JUST AGRICULTURE
multidisciplinary e-Newsletter

LCC-Leaf Colour Charts: An Emerging Tool For Nitrogen Management in Paddy (Rice)

Dhruvendra Singh Sachan[1]* and Medha Pandey[1]
Research Scholar Department of Agronomy, Chandra Shekhar Azad University of Agriculture and Technology, Kanpur- 208 002
M.Sc. Scholar, Department Agronomy, Department of Agriculture, IIAST, Integral University, Lucknow

ARTICLE ID: 27

Nitrogen: as a mineral element for plants

Nitrogen is a naturally occurring element that is required by all living things. It is a compound of all amino acids and the primary component of the Earth's atmosphere as inorganic nitrogen gas (N_2), accounting for approximately 80% of the total. Nitrogen is non-reactive and useless to plants in its gas state, thus it must be converted, such as by Rhizobium bacteria, before it can be used by plants. Nitrogen is absorbed by plants through their roots in organic form as an amino acid, nitrate (NO^{3-}), nitrite (NO^{2-}), and ammonium ions (NH^{4+}). Nitrogen is regarded as a mineral element that is most required by plants, and hence represents the most significant input in crop production management.Because of the variations in shape, chemistry, and location, it is the most complex input to control. Nitrogenous fertilizersare one of the most important agricultural inputs. Its significance is illustrated in years when excessive rainfall causes nitrogen deficits and production losses. Nitrogen can be lost from the soil under prolonged wet field conditions and warm temperatures. Depending on the type of nitrogenousfertilizer used and the level of wetness, warm circumstances that encourage its loss, losses might be minor or severe.

Role of Nitrogen in Plants

Nitrogen is present in amino acids, nucleic acids, nucleotides, chlorophyll, enzymes, and hormones. Through increased tillering, leaf area expansion, grain formation, grain filling, and protein synthesis, N promotes fast plant growth and enhances grain production and grain quality. N is extremely mobile within plants and soil. The availability of vital nutrients such as nitrogen to improve the plant's biological processes such as growth, absorption, transportation, and excretion is critical to the health of plant components (leaves, roots, trunks, and so on).Based on how it functions in plants, nitrogen may be considered "the

JUST AGRICULTURE
multidisciplinary e-Newsletter

backbone" of plants. Nitrogen is the most important nutrient for plants since it serves critical activities and can be a limiting factor in plant production and crop growth. Nitrogen is the most scarce element in nearly all soils. Thus, adequate N fertilizer application is critical to improving crop growth and grain yields, particularly in intensive agricultural systems. Inadequate fertilizer N management can harm crops and the environment. The goal of optimal N management systems is to match fertilizer N supply with real crop needs, optimizing crop N absorption while minimizing N losses to the environment.

When to Apply N Fertilizers?

Leaf colour and crop appearance indicate the plant N status and help determine the need for N fertilizer application.

a) Leaf Colour Chart (LCC) for crop need-based N management, and
b) Nitrogen split applications for growth stage-based N management using the LCC.

Nitrogen deficiency is the most commonly detected nutrient disorder observed in rice. Old leaves and sometimes all leaves become light green and chlorotic at the tip. Leaves die under severe stress. Except for young leaves, which are greener, deficient leaves are narrow, short, erect, and lemon yellowish. The entire field may appear yellowish. Nitrogen deficiency often occurs at critical growth stages such as tillering and panicle initiation, when the demand for N is large.

LCC- Leaf Colour Charts

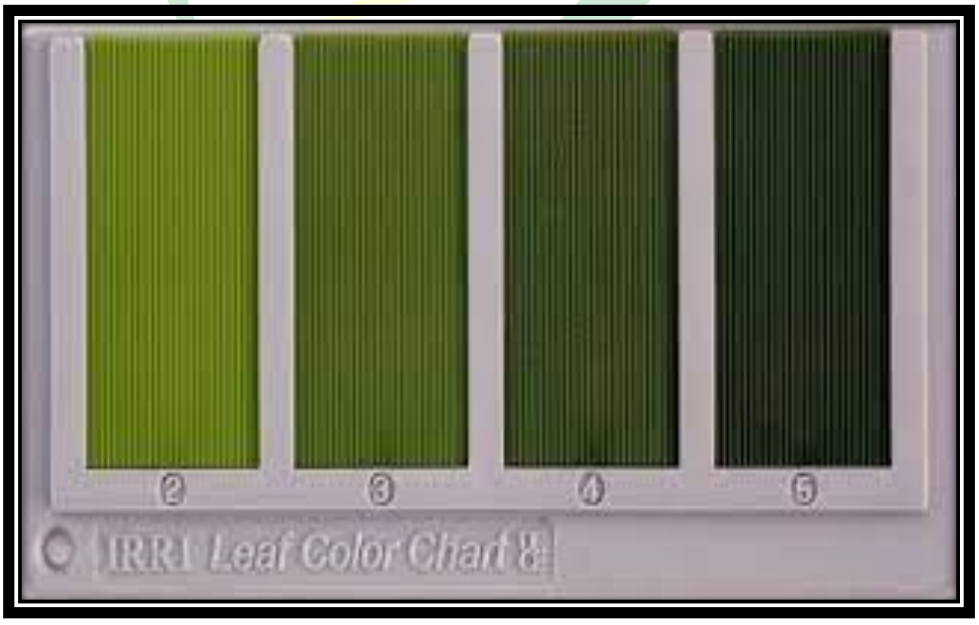


Figure: IRRI- Leaf Colour Chart

JUST AGRICULTURE
multidisciplinary e-Newsletter

Nitrogen fertilizer (N) is essential in rice cultivation. Apply N fertilizer numerous times during the growing season to ensure that the crop's nitrogen needs are met, especially during crucial growth phases. The leaf colour chart (LCC) is an easy-to-use and inexpensive diagnostic tool for monitoring the relative greenness of a rice leaf as an indicator of the plant N status. The Leaf Colour Chart is used to calculate the nitrogen fertilizer requirements of rice crops. LCC features four green strips ranging in tint from bright green to dark green. It determines the greenness of the rice leaf, which shows the amount of nitrogen it contains.

