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Effect of urea super granules on the performance of transplant aman rice

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Abstract: The yield performance of three transplant *aman* rice namely, BINA dhan7, BRRI dhan46 and Kalizira were evaluated under five levels of urea super granules (USG) viz. control (no USG), one, two, three and four pellet(s) of USG/4 hills providing 0, 30, 60, 90 and 120 kg N ha^{-1}, respectively, and recommended dose of prilled urea were evaluated at the Agronomy Field Laboratory, Bangladesh Agricultural University, Mymensingh during the *aman* season (July to December) of 2011. Variety exerted significant influence on yield of transplant *aman* rice. Grain yield was highest (5.46 t ha^{-1}) in BRRI dhan46 and straw yield was highest (6.58 t ha^{-1}) in Kalizira. Grain yield was found the highest (4.91 t ha^{-1}) from the level of 2 pellets of USG/4 hills and straw yield was found the highest (6.60 t ha^{-1}) from the level of 4 pellets of USG/4 hills. It was observed that in most of the cases, all the varieties performed better for their yield contributing characters with 2 pellets of USG/4 hills compared to any other levels. The findings suggest that BRRI dhan46 can be cultivated to obtain high rice yield, BINA dhan7 for short duration and Kalizira for obtaining aromatic rice with 2 pellets of USG in transplant *aman* season.
Key words: Urea Super Granules, transplant *aman* rice.

Introduction

Agriculture contributes significantly to the economy of Bangladesh since it comprises about 19.29% of the country's GDP and employs around 43.70% of the total labor force (BBS, 2011). The performance of this sector has an overwhelming impact on major macroeconomic objectives of the country like employment generation, poverty alleviation, human resources development and food security. About 75% of the total cropped area and over 80% of the total irrigated area is planted to rice (BBS, 2011) in Bangladesh. Thus, rice plays a vital role in the livelihood of the people of the country. Nutrient stresses in Bangladesh soils are increasing day by day. Depletion of soil fertility has been identified as a major constraint for higher crop yield. Use of fertilizer is an essential component of modern farming with about 50% of the world crop production (Pradhan, 1992). For rice production, nitrogen is the key nutrient required in the largest quantities while urea is the principal nitrogenous fertilizer. However, N from urea is subject to considerable losses to the atmosphere and runoff water in the rice ecosystem, especially where urea is broadcast on standing water. On a global level, more than 55 percent of the N applied through urea fertilizer to irrigated rice is not taken up. In Bangladesh, prilled urea (PU) conventionally applied by farmers is very inefficiently used in transplant *aman* rice largely because of serious losses (up to 60% of applied N) via NH_3 volatilization, denitrification, leaching, and/or runoff. In order to minimize N loss, especially loss due to denitrification, use of USG in place of prilled urea is very beneficial for transplant *aman* rice. Depending on agro climate and N rates used, in general deep-placed USG can help to provide a saving of urea fertilizer up to 65% with an average of 33% and can help to increase grain yields up to 50% with an average of 15% to 20% over that with the same amount of split-applied N as prilled urea. Thus, this practice is agronomically efficient as well as environmentally safe.Therefore, the experiment was undertaken to achieve the objectives to indentify the most suitable transplant *aman* rice variety and to find out the optimum level of USG for higher yield of transplant *aman* rice.

Materials and Methods

The experiment was conducted at the Agronomy Field Laboratory, Bangladesh Agricultural University, Mymensingh, during the period from July to December 2011. The experimental site belongs to the Sonatola series of the Old Brahmaputra Floodplain (AEZ-9). The climate of the area is characterized by high temperature and heavy rainfall during *kharif* season (April to September) and scanty rainfall associated with moderately low temperature during the *rabi* season (October to March). The overall relative humidity remains high during most part of the year except the winter season. Two experimental factors were included in the study: i) Factor A: Variety- 3 and Factor B: 5 levels of urea super granules (USG) and recommended dose of prilled urea.The selected varieties were: BINA dhan7 (V_1), BRRI dhan46 (V_2) and Kalizira (V_3). Level of USG were: control (no pellets of USG) = 0 kg N ha^{-1} (N_0), one pellet of USG (0.9 g)/4 hills = 30 kg N ha^{-1} (N_1), two pellets of USG (0.9 g)/4 hills = 60 kg N ha^{-1} (N_2), three pellets of USG (0.9 g)/4 hills = 90 kg N ha^{-1} (N_3), four pellets of USG (0.9 g)/4 hills = 120 kg N ha^{-1} (N_4) and prilled urea = recommended dose 200 kg urea ha^{-1} (N_5). The experiment was laid out in a randomized complete block design with three replications. The size of each unit plot was 4.0m × 2.5m. After final land preparation rice seedlings were transplanted on the experimental plots on 18 August, 2011. As per experimental specification one, two, three or four pellet (s) of USG were placed manually at 6-8 cm depth at the centre of four hills of two adjacent rows, ten days after transplanting (DAT). Then nitrogen in the form of prilled urea was applied as per experimental specification in 3 equal splits at 15, 30 and 45 DAT. The crops were harvested in different time according to varietal maturity. After harvesting, grains were threshed, cleaned and sun dried and the grain yield $plot^{-1}$ was recorded at 14% moisture content. Straw were sun dried to record the straw yield $plot^{-1}$. Experimental data on yield and yield contributing characters were recorded on different parameters. The collected data were analyzed by using "Analysis of Variance" technique and the differences among treatment means were adjudged by the Duncan's Multiple Range Test (Gomez and Gomez,1984).

