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Evaluation of Urea Super Granule as a Source of Nitrogen in Transplant *Aman* Rice

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Abstract: A field experiment was conducted during the Kharif season (June to November) of 1998 at the Agronomy Field Laboratory, Bangladesh Agricultural University, Mymensingh to study the effect of point placement of urea super granule (USG) and broadcasting prilled urea (PU) as sources of N in Transplant *aman* rice. One hybrid variety (Hybrid rice 6201) and one modern inbred variety (BRRI Dhan 32) were included in the experiment. USG and PU were applied at 40, 80, 120 or 160 Kg N ha^{-1}. A control (no N) treatment was also included in the experiment. Hybrid rice 6201 produced significantly longer panicle and higher number of total spikelets panicle^{-1} but showed poor performance regarding all other yield parameters. A considerable difference was noted between these two varieties in respect of spikelet sterility where Hybrid rice 6201 produced almost the double of sterile spikelets than that of BRRI Dhan 32 which ultimately led to inferior grain yield (3.25 t ha^{-1}). On the other hand, BRRI Dhan 32 produced taller plants, higher number of effective tillers hill^{-1}, grains panicle^{-1} and heavier grains which eventually contributed to higher grain yield (3.85 t ha^{-1}). USG was more efficient than PU at all respective levels of nitrogen in producing all yield components and in turn, grain and straw yields. Placement of USG at 160 kg N ha^{-1} produced the highest grain yield (4.32 t ha^{-1}) which was statistically identical to that obtained from 120 kg N ha^{-1} as USG and significantly superior to that obtained from any other level and source of N.

Key words: Urea super granule, Prilled urea, Transplant *aman* rice

Introduction

In Bangladesh introduction of high yielding modern varieties of rice has contributed a lot to the increased food production, as rice constitutes 95% of the total food grain production. But due to the alarming population growth the total food supply continues to lag behind the demand. Moreover, the yield of modern rice varieties has either reached the plateau or has been declining for the last few years because of intensive cropping and declining soil fertility status. One of the best options available to the agriculturists to make the country self-sufficient in food production by breaking the yield ceiling of conventionally bred modern rice varieties is the adoption of hybrid rice technology. Hybrid rice technology can offer considerable opportunity in increasing rice productivity in Bangladesh. Hybrid rice became highly successful in China where more than 50% of rice area is under hybrid rice (Yuan, 1994). Hybrid rice in China give a yield advantage of 1.0-1.5 t ha^{-1} (20-30%) over the conventionally bred varieties (Virmani, 1994). Some other countries such as India and Vietnam are also developing and popularizing hybrid rice technology. Therefore, to break the present yield ceiling of semi-dwarf modern varieties hybrid rice seems to be attractive as a viable alternative.

Urea is the principal source of N for rice in Bangladesh agriculture. 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 at prior to panicle initiation stage. But under this practice the efficiency of urea fertilizer in wetland rice culture is very low due to loss as ammonia volatilization, denitrification, surface run-off and leaching. 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 even less (Prashad and de Datta, 1979). However, the nature and magnitude of N loss largely depend upon the sources of N fertilizer and methods of N fertilizer application. This loss of N may be reduced by the deep placement of urea super granule (USG) instead of broadcasting prilled urea (PU). Point placement of USG can increase the efficiency of N utilization by rice in wet season (Roy, 1985). Hence, the study was undertaken to evaluate USG as a source of N instead of PU for hybrid as well as modern inbred varieties of rice in Transplant *aman* season.

