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Integrated nitrogen management by leaf color chart technique in transplanted rice

Mazher Farid Iqbal[1*], Muzzammil Hussain[2] and Muhammad Anjum Ali[3]
[1*]Adaptive Research Station Sialkot
[2]Adaptive Research Farm, Gujranwala
[3]Directorate General Agriculture (Extension and Adaptive Research) Punjab-Lahore
*Corresponding author: *mazherfareed2004@gmail.com*

Abstract

The study had been conducted at farmer's field on different sites of Adaptive Research Station, Sialkot to evaluate nitrogen management by leaf color chart (LCC) compared to farmer practice (FP) in rice-wheat cropping pattern during kharif 2014-2016. Maximum paddy yield 3.95tha^{-1}; 3.98tha^{-1}; 3.92tha^{-1} was recorded in case of "N" applied by LCC technique followed by FP 3.66tha^{-1}; 3.70tha^{-1} and 3.50tha^{-1} during 2015-2016 respectively. The results showed that in LCC technique 40% urea can be saved without any loss of yield compared to farmer's practice. Maximum net income (Rs.153063 ha^{-1}) was recorded in LCC technique compared to FP (Rs.141050 ha^{-1}). However maximum cost benefit ratio was recorded in leaf color chart technique (1.51) compared to farmer practice (1.31). It was concluded that leaf color chart (LCC) is an easy technique to use and cost effective apparatus for monitoring chlorophyll of leaf and improving nitrogen fertilizer management in transplanted rice.

Keywords: Leaf Color Chart technique; Nitrogen; Management; Rice; Sialkot; Punjab; Pakistan.

Introduction

Rice (*Oryza sativa* L.) is being one of principal food crop and utilized by one third of world population. It provides 700 calories per person, mostly residing in developing countries (Tari et al, 2009). Precise application of nitrogen based on plant need so it improves fertilizer use efficiency in rice crop. One of the recently introduced nitrogen management approach was estimating the leaf nitrogen concentration by the measurement of leaf greenness. Leaf color is generally used as a visual and subjective indicator of the rice crop need for nitrogen (N) fertilizer. Leaf color intensity is directly related to leaf chlorophyll content and leaf N status. LCC technique is a tool that can help farmers to improve their decision-making process in N management. 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. Inexpensive leaf color chart (LCC) has proved quick and reliable tool to decide the time when fertilizer needs to be applied to the crop (Tabar et. al., 2013). Knowing the required nutrients for all stages of growth and understanding the soil's ability to supply those needed nutrients is critical to profitable crop production. Nutrient management is a major component of a soil and crop management system (Nedunchezhiyan and Laxminarayan, 2011). Increase in fertilizer nutrient input, especially N fertilizer, has contributed significantly to the improvement of crop yields in the world (Peng et al, 2010). Nitrogen is the

major nutrient limiting the high yield potential of rice cultivars (Shrestha and Maskey, 2005). Farmers generally apply too much N (and little Phosphorus and Potash and other nutrients) that results in high pest and disease incidence and serious lodging (Chaudary *et. al*., 2009). More nitrogen application in the field results maximum expenditure on pesticides that reduced yield and poor grain quality due to lodging (Alam et al, 2007). Site specific nitrogen management has the potential to increase fertilizer use efficiency as well as grain yield in the farmers fields (Nath et al, 2013). Improved Nitrogen management and balanced fertilization are key components of the site-specific nutrient management approach development. The concept is based on results that show a close link between leaf chlorophyll content and leaf N content (Alam et al, 2007). However the study had been conducted on different sites to evaluate nitrogen management by leaf color chart (LCC) in rice-wheat cropping pattern in District Sialkot, Punjab-Pakistan.