Results and Discussion

The effect of variety, level of USG and their interaction on vegetative and yield contributing characters of transplant *aman* rice are presented in Tables 1-3.

Effect of variety on vegetative and yield contributing characters of transplant *aman* rice: Variety had

significant influence on most of the parameters (Table 1). BRRI dhan46 produced the highest number of effective tillers hills^{-1} (11.42) and highest 1000-grain weight (24.25g) resulted in highest (5.46 t ha^{-1}) grain yield (Fig.1). Kalizira performed with the highest plant height (129.08 cm) but failed to give satisfactory grain yield due to less number of effective tillers hill^{-1} (2.31). This yield retarding character led to lowest the grain yield (3.17 t $^{-1}$) of that variety. The lowest number of effective tillers hill^{-1} (9.36) which eventually contributed to lower grain yield (4.44 t ha^{-1}) of BINA dhan7 compared to BRRI dhan46 (5.46 t ha^{-1}). The tallest plant (129.08 cm) led to produce the highest straw yield (6.58 t ha^{-1}) in Kalizira. But BINA dhan7 produced the lowest straw yield (5.96 t ha^{-1}) due to the shortest plant (87.54 cm) and the lowest number of total tillers hill^{-1}(11.61).

Table 1. Effect of variety on vegetative and yield contributing characters of transplant *aman* rice

Treatments	Plant height (cm)	Effective tillers	1000-grain weight (g)	Straw yield (t ha^{-1})	Biological yield (t ha^{-1})	Harvest Index (%)
V1	87.54c	9.36b	23.97ab	5.96b	10.40ab	42.69b
V2	110.26b	11.42a	24.25a	6.34ab	11.80a	46.27a
V3	129.08a	11.08ab	20.41b	6.58a	9.75b	32.51c
CV (%)	2.50	6.49	2.13	2.88	1.97	2.10
Level of significance	**	**	**	**	**	**

In a column figures with same letter or without letter do not differ significantly, whereas figures with dissimilar letters differ significantly (as per DMRT). *= Significant at 5% level of probability, **= Significant at 1% level of probability, NS= Not significant, V_1= BINA dhan7, V_2= BRRI dhan46, V_3= kalizira

Table 2. Effect of USG on vegetative and yield contributing characters of transplant *aman* rice

Treatments	Plant height (cm)	Effective tillers	1000-grain weight (g)	Straw yield (t ha^{-1})	Biological yield (t ha^{-1})	Harvest Index (%)
N_0	106.26d	7.72d	22.69	5.78c	9.19d	37.10e
N_1	108.40bc	12.07ab	22.92	5.87c	10.56c	44.20ab
N_2	109.16b	12.30a	23.00	6.13b	11.04a	44.47a
N_3	113.23a	9.89c	22.77	6.10b	10.45c	41.62c
N_4	107.24cd	10.27c	22.90	6.60a	10.92b	39.56d
N_5	109.47b	11.48b	22.97	6.05bc	10.71bc	43.51b
CV(%)	2.50	6.49	2.13	2.88	1.97	2.10
Level of sig.	**	**	NS	**	**	**

In a column figures with same letter or without letter do not differ significantly, whereas figures with dissimilar letters differ significantly (as per DMRT). *= Significant at 5% level of probability, **= Significant at 1% level of probability, NS= Not significant, (i) Control (No pellets of USG) = 0 kg N ha^{-1} (N_0), (ii) One pellet of USG (0.9 g)/4 hills = 30 kg N ha^{-1} (N_1), (iii) Two pellets of USG (0.9 g)/4 hills = 60 kg N ha^{-1} (N_2), (iv) Three pellets of USG (0.9 g)/4 hills = 90 kg N ha^{-1} (N_3), (v) Four pellets of USG (0.9 g)/4 hills = 120 kg N ha^{-1} (N_4), (vi) Prilled urea = Recommended dose 200 kg urea ha^{-1} (N_5)