Materials and Methods

The field trial was conducted at the Old Brahmaputra Floodplain soils of Agronomy Field Laboratory, Bangladesh Agricultural University, Mymensingh during Transplant *aman* season (June-November) of 1998 with the view to study the effects of point placement of urea super granule (USG) and broadcasting prilled urea (PU) in rice. The experiment included two sources of N viz. USG (developed by the International Fertilizer Development Centre) and PU (ordinary form of urea) and four levels of N viz. 40, 80, 120 and 160 kg ha^{-1}. One hybrid variety (Hybrid rice 6201 developed by the Hybrid Rice International Ltd., Hyderabad, India) and one inbred modern variety (BRRI Dhan 32 developed by the Bangladesh Rice Research Institute) were used in the experiment. One, two, three and four pellets of USG (1 g by weight and 11.5 mm in diameter) equivalent to 40, 80, 120 and 160 kg N ha^{-1}, respectively were placed manually at a depth of 6-8 cm at the centre of four consecutive hills of two adjacent rows at 7 days after transplanting. PU at the same levels were top-dressed in three equal splits- one at immediately after seedling establishment, one at maximum tillering stage and the rest one at prior to panicle initiation stage. A control treatment for level of N was also included in the experiment. Other fertilizers viz. triple super phosphate, muriate of potash, gypsum and zinc sulphate were applied at 100, 50, 62.5 and 10 kg ha^{-1}, respectively (BARC, 1989) during final land preparation as basal dose. A randomized complete block design with three replications was followed. The unit plot size was 20 m^2 (5 m × 4 m). All necessary measurement practices were done in time as per requirement of the crop. Ten hills from each plot were randomly selected, uprooted and properly tagged before harvesting for recording of necessary data. Plot-wise yields of grain and straw were recorded at 14% moisture content and converted to t ha^{-1}. The collected date were analyzed using the "Analysis of Variance" technique and the significance of differences were adjudged by the Duncan's Multiple Range Test (Gomez and Gomez, 1984).

Results and Discuission

Effects of variety: Variety exerted significant influence on yield and yield components of Transplant *aman* rice. Table 1 shows that BRRI dhan 32 performed better than Hybrid rice 6201 in respect of effective tillers hill^{-1}, number of grains panicle^{-1}, number of sterile spikelets panicle^{-1}, 1000-grain weight and grain yield. On the other hand, Hybrid rice 6201 produced significantly superior panicle length and straw yield than BRRI dhan 32. The highest number of effective tillers hill^{-1} (8.30) grains hill^{-1} (92.13) and the heaviest 1000-grain weight (21.47 g) of BRRI dhan 32 eventually

Table 1: Effects of variety on yield and yield components of Transplant *aman* rice

Variety	No. of Effective tillers hill^{-1}	Panicle length (cm)	No. of total Spikelets panicle^{-1}	No. of grains panicle^{-1}	No. of sterile spikelets panicle^{-1}	1000-grain weight (g)	Grain yield (t ha^{-1})	Straw yiled (t ha^{-1})
Hybrid rice 6201	7.68b	25.50a	132.52a	82.44b	50.08a	21.36b	3.25b	4.70a
BRRI Dhan 32	8.30a	23.81b	114.99b	92.13a	21.86b	21.47a	3.85a	4.40b
Level of significance	0.01	0.01	0.01	0.01	0.01	0.01	0.01	0.01

Table 2: Effect of source and level of N on different yield components of Transplant *aman* rice Source and level of N

Source and level of N	No. of effective tillers hill^{-1}	Panicle length (cm)	No. of total spikelets Panicle^{-1}	No. Of grains panicle^{-1}	1000-grain weight (g)
No N (control)	6.20 g	24.10 e	121.58	80.85 ab	20.89 e
40 Kg N ha^{-1} as USG	6.67 f	24.40cde	120.25	88.02 a	21.13 d
80 Kg N ha^{-1} as USG	8.48 d	24.60bcd	126.00	89.12 a	21.41 bc
120 Kg N ha^{-1} as USG	9.17 b	24.82 b	126.87	92.27 a	21.48 b
160 Kg N ha^{-1} as USG	9.51 a	25.36 a	131.38	90.88 a	21.79 a
40 Kg N ha^{-1} as PU	6.33 g	24.30 de	105.67	70.45 b	21.22 cd
80 Kg N ha^{-1} as PU	7.70 e	24.32 de	129.37	95.08 a	21.36 bc
120 Kg N ha^{-1} as PU	8.75 c	24.75 bc	124.60	87.75 a	21.70 a
160 Kg N ha^{-1} as PU	9.13 b	25.27 a	128.80	95.67 a	21.77 a
Level of significance	0.01	0.01	NS	0.05	0.01

