Point Placement of Multi-Nutrient Super Granules on Rice

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Abstract

Two separate field experiments were carried out in two different agro-ecological zones in Bangladesh. The experimental sites selected were the Bangladesh Agricultural University (BAU) farm in Mymensingh and a farmers' field in Madhupur. The objective was to investigate the response of super granules of urea (USG), Urea-DAP and NPK on HYV rice crops. Soil types under investigation at both the BAU farm site and at the Madhupur farmers' field were silt-loam in texture and poor in nutrient status. The soil reaction was mildly acidic (pH 6.8) at the BAU farm, while it was strongly acidic at the Madhupur farmers' field (pH 5.5). Fertilizer treatments used in the experiments were (1) Control (without any fertilizer), (2) Urea (70 kg N ha^{-1} from urea), (3) USG (52 kg N ha^{-1} from USG super granule), (4) Urea-DAP SG (52 kg N and 20 kg P_2O_5 ha^{-1} from Urea-DAP super granule) and (5) NPK SG (52 kg N, 20 kg P_2O_5 and 20 kg K_2O ha^{-1} from NPK super granule). In treatments 2-3, P, K, S and Zn fertilizers were applied as basal @ 40 kg P_2O_5, 40 kg K_2O, 20 kg S and 3 kg Zn ha^{-1} respectively. In treatment 4, K was applied as basal @ 40 kg K_2O ha^{-1} along with S and Zn as in treatments 2-3, while in the case of treatment 5, S and Zn were applied as basal as in treatments 2-3. USG, Urea-DAP, and NPK super granules were point placed after 7 days of transplanting at a depth of 7 centimeter between every fourth rice mound. Each treatment was replicated four times in a completely randomized block design. Test crops used were HYV rice, BR-30 at the BAU farm and BR-11 at the Madhupur farmers' field. The experiments were conducted during the wet season (July-November) of 2001. Point placement of USG, Urea-DAP and NPK super granules greatly increased the grain yields of rice. The highest increase in grain yield was recorded in NPK super granule followed by Urea-DAP and USG point placemen at both of the experiment site. The maximum grain yield at the BAU farm recorded was 6.23 t ha^{-1}, while at the Madhupur farmers' field it was 5.73 t ha^{-1} using the NPK super granule point placement. The minimum yields of rice grain were obtained in the control treatment at both the BAU (3.41 t ha^{-1}) and Madhupur farmers' field (3.22 t ha^{-1}). Point placement of USG and multi-nutrient fertilizers in super granules both NP and NPK appeared to be highly promising for application on wetland rice.

Keywords: USG, Urea-DAP, NPK, Super-granules, Rice

Introduction

Urea is the most dominant form of nitrogen fertilizer used for rice production in Bangladesh. The rice ecosystems also favor high losses (60-70% of N applied) of urea fertilizer. Because of agronomic superiority and cost effectiveness of point placed urea super granules over split broadcast urea

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(BARC, 1985; Kumar, *et al*., 1989; Savant and Stangel, 1990, Haque, 2000), use of USG has become attractive and is being popularized among the country's farmers. An average of 15-20% yield increase of paddy with 25% less N in USG was reported to have been achieved in different areas of the Tangail district in Bangladesh over that of split-applied N as pilled urea (Haque,1998). The primary benefit: cost ratios of hand deep-placed USG in line transplanted rice have been found to be quite reasonable and are usually >5 for small scale rice farmers (Haque, 1998).

Multi-nutrient super granules, such as USG with DAP were experimentally found to be sound for wetland transplanted rice paddy. Its application technology is similar to that of USG, which is already known to the farmers. Recent developments in USG agro-technology (Savant et al.) include use of USG/Urea containing Di-ammonium phosphate as a NP source for both rain-fed and irrigated transplanted rice. It has a particular advantage in soils with high P-fixing capacity such as the red terrace soils of Madhupur in Bangladesh (Haque, 2001). Use of deep point placement of NPK super granules in rice is a recent development in multi-nutrient fertilizer technology in Bangladesh and was first initiated in the present research work. Use of urea-DAP and NPK super granules in addition to USG are expected to reduce fertilizer handling by the farmers as well as to improve efficiency of applied fertilizers. Thus, the objective of the investigation was to increase the efficiency of applied fertilizer and boost crop production through field research trials on USG and multi-nutrient super granules such as Urea-DAP and NPK on rice, the staple food crop of Bangladesh.

