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EFFECTIVENESS OF PRILLED UREA AND UREA SUPER GRANULE ON RICE PRODUCTION IN THE EASTERN SURMA KUSHIYARA FLOODPLAIN SOILS

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Abstract

The experiment was conducted at the farmer's field Alampur, Sylhet to investgate the effect of prilled urea (PU) and urea super granule (USG) on rice during transplanted aman season. Three doses (50, 75 and 100 kg ha^{-1}) of nitrogen from PU and USG including a control (no N added) were tested in the Randomized Complete Block Design. The test variety was BRRI dhan31. PU was applied into three equal splits e.g. 1/3rd at basal, 1/3rd at maximum tillering stage and the remaining 1/3rd at panicle initiation stage while USG was applied at deep placed at 10 days after transplanting (DAT). USG at 75 kg N ha^{-1} produced the highest grain yield. The highest total N uptake and N use efficiency were recorded in treatment T_4 (USG 75 kg N ha^{-1}). The highest net benefit was also observed in treatment T_4 (USG 75 kg N ha^{-1}). Therefore, it can be concluded that USG (75 kg N ha^{-1}) is more suitable for rice cultivation.

Keywords: USG, rice production, the eastern Surma Kushiyara floodplain

Introduction

Nitrogen fertilizer plays a vital role in the production of modern high yielding rice varieties. Unfortunately, the efficiency of N fertilizer in wetland rice culture is about 30% of the applied N. This low N use efficiency in wetland rice culture is attributed to N loss from the rice fields due to NH_3 volatilization, de-nitrification, runoff and leaching. High NH_4-N conc. in the flood water, high temperature and high wind velocity are responsible for NH_3 volatilization. Deep point placement of USG decreases the de-nitrification process and minimizes urea concentration in flood water, thus reduce N loss and improve N absorption by the rice crop. A good alternative may be the deep placement of USG for higher yield of rice. USG was more efficient than PU at all respective levels of nitrogen in producing all yield component and in turn, grain and straw yields. Mishra *et al.* (1999) conducted an experiment to study the effect of USG in wetland rice soil. Placement of USG @ 75 kg N ha^{-1} significantly increased both the grain and straw yields of rice compared to PU or USG broadcast. USG deep placement @ 75 kg N ha^{-1} produced 0.85 t ha^{-1} (20%) higher grain yield than that of equivalent amount of PU-N in Boro season (Aziz *et al.* 2009). USG or urea is the most important fertilizer for crop production. Production will be drastically reduced without urea. The main objective of this study was to observe the effect of PU and USG for the Eastern Surma Kushiyara Floodplain.

Materials and Methods

The study was conducted at farmer's field Alampur, Sylhet. The study area is situated in the Eastern Surma and Kushiyara floodplain. The region has broad ridges and basins. Annual maximum temperature is 33.2^{o}C and minimum is 13.5^{o}C, annual rainfall 3334 mm. Soils of the area are predominantly clay to sandy clay loams on the ridges and sandy in the basin. General soil types predominantly include dark yellowish soil. Organic matter content is low on the ridge and moderate in the basin, top soils are moderately acidic but sub soils are neutral in reaction. General soil fertility level is low (BBS, 2005).

The initial soil properties of the experimental site have been presented in Table 1. Soil texture, pH, organic matter, available P, S & Zn and exchangeable K were determined following standard methods (Black, 1965; Jackson, 1962; Olsen *et al.* 1954; Page *et al.* 1982; Walkley and Black, 1935).

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Table 1. Initial soil characteristics of the experimental site

Parameters	Value
Texture	Clay loam
pH	5.1
Total N (%)	0.12 (low)
Available P (ppm)	8.0 (low)
Exchangeable K (meq $100g^{-1}$ soil)	0.17 (medium)
Available S (ppm)	20.0 (medium)
Available Zn (ppm)	1.6 (very high)

There were seven treatment combinations viz. T_1 = Control (No), T_2 = USG deep-placement @ 50 kg N ha^{-1}, T_3 = PU @ 50 kg N ha^{-1}, T_4 = USG deep-placement @ 75 kg N ha^{-1}, T_5 = PU @ 75 kg N ha^{-1}, T_6 = USG deep-placement @ 100 kg N ha^{-1}, T_7 = PU @ 100 kg N ha^{-1}. Other fertilizer doses on soil test bases were 18 kg P, 36 kg K and 13 kg S ha^{-1} and was applied as TSP, MP and gypsum respectively. BRRI dhan31 was used as test crop.

The experiment was laid out in a randomized complete block design with three replications having unit plot size of 5 m × 6 m. TSP, MP and gypsum were applied at final land preparation. USG deep-placement would be done at 40 cm distance in every alternate row at 10 DAT. Urea was applied into three equal splits, 1/3 basal, 1/3rd maximum tillering stage and the remaining 1/3rd at panicle initiation stage.

Necessary intercultural operations were done as and when required. At maturity, the crop was harvested from 5 m^2 and grain yield was adjusted to 14% moisture content. The plant height, tiller, panicle, filled grain and sterile grain production and grain & straw yield were recorded. Finally economic analyses were done for net benefit.

