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# Need-Based Nitrogen Management Through Leaf Colour Chart in High Yielding Rice Variety

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## Abstract

A field trial comprising two rice varieties (GAR 13 and Mahisagar) and 3 LCC scores (≤2, ≤3 and ≤4, Threshold level of LCC is 20 kg N/ha) with the recommended dose of N (80 kg and 120 kg N/ha, three split 40% basal, 40% at tillering and 20% at PI stages) was conducted in a factorial randomized block design with three replications to calibrate the LCC for nitrogen requirement of rice. In leaf color chart treatment LCC Score ≤ 4 recorded significantly higher yield attributing character *viz.,* panicle length, panicle weight, panicle/ $m^2$, grain and straw yield it followed by the 100% RDN (application of fertilizer as per recommendation) and LCC Score ≤ 3 during the both years and highest cost benefit ratio (2.43) was incurred under the treatment LCC Score ≤ 4 followed by treatment LCC Score ≤ 3 and 100% RDN).

**Key words:** Rice varieties, leaf colour chart, nitrogen management, high yielding varieties, RBD

## Introduction

Rice is grown in over hundred countries and is the primary food for half of the people in the world. World population is expected to 8.5 billion by 2025 and to maintain self-sufficiency in rice, an increase of 2% - 3% per year in rice production has to be maintained within limited land (Vallino *et al*., 2009). The efficiency of fertilizer use for nitrogen is lower than 50% for phosphorus, lower than 10% and for potassium 40%. This low efficiency of fertilizer use is also associated with other losses by immobilization, volatilization, denitrification, leaching, and clay adsorption (Ruiz *et al*., 2012). Nutrient management is a major component of a soil and crop management system. Knowing the required nutrient for all stages of growth and understanding the soil's ability to supply the needed nutrient is critical to profitable crop production (Nedunchezhiyan and Laxminarayan, 2011). Higer dose of nitrogen gave significantly higher grain yield of rice (Kacha *et al.,* 2023). Increase in fertilizer nutrient input, especially N fertilizer, has contributed significantly to the improvement of crop yield in the world (Peng *et al.*, 2010). Farmers generally apply fertilizer nitrogen in several spilt applications that results in high pest and disease incidence and serious lodging. The leaf color 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. Leaf color chart have proved quick and reliable tool to decide the time when nitrogen fertilizer needs to be applied to the crop, farmers can apply N at the right time, thereby increasing the productivity and profitability of rice and reduction of used nitrogen fertilizer (Yosef tabar, 2013). The present research programme aims to identify the LCC threshold score and optimum dose of N through LCC for a different local rice variety.

## Materials and Methods

A field experiment was conducted during the *Kharif* seasons 2016 to 2017 at Main Rice Research Station, Anand Agricultural University, Nawagam. A composite representative soil sample was collected from the experimentation and analysed for physico-chemical properties. The soils of experimental site

was slightly clay loam and alkaline (*p*H value 8.20 with 1:2.5 soil and water ration). It consists 0.32% organic carbon, 31.20 kg/ha available $P_2O_5$ and 274.10 kg/ha available $K_2O$. The soil was low in organic matter and nitrogen content. The average rainfall 730 mm and average minimum and maximum temperature were recorded $20.35^0$ C and $33.27^0$ C respectively, in the year 2016 and 2017.

The experiment was laid out in factorial randomized block design (FRBD) with three replications. The treatment consisted of two varieties GAR 13 and Mahisagar that is originally Nawagam province four nutrient management treatments in which, three levels of LCC scores (≤2, ≤3 and ≤4, Threshold level of LCC is 20 kg N/ha), one levels of recommended dose of N (80 kg and 120 kg N/ha, three split 40% basal, 40% at tillering and 20% at PI stages) and 8 treatment combination in each replication.

