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EFFECT OF MODIFIED UREA ON GROWTH, YIELD AND ECONOMICS OF TRANSPLANTED RICE

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ABSTRACT

A field experiment was conducted at Instructional farm of Narendra Deva University of Agriculture and Technology, Kumarganj, Faizabad during Kharif season of 2012 and 2013 to study the effect of modified urea on nitrogen use efficiency, growth, yield and economics of transplanted rice (Oryza sativa L.) cultivar NDR-359. Seven treatments viz. Control, split application of urea, sulphur coated, neem coated, coaltar coated, FYM mixed (1:5) and clay mixed (1:10) urea were replicated thrice in randomized block design. Results revealed that neem coated urea was found most effective in increasing growth, yield attributes, grain yield (58.50 qha^{-1}), net return (₹.66042 ha^{-1}) and B:C ratio (2:1) of rice over other treatments. The neem coated urea also recorded highest available N, P and K in soil after harvest of crop as well as N uptake by crop, N use efficiency and N utilization efficiency. Thus, neem coated urea proved most effective for rice cultivation. Lowest values of these characters were recorded under control.

Keywords: Modified urea, growth, economics, yield, rice

INTRODUCTION

Rice (*Oryzasativa* L.) is the most important staple food crop in the World. Rice is the rich source of energy and contains reasonable amount of protein (6-10%), carbohydrate (70-80%), mineral (1.2-2.0 %) and vitamin (Riboflavin, Thiamine Niacin and Vitamin E). India alone produces nearly one fourth (22%) of the total rice in the world.Globally, it rank 1st in respect of area (45.35 ha) and second in production (95.32 million tons). Uttar Pradesh is second largest rice growing state after West Bengal in the country. The area and production of rice in the state is about 13.84 mha and 14.00 mt, respectively with productivity of 2358 kgha^{-1} (Anonymous, 2014). Among major nutrients, nitrogen is one of the most important nutrients. The major source of nitrogen is urea. Modification of urea has been experimented extensively in India to increase its use efficiency by rice crop. Neem cake and elemental sulphur has been used extensively as coating material for modifying urea fertilizer (Purakayastha *et al.,* 2006). Neem coated and sulphur coated urea are more effective than normal (prilled) urea in increasing nitrogen use efficiency in transplanted rice. The experiment conducted at Ludhiana (Punjab) showed that the application of N through NCU and prilled urea increased the rice yield significantly with increasing levels of N at both the locations. The application of NCU at recommended rate (120 kg N ha^{-1}) produced significantly higher rice grain yield than the yield obtained with ordinary urea at PAU, Ludhiana, Punjab (Thind *et al.,* 2010) However, the major disadvantage of urea its high solubility in water, and is very much susceptible to nitrogen loss through various pathways like leaching, ammonia volatilization happen to be the dominant loss mechanism because of conventional methods of fertilizer application (wet soil surface broad casting) and farmers encourage it. Keeping these facts in view, the present investigation was aimed to study the effect of modified urea on nutrient use efficiency, yield contributing characteristics, yield and economics of transplanted rice.

MATERIALS AND METHODS

The field experiment was conducted during rainy (*Kharif*) seasons of 2012 and 2013 at the Instructional farm of Narendra Deva University of Agriculture and Technology, Kumarganj, Faizabad. The experimental site falls under subtropical zone in Indo-Gangetic plains and lies between 24.4^0 -26.56^0 north latitude and 82.12^0- 83.98^0 east longitude with in elevation of about 113m from mean sea level. The soil was silty loam in texture, alkaline in reaction (pH 8.7), low in organic carbon (3.9 g kg^{-1}), Available N, P and K were 190, 14 and 237 kgha^{-1}, respectively. The seven treatments *viz.* T_1 control, T_2 100% N as fertilizer, T_3 75% N as fertilizer + 25% N as FYM, T_4 75% N as fertilizer + 25% N as green manure (Sesbania), T_5 50% N as fertilizer + 25% N as FYM+25% N as green manuring, T_6 50% N as fertilizer + 50% N as FYM and T_7 100% N as FYM were tested in randomized block design with three replicate rows. The rice seedlings were transplanted at spacing of row to row 20 and plant to plant 10 cm. Recommended dose of fertilizer was applied @ NPK 150:60:60 kg ha^{-1}. The rice variety NDR-359 was taken as a test crop. The coated urea materials were prepared in the laboratory by following methods of Prakash *et al.* (1980). The total quantity of coated urea materials were applied as per treatments to the soils before seedlings transplanting. Clay mixed urea was placed at 8-10 cm depth after 7 days of

