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Need based nitrogen management using leaf colour chart for rice in Balaghat district Madhya Pradesh

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Abstract
The present study was conducted in Balaghat district of Madhya Pradesh. The front line demonstrations on rice crop conducted by Krishi Vigyan Kendra, Badgaon, Balaghat during the last two years 2017 to 2018. The study was conducted to compare the farmer's practices of application of nitrogen fertilizer with N fertilizer application as per leaf colour chart. The N fertilizer application as leaf colour chart recorded superior in growth and yield traits as compared to farmer's practices. The grain yield was recorded 53.15 q/ha and net income and Benefit: Cost ration recorded Rs. 43597/- per ha and 1:2.01 on pooled basis in N application as per LCC. The N save over farmer practices was recorded 25.50 per cent. Leaf colour chart is tool that can help farmers improve their decision-making process in nitrogen management.

Keywords: nitrogen fertilizer, leaf colour chart, rice

Introduction
Fertilizer nitrogen (N) has become the key input in food production. Cereals including rice account for more than half of the total fertilizer N consumption in the world and Madhya Pradesh typically consist of fixed rate and timings for large rice growing tracts. These 'blanket' recommendations have served their purpose in producing good yields, but they are limited in their capacity to increase nutrient use efficiency. Many times, to ensure high yields, farmers apply fertilizer N rates even higher than the blanket recommendation. Over application of N in rice crop leads to further lowering of N fertilizer recovery efficiency. The blanket recommendations are also not responsive to temporal variations in crop N demand. Use of N in excess of crop requirement and inefficient splitting of N applications are the main reasons for low N use efficiency in rice.

Since improving the synchrony between crop N demand and the N supply from soil and or the applied N fertilizer is likely to be the most promising strategy to increase N use efficiency, the split application of fertilizer N is going to remain an essential component of fertilizer N management strategies in rice (Singh *et al.*, 2010) [12]. Real-time corrective N management is based on periodic assessment of plant N status, and the application of fertilizer N is delayed until N deficiency symptoms start to appear. Thus, a key ingredient for real-time N management is a method of rapid assessment of leaf N content that is closely related to photosynthetic rate and biomass production and is a sensitive indicator of changes in crop N demand within the growing season. As rice leaf colour is a good indicator of leaf N content, the LCC, developed through collaboration of the International Rice Research Institute (IRRI, 1999) [5] with agricultural research systems of several countries in Asia, serves as a visual and subjective indicator of plant N deficiency.

Use of this approach in developing countries of Asia is very limited. LCC provide a simple, quick, and nondestructive method for estimating N of rice leaves. Leaf colour chart (LCC) is a high quality plastic strip on which are embedded a series of panels with colours based on the wavelength characteristics of leaves. The range of green plastic chips ranging from yellowish green to dark green cover a continuum from leaf N deficiency to excessive leaf N content (Pasuquin *et al* 2004) [7]. Thus, LCCs measure leaf greenness and the associated leaf N by visually comparing light reflection from the surface of leaves and the LCC (Yang *et al* 2003) [14]. Very limited research work is available so far to establish LCC for rice in central India, particularly in Madhya Pradesh. Therefore, the present investigation was conducted to evaluate real-time N fertilizer management with the LCC relative to the 'blanket' recommendations with the objective to find out the relative efficiency of LCC for the N economy as well as increasing yield.

Materials and Methods

The present study was carried out by the Krishi Vigyan Kendra, Balaghat (M.P.) during *kharif* season from the year 2017 and 2018 in farmer's field of two adopted village's *viz.*, Butte hazari, Anolajiri and Badgaon. It was front line demonstration conducted reason of lower productivity in *kharif* rice. The average productivity of two village is 2.78 t/ha. The climate of Balaghat is semiarid subtropical with dry hot summer and cold winter. The average annual rainfall is 1447 mm, major part of which is received during the latter part of June to mid-September. The constraints of villages were soil type (mixed red and black), improper fertilizer management of crops, lower economic back-up etc. Except the improper fertilizer management of rice crop, all other factors were beyond farmers' perspective. So, management of the crops can be the better option. During the PRA (Participatory Rural Appraisal) exercise and survey work it was observed that the farmers used to cultivate *Kharif* rice crop with improper fertilizer doses of N, P and K. The general recommendation for *Kharif* rice in our state for medium fertility soil is 100:60:40 for JRB- 81 rice variety. In Madhya Pradesh the general ratio of N: P: K use is 2:1:1. However, a great disparity was observed in the farmers' practice. Mostly small and marginal farmers are dominant in two villages, so the survey in a participatory mode was made with these sections of farming community. After preliminary survey, practicing farmers were trained about the importance of balanced fertilization through soil testing and low cost N management through LCC. They were demonstrated to use the LCC in field through participatory mode. Finally, Five farmers were selected (as replication) from each villages and experiment was conducted taking two treatments as under Farmers' Practice - T1: N:P:K : 150: 30: 0 kg/ha nitrogen.

Nitrogen application through LCC – T2: (25-40 kg N /ha) (at 1st and 2nd top dressing which is 22±2 and 40±2 days after sowing respectively) and soil test based P and K (60:40) application.

Pre- and post-harvest soil sampling was done in order to determine the treatment effects on soil fertility. The soil samples were analyzed according to the standard methodology outlined by Jackson (1973) [6]. The yield attributes, yield and cost of cultivation were calculated for each treatment.