Thirty days old seedlings of rice varieties transplanted on well puddled soil at 25th July, 2016 and 12th August 2017 at a spacing of 20 × 15 cm, 2-3 seedlings/ hill. After the establishment of seedlings a constant water level of 5 ± 2 cm was maintained during the entire crop growth period till early dough stage. For the management of weeds two hand weeding were done at 35 and 55 days after transplanting (DAT). Irrigation, weeding and other agronomic practices were done as per recommendations. The crop was harvested manually at maturity at ground level on 22th November, 2016 and 30th November, 2017 respectively.

**Leaf Colour Chart**

The five green shades ranging from yellowish green to dark green was used in the trial. LCC readings were taken at 7 days interval starting from 30 DAT till 50% flowering. Ten disease free hills were selected at random from the sampling area in each plot. From each hill topmost fully expanded leaf was selected and LCC readings were taken by placing the middle part of the leaf on the chart and the leaf colour was observed by keeping the sun blocked by body as sun light affects leaf colour reading. Whenever the green colour of more than 5 out of 10 leaves were observed equal to or below a set critical limit of LCC score, nitrogen was applied @ 20 kg/ha to all the three varieties. For both rice varieties GAR 13 and Mahisagar variety the final split application of N was completed by 65 days after transplanting coinciding with the heading stage (**Table 1**). In Mahisagar variety a total nitrogen was applied with LCC chart 40 kg, 60 kg, and 80 kg N/ha under the treatment LCC Score ≤2, ≤3 and ≤4 in the year of 2016 and 2017 respectively. Whereas, GAR 13 variety a total nitrogen was applied with LCC ≤2, ≤3 and ≤4 were 60 kg, 80 kg, and 100 kg N/ha during the year 2016 and 2017 respectively. However, under recommended dose of nitrogen it was 80 kg N/ha and 120 kg N/ha applied in 3 splits, 40% basal, 40% at tillering and 20% at PI stages for Mahisagar and GAR 13 varieties respectively.

**Table 1: No of observation of LCC and application of total quantity of N kg/ha**

| Treatment | No. of splits | | N applied kg/ha | | Time of N application DAT | | | | | | | | | |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| | 2016 | 2017 | 2016 | 2017 | 2016 | | | | | 2017 | | | | |
| **Mahisagar** | | | | | | | | | | | | | | |
| $T_1$: LCC Score ≤ 2 | 2 | 2 | 40 | 40 | 30 | 37 | - | - | - | 30 | 37 | - | - | - |
| $T_2$: LCC Score ≤ 3 | 3 | 3 | 60 | 60 | 30 | 37 | 41 | - | - | 30 | 37 | 41 | - | - |
| $T_3$: LCC Score ≤ 4 | 4 | 4 | 80 | 80 | 30 | 37 | 41 | 55 | - | 30 | 37 | 41 | 55 | - |
| $T_4$: 100 % RDN | 3 | 3 | 80 | 80 | 0 | 30 | 55 | - | - | 0 | 30 | 55 | - | - |
| **GAR 13** | | | | | | | | | | | | | | |
| $T_1$: LCC Score ≤ 2 | 3 | 3 | 60 | 60 | 30 | 37 | 41 | - | - | 30 | 37 | 41 | - | - |
| $T_2$: LCC Score ≤ 3 | 4 | 4 | 80 | 80 | 30 | 37 | 41 | 55 | - | 30 | 37 | 41 | 55 | - |
| $T_3$: LCC Score ≤ 4 | 5 | 5 | 100 | 100 | 30 | 37 | 41 | 55 | 62 | 30 | 37 | 41 | 55 | 62 |
| $T_4$: 100 % RDN | 3 | 3 | 120 | 120 | 0 | 35 | 60 | - | - | 0 | 35 | 60 | - | - |