Table 3. Interaction effect between variety and level of USG on crop characters and yield of transplant *aman* rice

Treatments	Plant height (cm)	Total tillers	Effective tillers	Grains panicle^{-1}	1000-grain weight (g)	Grain yield (t ha^{-1})	Straw yield (t ha^{-1})	Biological yield (t ha^{-1})	Harvest Index (%)
V_1N_0	84.95	7.33g	5.58h	67.62f	23.31	3.75g	5.05hi	8.80g	42.61g
V_1N_1	86.80	13.05cde	11.52cd	88.88bc	24.26	4.78c	5.22ghi	10.00f	47.80d
V_1N_2	87.87	12.49def	11.37cd	86.61cd	24.25	4.75cd	5.40efg	10.15ef	46.79de
V_1N_3	91.29	12.74cde	9.36efg	83.60d	24.15	4.51e	5.37fgh	9.88fg	45.65e
V_1N_4	86.53	11.00f	9.12fg	77.49e	23.52	4.69cd	5.07i	9.76fg	48.05c
V_1N_5	87.80	13.07cde	9.20fg	83.26d	24.30	4.15f	5.47efg	9.62fg	48.15c
V_2N_0	106.45	11.14f	8.47g	69.96f	24.54	4.58de	5.49efg	10.07f	45.48f
V_2N_1	109.13	14.83ab	12.25bc	88.99bc	24.15	5.78a	5.68def	11.26bc	49.56b
V_2N_2	110.63	15.94a	13.83a	89.24bc	24.56	5.80a	5.90d	11.70a	50.42a
V_2N_3	114.07	12.40def	9.78ef	84.45cd	24.24	5.31b	5.83d	11.14c	47.66d
V_2N_4	109.87	13.17cde	11.54cd	83.12d	23.59	5.63a	5.70de	11.33b	49.69b
V_2N_5	111.40	14.87ab	12.67ab	85.70cd	24.40	5.69a	5.64def	11.33b	50.22a
V_3N_0	127.37	11.64ef	9.12fg	93.05b	20.22	1.91j	6.18c	8.09h	23.60k
V_3N_1	129.28	13.60bcd	12.43bc	112.59a	20.34	3.55h	7.11a	10.66d	33.33i
V_3N_2	128.97	14.10bc	12.86ab	114.68a	20.59	3.55h	6.76b	10.30e	34.46hi
V_3N_3	134.33	14.29bc	10.52de	112.89a	20.47	3.22i	7.12a	10.34de	31.14j
V_3N_4	125.33	13.95bcd	10.14ef	113.54a	20.64	3.17i	7.18a	10.35de	30.62j
V_3N_5	129.20	12.75cde	11.42cd	114.07a	20.23	3.59gh	6.71b	10.30e	34.85h
CV(%)	2.50	6.45	6.49	2.89	2.13	2.32	2.88	1.97	2.10
Level of sig.	NS	**	**	*	NS	**	**	**	**

In a column figures with same letter or without letter do not differ significantly, whereas figures with dissimilar letters differ significantly (as per DMRT). *= Significant at 5% level of probability, **= Significant at 1% level of probability, NS= Not significant, (i) Control (No pellets of USG) = 0 kg N ha^{-1} (N_0), (ii) One pellet of USG (0.9 g)/4 hills = 30 kg N ha^{-1} (N_1), (iii) Two pellets of USG (0.9 g)/4 hills = 60 kg N ha^{-1} (N_2), (iv) Three pellets of USG (0.9 g)/4 hills = 90 kg N ha^{-1} (N_3), (v) Four pellets of USG (0.9 g)/4 hills = 120 kg N ha^{-1} (N_4), (vi) Prilled urea = Recommended dose 200 kg urea ha^{-1} (N_5)

Level of USG exhibited their differences in almost all the parameters considered except 1000-grain weight (Table 2). Plant height was found to be increased linearly with the increasing level of USG. Plant height was found to be the highest with the level of USG (3 pellets of USG/4 hills), the corresponding values for this character was 113.23 cm. The shortest plant (106.26 cm) was found with control treatment (no USG applied). These results explicitly confirm the similar results obtained by Singh and Singh (1980), Chakravorti (1989) and Alam (2002) who recorded a positive effect of USG level on plant height.