Materials and Methods

Two separate field experiments were carried out in two different agro-ecological zones in Bangladesh. The selected sites were old Brahmaputra Floodplain at the Bangladesh Agricultural University (BAU) farm, Mymensingh and the Madhupur Tract at a farmers' field in Madhupur. The experimental site at the BAU farm was medium-high land with silt-loam soil texture. The soil properties were: pH of 6.8, CEC 11.20 m.e.%, organic matter content 2.34%, total N 0.16%, available P 0.66 ppm, exchangeable K 0.12 m.e.% available S 4.0 ppm and Zn 12.81 ppm. The experimental site at Madhupur was also high land with silt loam in soil texture. The soil properties were: pH of 5.5, CEC 5.6 m.e.%, organic matter content 1.28%, total N 0.08%, available P 0.82 ppm, exchangeable K 0.04 m.e.%, available S 5.0 ppm and Zn 0.59ppm.

Fertilizer treatments used in both the experiments were (1) Control (without any fertilizer), (2) Urea (70 kg N ha^{-1} from urea), (3) USG (52 kg N ha^{-1} from USG super granule), (4) Urea-DAP SG (52 kg N and 20 kg P_2O_5 ha^{-1} from Urea-DAP super granule) and (5) NPK SG (52 kg N, 20 kg P_2O_5 and 20 kg K_2O ha^{-1} from NPK super granule). In treatments 2-3, P, K, S and Zn fertilizers were applied as basal @ 40 kg P_2O_5, 40 kg K_2O, 20 kg S and 3 kg Zn ha^{-1} respectively. In treatment 4, K was applied as basal @ 40 kg K_2O ha^{-1}along with S and Zn as in treatments 2-3, while in the case of treatment 5, S and Zn were applied as basal as in treatments 2-3. USG, Urea-DAP, NPK super granules were point placed after 7 days of transplanting at a depth of 7 centimeters between every fourth rice

mound. Each treatment was replicated four times in a completely randomized block design. Test crops used were HYV rice, BR-30 at BAU farm and BR-11, at the Madhupur farmers' field. The experiments were conducted during wet season (July-November) of 2001.

Results and Discussion

BAU farm:

Point placement of USG and multi-nutrient super granules had a great impact on the yield contributing attributes of rice plants at the BAU farm. Placement of USG almost doubled the number of effective tillers compared to the control treatment. Urea-DAP super granules had further increased the tiller numbers. The maximum number of effective tillers was obtained from NPK point placement (12.0). Similarly, length of panicles of the rice plants were positively effected by point placement of fertilizers over that of broadcast application. Number of filled grains was greatly boosted in the NPK plot as well as the Urea-DAP super granule point placement compared to the control treatment. In the control treatment, the number of filled grains was 61.7, whereas in the case of Urea-DAP and NPK super granules the filled grains panicles^{-1} were 106.0 and 115.0 respectively. Again, the increase of filled grains in the NPK point placement plot was 86.4% compared to 35.3% as obtained in standard urea (inclusive of other nutrients) applied broadcast. 1000-grain weight also increased with the point placement of fertilizer nutrients (Table 1).

