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PERFORMANCE OF SEEDLING NUMBER HILL^{-1} AND UREA SUPERGRANULES ON THE YIELD OF TRANSPLANTED AMAN RICE VARIETIES

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ABSTRACT

A field experiment was conducted at the experimental field of Sher-e-Bangla Agricultural University during July to December 2007 to find out the effect of four levels of seedling hill^{-1} *viz.*; 1, 2, 3 and 4 and two forms of nitrogen fertilizer-prilled urea (PU) and urea supergranules (USG) on yield and yield components of modern (BRRI dhan44) and traditional (Nizershail) transplant *aman* rice. The experiment was laid out in a split split-plot design with three replications. Urea was top dressed @ 58 kg N ha^{-1} in three equal splits at 10, 30 and 50 DAT. The USG (1.8 g) was placed at 5-10 cm soil depth at 10 DAT in the center of four hills in alternate rows @ 1 granule in one spot to supply 58 kg N ha^{-1}. Results showed that BRRI dhan44 produced higher grain yield (4.85 t ha^{-1}), two seedlings hill^{-1} gave the highest grain yield (3.96 t ha^{-1}) and USG gave higher grain yield (12.2%) over PU. Interaction results showed that significantly highest grain yield (5.28 t ha^{-1}) was obtained from transplanting one seedling of BRRI dhan44, application of USG in BRRI dhan44 gave 5.08 t ha^{-1} and transplanting one seedling hill^{-1} with application of USG gave 4.18 t ha^{-1} and finally placement of USG by transplanting one seedling hill^{-1} of BRRI dhan44 gave 5.77 t ha^{-1}. The higher grain yield was attributed mainly to the number of effective tillers hill^{-1}, filled grains panicle^{-1} and 1000-grain weight.

Key words: Transplanted *aman* rice, seedling rate, urea supergranules, prilled urea

INTRODUCTION

Rice (*Oryza sativa* L.) is a semi aquatic cereal among the oldest and most important food crops of the world (Mikkelsen *et al.*, 1995) which is favored by the hot, humid climate and the large number of deltas across Asia's vast tropical and subtropical areas. Rice is the staple food of about 140.6 million people of Bangladesh (BBS, 2006) and the population of Bangladesh is still increasing by two million every year and may increase by another 30 millions over the next 20 years. Thus, Bangladesh will require about 27.26 million tons of rice for the year 2020. During this time total rice cultivation area will also shrink to 10.28 million hectares. Rice (clean) yield therefore, needs to be increased from the present 2.44 to 3.74 t ha^{-1} (BRRI, 2006). The potential for increased rice production strongly depends on the ability to integrate a better crop management for the different varieties into the existing cultivation systems (Mikkelsen *et al.*, 1995). Mustafi *et al.* (1993) justified the cultivation of traditional *aman* varieties by the poor farmers. They reported that major reasons for growing traditional *aman* varieties were low production cost, palatability of rice and lack of irrigation water. Planting density as a management practice in transplanted rice culture constitutes the number of seedling hill^{-1} or per hills unit area. Excess or less number of seedlings hill^{-1} may badly affect the normal physiological activities (Miah *et al.*, 2004). Urea is the principal source of N, which is the essential element in determining the yield potential of rice (Mae, 1997). Generally urea is broadcast in three equal splits- one as basal dose at the time of final land preparation, one at maximum tillering stage and the remaining one before panicle initiation stage. However, under this practice high floodwater, pH, high ammonium N concentration in flood water, high temperature and high wind speed are the factors, which have been identified to enhance ammonium-N loss. Numerous experiments have shown that the efficiency at which N is utilized by wetland rice is only about 30% of the applied fertilizer N and in many cases

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even less (Prasad and De Datta, 1979). So, any method of N fertilizer application that reduce the concentration of flood water N (urea + NH_4) in the rice field will be subject to less loss of N through NH_3 volatization, algal assimilation, denitrification and surface runoff. Modifying urea materials is an important aspect of nitrogen management in rice from the view points of its efficient utilization. These losses of N may be reduced by the deep placement of urea supergranules (USG) instead of broadcasting prilled urea (PU). Moreover, in conventional urea fertilization, it is often difficult to determine when to apply fertilizer to achieve optimal results. Keeping all the points in mind mentioned above, the present research work was undertaken to compare the performance of modern and traditional variety of transplanted aman (T. *aman*) rice in relation to different number of seedling(s) $hill^{-1}$ and urea supergranules on the yield and yield contributing characters of T. *aman* rice.