Results and discussion

The results obtained from the present study as well as suitable conversation have been summarized under following themes:

Soil fertility status:

The soils of the adopted villages were medium in organic carbon, medium in available phosphorus, high in available potassium. The pH and electrical conductivity of soils of all villages were normal in nature. The organic carbon, available phosphorus, either or nor available potassium were recorded in Butte (Hazari), Anolajiri and Badgaon villages having low, medium and high, respectively. The ranges of soil properties as were given in Table 1.

Table 1: Soil properties of the demonstration plot different villages

Parameters	Butte (Hazari)			Anolajiri			Badgaon		
	Min.	Max.	Mean	Min.	Max.	Mean	Min.	Max.	Mean
pH	5.68	6.31	6.00	5.57	7.41	6.49	5.12	7.61	6.37
EC (ds/m)	0.12	0.36	0.24	0.19	0.66	0.43	0.20	0.36	0.28
OC (%)	1.20	1.59	1.40	1.50	1.49	1.50	1.47	1.68	1.58
Avail. P(kg/ha)	16.98	21.30	19.14	16.98	27.20	22.09	12.18	22.26	17.22
Avail. K (kg/ha)	181.80	298.40	240.10	176.40	223.10	199.75	176.80	238.40	207.60

Growth and yield traits

The pooled data on various growth parameters indicated that plant height was higher in T2 on pooled basis due to steady supply of N applied at seedling stage helped to crop favourable effect on growth characters (Table 2). Among the treatments, T2 (use N fertilizer as per LCC) was recorded effective tiller per plant on pooled basis and it was 19.20 higher than farmer practices. Panicle length, number of grain per panicle and test weight at harvest was recorded higher in T2 as compared to T1. The grain yield was recorded 53.15 higher in treatment where N fertilizer applied as per leaf colour chart. The results showed that the farmers can achieve the grain yield by N management using leaf colour chart. However, several other experimenter reported higher grain yield of rice at LCC 4 and suggested for adoption of LCC 4 to be optimum value. The similar results were also reported earlier by Singh and Sharma (2016) [3]; Budhar (2005) [4]; Balaji and Jawahar (2007) [2]; Sathiya and Ramesh (2009) [9] for real time N management considering higher grain yield and N saving.

Table 2: Growth and yield attributes characters of rice as influenced by use of N application as per leaf colour chart

Parameters	Plant Height at Harvest (cm)			effective tiller per plant (No.)			Panicle length (cm)			Number of grain per panicle			Test weight (gm)			Grain yield (q/ha.)		
	2017	2018	Mean	2017	2018	Mean	2017	2018	Mean	2017	2018	Mean	2017	2018	Mean	2017	2018	Mean
Farmer Practices (T1)	129.34	127.41	128.38	11.30	12.60	11.95	19.08	18.28	18.68	206.41	219.22	212.82	21.25	22.16	21.71	42.35	43.21	42.78
Use of LCC (T2)	133.82	134.54	134.18	18.60	19.80	19.20	21.35	22.36	21.86	241.27	246.83	244.05	24.29	25.67	24.98	51.8	54.5	53.15

Nitrogen management in rice

Application of nitrogen as per LCC resulted using total of 37.55 kg N /ha which was equivalent to the recommended N dose whereas, farmer practices total N used 147.22 kg/ha. The N save over farmer practices was recorded 25.50 per cent without loss in grain yield of rice. The similar reports were also published earlier by Singh and Sharma (2016) [3]; and Ahmad *et al.* (2016) [1]; Sheikh *et al.*, (2017) [10].

Economics

Economic returns as a function of grain yield and MSP sale price varied during both years. The data in Table 3 revealed that paddy under treatment recorded 22.62 per cent higher net return (Rs. 43597/- per ha) and B:C. ratio (1:1.84) as compared to the local check where farmers got net returns and B:C ratio of Rs. 33737/- per ha and 1:1.80 on pooled basis, respectively. The higher additional returns and effective gain

obtained under demonstrations could be due to nitrogen management on basis of leaf colour chart, improved technology, nonmonetary factors, timely operations of crop cultivation and scientific monitoring. The results confirm the findings of the leaf colour chart appeared to be an easy and inexpensive tool for efficient N management in irrigated transplanted rice crop by Raddy and Pattar (2006) [8]. The leaf colour chart based application of N recorded higher grain yield and net returns besides resulting in greater savings in fertilizer N and can be easily adopted by famers.

Table 3: Effect of nitrogen application as per leaf colour chart on economics in rice crop

Parameters	Net Return (Rs.)			B:C ratio			N use (kg/ha.)			% N save over farmers practices
	2017	2018	Mean	2017	2018	Mean	2017	2018	Mean	
Farmers practices (T1)	28453	39020	33736.5	1.80	2.07	1.94	145.65	148.79	147.22	
Use of LCC (T2)	35658	51535	43596.5	1.84	2.18	2.01	39.68	35.42	37.55	25.50

* Market price of paddy seed Rs.1510 and Rs.1750 q per ha. for the year 2017 and 2018, respectively.

Conclusion

From the above findings it is concluded that leaf colour chart in rice crop yield is a higher as compared to farmer practices. The LCC practice of nitrogen application which was worked out to be 37.55 kg per ha is the most appropriate dose of Nitrogen in rice crop which should be applied in splits. Moreover, the leaf color chart is an easy-to use and inexpensive diagnostic tool for monitoring the relative greenness of a rice leaf as an indicator of the plant nitrogen status. The LCC can be used to guide the application of nitrogen fertilizer to maintain optimal leaf nitrogen content for achieving high rice yield with effective nitrogen management. Leaf color is generally used as a visual and subjective indicator of the rice crops need for nitrogen fertilizer. Leaf colour chart is tool that can help farmers improve their decision-making process in nitrogen management.

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