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In the past, farmers apply fertilizer to their crop at fixed intervals. In rice, for instance, the total N requirement of the rice crop is applied in three splits: at basal, before panicle initiation, and at early flowering. Recent scientific findings, however, show that this “feeding time” is not applicable to all varieties. There are varieties which mature earlier or later. Maturity is also affected by season and climate. More recent findings indicate that native soil fertility vary not only by region or province, but even within a field plot. The result is that farmers have been applying N fertilizer much earlier — when the plant does not need it — or applying much later than when the plant needs it most. Hence, the crop recovers only 30-50 percent of the fertilizer applied due to improper time of application and losses through leaching and volatilization.

Recognizing that fertilizer management is a knowledge-intensive technology, the Philippine Rice Research Institute (PhilRice), based in Muñoz, Nueva Ecija, and the International Rice Research Institute (IRRI) based in Los Baños, Laguna, designed a simple decision aid tool that will help farmers visually assess the nitrogen status of the rice plant. The tool is called the Leaf Color Chart (LCC).

The LCC is handy plastic “ruler” with strips of six shades of green color to simulate the color of rice leaves under field conditions. The topmost fully expanded and healthy leaf from a rice plant is placed on top of the leaf color chart and graded according to the corresponding color strip on the “ruler”. The result of the grading, taken on a weekly basis, forms the basis of fertilizer application. Green leaf color intensity can be related to plant nitrogen concentration, requirement and, hence, the time and amount of N fertilizer to apply.

The LCC can generate savings of up to P1,000 per hectare in nitrogen fertilizer use. It is a cheap, fast, and handy field instrument to measure color intensity of the green leaf. Knowledge of proper “feeding time and amount” can increase fertilizer use efficiency, and protect the ground and surface water from contamination.
**Basal P and K, and Zn as broadcast**

During the final land preparation, incorporate at least 40 kg/ha phosphorous (3 1/2 bags of solophos or 0-18-0) and 30 kg potassium (1 bag muriate of potash 0-0-60). Two weeks after transplanting or direct seeding, broadcast 20 kg zinc sulfate per hectare when discoloration of the older leaves is observed.

**When to take first reading**

Starting at 14 days after transplanting until the flowering stage, begin to take weekly readings and apply the needed nitrogen fertilizer. This will require 8-9 weekly readings depending on the maturity date of the variety used. For direct seeded rice, start taking readings 21 days after sowing. Weekly visit to the field allows the farmer to closely observe the crop’s response to fertilization.

**How to Use the LCC**

Compare the color of the topmost fully expanded and healthy leaf of a representative rice plant with the LCC.
Take readings between 8-10 am when there is not much glare from the sun. Avoid taking readings very early in the morning since few drops can make reading difficult.

The LCC comes with six color gradients, starting with yellowish green (1) representing the lowest N concentration, and dark green (6) or highest N concentration. The critical value set for irrigated lowland rice variety is 4.

apply 30 kg N/hectare if majority of the leaves in a sample have LCC readings below 4 (1 1/3 bags urea or 3 bags ammonium sulfate)

no need to apply fertilizer if majority of the leaves in the sample have LCC readings above 4

critical value set for irrigated lowland rice variety

Take readings between 8-10 am when there is not much glare from the sun. Avoid taking readings very early in the morning since few drops can make reading difficult.
Homogenous Plots  
*(Fairly level area with uniform crop growth)*

Measure the topmost fully expanded healthy leaves of 10 plants from a plot or hectare if the area is homogenous. If 5 or more of the leaves have LCC readings below 4, apply 30 kg N/ha. This is equivalent to 1 1/3 bags of urea or 3 bags ammonium sulfate.

**PLOT 1**

Measure the first fully expanded leaf of the tallest tiller.

- leaf 1
- leaf 2
- leaf 3
- leaf 4
- leaf 5
- leaf 6
- leaf 7
- leaf 8
- leaf 9
- leaf 10

1 Hectare
**Sample Readings from Homogenous Plots**

**Rule:** If 5 or more of the leaves have LCC readings below 4, apply 30 kg N

<table>
<thead>
<tr>
<th>LCC Reading</th>
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<tbody>
<tr>
<td>1</td>
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<td>2</td>
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<td>3</td>
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<td>4</td>
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<td>5</td>
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<td>6</td>
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<table>
<thead>
<tr>
<th>Frequency of leaves per LCC reading</th>
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</table>

**Decision:** **Apply N fertilizer**

*Since 7 leaves have LCC readings below 4, apply 30 kg N/ha*

30 kg N/ha = \( \frac{1}{3} \) urea or 1 ammonium sulfate

![Image of a person applying fertilizer in a field]
Heterogenous Plots
*(High and low areas with non-uniform crop growth)*

