devised by "Fuji Film Co" especially for paddy leaf colour. Leaf Colour Chart measures the green colour intensity of paddy leaves. Leaf greenness was calibrated very precisely to the leaf N content. The first leaf colour chart was developed in Japan. Chinese researchers at Zheijang Agricultural University developed a much improved LCC and calibrated it for *indica*, *japonica* and hybrid paddy. This chart later became a model for the LCC developed by Crop Resources and Management Network (CREMNET) of International Paddy Research Institute, Philippines. In India, these charts are provided by Nitrogen Parameters, a Chennai based company.

LCC: An Outlook

The leaf colour chart is a 15 inch long chart. The colour chart had originally eight shades of unnamed green. Leaf colour is compared with the standard colour charts under the same environmental condition. The colour scale is made of plastic resistant to sunshine damage. It is less light reflectable and consists of many strip colour lines arranged like leaf

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veins. The lightest, more yellowish shade is labeled as 1 and the deepest, darkest green shade is labeled 8. Later, a colour chart with seven shades of greenness was developed and the present form of the colour chart has six shades of green colour. It has been calibrated with the chlorophyll meter and is used to guide nitrogen top dressing for paddy. A simple construction sheet in the local language accompanies the chart and explains the farmers how to determine the correct time of N application. The colour chart is an ideal tool to optimize N use in paddy cropping, irrespective of the nitrogen source applied, inorganic, organic or bio-fertilizers.

LCC is used to assess the canopy green as well as green colour of a single leaf. The readings obtained with canopy and with a single leaf differ in the same field and relationship of the two readings is expressed by

$$Y = 1.00\ x - 1.01.$$

Y – Canopy green and x is the colour of a single leaf.

How to use LCC in Paddy

1. At 14 days after transplanting (DAT) or 21 days after direct wet seeding (DAS), randomly select 10 healthy plants in your field where plant distribution is uniform.
2. Compare the topmost, fully expanded, and healthy leaf of each of the 10 plants with the LCC. Place the middle part of the leaf on top of the LCC's colour strips for comparison. Do not detach the leaf. Take readings at same time of the day (8-10 AM). Do not expose the LCC to direct sunlight during reading s. The same person should take the first up to the last LCC reading.
3. If six (6) or more of the 10 leaves have readings below the critical LCC value, apply N as given below:
   - For wet season (*kharif*) non-basmati paddy, use LCC critical value 4, and apply 28 kg N/ha or 1.25 bag urea per hectare.
   - For wet season (*kharif*) basmati paddy, use LCC critical value 3, and apply 23 kg N/ha or 1 bag urea per hectare.
   - For direct-seeded paddy, apply 23 kg N/ha as basal, then use LCC critical value 3, and apply 23 kg N/ha or 1 bag urea per hectare.
   - For Boro paddy, apply 23 kg N/ha as basal, then use LCC critical value 4 and apply 35 kg N/ha or 1.5 bags of urea per hectare.

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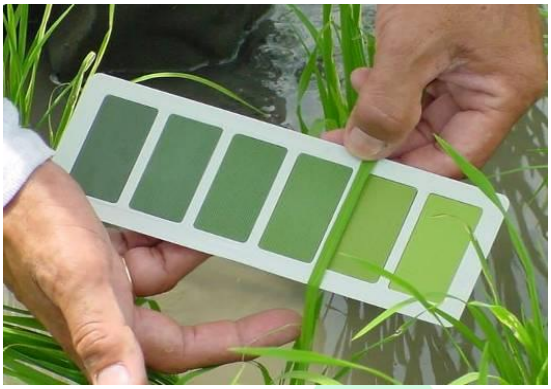

Using 6 Panel LCC in Paddy

Using 4 Panel LCC in Paddy

4. Repeat LCC readings every 7 days for 110-130-day paddy crops and every 10 days for more than 130-day crops until first heading. Different sets of 10 leaves can be used for each weekly or 10-day reading.
5. If basal fertilizer with N (DAP or NPK compound) is applied 0-14 DAT or 0-14 DAS, the first LCC reading is done at 21-25 DAT or 28-30 DAS instead of 14 DAT or 21 DAS.

Making understanding the farmers regarding benefits of using LCC in paddy

Field demonstration on using LCC in paddy for real time nitrogen management

Merits of LCC

1. It is a simple and easy to use tool for farmers to assess the leaf nitrogen status and to determine the time of N top dressing to paddy.
2. LCC is inexpensive than SPAD meter
3. No samples need to be collected, processed and sent to a laboratory for analysis

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4. SPAD meter involves technical skill but LCC do not demand expertise in usage as it is only matching the colour scores of the leaf with standard chart.

Demerits of LCC

1. LCC cannot indicate smaller differences in leaf greenness as the colour shades fall in between two shades, the mean of the two scores is taken which may result in less accuracy.
2. There is a possibility of occurrence of more personal variations.
3. The relative accuracy of LCC to assess the leaf N status can be determined only when it is compared and correlated with chlorophyll meter readings and calibrated properly with the cultivar groups (semi dwarf, local tall, hybrid).
4. LCC is used only to fine tune the top dressed N but one cannot decide the basal nitrogen application by LCC.
5. LCC can be more successful in integrated site-specific nutrient management strategy in which to achieve optimum response to N fertilizer, other nutrients (P, K, S, Zn) must not be limiting. Therefore, adequate levels of other nutrients have to be applied based on soil tests or local recommendations.
6. P or K deficiencies may cause darker leaf colour which leads to erroneous LCC readings. Hence local calibration of LCC is always required. But SPAD meter is less affected by these deficiencies.
7. LCC values are influenced by diurnal variations of the day, varieties and seasons, hence needs calibration.

Conclusion

Nitrogen is the kingpin in fertilizer management programme for paddy as it is the key to realize the yield potential of high yielding varieties and hybrids. It is more imperative than other nutrients because timing of N application decides the efficiency. Blanket or package fertilizer recommendations over larger areas are not efficient because indigenous supply varies widely among paddy fields in Asia. Leaf Colour Chart based N management will significantly benefit the farmers in adjusting N input to actual crop conditions and nutrient requirements. Need based N management based on LCC aid in optimizing threshold levels without any yield loss. These tools are inevitable guidelines in deciding the top dressed N requirements and synchronize fertilizer N application with actual crop demand and adds more

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returns to the farming community. Thus, LCC provides rescue over the conventional method of N estimation which is very tedious and emphasis on need based N application to the crops.