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Effect of customized leaf colour chart and different doses of Neem coated urea on the nitrogen use efficiency and yield of rice

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Abstract
Need based application of neem coated urea can enhance the nitrogen use efficiency as neem (Azadirachta indica) has nitrification inhibiting properties. A field study was performedat institute research farm of ICAR-NRRI Cuttack (Odisha) during the Kharif season, 2017 to evaluate the effect of customized leaf colour chart and different doses of neem coated urea on the nitrogen use efficiency and yield of rice. Along with a no-N control, NCU tried at three N levels-50, 75 and 100% of the recommended level of 80 kg N ha -1. Different doses of N were applied based on conventional approach in three split doses i.e. 50% at transplanting and 25% both at maximum tillering and panicle initiation stage in three treatments and for need based site specific N management (SSNM) and to improve N use efficiency, different doses of NCU was applied in three treatments using customized leaf colour chart (CLCC) in three equal splits i.e. 33% at transplanting and whenever N was deficient according to CLCC observations. In one treatment ordinary urea was applied at 100% of its recommended dose in conventional approach. Naveen variety of rice as test crop was transplanted on 5th August 2017 and harvested on 13thNovember 2017. From all the analysis it was found that application of NCU based on CLCC recorded higher yield i.e. by 7.74% as compared to NCU applied conventionally and 75% recommended dose of nitrogen in form of NCU based on CLCC recorded the highest N recovery efficiency (RE N) (49.62%). Based on this results it can be stated that 25% N can be saved in comparison to 100 % of its recommended dose.

Keywords: Neem coated urea, CLCC, need based application, SSNM

Introduction
Rice (*Oryza sativa* L.) serves as the most important staple food on this planet since it is not only a grain, it is a life for more than 50 per cent of the global population. Nitrogen increases the vigour and enhances the growth of the rice plant. The major prerequisite to secure a certain target yield is the adequate number of grains per unit land area. There is a close relationship between the number of grain per unit land area and the amount of nitrogen absorbed by rice plants. It requires N during different crop growth stages of such as vegetative stage to promote growth and tillering, which determines the potential number of panicles (Mae, 1997) [4]. Use of Customized Leaf Colour Chart brings about 10% to 15% increased in yield in comparison to conventional method. Neem coated urea (NCU) applied on the basis of CLCC reading enhanced N uptake by ensuring better synchrony between supply and demand and hence improved yield (Alam *et al*., 2005) [1]. Nitrogen use efficiency and fertility status of soil can be enhanced by reducing the release rate of N from the fertilizer and application of fertilizer in right time according to the plant demand. Nitrification inhibiting property of neem and its role in increasing urea N use efficiency in rice was first reported in early 1970s by Bains *et al*. (1971) [2]. Application of NCU based on CLCC will further enhance the efficiency.

Methodology
A field experiment was conducted at the research farm of the ICAR - National Rice Research Institute, Cuttack, India during *Kharif* season, 2017 with the application of neem coated urea in combination with customized leaf colour chart on rice which was comprised of eight treatments and were replicated thrice. Treatments comprised of T1: control with no nitrogen applied; T2: 100% RDN (Recommended dose of N) as NCU in conventional method; T3: 75% RDN as NCU in conventional method; T4: 50% RDN as NCU in conventional method; T5: 100% RDN as NCU with CLCC recommendation; T6: 75% RDN as NCU with CLCC

recommendation; T7: 50% RDN as NCU with CLCC recommendation; T8: 100% RDN as prilled urea (PU) in conventional method. Rice variety "Naveen" was taken as test crop which was transplanted in the field on 5th August 2017 and harvested on 13th November 2017. The soil texture of the field was categorized as sandy clay loam with pH 6.23 and EC 0.19 dsm^{-1}. Recommended dose of fertilizer, i.e. 80-40-40 kg N-P_20_5-K_20 was applied to both treatments of rice.