MATERIALS AND METHODS

The experiment was conducted during the period from July to December, 2007 in T. *aman* season at Sher-e-Bangla Agricultural University farm, Dhaka under the agro-ecological zone of Modhupur Tract, AEZ-28 which is characterized by high temperature, high humidity and heavy rainfall with occasional gusty winds in *kharif* season (April-September) and less rainfall associated with moderately low temperature during the *rabi* season (October-March). The farm belongs to the Shallow Red Brown Terrace Soils under Tejgaon Series. Rice variety BRRI dhan44 and Nizershail were used as the test crop. Ordinary or PU and USG were used as the sources of nitrogen fertilizer. At the time of first ploughing cowdung at the rate of 10 t ha^{-1} was applied. The experimental plots were fertilized with 100, 50, 62.5, 10 kg ha^{-1} of P, K, S and Zn in the form of triple superphosphate (TSP), muriate of potash (MOP), gypsum and zinc sulphate, respectively (BARC, 1989) one day before transplanting. Urea was top dressed @ 58 kg N ha^{-1} in three equal splits at 10, 30 and 50 DAT. The entire amounts of triple superphosphate (TSP), muriate of potash (MOP), gypsum and zinc sulphate were applied at final land preparation as basal dose. The USG weighing 1.8 g each were placed at 5-10 cm soil depth at 10 DAT in the center of four hills in alternate rows @ 1 granule in one spot to supply 58 kg N ha^{-1}. Three sets of treatments included in the experiment were as follows: A. Variety (2) V_1= BRRI dhan44 (MV) and V_2= Nizershail (LV) B. Seedling(s) no. $hill^{-1}$ (4) S_1= 1 seedling, S_2= 2 Seedlings, S_3= 3 Seedlings and S_4= 4 Seedlings. C. Form of nitrogen fertilizer (2) N_1= Prilled Urea and N_2= Urea Supergranules. The experiment was laid out in a split split-plot design with three replications having urea application in the main plots, variety in the sub-plots and seedling number(s) $hill^{-1}$ in the sub-sub plots. There were 16 treatment combinations. The total numbers of unit plots were 48. The size of unit plot was 5 m x 3 m = 15 m^2. Thirty days old seedlings were transplanted as per experimental treatment with 25 cm spacing between lines and 15 cm spacing between hills on the well puddled plots on 27 July 2007. In each plot, there were 12 rows, each row contained 33 hills of rice seedlings. Experimental data collection began at 15 days after transplanting, and continued till harvest. The data collected on different parameters were statistically analyzed to obtain the level of significance using the IRRISTAT (Version 4.0, IRRI, Philippines) computer package program developed by IRRI. The mean differences among the treatments were compared by least significant difference (LSD) test at 5% level of significance.

RESULTS AND DISCUSSION

The experiment was conducted to compare the performance of modern and traditional T. *aman* rice variety with seedling(s) $hill^{-1}$ and urea supergranules. BRRI dhan44 and Nizershail were considered as modern and traditional variety, respectively and 4 seedling numbers i.e., 1, 2, 3 and 4 seedlings $hill^{-1}$ with two forms of N-fertilizer *viz.*; prilled urea and urea supergranules were treated to find out the yield and yield attributes of the T. *aman* rice.

Effect of variety

Grain yield is a function of interplay of various yield components such as number of productive tillers, grains $panicle^{-1}$ and 1000-grain weight (Hassan *et al.*, 2003). Variety exerted significant influence on

effective tillers hill^{-1}, panicle length, number of filled and unfilled grains panicle^{-1}, 1000-grain weight, grain yield and straw yield. It was observed in Table 1 that BRRI dhan44 produced higher (4.85 t ha^{-1}) grain yield which was contributed from higher number of effective tiller hill^{-1}, higher number of grains panicle^{-1} and more weight of 1000-grain than Nizersail (2.46 t ha^{-1}). However, the variety Nizershail was tall produced higher straw yield compared to dwarf variety of BRRI dhan44.

Effect of seedling numbers hill^{-1}

Among the yield components and yield of T. *aman* rice 1000-grain weight and grain yield were significantly influenced due to the variation of seedling number hill^{-1} (Table 1). The highest grain yield (3.96 t ha^{-1}) was found with 2 seedlings hill^{-1} which was statistically similar to 1 seedling hill^{-1} (3.83 t ha^{-1}) and the lowest grain yield (3.26 t ha^{-1}) was found with 4 seedlings hill^{-1}. The result was in conformity with the findings of Islam *et al.* (2002) who observed that the highest grain yield with 2 seedlings hill^{-1}. Likewise, Srinivasulu *et al.* (1999) noted that planting 1 seedling hill^{-1} of rice gave grain yield comparable to that of 2 seedlings hill^{-1}.

Effect of form of nitrogen fertilizer

Placement of nitrogen fertilizer in the form of USG @ 58 kg N ha^{-1} produced the highest number of effective tillers hill^{-1}, filled grains panicle^{-1}, which ultimately gave higher grain yield than split application of urea in T. *aman* rice (Table 1). This result was in agreement with that of BRRI (2000) where USG gave 18% yield increase over the recommended prilled urea. In the present experiment, 12.2% higher grain yield was found in USG over urea. It was also observed that USG produced significantly higher straw yield than PU.

