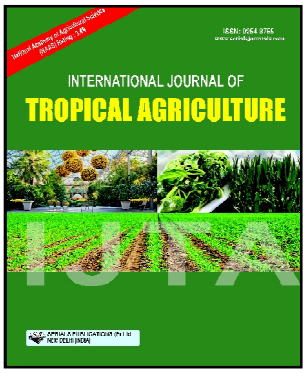

INTERNATIONAL JOURNAL OF TROPICAL AGRICULTURE

ISSN : 0254-8755

available at http: www.serialsjournals.com

Volume 36 • Number 1 • 2018

Effect of N applied through neem coated and ordinary urea on the yield and N use efficiency of transplanted rice

R. K. Gupta[a], Varinderpal Singh[a], Onkar Singh[b], R. Sikka[a], Amrit Paul Singh Brar[c], Gurpreet Kaur Gill[d] and Gulshan Mahajan[d]

[a] *Department of Soil Science, Punjab Agricultural University, Ludhiana*
[b] *Regional Research Station, Kapurthala*
[c] *Department of Agronomy, Punjab Agricultural University, Ludhiana*
[d] *Department of Plant Breeding and Genetics, Punjab Agricultural University, Ludhiana*

INTRODUCTION

Of all the nutrients required by crops, nitrogen is the one most often deficient in soils, applied in greater quantities and is subjected to losses in rice compared with other cereals grown under upland conditions. When urea is applied to the soil, it is transformed into other N forms, of which some are susceptible to loss and therefore lead to reduced availability of N to crop plants. In the first step hydrolysis of urea by urease enzyme takes place which rapidly converts amide-N to ammonium-N and in the second step nitrification is brought about by nitrifying bacteria that converts ammonium-N to nitrate-N. Ammonium-N is susceptible to loss via ammonia volatilization or nitrate-N can escape soil-plant system through leaching below the rooting zone and also in gaseous forms via denitrification (Cassman *et al* 1998; Buresh *et al* 2008) leading to reduced fertilizer N use efficiency. Use efficiency of urea-N by different crops is as low as 20% and it rarely exceeds 50%. In highly permeable alkaline soils of Punjab, alternating aerobic and anaerobic soil conditions under rice, the applied N is readily converted to NO_3^-, which is prone to losses via leaching and nitrification-denitrification (Aulakh and Bijay Singh 1997; Bijay Singh *et al* 2002). Improving efficiency of fertilizer N use is vital to sustain high crop yields and achieve high NUE. Appropriate modification in fertilizer source or management practices can help in reducing N losses and increasing N use efficiency. Neem coated urea (NCU) contains nitrification inhibition properties and thereby delays the bacterial oxidation of ammonium –N by depressing the activity of the nitrosomonas bacteria in the soil. This helps in controlling the loss of nitrate by leaching and or denitrification from the top soil

by keeping nitrogen in the ammonium form longer and thereby increasing the N use efficiency and yield of crops. Keeping this in view, studies were conducted on neem coated urea vs ordinary urea at Ludhiana and Kapurthala.

EXPERIMENTAL DETAILS

Field experiments were conducted during kharif 2016 at research farm, department of Soil Science Ludhiana, RRS Kapurthala and at research farm, department of Plant Breeding and Genetics Ludhiana. Another experiment was conducted in kharif 2017 at research farm, the department of Agronomy.

Table 1
Physical and chemical properties of the experimental sites

Soil characteristics	*Ludhiana*	*Kapurthala*
Texture	Loamy sand	Loam
pH	7.3	8.4
EC(dS m^{-1})	0.11	0.17
OC (%)	0.48	0.45
Available P (kg/ha)	44.5	8.75
Available K (kg/ha)	150	350

The physico-chemical properties of the two sites are given in Table 1. The experiment was laid out in a split-plot design with sources of nitrogen in the main plots (ordinary urea and neem coated urea).The sub plots consisted of 3 levels of nitrogen ie control, 100 kg N and 120 kg N applied in three equal splits at transplanting, 3 weeks and 6 weeks after transplanting. The treatments were replicated thrice with a plot size of 10 × 2.2 m^2.

RESULTS

Ludhiana site

Grain yield: The grain yield of rice obtained with 100 kg N $ha^{-1}$was statistically similar as compared to that with 120 kg N. Application of 100 and 120 kg N through neem coated urea resulted in 8.4 and 11.2 % increase in yield over the similar application made through ordinary urea (Table 2).

N uptake by rice grain: Comparing the two sources, it was found that N uptake through neem coated urea by rice grain was significantly higher as compared to its uptake through ordinary urea. The N uptake by rice increased significantly at all the three levels of N application. However, uptake of N by rice through neem coated urea over ordinary urea was 23.4 and 14.6 per cent higher with the application of 100 and 120 kg N ha^{-1}, respectively (Table 2).

Table 2
Grain yield, N uptake and N use efficiency of rice at Ludhiana under different sources of nitrogen application during kharif 2016

Treatments		*Grain yield (t/ha)*				*Grain N uptake (kg/ha)*			*AE (kg grain/ kg N)*	
	Total N applied (kg / ha)	*Urea*	*NCU*	*Mean*	*Increase in yield over urea (%)*	*Urea*	*NCU*	*Mean*	*Urea*	*NCU*
T1	0	4.63	4.66	4.65	-	41.4	45.4	43.2		
T2	100	6.49	7.22	6.86	8.36	70.8	87.4	79.1	18.6	25.6
T3	120	6.93	7.51	7.22	11.20	88.7	101.7	95.2	19.2	23.7
Mean		6.02	6.46			67.0	78.2			
LSD (0.05): Sources-NS, Treatments-0.799, Interaction-NS						Sources-8.39, Treatments-8.71, Interaction-NS				

Agronomic efficiency: Similarly grains produced per kg N (AE) through neem coated urea over ordinary urea were also considerably higher at each level of N application (Table 2).