transplanting @ one per hill per four hills. Remaining ½ quantity of urea split urea was applied in two equal splits at tillering and panicle initiation. Uniform doses of P_2O_5 and K_2O were applied as basal before transplanting. Soil samples collected before and after harvest of the crop from each experimental plot to a depth of 15 cm were analyzed for organic carbon, available N by alkaline $KMnO_4$ method (Subbiah and Asija 1956), available P **(**Olsen *et al.* 1954) and available K by flame photometer (Jackson 1973). The nitrogen use efficiency and utilization efficiency were also calculated. Economics was calculated on the basis of prevailing market prices of inputs and output.

RESULTS AND DISCUSSION

Growth, yield attributes and yield

The data (Table 1) indicated that the modified forms of urea followed by prilled urea significantly increased the plant height, number of tillers m^{-2}, number of panicles $hill^{-1}$, number of grains $panicle^{-1}$ and test weight and finally grain and straw yield of transplanted rice over control. The maximum plant height (107.5 cm), number of tillers m^{-2} (382.5), number of panicles $hill^{-1}$ (7.3), number of grains $panicle^{-1}$ (116), test weight (29.50 g), grain (58.50) and straw yield (87.50 q ha^{-1}) were recorded with neem cake coated urea followed by sulphur coated urea. The superiority of neem cake coated urea (NCU) and sulphur coated urea (SCU) in general, over prilled urea accounted for slow release of nitrogen which synchronized the nitrogen as need for growing the plants. Nitrogen released slowly, which is absorbed and utilized by the plants and loss of the nitrogen, is retarded thereby. The neem cake coated urea maintained prominence over other coated materials due to its nitrification inhibiting characters Barati *et al.* (2006), which suppressed nitrification rate of urea and leaching loss of nitrogen. Neem cake and sulphur have acidic properties which also inhibit the loss of ammonia volatilization through reducing alkalinity of the soil medium. Because of this, nitrogen absorption and its subsequent utilization in plants with neem cake coated urea resulted in to higher growth, yield of transplanted rice over prilled urea and other slow release modified urea fertilizers (Thind *et al.* 2010).

Table 1: Effect of modified urea fertilizers on growth, yield attributes and yield of rice (mean data of 2 years)

Treatment	Plant height (cm)	Tillers m^{-2}	Panicles $hill^{-1}$	Grains $panicle^{-1}$	Test weight (g)	Yield (qha^{-1})		Harvest Index (%)
						Grain	Straw	
Control	82.8	193.5	3.8	99.0	25.90	34.70	45.20	43.43
Urea split (1/2, ¼, ¼ RDF)	102.4	351.0	6.8	111.0	27.80	53.20	82.40	39.25
Sulphur coated urea	104.3	369.0	7.1	113.0	29.70	56.70	85.90	39.83
Neem coated urea	107.5	382.5	7.3	116.0	29.50	58.50	87.50	40.14
Coaltarcoated urea	92.5	270.0	5.4	109.0	26.20	45.50	68.50	39.94
FYM mixed (1:5)	97.2	306.0	6.2	106.0	27.70	48.70	74.40	39.60
Clay mixed urea (1:10)	95.1	274.5	5.8	103.0	26.50	47.10	72.80	39.28
SEm±	3.55	13.64	0.27	3.15	0.67	1.77	3.23	1.59
CD at 5%	10.95	42.05	0.83	9.71	NS	5.47	9.95	4.90