In a column, figures with same letter(s) or without letter do not differ significantly whereas figures with different letters differ significantly (as per DMRT)

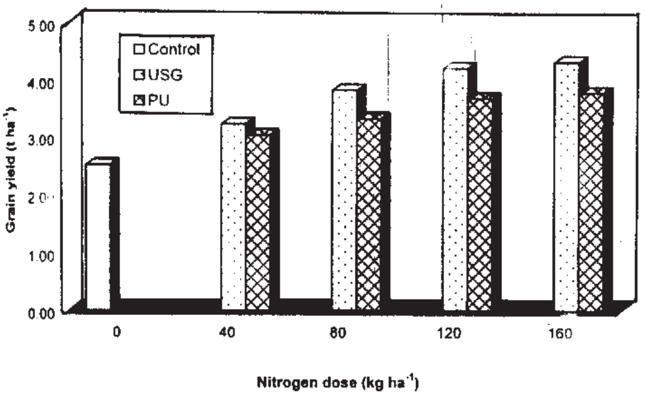
Table 3: Interaction effects of variety and source and level of N on yield and yield components of transplant *aman* rice

Variety x source and level of N	No. of effective tillers hill^{-1}	Panicle length (cm)	No. of total Spikelets Panicle^{-1}	No. of grains panicle^{-1}	No. of straile spikelets Panicle^{-1}	1000-grain weight (g)	Grain yield (t ha^{-1})	Straw yield (t ha^{-1})
Hybrid rice 6201 × 0 kg N ha^{-1}	6.11 h	25.0	143.00	82.90	60.10 a	20.80	2.35 k	3.46 m
Hybrid rice 6201 × 40 kg N ha^{-1} as USG	6.49 g	25.3	123.40	78.37	45.03 bc	21.00	2.91 i	4.05 ij
Hybrid rice 6201 × 80 kg N ha^{-1} as USG	8.23 d	25.6	134.93	80.77	54.17 ab	21.40	3.39 fg	4.68 g
Hybrid rice 6201 × 120 kg N ha^{-1} as USG	8.69 c	25.44	137.23	89.77	47.47 bc	21.50	3.56 ef	5.42 c
Hybrid rice 6201 × 160 kg N ha^{-1} as USG	9.32 b	26.02	152.00	91.10	60.90 a	21.70	3.89 cd	5.88 a
Hybrid rice 6201 × 40 kg N ha^{-1} as PU	6.07 h	25.2	109.23	62.20	47.03 bc	21.25	2.83 ij	4.00 jk
Hybrid rice 6201 × 80 kg N ha^{-1} as PU	7.40 e	25.24	136.00	89.60	46.40 bc	21.31	3.15 h	4.13 i
Hybrid rice 6201 × 120 kg N ha^{-1} as PU	8.06 d	25.7	125.60	79.23	46.37 bc	21.56	3.41 fg	4.64 f
Hybrid rice 6201 × 160 kg N ha^{-1} as PU	8.79 c	26.03	131.30	88.03	43.27 c	21.73	3.72 de	5.82 a
BRRI dhan 32 × 0 kg N ha^{-1}	6.31 gh	23.2	100.16	78.80	21.37 d	20.98	2.67 j	3.06 n
BRRI dhan 32 × 40 kg N ha^{-1} as USG	6.85 f	23.5	117.10	97.67	19.43 d	21.26	3.57 ef	3.82 l
BRRI dhan 32 × 80 kg N ha^{-1} as USG	8.73 c	23.6	117.06	97.47	19.60 d	21.42	4.26 b	4.44 h
BRRI dhan 32 × 120 kg N ha^{-1} as USG	9.64 a	24.2	116.50	94.77	21.73 d	21.45	4.87 a	5.25 d
BRRI dhan 32 × 160 kg N ha^{-1} as USG	9.71 a	24.7	110.77	90.67	20.10 d	21.88	4.74 a	5.57 b
BRRI dhan 32 × 40 kg N ha^{-1} as PU	6.58 fg	23.4	102.10	78.70	23.40 d	21.19	3.26 gh	3.88 kl
BRRI dhan 32 × 80 kg N ha^{-1} as PU	8.0 d	23.4	122.73	100.57	22.17 d	21.40	3.51 f	3.99 jk
BRRI dhan 32 × 120 kg N ha^{-1} as PU	9.45 ab	23.8	123.60	96.27	27.33 d	21.85	3.95 c	4.50 h
BRRI dhan 32 × 160 kg N ha^{-1} as PU	9.47 ab	24.5	124.90	103.30	21.60 d	21.80	3.83 cd	5.11 e
Level of significance	0.01	NS	NS	NS	0.01	NS	0.01	0.01