Data on different growth parameters, yield components and yield were recorded. Plant samples were collected at different growth stages of the crop. The above ground plant parts were segmented into different components as leaf, stem and panicle. The partitioned plant parts were then dried in an oven at 70 ˚C for 72 hours and weighed. For determination of yield attributes, five hills were selected and number of tiller per hill, number of filled and unfilled grains per panicle and thousand grain weights was measured. The crop was harvested from an area of 1 m^2 leaving two rows to avoid border effect. The harvested yield was converted into $t{\cdot}ha^{-1}$ at 14% moisture content. Nitrogen use efficiency (NUE) was derived according to Miyoshi (1991) [5]. All collected data were subjected to SAS (version 9.2 English) software package to perform analysis of variance (ANOVA) and arithmetic means of the treatments were compared by employing least significant difference (LSD) test.

Results and Discussion

Application of 100% RDN based on CLCC recorded notable performance in most of the yield attributing characters such as number of panicles m^{-2}, panicle length, number of grains $panicle^{-1}$and number of filled grains $panicle^{-1}$. This was mainly due to higher photosynthetic efficiency and net assimilation which helped in increasing the overall growth of the plant. These findings are in agreement with Prasad *et al*. (1999) [6], Suresh *et al.* (1999) [8]. Split application of NCU at panicle initiation stage maintained good supply of NH_4^+-N up to the flowering stage which might have resulted in better yield attributes as reported by Sannigrahi and Nayak (2000) [7]. It also recorded the highest yield (4.59 t ha^{-1}) among all the treatments and increases the yield by 7.74% as compared to NCU applied conventionally and 12.5% as compared to PU applied conventionally. It was probably due to better growth and development of the crop due to synchronization of demand and supply which increase uptake of nutrients and better nourishment of the grains resulting in size of grain, which ultimately increased number of grains per panicle and better grain yield (Banerajee and Pal, 2011). N recovery efficiency (RE_N) was observed higher under CLCC based NCU application than that under conventional method and 75% RDN in form of NCU based on CLCC (T6) recorded the highest (49.62%). It also recorded statistically *at par* result incase of grain yield with 100 % RDN as NCU (T2) and PU (T8) applied conventionally.

Table 1: Effect of different nitrogen management practices on yield and nitrogen recovery efficiency of rice

Treatment	No of panicles m^{-2}	panicle length (cm)	No of grains per panicle	No of filled grains	Test weight	Grain yield (t ha^{-1})	Biomass yield at harvest (t ha^{-1})	RE_N (%)
T1	171.6c	14.87c	110.67d	94.78c	22.7a	2.73d	6.65d	-
T2	210.1a	25.47a	125.56a	111.33a	24.8a	4.26b	9.35b	42.25b
T3	209a	23.52a	122.78ab	107.33ab	24.7a	3.98b	9.08b	43.28ab
T4	192.5b	21.48ab	117.44c	104b	25.3a	3.10c	7.50c	46.44ab
T5	211.2a	23.97a	122.56ab	110.22a	23.7a	4.59a	10.09a	45.11ab
T6	210.1a	21.12ab	121.33cab	107.89ab	24.2a	4.17b	9.48ab	49.62a
T7	190.3b	18.67cb	119.33cb	104.33b	24.6a	3.24c	7.08c	48.61ab
T8	209a	22.37ab	123.78ab	110.22a	24.8a	4.08b	8.99b	33.81c
L.S.D (P<0.05)	11.05	4.26	4.52	3.88	NS	0.281	0.67	6.64

(The treatment having different alphabets in a column indicate significant difference between the treatment means) (*Note*: T1-N0 (control); T2-N80 kg ha^{-1}; T3-N60 kg ha^{-1}; T4-N40 kg ha^{-1}; T5-N80 kg ha^{-1} (LCC); T6-N60 kg ha^{-1} (LCC); T7-N40 kg ha^{-1} (LCC); T8-N80 kg ha^{-1}(PU))

Conclusion

It can be concluded from the results under study that CLCC based application of NCU performed better in terms of higher rice yield, N uptake, yield attributing character (number of panicle, panicle length, number of grain per panicle, number of filled grains per panicle and test weight) and higher N recovery efficiency.

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