Efficiency of modified urea

The data (Table 2) revealed that the nitrogen use efficiency of modified urea and prilled urea applied in splits (normal urea application in splits) ranged between 7.20 and 15.86 kg grain produced kg^{-1} nitrogen applied and Nitrogen utilization efficiency ranged from 19.45 to 58.71 %. The higher N use efficiency (15.86 kg grain kg^{-1} N) was noticed with application of neem coated urea followed by sulphur coated urea and normal urea applied in splits respectively, which may be due to regulated release of nitrogen by inhibiting the nitrification in medium textured soil. Whereas, lower efficiency of nitrogen through coaltar coated urea (7.20) and clay coated urea (mud mixed urea) (8.26 kg grain kg^{-1} N) and higher neemcake coated urea and elemental sulphur coated urea followed by splits application of normal urea. These results are corroborated with the findings of Mishra and Lal (1994) and Osman *et al.* (2004).

Soil fertility

The organic carbon (Table 2) content slightly increased in all modified and split urea application over control. The maximum organic carbon (4.2 g kg^{-1}) was recorded with the application of FYM mixed urea followed by neem coated urea (4.0 g kg^{-1}) and sulphur coated urea (4.0 g kg^{-1}) which was significantly superior over the control. Neem coated urea, maintained maximum amount of available nitrogen (210.5), phosphorus (17.0) and potassium (255.4 kg ha^{-1}) in post harvest soils This may owing to organic nature and nitrification inhibiting property and acidic behavior of neem cake which helped in maintaining higher amount organic carbon, and available nitrogen, phosphorus and potassium in soil. The similar finding was also reported by Suganya *et al.* (2009).

Table 2: Nitrogen Efficiency, uptake, economics and soil fertility affected by the different treatments (mean of 2 years)

Treatment	N uptake (kg ha^{-1})	N use efficiency (kg grain kg^{-1})	N utilization efficiency (%)	Total cost of cultivation (₹ha^{-1})	Gross return (₹ha^{-1})	Net return (₹ha^{-1})	Benefit cost ratio	Org. carbon (g kg^{-1})	Avail. nutrients (kg ha^{-1})		
									N	P	K
Control	50.5	-	-	29510	56935	25577	0.86	3.6	181.7	15.2	235.0
Urea split (1/2, ¼, ¼ RDF)	125.4	12.3	49.92	30833	91220	58087	1.88	3.9	204.6	16.6	240.2
Sulphur coated urea	136.6	15.3	57.39	32085	96445	63362	1.80	4.0	207.4	16.8	251.7
Neem coated urea	138.6	15.8	58.71	32388	99375	66042	2.00	4.1	210.5	17.0	255.4
Coaltarcoated urea	79.7	7.20	19.45	30933	77425	44192	1.42	3.7	203.4	16.3	238.1
FYM mixed (1:5)	98.5	9.32	32.01	31730	83195	49165	1.54	4.2	202.1	16.5	239.6
Clay mixed urea (1:10)	90.7	8.26	26.78	32193	80715	46222	1.43	0.39	200.3	16.1	236.5
SEm±	4.58	-	-	-	-	-	-	0.01	4.9	0.4	5.8
CD at 5%	13.53	-	-	-	-	-	-	0.03	15.2	1.3	18.0

Economics

The data presented (Table 2) revealed that the maximum gross return (₹. 99375) and net return (₹. 66042 ha^{-1}) were obtained with the application of neem coated followed by sulphur coated urea. It is due more net profit than the cost of cultivation involved with this treatment. The sulphur coated were proved the second best in net return (₹. 63362 ha^{-1}). The cost –benefit ratio was also maximum with neem cake (2:1) followed by prilled urea (1.88). The benefit cost ratio with prilled urea found higher over sulphur coated (1.80). These reduction of benefit cost ratio with sulphur cooted urea over prilled urea may be due increasing the cost of sulphur and maximum with neem cake due to more favorable behavior in production of rice. These results were also corroborated with the findings of Bazaya *et al.* (2008).

From the present investigation, it may be concluded that neem coated urea was found best followed by split application of prilled urea for increasing yield, higher N use efficiency, utilization efficiency, productivity and profitability of rice. Thus, the use of neemcake may be recommended for coating of urea in transplanted rice.

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