If the area is heterogenous, that is, there are low or elevated areas or different soil nitrogen status, divide the area into several plots of similar characteristics. Then get LCC readings of 10 representative plants from each plot. For each plot, if there are five or more leaves with LCC readings below 4, apply 30 kg N/ha. This is equivalent to 1 1/3 bags urea or 3 bags ammonium sulfate.
Sample Readings from Heterogenous Plots

**Plot 1**

<table>
<thead>
<tr>
<th>Frequency of leaves per LCC reading</th>
<th>LCC Reading</th>
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<tbody>
<tr>
<td></td>
<td>1 2 3 4 5 6</td>
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</tbody>
</table>

**Decision:** Apply N fertilizer

Since 8 leaves have LCC readings below 4, apply 30 kg N/ha

**Plot 2**

<table>
<thead>
<tr>
<th>Frequency of leaves per LCC reading</th>
<th>LCC Reading</th>
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<tbody>
<tr>
<td></td>
<td>1 2 3 4 5 6</td>
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</table>

**Decision:** Do not apply N fertilizer

Since only 3 leaves have LCC readings below 4, no need to apply N fertilizer

**Plot 3**

<table>
<thead>
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<th>Frequency of leaves per LCC reading</th>
<th>LCC Reading</th>
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<tbody>
<tr>
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<td>1 2 3 4 5 6</td>
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</table>

**Decision:** Do not apply N fertilizer

Since all the leaves fall in LCC 4 and above, no need to apply N fertilizer
Japan and China were the first to use the leaf color chart (LCC). Japan used the LCC extensively on crops like corn and rice. Its practicality and ease of use prompted PhilRice to study its application in the Philippines. In 1995, PhilRice researchers tested a Japanese LCC prototype on four Indica rice varieties, PSB Rc2, PSB Rc6, PSB Rc22, and IR 72. The Japanese LCC measures 10 cm x 35.5 cm with seven plates or color gradients ranging from yellowish green to dark green. Researchers found that the LCC readings “matched” the more accurate readings of leaf nitrogen content by a digital chlorophyll meter (SPAD) and chemical analysis using Kjedahl method. These two methods, however, are very expensive and beyond the reach of ordinary farmers.

With these encouraging results, PhilRice linked up with the Crop Resource Management Network and International Rice Research Institute (CREMNET-IRRI) to develop a local prototype, smaller in size and lighter in weight. The first material used was a laminated photographic paper measuring 5.5 cm x 13 cm. The LCC still had seven color gradients. Nueva Ecija farmers had some difficulty comparing the leaf color to the LCC due to the glare from the glossy surface of the prototype. Field tests also showed that only six color gradients were needed or Philippine indica rices. With the assistance of a local chemical company, a plastic LCC measuring 7 cm x 19.5 cm with six color plates was developed, as shown in the cover photo. A one-page instructional handout was initially made to guide farm technicians and farmers on how to use the LCC. A number of Nueva Ecija farmers were trained on the use of LCC.

The present LCC was tested in farmers’ fields and over 40 local varieties including hybrids. Based on positive feedback from farmers and technicians, the Department of Agriculture procured 15,000 units of the LCC to be distributed to agricultural technicians nationwide, including farmer-cooperators in the Gintong Ani technology demonstration project. Instructions on its use were further simplified for ordinary farmers to make full use of this inexpensive and practical technology.
Acknowledgment

This bulletin was prepared at the Philippine Rice Research Institute (PhilRice) by Dr. Rolando T. Cruz (subject matter specialist), Dr. Santiago R. Obien (technical adviser), Roger F. Barroga (technology synthesis); Carlo G. Dacumos (design and layout), and Arleen Robert E. Baclit (photographs).

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We are a 12-year-old government corporation attached to the Department of Agriculture. We help our country to locally produce enough rice for all Filipinos. We develop rice production technologies suited to the different growing conditions in our country - irrigated, rainfed, upland, cool/elevated, and salty.

We develop and adapt suitable varieties and make these available and accessible to seed growers and farmers. We collect, document, and preserve seeds of local traditional rice varieties. We transfer the good qualities of these rices into the modern rice varieties, making them strong against insect pests and diseases, high-yielding, delicious to eat, and can thrive in harsh environments.

We develop efficient methods of planting, remedying poor soils, and protecting rice crops from pests without harming the environment. We develop small farm machines and approaches to making full use of land and water resources, including postharvest technologies. To improve rice-based farming systems, we determine the most productive crops for planting after rice, especially in rainfed areas. We also identify other special uses of rice and its by-products as food or drink.

Most of all, we promote the adoption of these technologies among rice farmers and seed producers, agricultural extension and development workers, and rice-based businessmen. We likewise espouse policies favorable to the rice industry.

We are PhilRice. We serve.

If you feel you're not getting enough of our services, or if there are other services you desire from us, please let us know. At once.