Results and Discussion

Growth and Yield of Rice

Application of USG and PU increased the plant height of rice over control. The highest plant height was found in treatment T_2 (USG deep-placement @ 50 kg N ha^{-1}) followed by treatment T_4 (USG deep-placement @ 75 kg N ha^{-1}). Application of USG significantly increased the tiller and panicle numbers and grain yield of rice over control. Maximum number of tiller was recorded in treatment T_4 (USG deep-placement @ 75 kg N ha^{-1}) followed by treatment T_5 (PU broadcast @ 75 kg N ha^{-1}) and T_6 (USG deep-placement @ 100 kg N ha^{-1}). On the other hand, treatment T_4 produced the highest number of panicle followed by T_5. Maximum grain yield was recorded in treatment T_4 followed by treatment T_5. Maximum grain yield was recorded in treatment T_4 followed by T_5. Application of USG increased the straw yield of rice over control. The highest straw yield was observed in treatment T_4 followed by treatment T_5 (Table 2). Alam and Khaldun (2009 found that 3 pellets of USG (0.9 g) 4 $hills^{-1}$ produced the tallest plant (126 cm), longest panicle (26.74 cm), highest grain yield (3.81 t ha^{-1}), biological yield (10.59 t ha^{-1}) and harvest index (45%) in four varieties of fine rice.

It is appeared from the results that treatment T_4 where USG deep-placement @ 75 kg N ha^{-1} gave highest yield.

Table 2. Effect of PU and USG on the rice production in the Eastern Surma Kushiyara Floodplain soils

Treatment	Tiller No. m^{-2}	Panicle No. m^{-2}	% Sterility	1000 grain wt. (g)	Grain yield (t ha^{-1})	Straw yield (t ha^{-1})
T_1	175	150	26	25	2.60	3.10
T_2	200	182	20	26	3.38	4.25
T_3	197	178	22	27	3.27	4.30
T_4	238	222	20	26	4.74	5.52
T_5	236	220	24	26	4.55	5.40
T_6	235	218	23	26	4.45	5.27
T_7	231	215	24	25	4.31	5.15
LSD (5%)	35	30	4	2	0.38	0.43

T_1 = Control (No), T_2 = USG deep-placement @ 50 kg N ha^{-1}, T_3 = PU @ 50 kg N ha^{-1}, T_4 = USG deep-placement @ 75 kg N ha^{-1}, T_5 = PU @ 75 kg N ha^{-1}, T_6 = USG deep-placement @ 100 kg N ha^{-1}, T_7 = PU @ 100 kg N ha^{-1}.

Total N uptake (kg ha^{-1}) and N use efficiency

Maximum total N uptake was recorded in the treatment T_6 followed by treatment T_4. The highest N use efficiency was recorded in the treatment T_4 followed by treatment T_5. USG deep placement @ 75 kg N ha^{-1} at 5 cm soil depth produced significantly high grain (43.1 g ha^{-1}) and straw (47.8 g ha^{-1}) yields with highest mean N use efficiency (Dash *et al.* 2003).

Deep placement of USG also significantly improved grain yield, straw yield and nitrogen use efficiency of rice and reduced the volatilization loss of ammonia relative to the application of prilled urea (Jena *et al.* 2003)

Table 3. Effect of PU and USG on the N content and N use efficiency in the Eastern Surma Kushiyara floodplain soils

Treatment	N content (%)		Total N uptake (kg ha^{-1})	N use efficiency (kg kg^{-1})
	Grain	Straw		
T_1	1.05	0.60	45.90	-
T_2	1.14	0.61	64.45	15.6
T_3	1.09	0.66	64.02	13.4
T_4	1.20	0.65	92.76	28.5
T_5	1.16	0.64	87.27	26.0
T_6	1.35	0.63	93.27	18.5
T_7	1.31	0.63	88.90	17.1

T_1 = Control (No), T_2 = USG deep-placement @ 50 kg N ha^{-1}, T_3 = PU @ 50 kg N ha^{-1}, T_4 = USG deep-placement @ 75 kg N ha^{-1}, T_5 = PU @ 75 kg N ha^{-1}, T_6 = USG deep-placement @ 100 kg N ha^{-1}, T_7 = PU @ 100 kg N ha^{-1}.

Economic analysis

Net benefit

Economic analysis on partial budget of the experiment has been presented in Table 4. The net benefit of each treatment was calculated by subtracting the total costs that vary from the gross return. The total costs that vary are the sum of all the costs that vary for a particular treatment. The highest net benefit was found in treatment T_4 followed by T_5 .

Table 4. Partial budget for the effect of PU and USG on rice production in the Eastern Surma Kushiyara floodplain soils

Treatment	Gross return (Tk ha^{-1})	Cost of cultivation (Tk ha^{-1})	Net return (Tk ha^{-1})	BCR
T_1	64400	3720	60680	17.31
T_2	84600	5900	78700	14.33
T_3	82600	5900	76700	14.00
T_4	116880	6980	109900	16.74
T_5	112600	6980	105620	16.13
T_6	110080	8060	102020	13.65
T_7	106800	8060	98740	13.25

Urea = Tk. 20.00 kg^{-1}, TSP= Tk 25.00 kg^{-1}, MP= Tk.20.00 kg^{-1}, Gypsum= Tk. 12.00 kg^{-1}, USG =Tk. 20.00 kg^{-1}, Paddy= Tk.20.00 kg^{-1} and Straw= Tk. 4.00 kg^{-1}

USG deep-placement @ 75 kg N ha^{-1} appeared to be the economically most effective treatment of this experiment and also produced higher yield than that of USG broadcast and application of PU. USG deep-placement is better than broadcast and prilled urea. USG is a new technology which requires extensive and repeated training to extension worker and farmers.

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