Karnataka J. Agric. Sci.,20(2): (391-393) 2007

Yield and Economics of Leaf Colour Chart Based Nitrogen Management in Rainfed Rice*

Rice is a staple food crop of more than half of the world's population and majority of Asians. Rice is grown in both rainfed and irrigated conditions. Rainfed rice accounts for 55 per cent of total area under rice and 39 per cent of production in India (Anon., 1995).

The most common method of cultivating rice in rainfed area is by drill sowing and broad casting, besides transplanting in some low lying high rainfall areas. The cultivation and nutrient management practices of drill sown rice are quite different from those of transplanted rice. Vagaries of monsoon and inadequate and improper nutrient management are the main reasons for lower yields in drill sown rainfed rice as compared to transplanted rice. There is need for efficient nutrient management in rainfed rice in order to optimize yields. It is well known that among the three major plant nutrients, nitrogen (N) has a major role in productivity of rice since it is the most limiting nutrient in rice soils of India. The tendency to use excess and indiscriminate quantities of N fertilizer has resulted in environmental pollution and incidences of pests and diseases. There is need for scientific management of nitrogen, there by optimizing its use. Striking a the congruence between N demand and available N supply from soil and applied fertilizer N is an important strategy to increase N use efficiency using chlorophyll meter (SPAD - 502) and leaf colour chart (LCC).

LCC is a simple and inexpensive tool developed at IRRI, Manila, Phillipines to determine the need for N application in rice (Furuya, 1987). A field experiment was conducted during Kharif 2001 to determine the time and rate of N application to drill sown rainfed rice under upland conditions. 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 plot size was 3m X 3m and the design adopted was RBD. 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. The economics of LCC based N management was worked out taking into account the market value of the paddy and input costs.

The treatments which received nitrogen @ 20 kg N ha^{-1} (T_2, T_5, T_8 and T_{11}) or 30 kg N ha^{-1} (T_3, T_6, T_9 and T_{12}) each time based on LCC observations accounted for a significantly higher grain yield which could be attributed to suffIciency of N to meet the crop needs. The lower rate (10 kg N ha^{-1}) of LCC based N application (T_1, T_4, and T_{10}) gave signillcantly lower yields than others. This could be due to insuffIciency of N to meet crop requirement during its growth period.

The highest grain yield was recorded in T_{11} (29.07 q ha^{-1}) followed by T_8 (28.82 q ha^{-1}) both of which received 20 kg N ha^{-1} as basal dose plus LCC based N @ 20 kg ha^{-1}. The treatment which received a total of 80 kg N ha^{-1} under LCC guidance (T_5) also recorded grain yield on par with T_{11} & T_8 which had received a total of 100 kg N ha^{-1}. Thus there was saving of 20 kg N ha^{-1} without causing reduction in yield. The lowest grain yield of 18.13 q ha^{-1} was recorded in T_4 which received lower rate of N @ 10 kg N ha^{-1} at biweekly LCC observations. This could be due to insuffIciency of nitrogen to meet the crop demand. The grain yield in recommended practice, T_{13} (25.54 q ha^{-1}) was slightly lower but on par with the farmers practice, T_{14} (26.02 q ha^{-1}). Both the controls, accounted for significantly higher yield than yields due to lower rate of N application (T_1, T_4 and T_{10}) based on LCC reading. Although the two controls received 100 kg N ha^{-1}, the grain yield was signifIcantly lower than LCC based N application @ 20 or 30 kg N ha^{-1}. This was probably due to more vegetative growth and secondary tillers and less partitioning of biomass to the productive parts, due to less availability of N at grain filling phase of the crop in case of the two controls. The results are in agreement with the findings of Hussain *et al*. (2000), Kenchaiah *et al*. (2000), Singh *et al*. (2000) and Mahender Kumar *et al.* (2001). The straw yields in various treatments followed the same trend as that of grain yield.