Interaction effect of variety and seedling numbers hill^{-1}

Interaction effect of variety and seedling numbers hill^{-1} had significant effect on effective tillers hill^{-1}, panicle length, filled grains panicle^{-1}, 1000-grain weight, grain yield and harvest index (Table 1). BRRI dhan44 with 1 seedling hill^{-1} produced highest filled grains panicle^{-1}, filled grain percentage and heavier 1000-grain weight which produced highest grain yield (5.38 t ha^{-1}). In case of Nizershail 2 seedlings hill^{-1} produced highest grain yield (2.67 t ha^{-1}).

Interaction effect of variety and form of nitrogen fertilizer

It was found that interaction of variety and form of urea significantly affected effective tillers hill^{-1}, panicle length, filled grains panicle^{-1}, 1000-grain weight, grain yield and straw yield of T. *aman* rice (Table 1). In the case of both varieties, superior grain yield was obtained by the application of USG. Significantly the highest grain yield (5.08 t ha^{-1}) was recorded from the combination of BRRI dhan44 with USG and the lowest (2.27 t ha^{-1}) from Nizershail with PU. Application of USG gave 9.72% higher yield in BRRI dhan 44 and 17.18% in Nizershail over urea.

Interaction effect of seedling numbers hill^{-1} and form of nitrogen fertilizer

Although the yield components were insignificant but grain yield and straw yield of T. *aman* rice was significantly affected due to the interaction of seedling numbers hill^{-1} and form of nitrogen fertilizer (Table 1). It was also observed that grain yield decreased when more than 2 seedlings hill^{-1} was transplanted but the yield of USG receiving plots were higher than those with urea applied plots.

Interaction effect of variety, seedling numbers hill^{-1} and form of nitrogen fertilizer

Interaction effect of variety, seedling numbers hill^{-1} and form of nitrogen fertilizer significantly affected panicle length, 1000-grain weight and grain yield of T. *aman* rice (Table 1). Considering grain yield, maximum yield (5.77 t ha^{-1}) was obtained from the combination of BRRI dhan44 having 1 seedling with USG. Based on the results of the study it can be concluded that transplanting 1 or 2 seedlings hill^{-1} for modern variety of transplant *aman* cv. BRRI dhan44 and 2 or 3 seedlings hill^{-1} for traditional variety of Nizershail coupled with urea supergranules will be a promising practice for good yield. However, to reach a specific conclusion and recommendation, more research work on modern and traditional variety, seedling numbers hill^{-1} and forms of nitrogen fertilizer should be done over different Agro-ecological zones.

Table 1. Effect of variety, seedling numbers hill^{-1} and form of nitrogen fertilizer and their interaction on yield contributing characters and yield of T. *aman* rice