How to use LCCin Rice crop?

As per the information given by IRRI, the following process must be used

Step 1. Select Plant for Testing

Select any 10 disease free plants of rice or hills in a farm field where population is uniform.

Step 2. Match the Rice Leaf to The Chart

Select the topmost, youngest, fully expanded leaf from each hill or plant. This part best reflects the N status of the plants. Place the middle part of the leaf on the LCC and compare its colour with the colour panels.

Step 3. Measure the Leaf Colour

Measure the leaf colour under the shade of your body. Direct sunlight affects leaf colour readings. If possible, the same person should read the LCC at the same time of the day, every time. If the colour of a rice leaf is in between two shades, take the average of the two values as the reading. For example, if the colour is in between 3 and 4, the reading should be 3.5.

Step 4. Take Average of Lcc

Use the LCC once every 7−10 Days starting from the beginning of tillering (14 DAT). Continue this process up to 5−10 days after panicle initiation.

Reviews on Nitrogen Management by LCC

Shukla et al. (2006) from Uttar Pradesh revealed that, LCC threshold value 4 gave higher grain yield, N uptake and N use efficiency than with 120 N kg ha^{-1} applied in 3 fixed time splits in wheat crop. Alam et al. (2006) revealed that use of LCC for N management consistently increased the wheat grain yield and added net return as compared to the farmers' fertilizer practice, in the study conducted at south-western Bangladesh.

JUST AGRICULTURE
multidisciplinary e-Newsletter

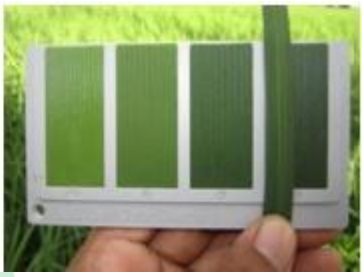
Samson et al. (2005) from the field experiments conducted at IRRI and Philippines, where real-time Nitrogen management through LCC in the dry season was carried out, reduced the N fertilizer use by 45 to 80% compared to the conventional N management with a fixed seasonal N rate of 210 kg N ha^{-1}, while achieving comparable or higher yields of 6–8 t ha^{-1}.

Options Available For Farmers to Mitigate N Deficiency Using LCC

1. **Adjustable Dose N management option**

Farmers measure leaf colour before applying N at active tillering and panicle initiation. If mean leaf colour is intermediate between 3 and 4, apply a standard rate of fertilizer N. If the mean leaf colour is higher (for example ≥4), apply less fertilizer N than the recommended rate. If the mean leaf colour is lower (for example ≤3), apply more fertilizer N than the recommended rate.



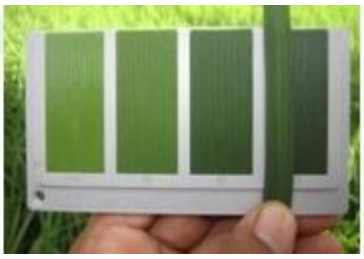


apply high N dose *apply baseline N dose* *apply No N/Little N*

2. **Real time N management option**

Rice leaf colour is monitored by the farmers at 7 to 10 days intervals from tillering stage to 5-10 days after panicle initiation. Farmers apply fertilizer N whenever the leaves become more yellowish-green than a critical threshold value indicated on the LCC.





Immediately apply N *apply N very soon* *don't apply N*

Summary:

Plants without N application are yellowish. Nitrogen deficiency is confirmed when the LCC reading is between panels 2 and 3. At lower fertilizer N rates in photos the plants look better, but the low LCC reading still indicates N deficiency. The LCC reading is

JUST AGRICULTURE
multidisciplinary e-Newsletter

between panels 3 and 4, which is the critical range for most transplanted rice. In plants with a high N rate, leaves are dark green. Leaf colour is darker than the LCC panel no. 4 indicating a surplus of fertilizer N.

References

Alam, M.M., Ladha, J.K., Foyjunnessa, Rahman, Z., Khan, S.R., Khan, A.H., and Buresh, R.J. (2006), "Nutrient Management for Increase Productivity of Rice-wheat Cropping System in Bangladesh", *Field Crops Res., Vol. 96: pp. 374–386.*

Samson, M.I., Laureles, E.V., Larazo, W.M., Gines, H.C., and Buresh, R.J. (2005), "Benefits ofReal-time N Fertilizer Management within 4 years in 2 long-term Experiments (IRRI and PhilRice)", *Philippines J. Crop Sci., Vol. 30: pp. 37–51.*

Shukla, A.K., Singh, V.K., Divedi, B.S., Sharma, S.K., and Singh, Y. (2006),"Nitrogen use Efficiencies using Leaf Colour Chart in Rice (Oryza Sativa)-wheat (Triticum Aestivum) Cropping System", *Indian J. Agril. Sci., Vol. 76(11): pp. 651–656.*