Materials and Methods

The study had been conducted on different sites at farmer's field of Adaptive Research Station, Sialkot to evaluate nitrogen management by leaf color chart (LCC) in rice-wheat cropping pattern in District Sialkot, Punjab-Pakistan during kharif 2014-2016. In FP treatment 125kgha^{-1} Di-ammonium Phosphate (DAP) + 62.50kgha^{-1} of Urea + 125kgha^{-1} Murate of Potash (MOP) fertilizer were broadcasted in the field in well prepared land followed by puddling. In FP treatment 125kgha^{-1} Urea was applied in the field one month after transplantation. In LCC treatment 125kgha^{-1} of Di-ammonium Phosphate (DAP) + 125kgha^{-1} of Murate of Potash (MOP) fertilizer were broadcasted in well prepared land followed by puddling. However where 62.50kgha^{-1} Urea was applied in the field after every 10 days after transplanting if color showed reading less than No: 4 on LCC technique. Randomly select at least 10 disease-free rice plants or hills in a field having uniform plant population. Select the top most fully expanded leaf from each hill or plant. Place the middle part of the leaf on a chart and compare the leaf color with the color panels of the LCC. Be careful and do not detach or destroy the leaf from the plant and determine average LCC reading of the selected leaves. All the agronomic practices and plant protection measures were kept constant to avoid biasness. The benefit cost ratio was recorded by the formula given by Kahloon et al., 2012.

How to use Leaf Color Chart (LCC)?

A leaf color chart developed in Japan and used to measure green color intensity of rice leaves, serves as a cheaper tool to assess the nitrogen requirements by non destructive method (Nachimuthu et al, 2007). Being a standardized chlorophyll meter, the LCC can be compared with the chlorophyll meter to determine their relative accuracy of assessing the leaf status (IRRI, 2003). Leaf color chart (LCC) is made of high quality plastic material (8×3 inches) (singh et al, 2008). It consist of six color shades ranging from light yellowish green (No: 1) to dark green (No: 6) color strips fabricated with veins resembling those of rice leaves (Nachimuthu et al, 2007); (Sathiya et al, 2009) and (Ramanathan et al, 2003). The LCC used in Asia are typically a durable plastic strip about 7 cm wide and 13 to 20 cm long, containing four to six panels that range in color from yellowish green to dark green (Hushmandfar and Kimaro,2011). These include use of a Leaf Color Chart (LCC), which relies on visual comparison between leaf color and a color chart to assess the N status of certain plants (Ali et al, 2012). It is a simple-to-use and inexpensive and can even help farmers who are not highly trained in making nitrogen applications. Inexpensive leaf color chart (LCC) has proved quick and reliable tool to decide the time when fertilizer needs to be applied to the crop (singh, 2008).

Photo-1 showing Leaf Color Chart technique and its usage

Results and Discussion

Table-1 showed that maximum paddy yield 3.95tha^{-1}; 3.98tha^{-1}; 3.92tha^{-1} was recorded in case of "N" applied by LCC technique followed by FP 3.66tha^{-1}; 3.70tha^{-1} and 3.50tha^{-1} during 2015-2016 respectively. These results were in accordance to Tabar (2013) who reported that the Split application of N fertilizer using leaf color chart resulted LCC values increased by application of N fertilizer at different growth stages. However the Real-time N management based on applying N whenever leaf color was less than critical greenness resulted in application of 60-120 kgNha^{-1} with rice yields being equivalent to those obtained with the blanket recommendation (Singh et al, 2008). Each time with a total dose of 60 kgNha^{-1} recorded comparable yield with 120 kgNha^{-1} in four equal split, with saving of 50% N fertilizer (Hushmandfar and Kimaro, 2011). The results showed that in LCC technique 40% urea can be saved without compromising yield compared to farmer's practice. Maximum net income (Rs.153063 ha^{-1}) was recorded in LCC using technique compared to FP (Rs.141050 ha^{-1}). However maximum cost benefit ratio was recorded in leaf color chart technique (1.51) compared to farmer practice (1.31).

Table-1 showing economic comparison between FP and LCC technique during 2014-2016.

Treatment	Yield (tha^{-1})			Mean Yield (kgha^{-1})	Income (Rsha^{-1})	Total cost (Rsha^{-1})	CBR
	2014	2015	2016				
Farmer Practice	3.66b	3.70b	3.55b	3640b	141050	107509	1.31
Leaf Color Chart technique	3.95a	3.98a	3.92a	3950a	153063	100075	1.53
LSD	0.52	0.41	0.31				

Means sharing different letter in a column differ significantly (P>0.05)

Conclusions

It was concluded that leaf color chart (LCC) is an easy to use and cost effective technique for monitoring chlorophyll of leaf and effective in improving nitrogen fertilizer management in transplanted rice. LCC helped farmers to estimate plant nitrogen demand, without compromising their yield. The critical leaf color has to be maintained for optimal growth. LCC provides guidance when to apply nitrogen fertilizer and how much quantity of "N" is to be applied for getting better yield.

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