The gross returns in all the treatments which received LCC based N at higher rate i.e. 20 or 30 kg N ha^{-1} was on par with each other and higher than the lower rate of N application (10 kg N ha^{-1}). The highest gross returns of Rs. 18,036 ha^{-1} was obtained when N was applied @ 20 kg N ha^{-1} basal plus LCC based N at the same rate (T_{11}) followed by T_8 (Rs. 18008) and T_3 (Rs. 17,811). It was attributed to the higher grain and straw yields obtained in these treatments. The gross returns in recommended practice (Rs. 16,617) and farmers practice (Rs. 16,902) which also received a total of 100 kg N ha^{-1} at fixed intervals was significantly lower than LCC based N application at a higher rate of 20 kg N ha^{-1}. This could be due to higher input cost of fertilizer and comparatively lower grain yields in case of the two controls.

The net returns in different treatments followed almost the same trend as that of gross returns. The highest net returns of Rs. 10,059 ha^{-1} was obtained when N was applied @ 20 kg N

*Part of M.Sc. (Agri) thesis submitted by the Senior outher to the University of Agricultural Sciences, Dharwad - 580 005, India.

ha^{-1} based on LCC readings with no basal N application (T_5). This was attributed to the reduction in the input cost of fertilizer due to saving of nitrogen by 20 per cent over the recommended dose. Saving of fertilizer N adopting LCC based N management has also been reported by several workers (Nguyen Nogoc De and Le Huu Hai, 1999; Hussain *et al.,* 2000; Kenchaiah *et al.,* 2000 and Mahender Kumar *et al.*, 2001). Both the controls had net returns on par with each other but were significantly lower than LCC based N @ 20 kg N ha^{-1} and higher than the lower rate of LCC based application. The benefit cost ratio (B:C ratio)was significantly higher in LCC based N treatments which received either @ 20 kg N ha^{-1} (T_2, T_5, T_8 and T_{11}) or 30 kg N ha^{-1} (T_3, T_9 and T_{12}) per application than those which received lower dose of N (10 kg ha^{-1} each time) (T_1, T_4 and T_{10}). The highest B : C ratio of 1.29 was recorded in LCC based N application @ 20 kg N ha^{-1} with no basal N application (T_5). Higher grain and straw yields accounting for higher returns and lower cost of cultivation due to saving of fertilizer N (up to 20 kg ha^{-1}), time and labour were probably responsible for highest B:C ratio in this treatment. The other treatments which received a total of 80 - 100 kg N ha^{-1} based on LCC readings (T_2, T_3, T_6, T_8 and T_{11}) recorded B : C ratio on par with each other. The lowest B : C ratio of 0.64 was recorded in the treatment which received LCC based N at 10 kg N ha^{-1} (T_4). Though the cost of input in this treatment was lowest as compared to other treatments but inadequacy of applied N to meet the crop requirement resulted in lowest grain and straw yield which in turn accounted for the lowest gross returns and net retums and hence the lowest B : C ratio. The B : C ratios of two controls (T_{13} and T_{14}) were on par with each other but significantly lower than LCC based N application @ 20 kg N ha^{-1}. Narasimman *et al.* (1990) also observed that chlorophyll chart based N application recorded the highest grain yield as well as B : C ratio. Considering grain yield, net retums and saving of fertilizer N, application of nitrogen @ 20 kg N ha^{-1} based on biweekly LCC observations appeared to be a better and economical method of nitrogen management in rainfed rice.

Table. Yield, Returns and Economics of rice as influenced by N management adopting LcC method