Treatments	Effective tillers hill^{-1} (No.)	Panicle length (cm)	Filled grains panicle^{-1} (No.)	Unfilled grains panicle^{-1} (No.)	Total grains panicle^{-1} (No.)	Filled grains panicle^{-1} (%)	1000-grain weight (g)	Grain yield (t ha^{-1})	Straw yield (t ha^{-1})
Variety									
V_1	11.30	28.65	119.29	16.97	136.27	87.47	29.34	4.85	6.34
V_2	7.50	24.51	86.35	11.22	97.57	88.31	19.30	2.46	7.22
LSD (5%)	1.00	0.58	5.67	1.57	5.64	ns	0.79	0.14	0.30
Seedling numbers hill^{-1}									
S_1	8.66	26.94	109.43	11.71	121.13	90.48	25.63	3.83	6.29
S_2	9.23	26.78	105.74	13.22	118.97	88.90	25.11	3.96	6.68
S_3	9.68	26.43	100.35	14.88	115.23	87.05	23.46	3.58	7.03
S_4	10.06	26.18	95.77	16.58	112.35	85.14	23.08	3.26	7.13
LSD (5%)	NS	NS	NS	NS	NS	NS	1.12	0.20	NS
Form of nitrogen fertilizer									
N_1	8.87	26.48	99.73	14.70	114.43	87.04	24.01	3.45	6.52
N_2	9.94	26.69	105.91	13.50	119.40	88.75	24.63	3.87	7.04
LSD (5%)	1.00	NS	5.67	NS	NS	NS	NS	0.14	0.30
Interaction of variety and seedling numbers hill^{-1}									
V_1S_1	10.70	29.00	127.17	14.82	141.98	89.56	30.59	5.28	6.68
V_1S_2	11.10	28.92	121.83	15.97	137.80	88.36	29.92	5.15	7.17
V_1S_3	11.50	28.47	117.07	17.95	135.02	86.73	28.66	4.45	7.47
V_1S_4	11.92	28.23	111.10	19.17	130.27	85.25	28.19	4.12	7.57
V_2S_1	6.62	24.88	91.68	8.60	100.28	91.40	20.67	2.28	5.9
V_2S_2	7.35	24.63	89.65	10.48	100.13	89.43	20.30	2.67	6.18
V_2S_3	7.85	24.40	83.63	11.80	95.43	87.38	18.26	2.60	6.58
V_2S_4	8.20	24.13	80.43	14.00	94.43	85.03	17.98	2.30	6.68
LSD(5%)	2.00	1.16	11.34	NS	11.27	NS	1.58	0.29	NS
Interaction of variety and form of nitrogen fertilizer									
N_1V_1	10.75	28.48	117.12	17.52	134.64	86.92	29.08	4.63	6.07
N_1V_2	6.98	24.48	82.35	11.88	94.23	87.15	18.95	2.27	6.97
N_2V_1	11.85	28.83	121.47	16.43	137.89	88.02	29.60	5.08	7.48
N_2V_2	8.03	24.54	90.35	10.57	100.92	89.48	19.65	2.66	6.61
LSD (5%)	1.41	0.82	8.02	2.22	7.97	NS	1.12	0.20	0.43
Interaction of seedling numbers hill^{-1} and form of nitrogen fertilizer									
N_1S_1	7.92	26.85	106.22	12.42	118.63	89.66	25.22	3.48	6.05
N_1S_2	8.60	26.68	102.82	14.02	116.83	87.98	24.48	3.78	6.47
N_1S_3	9.25	26.32	97.70	15.30	113.00	86.31	23.32	3.37	6.78
N_1S_4	9.70	26.07	92.20	17.07	109.27	84.20	23.03	3.15	6.77
N_2S_1	9.4	27.03	112.63	11.00	123.63	91.31	26.04	4.18	6.53
N_2S_2	9.85	26.87	108.67	12.43	121.10	89.81	25.74	4.13	6.88
N_2S_3	10.10	26.55	103.00	14.45	117.45	87.80	23.60	3.78	7.27
N_2S_4	10.42	26.30	99.33	16.10	115.43	86.08	23.13	3.37	7.48
LSD (5%)	NS	NS	NS	NS	NS	NS	NS	0.29	0.60
Interaction of variety, seedling numbers hill^{-1} and form of nitrogen fertilizer									
$N_1V_1S_1$	10.20	28.87	124.13	15.63	139.78	88.81	29.81	5.00	5.63
$N_1V_1S_2$	10.40	28.77	119.33	16.73	136.06	87.65	29.65	5.20	5.97
$N_1V_1S_3$	11.00	28.23	115.60	18.20	133.80	86.44	28.55	4.20	6.27
$N_1V_1S_4$	11.40	28.03	109.40	19.53	128.93	84.79	28.29	4.10	6.40
$N_1V_2S_1$	5.63	24.83	88.30	9.20	97.50	90.50	20.63	1.97	6.47
$N_1V_2S_2$	6.80	24.60	86.30	11.30	97.60	88.32	19.31	2.37	6.97
$N_1V_2S_3$	7.50	24.40	79.8	12.40	92.20	86.18	18.09	2.53	7.30
$N_1V_2S_4$	8.00	24.10	75.00	14.60	89.60	83.60	17.77	2.20	7.13
$N_2V_1S_1$	11.20	29.13	130.20	14.00	144.20	90.31	31.37	5.77	6.17
$N_2V_1S_2$	11.80	29.07	124.33	15.20	139.53	89.06	30.19	5.30	6.40
$N_2V_1S_3$	12.00	28.70	118.53	17.70	136.23	87.02	28.77	4.90	6.90
$N_2V_1S_4$	12.43	28.43	112.80	18.80	131.60	85.71	28.08	4.33	6.97
$N_2V_2S_1$	7.60	24.93	95.07	8.00	103.07	92.31	20.71	2.60	6.90
$N_2V_2S_2$	7.90	24.67	93.00	9.67	102.67	90.56	21.28	2.97	7.37
$N_2V_2S_3$	8.20	24.40	87.47	11.20	98.67	88.58	18.44	2.67	7.63
$N_2V_2S_4$	8.40	24.17	85.87	13.40	99.27	86.45	18.18	2.40	8.00
LSD (0.05)	NS	1.64	NS	NS	15.94	NS	2.24	0.41	NS

N_1= Prilled urea, N_2= Urea supergranules, V_1= BRRI dhan44, V_2= Nizershail, S_1= 1 seedling, S_2=2 seedlings, S_3= 3 seedlings, S_4= 4 seedlings

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