## Results and Discussion

Growth and yield of rice variety was ascribed by plant height, panicles/m2, test weight, straw and grain yield was affected due to various levels of LCC score along with RDN. Data presented in **Table 2** showed that influence of rice varieties found non-significant, while LCC scores (≤2, ≤3 and ≤4, Threshold level of LCC is 20 kg N/ha), one levels of recommended dose found significant. Effect of leaf color chart score T3: LCC Score ≤ 4 was found significant and highest for character *viz.,* panicle length, panicle weight, panicles/ $m^2$, grain yield (5720 and 5928 kg/ha respectively 2016 and 2017) and straw yield (8768 and 7652 kg/ ha, respectively in 2016 and 2017) over the rest of treatment. It was statistically at par with treatment T4: 100% RDN (80 kg and 120 kg N/ha, three split 40% basal, 40% at tillering and 20% at PI stages) and T2: LCC Score ≤ 3, with respect to panicle length, panicle weight, panicle/$m^2$, grain yield and straw yield during the both the year. The increment of grain yield in this study at higher nitrogen levels might be due to efficient absorption of nitrogen and other elements which raise the production and translocation of dry matter from source to sink (Morteza *et al*., 2011). Same result was revealed by Yadvinder-Singh *et al*., (2007. LCC score was threshold, found an average saving of 26% fertilizer N across villages and seasons in 100 on-farm experiments with irrigated rice conducted during 4 years in the northwestern India.

**Table 2: Growth and yield attributes influenced by various treatment of LCC**

| Treat | Panicle length (cm) | | Panicle weight (g) | | Panicle/$m^2$ | | Grain yield kg/ha | | Straw yield kg/ha | | Benefit:cost ratio | |
|---|---|---|---|---|---|---|---|---|---|---|---|---|
| | 2016 | 2017 | 2016 | 2017 | 2016 | 2017 | 2016 | 2017 | 2016 | 2017 | 2016 | 2017 |
| **Variety (V)** | | | | | | | | | | | | |
| $V_1$ | 24.23 | 21.98 | 3.96 | 3.53 | 283 | 228 | 5155 | 5109 | 7905 | 6131 | 2.22 | 2.13 |
| $V_2$ | 22.71 | 22.93 | 4.18 | 3.68 | 294 | 246 | 5562 | 5445 | 8380 | 7440 | 2.39 | 2.31 |
| S.Em. ± | 0.77 | 0.48 | 0.16 | 0.12 | 9.69 | 7.98 | 151 | 174 | 250 | 217 | - | - |
| C. D. | NS | NS | NS | NS | NS | NS | NS | NS | NS | 658 | - | - |
| **Treat.** | | | | | | | | | | | | |
| $T_1$ | 19.12 | 20.33 | 3.06 | 3.12 | 230 | 203 | 4519 | 4588 | 6567 | 5911 | 1.91 | 1.91 |
| $T_2$ | 24.57 | 22.42 | 4.17 | 3.48 | 295 | 232 | 5543 | 5255 | 8554 | 6728 | 2.34 | 2.17 |
| $T_3$ | 25.11 | 23.83 | 4.68 | 4.05 | 320 | 261 | 5720 | 5928 | 8768 | 7652 | 2.40 | 2.43 |
| $T_4$ | 25.09 | 23.25 | 4.38 | 3.76 | 309 | 253 | 5653 | 5336 | 8683 | 6851 | 2.37 | 2.19 |
| S.Em. ± | 1.09 | 0.67 | 0.23 | 0.17 | 13.70 | 11.28 | 213 | 246 | 353 | 307 | - | - |
| C. D.* | 3.30 | 2.05 | 0.69 | 0.52 | 41 | 34 | 646 | 746 | 1071 | 930 | - | - |

*C.D. at 0.05%, Selling price: Paddy300 Rs/20 kg, 15 Rs/ kg (Three year average), Paddy Straw 1 Rs / Kg
Input cost: Urea Rs. 350/50 kg, DAP Rs. 1250/50 kg, ZnSo4 750 Rs / 25 kg

### Conclusion

The highest cost benefit ratio was incurred under the treatment $T_3$ (LCC Score ≤ 4) followed by treatment $T_4$(100 % RDN) and $T_2$ (LCC Score ≤ 3) (**Table 2**). As per the results the farmers of middle Gujarat Agro Climatic Zone-III are advised to use Leaf Color Chart critical score "4" for nitrogen management in mid late maturing rice varieties to get higher net return and save 17 % Nitrogen.

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