In a column, figures with same letter(s) or without letter do not differ significantly whereas figures with different letters differ significantly (as per DMRT)

led to the highest grain yield (3.85 t ha^{-1}) which was statistically better than that of Hybrid rice 6201. On the other hand, despite the production of significantly longer panicle length and higher number of total spikelets panicle^{-1} Hybrid rice 6201 could not outyield BRRI dhan 32 probably because of production of more number of sterile spikelets. However, in respect of straw yield Hybrid rice 6201 performed well compared to BRRI dhan 32 and produced the highest straw yield (4.70 t ha^{-1}).

Effects of source and level of N: Yield and yield components of Transplant *aman* rice were influenced significantly due to the source and level of N (Table 2). Number of effective tillers hill^{-1} increased with the increasing level of N regardless of the sources over the control but the highest number of effective tillers hill^{-1} was achieved from USG applied at 160 kg N ha^{-1}. The second highest number of effective tillers hill^{-1} was also counted with the same at 120 kg N ha^{-1} which indicates that USG performed better at a lower level compared to PU with higher level. In the same manner, panicle length increased progressively with the increasing levels of N regardless of sources but the longest panicle length was found with USG applied at 160 kg N ha^{-1}, which was statistically similar to that of PU applied at the same level. Weight of 1000-grain increased with the increasing level of N up to 160 kg regardless of sources but the heaviest grain was obtained from



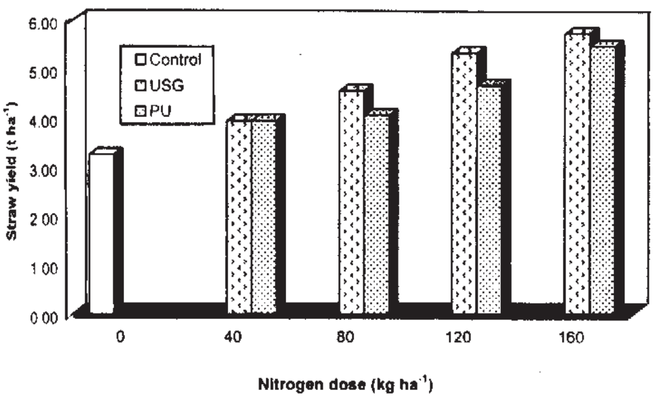


Fig. 1: Effect of sources and doses of nitrogen on grain and straw yields of transplant aman rice

USG applied at 160 kg N ha^{-1}, which was identical with PU applied at 160 and 120 kg N ha^{-1}. Similarly each increment of N level increased grain and straw yields irrespective of sources (Fig. 1). Due to the production of almost all superior yield components USG at 160 kg N ha^{-1} produced the highest grain yield which was identical with that of 120 kg N ha^{-1} of the same source. On the other hand, the control treatment gave the lowest grain yield. Figure 1 also reveals that comparatively higher grain yields were obtained from USG than those of PU at all respective levels of N. Probably the slow release property of deeply placed USG was responsible for this better performance in producing the yield and yield components of Transplant *aman* rice. This result is almost in conformity with that of Islam and Black (1998) who found that hybrid rice with deeply placed USG gave 17% higher grain yield than hybrid plot that received PU. Almost similar trend was also observed in case of straw yield.