Treatment	Grain yield (q ha^{-1})	Straw yield (q ha^{-1})	Gross returns (Rs. ha^{-1})	Net returns (Rs. ha^{-1})	B:C ratio
T_1: 10 kg N ha^{-1} based on weekly LCC observations	23.26^{d}	48.10^{b-d}	15277^{e}	7249^{e}	0.93^{d}
T_2 : 20 kg N ha^{-1} based on weekly LCC observations	28.36^{a}	49.46^{a-c}	17706^{ab}	9260^{a}	1. 24^{ab}
T_3: 30 kg N ha^{-1} based on weekly LCC observations	28.14^{a}	51. 48^{ab}	17811^{a}	9285^{a}	1. 19^{ab}
T_4: 10 kg N ha^{-1} based on biweekly LCC observations	18.13^{f}	45.48^{d}	12706^{g}	4957^{g}	0.64^{f}
T_5: 20 kg N ha^{-1} based on biweekly LCC observations	28.57^{a}	52.49^{a}	18106^{a}	10059^{a}	1.29^{a}
T_6: 30 kg N ha^{-1} based on biweekly LCC observations	28.10^{a}	50.29^{ab}	17674^{ab}	9548^{ab}	1. 22^{ab}
T_7: T_1 with 20 kg N ha^{-1} as basal dose	27.32^{b}	50.98^{ab}	16490^{d}	8444^{d}	1.08^{c}
T_8: T_2 with 20 kg N ha^{-1} as basal dose	28.82^{a}	50.37^{ab}	18008^{a}	9713^{a}	1. 25^{ab}
T_9 : T_3 with 20 kg N ha^{-1} as basal dose	28.07^{a}	49.01^{a-c}	17353^{a-c}	9159^{a-d}	1.17^{bc}
T_{10}: T_4 with 20 kg N ha^{-1} as basal dose	20.99^{e}	46.62^{cd}	14107^{f}	6091^{f}	0.78^{e}
T_{11}: T_5 with 20 kg N ha^{-1} as basal dose	29.07^{a}	49.54^{a-c}	18036^{a}	9741^{b-d}	1. 25^{ab}
T_{12} : T_6 with 20 kg N ha^{-1} as basal dose	28.00^{a}	51. 19^{ab}	17719^{ab}	9345^{a-c}	1.19^{bc}
T_{13}: Recommended Dose of Nitrogen in three splits*	25.54^{c}	51.24^{ab}	16617^{cd}	8382^{d}	1.07^{c}
T_{14}: Farmers practice in three splits**	26.02^{bc}	51.93^{a}	16902^{b-d}	8667^{cd}	1.11^{c}
LSD (5%)	1.56	3.21	794.20	794.20	0.09

In columns, the means followed by same letter do not differ significantly 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.

Department of Soil Science and Agriculture Chemistry
University of Agricultural Sciences
Dharwad – 580 005

T. JAYANTHI
S. K. GALI
V. P. CHIMMAD
V. V. ANGADI

(Received: July, 2006)

References

ANONYMOUS, 1995, Supplementing nutrients through organics. In: *Annual Report*, 1994-95. Agricultural Research Station, Sankeshwar, University of Agricultural Sciences, Dharwad.

FURUYA, S., 1987, Growth diagnosis of rice plants by means of leaf colour. *Japanese Agricultural Researh Quarterly*, **20** : 147 - 153.

HUSSAIN, F., BRONSON, K.F., YADVINDER SINGH, BIJAY SINGH AND PENGS, S., 2000, Use of chlorophyll meter sufficiency indices for nitrogen management of irrigated rice in Asia. *Agronomy Journal,* **92** : 875-879.

KENCHAIAH, K., VEERANNA, H. K AND DEVARAJU, K. M., 2000, LCC and SPAD based N management under different method of sowing in rice. In: *Abstracts of the 3rd CREMNET Workshop cum meeting in direct seeding and seeders in Rice,* Mysore, 18-19 August, 2000, p.9.

MAHENDER KUMAR, R., SUBBAIAH, S.V., PADMAJA, K., SINGH, S.P. AND BALASUBRAMANIAN, V., 2001, Nitrogen management through soil and plant analysis development and leaf colour chart in different groups of rice (*Oryza sativa*) varieties grown on vertisols of Deccan plateau. *Indian Journal of Agronomy*, **46** : 81-88.

NARASIMMAN, R., ROLLIN BASKAR, P. AND SATHIYA SEELAN, R., 1990, Effect of CRN urea, prilled urea, chlorophyll meter / chart on rice yield. *Paper presented at 2nd CREMNET workshop cum group meeting*, Thanjavur, 24-27 August, 1999, pp. 124-125.

NGUYEN NOGOC DE AND LE HUU HAl, 1999, Leaf colour chart as a farmers guide for N management in direct seeded rice in the Mekong Delta of Vietnam. *Paper presented at 2nd CREMNET Workshop cum group meeting*, Thanjavur, 24-27 August, 1999, pp. 67-72.

SINGH, S. P., SUBBAIAH, S. V. AND KUMAR, R. M., 2000, Nitrogen management under direct seed rice in puddle conditions. In: *Abstracts of the 3rd CREMNET India Workshop cum meeting on direct seedling and seeders in rice,* Mysore, 18-19 August, 2000, p. 8.