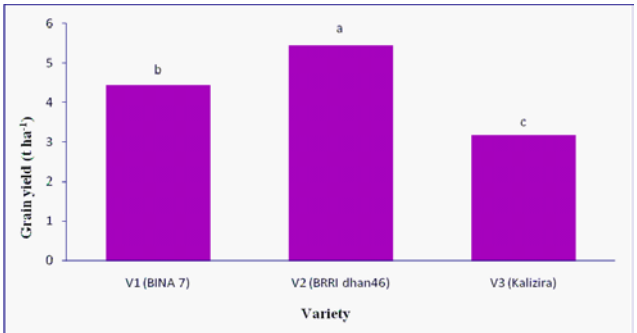

Fig. 1 Effect of variety on grain yield (t ha^{-1}) of transplant *aman* rice

The lowest straw yield (5.78 t ha^{-1}) was obtained from control treatment (no USG applied). The highest straw yield (6.60 t ha^{-1}) was obtained from 4 pellets of USG/4 hills. The yield contributing character like number of effective tillers hill^{-1} was found to be the highest (12.30) which eventually contributed to the highest grain yield (4.91 t ha^{-1}). The yield contributing characters like number of effective tillers hill^{-1} was found to be lowest (7.72) when no USG was applied which performed the worst in respect of grain yield (3.41 t ha^{-1}). Grain yield was gradually increased with the increasing level of USG up to 2 pellets of USG/4 hills and thereafter declined due to declining tendency most of the yield contributing characters (Fig. 2).

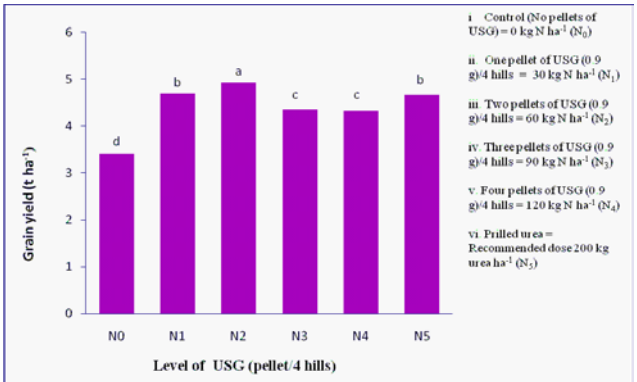

Fig. 2 Effect of level of USG on grain yield (t ha^{-1}) of transplant *aman* rice

Interaction effect between variety and level of USG on crop characters and yield of transplant *aman* rice: The interaction effect of variety and the level of USG significantly influenced the number of effective tillers hill^{-1}, grains panicle^{-1} , grain yield, straw yield, biological yield and harvest index but did not show any significant effect on plant height, number of total tillers hill^{-1} and 1000-grain weight (Table 3). BRRI dhan46 fertilized with 2 pellets of USG/4 hills gave the highest number of effective tillers hill^{-1}(13.83) while that was only 5.58 (the lowest value) in BINA dhan7 when grown without any N fertilizer. It was found that prilled urea did not give any satisfactory result. The highest number of filled grains panicle^{-1} (114.68) was given by Kalizira grown with 2 pellets of USG/4 hills and the lowest one (67.62) was given by BINA dhan7 grown with control.

BRRI dhan46 produced the highest grain yield (5.80 t ha^{-1}) when grown with 2 pellets of USG/4 hills which was identical with the same variety grown with 1 pellet of USG/4 hills and usual dose of prilled urea (5.78 and 5.69 t ha^{-1}, respectively). Kalizira produced the lowest grain yield (1.91 tha^{-1}) when no USG fertilizer was applied. Maximum varieties gave the highest grain yield when fertilized with 2 pellets of USG/4 hills and all varieties gave the lowest grain yield when fertilized with no USG pellet, respectively. BRRI dhan46 with 2 pellets of USG/4 hills was produced the highest grain and biological yields (5.80 and 11.07 t ha^{-1}, respectively) and the lowest grain and biological yields (1.91 and 8.09 t ha^{-1}, respectively) were obtained from control treatment when interacted with Kalizira. BRRI dhan46 coupled with 2 pellets of USG/4 hills produced the highest harvest index (50.42%) which was statistically at par with usual dose of prilled urea with the same variety (50.22%).

Based on the results, among the three varieties studied BRRI dhan46 performed the best in producing grain yield. But all the varieties have some advantages and disadvantages over one another. This may facilitate the accommodation of the succeeding crop. Hence, it may be concluded that BRRI dhan46 is the most suitable variety among the three transplant *aman* rice varieties to obtain high yield. BINA dhan7 is suitable as a short duration *aman* rice variety toaccomodaterabi crops in the crppping pattern. Kalizira can be grown to obtain aromatic rice which has the highest market price among the three transplant *aman* rice varieties. Therefore, farmers can transplant BINA dhan7, BRRI dhan46 and Kalizira with proper spacing and fertilizer management during *aman* season. Two pellets of USG/4 hills performed the best result in respect of grain yield irrespective of varieties. Hence, it is recommended that farmers can use 2 pellets of USG weighing 0.9 g of each pellet by placing them in the center of four hills of two adjacent rows with the spacing of 25 cm x 15 cm for higher yield of *aman r*ice.

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