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Leaf Colour Chart Based N Management on Yield, Harvest Index and Partial Factor Productivity of Rainfed Rice*

Among the essential elements, nitrogen (N), a limiting factor in crop production plays an important role in increasing the productivity of rice. It accounts for about 67% of total nutrients applied to rice but recovery is only 30-35%. Low nitrogen use efficiency in rainfed rice is mainly due to its leaching loss since the soil moisture conditions are not favourable for puddling. Hence, there is a need to improve the fertilizer use efficiency by adopting proper nitrogen management practice such as increasing number of split applications. Leaf colour chart (LCC) is a simple and inexpensive device developed by IRRI, Manila, Phillipines to determine the need for nitrogen application to rice (Furuya, 1987). It is an ideal tool to optimize N use, irrespective of source of N applied (Balasubramanian *et al.,* 1999).

A field experiment was conducted during kharif 2001 to study the effect of leaf colour chart (LCC) based nitrogen management in drill sown rainfed rice under upland conditions of north transitional zone of Karnataka. A rice variety "Amruth" was used as test crop. The soil at experimental site was a silty loam, non saline and medium in available nitrogen and phosphorus and high in potassium. The treatments included application of variable amount of fertilizer N (as urea) @ 10,20 and 30 kg ha^{-1}per application based on weekly and biweekly LCC observations at critical value of LCC-3. The first application of N based on LCC was made after 21 days of rice emergence and the last application during 13th week (reproductive phase). The treatments were compared with the recommended practice and farmers practice.

After harvest of the crop, Harvest Index was worked out using grain and straw yields with the help of formula given by Donald (1962).

$$\text{Harvest Index (\%)} = \frac{\text{Economic yield (qha}^{-1})}{\text{Biological yield (qha}^{-1})} \text{ X } 100$$

Partial factor productivity (PFP), an important indicator of fertiliser use efficiency was calculated using grain yield and amount of N applied

$$\text{Partial factor productivity (PFP)} = \frac{\text{Grain yield (kgha}^{-1})}{\text{N applied (kgha}^{-1})}$$

Application of LCC based nitrogen either @ 20 or 30 kg N ha^{-1} accounted for significantly higher grain yield than lower rate (10 kg N ha^{-1}) and the two controls *viz.,* recommended practice and farmers practice.

The straw yield in different treatments followed the same trend as that of grain yield except that the two controls also recorded significantly higher straw yields. The harvest index favourably increased with increasing N rates in LCC based nitrogen application. The highest harvest index (36.98%) was

Table. Grain yield, straw yield, harvest index and partial factor productivity under LCC based N management

Treatment details	Grain yield (q ha^{-1})	Straw yield (q ha^{-1})	Harvest index (%)	PFP
T_1: 10 kg N ha^{-1} based on weekly LCC observations	23.26^{d}	48.10^{b-d}	32.59^{cd}	33.23^{bc}
T_2 : 20 kg N ha^{-1} based on weekly LCC observations	28.36^{a}	49.46^{a-c}	36.45^{a}	35.21^{ab}
T_3: 30 kg N ha^{-1} based on weekly LCC observations	28.14^{a}	51. 48^{ab}	36.67^{a}	31.26^{c}
T_4: 10 kg N ha^{-1} based on biweekly LCC observations	18.13^{f}	45.48^{d}	28.50^{e}	36.24^{a}
T_5 : 20 kg N ha^{-1} based on biweekly LCC observations	28.57^{a}	52.49^{a}	35.24^{ab}	35.71^{a}
T_6 : 30 kg N ha^{-1} based on biweekly LCC observations	28.10^{a}	50.29^{ab}	35.86^{a}	31.22^{c}
T_7: T_1 with 20 kg N ha^{-1} as basal dose	27.32^{b}	50.98^{ab}	33.19^{c}	31.64^{c}
T_8: T_2 with 20 kg N ha^{-1} as basal dose	28.82^{a}	50.37^{ab}	36.39^{a}	28.82^{d}
T_9 : T_3 with 20 kg N ha^{-1} as basal dose	28.07^{a}	49.01^{a-c}	36.42^{a}	25.52^{e}
T_{10}: T_4 with 20 kg N ha^{-1} as basal dose	20.99^{e}	46.62^{cd}	31.07^{b}	34.98^{ab}
T_{11}: T_5 with 20 kg N ha^{-1} as basal dose	29.07^{a}	49.54^{a-c}	36.98^{a}	29.07^{d}
T_{12} : T_6 with 20 kg N ha^{-1} as basal dose	28.00^{a}	51. 19^{ab}	35.40^{a}	25.45^{e}
T_{13} : Recommended Dose of Nitrogen in three splits*	25.54^{c}	51.24^{ab}	33.28^{c}	25.54^{e}
T_{14}: Farmers practice in three splits**	26.02^{bc}	51.93^{a}	33.39^{bc}	26.03^{e}
LSD (5%)	1.56	3.21	1.86	1.99

In columns the means followed by same letter do not differ significantly by DMRT * at 21, 40, 60 days after rice emergence @ 33.3 kg N ha^{-1}

** at basal, active tillering and panicle initiation stage @ 20, 40 and 40 Kg N ha^{-1} respectively.

Note :No basal N was given for T_1, to T_6, while, 20 kg N ha^{-1} as basal dose was given to T_7 to T_{12} treatments.

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obtained when nitrogen was applied @ 20 kg N ha^{-1} basal dose plus LCC based N application at the same rate (T_{11}). The other treatments which received LCC based N at higher rate (20 or 30 kg N ha^{-1}) also recorded on far values with T_{11}. The recommended practice and farmers practice, though received a total of 100 kg N ha^{-1} accounted for significantly lower harvest index due to lower grain yield than LCC based N application at higher rates receiving the same amount. Application of LCC based N at lower rate (10kg ha^{-1}) (T_1,T_4 and T_{10}) showed comparatively lower harvest index due to lower grain yields than the other treatments indicating inadequacy of nitrogen to meet the crop demand.

The partial factor productivity (PFP) values were lower when either the total amount of N applied was more than 100 kg N ha^{-1} (T_9 and T_{12}) due to higher input cost on fertilizer or when the grain yields were low (T_{13} and T_{14}). However, the PFP was higher when a total of 100 kg N ha^{-1} was applied @ 20 kg N ha^{-1} based on LCC observations indicating better utilization of the applied nitrogen. This is in agreement with the findings of Panigrahi and Dixit (1991), Rachhpal *et al.* (1995) and Mahender Kumar *et al.* (2001). The highest PFP (36.24) was recorded when N was applied @ 10 kg N ha^{-1} at bi weekly LCC observations (T_4). This was due to reduced cost on fertilizer as the amount of total N applied was only 50 kg ha^{-1} rather than to the grain yield. The PFP in the treatment which received a total of 80 kg N ha-1 under LCC guidance @ of 20 kg N ha^{-1} (T_5) was higher and on par with PFP value in T4 besides accounting for higher grain yield. The two controls recorded lower PFP values due to higher input cost on fertilizer and lower yields.

Considering both the harvest index and partial factor productivity, application of LCC based nitrogen @ of 20 kg N ha^{-1} at biweekly observations appears to be a better method of nitrogen management in rainfed rice grown under upland conditions of north transitional zone of Karnataka.

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