Interaction effects of variety and source and level of N: Yield and yield components of Transplant *aman* rice as influenced by interaction of variety and source and level of N are presented in Table 3. The table reveals that among the yield components studied only the number of effective tillers hill^{-1} and sterile spikelets panicle^{-1} varied significantly due to the interaction effect of variety and source and level of N. But panicle length, number of total spikelets panicle^{-1}, grains panicle^{-1} and 1000-grain weight did not show significant variation due to the same. In terms of effective tillers hill^{-1} BRRI dhan 32 in combination with the higher levels (160 and 120 kg ha^{-1}) of N of either source performed better than any other combination. But in respect of sterile spikelets panicle^{-1} interaction of Hybrid rice 6201 and USG at 160 kg N ha^{-1}produced the highest number of sterile spikelets panicle^{-1}. On the other hand, BRRI dhan 32 irrespective of source and level on N produced the minimum and statistically identical number of sterile spikelets panicle^{-1}. Considering grain yield, BRRI dhan 32in combination with USG at 120 kg N ha^{-1} claimed significant superiority to other treatments and gave the highest grain yield (4.87 t ha^{-1}) which was similar to that of USG at 160 kg N ha^{-1} but significantly higher than that of any other interaction.

Results of the experiment reveal that the performance of BRRI Dhan 32 was better than that of Hybrid rice 6201 in the transplant *aman* season. USG as a source of N is more efficient and economic than PU. BRRI Dhan 32 produced the highest grain yield with USG at120 kg ha^{-1} which was statistically identical with that of USG at 160 kg N ha^{-1}. Therefore, the former dose may be considered as a suitable one from economic point of view. Hybrid rice 6201 gave the highest yield with the highest N level from USG which does not ventilate any clue for deciding the optimum N level for the variety.

References

BARC., 1989. Fertilizer recommendation guide. Bangladesh Agricultural Research Council, Publication No. 32. Khamarbari, Farmgate, Dhaka, pp: 23-24.

Gomez, K.A. and A.A. Gomez, 1984. Duncan's Multiple Range Test. Statistical Procedures for Agricultural Research. 2nd Edn., Wiley Inter-Science Publication, John Wiley and Sons, New York, pp: 202-215.

Islam, M.M. and R.P. Black, 1998. Urea super granule technology-impact and action plan for 1988-1989. Proceedings of the National Workshop on Urea Super Granule (USG) Technology, June 25, 1998, BARC., Dhaka, Bangladesh.

Prashad, R. and S.K. de Datta, 1979. Increasing fertilizer nitrogen efficiency in wetland rice. In: Nitrogen and Rice, International Rice Research Institute, Los Banos, Philippines, pp: 465-497.

Roy, B., 1985. Nitrogen use efficiency in transplanted rice with point placement method. Oryza, 22: 53-56.

Virmani, S.S., 1994. Prospects of Hybrid Rice in the Tropics and Subtropics. In: Hybrid Rice Technology: New Developments and Future Prospects, Virmani, S.S. (Ed.). International Rice Research Institute, Manila, Philippines, pp: 7-19.

Yuan, L.P., 1994. Increasing Yield Potential of Rice by Exploitation of Heterosis. In: Hybrid Rice Technology: New Development and Future Prospects, Virmani, S.S. (Ed.). International Rice Research Institute, Los Banos, Manila, Philippines, pp: 1-6.