Kapurthala site: Neem coated urea out performed ordinary urea. Application of 100 and 120 kg N through neem coated urea resulted in 13.4 and 20.2 % increase in yield over the similar application made through ordinary urea. Application of 100 kg N through neem coated urea produced significantly higher grain yield of rice as compared with either 100 or 120 kg N application through ordinary urea (Table 3).

N uptake by rice grain: Perusal of the data given in table 3 indicates that N uptake by rice grain was significantly higher in the plots receiving neem coated urea over ordinary urea. The N uptake by rice increased significantly at all the three levels of N application. However, uptake of N by rice through neem coated urea over ordinary urea was 31.0 and 16.7 per cent higher with the application of 100 and 120 kg N ha^{-1}, respectively (Table 3).

Agronomic efficiency: At this site also, grains produced per kg N (AE) through neem coated urea over ordinary urea was almost double at each level of N application (Table 3).

Table 3
Grain yield, N uptake and N use efficiency of rice at Kapurthala under different sources of nitrogen application during kharif 2016.

Treatments		*Grain yield (t/ha)*				*N uptake (kg/ha)*			*AE(kg grain/ kg N)*	
	Total Napplied (kg / ha)	*Urea*	*NCU*	*Mean*	*Increase in yield over urea(%)*	*Urea*	*NCU*	*Mean*	*Urea*	*NCU*
T1	0	5.53	5.60	5.57	-	50.2	54.4	52.3		
T2	100	6.43	7.73	7.08	13.4	73.8	96.7	85.3	9.0	21.3
T3	120	6.83	7.75	7.29	20.2	90.5	105.6	98.0	10.8	17.9
Mean		6.27	7.02			71.5	85.6			
LSD (0.05): Sources-0.698, Treatments-0.53, Interaction-NS						Sources-11.4, Treatments-8.34, Interaction-NS				

Results of the experiment conducted at research farm, department of Plant breeding and Genetics, Ludhiana

The data given in table 4 indicated that grain yield of rice obtained with the application of 75% of the recommended dose (90 kg N ha^{-1}) through NCU produced statistically similar yields as that obtained with the application of 100% recommended dose of N (120 kg ha^{-1}) through ordinary urea suggesting that 30 kg N ha^{-1} can be saved if N is applied through NCU.

Table 4
Efficiency of neem coated urea vs ordinary urea in transplanted paddy during kharif 2016

Treatments N(kg/ha)	*Grain yield (t/ha)*	*AE(kg grain/ kg N)*
Control	5.05	-
120 -urea	6.37	11.0
90-NCU	6.67	18.0
120-NCU	6.19	9.5
LSD (0.05)	0.96	

Results of the experiment conducted at research farm, department of Agronomy, Ludhiana

The data given in table 5 indicated that grain yield of rice obtained with the application of 100 kg NCU (115 kg N ha^{-1}) were similar to that as obtained with the application of 110 kg ordinary urea (126.5 kg N ha^{-1}). Otherwise also application of N at the rate of 115, 126.5 and 138 kg ha^{-1} through NCU resulted in 8.17, 6.28 and 6.67 per cent higher yields over similar doses through ordinary urea.

Table 5
Efficiency of neem coated urea vs ordinary urea in transplanted paddy during kharif 2017

Treatments	*Grain yield (t/ha)*		*Increase in yield (%)*
N applied (kg/ha)	*Ordinary urea*	*NCU*	
115.0	54.4	58.9	8.17
126.5	59.3	63.0	6.28
138.0	60.7	64.7	6.67

CONCLUSIONS

Application of 100 kg N ha^{-1} through NCU can produce similar yields as that obtained with 120 kg N through ordinary urea. Application of N through NCU will help in increasing the N use efficiency by reducing the consumption of nitrogenous fertilizers. This will help in reducing the nitrogen losses through leaching or as gaseous nitrogen, thereby saving groundwater from pollution and cleaner environment. Further, if not to lower the fertilizer application rates, even then it may help realizing more yields. An increase of 10 to 15 % increase in grain yield of rice is likely to increase the income of the farmers considerably.

REFERENCES

Aulakh M S and Bijay-Singh (1997). Nitrogen losses and N-use efficiency in porous soils. *Nutr Cycling Agrosyst* **47**: 197-212.

Bijay-Singh, Yadwinder Singh, Ladha J K, Bronson K F, Ballasubramanian V, Singh J and Khind C S (2002). Chlorophyll chart and leaf colour chart based nitrogen management for rice and wheat in north western India. *Agron J* **94**: 821-29.

Buresh R J, Reddy K R and Kessel C van (2008). Nitrogen transformations in submerged soils.In: Nitrogen in Agricultural Systems, Agronomy monograph 49, *Am Soc Agro,* Madison, WI, USA 401–36.

Cassman K G, Peng S, Olk D C, Ladha J K, Reichardt W, Dobermann A and Singh U (1998). Opportunities for increased nitrogen-use efficiency from improved resource management in irrigated rice systems. *Field Crops Res* **56**: 7–39.