Point placement of USG and multi nutrient super granules greatly increased grain and straw yields of rice. The grain yield increases ranged from 64.22-82.69% under point placed USG, Urea-DAP and NPK super granules over control, whereas in the case of standard urea treatment, the yield increase over the control treatment was only 27.56%. Among the USG and multi-nutrient treatments such as Urea-DAP and NPK super granules, the maximum grain yield increase was obtained from NPK super granule treatment (82.69%) and second highest yield increase (68.91%) was obtained from Urea-DAP super granule treatment. The maximum grain yield of rice (6.23 t ha^{-1}) was obtained in NPK super granule treatment, while the minimum grain yield (3.41 t ha^{-1}) was recorded from the control treatment (Table 2). Maximum straw yield of rice was obtained from NPK super granule

Table 1. Effects of USG and multi-nutrient super granules on yield components of rice at BAU farm

Treatment	No. of effective tillers hill^{-1}	Length of panicles (cm)	No. of grains/panicle		1000-grain. wt (g)
			filled	unfilled	
Control	5.3	21.0	61.7	12.0	20.7
Urea	7.7	23.7	85.0	15.0	23.0
USG	10.3	26.0	96.0	17.7	26.3
U-DAP SG	11.7	27.0	106.0	16.3	26.6
NPK SG	12.0	27.3	115.0	13.3	26.6

Table 2. Effects of USG and multi-nutrient super granules on grain and straw yields of rice at BAU farm

Treatment	Grain yield		Straw yield	
	(t ha^{-1})	over control	(t ha^{-1})	over control
Control	3.41 d	–	4.64 d	–
Urea	4.35 c	27.56	5.59 c	20.25
USG	5.60 b	64.22	6.45 b	39.00
U-DAP SG	5.76 b	68.91	6.57 b	41.59
NPK SG	6.23 a	82.69	7.32 a	57.75

Figures in a column having common letters do not differ significantly at 5% level of significance.

treatment (7.32 t ha^{-1}). The second highest straw yield of rice was obtained from Urea-DAP super granule treatment (6.57 t ha^{-1}), which, however, was statistically similar to that obtained from USG treatment (6.45 t ha^{-1}). USG and Urea-DAP super granule treatments produced significantly higher straw yields over urea treatment (Table 2).

Madhupur farmers' field:

The influence of point placement of nutrients over that of broadcast application of fertilizers on yield contributing attributes of rice plants was also recorded at the Madhupur farmers' field. Point placement of USG greatly increased the number of effective tillers hill^{-1} of the rice plants. The increase was more than 70% in comparison to the control treatment. A similar increase was obtained from Urea-DAP treatment. The maximum number of effective tillers was recorded in NPK point placement (12.3), which more than doubled the tiller numbers obtained from the control treatment (5.7). The maximum panicle length of the rice plants was also obtained in NPK point placement treatment, which was 27.3 cm compared to 19.7 cm obtained from the control. Increases in panicle length were much higher in the point placement of USG plots and in the Urea-DAP treatment plot compared to both the control and standard urea broadcast application. The number of filled grains was greatly boosted in the NPK point placed plots, as obtained from the BAU farm. The increase was 106.0% in NPK treatment compared to 44.7%, as obtained in standard urea treatment applied broadcast. 1000-grain weight as well increased with NPK point placement treatment over that of urea broadcast application (Table 3).

At the Madhupur farmers' field, the grain yield increases, due to USG and multi-nutrient super granules point placement, ranged from 59.63-77.95% over the control. In the case of standard urea broadcast application, the yield increase over the control treatment was only 30.75%. Among USG and the multi-nutrient treatments such as Urea-DAP and NPK super granules, the maximum yield increase was obtained from NPK super granule treatment (77.95%). The second highest yield increase (70.19%) was obtained from Urea-DAP super granule treatment (Table 4). The maximum grain yield of rice was obtained from NPK super granule treatment (5.73 t ha^{-1}), while the minimum grain was recorded in control treatment (3.22 t ha^{-1}). The maximum straw yield of rice was obtained in NPK

Table 3. Effects of USG and multi-nutrient super granules on yield components of rice at Madhupur farmers' field

Treatment	No. of effective tillers hill^{-1}	Length of panicles (cm)	No. of grains/panicle		1000-grain. wt (g)
			filled	unfilled	
Control	5.7	19.7	55.0	14.3	20.3
Urea	8.0	22.0	78.3	19.3	24.7
USG	9.7	25.3	92.0	20.0	27.0
U-DAP SG	11.7	26.3	105.3	15.0	28.0
NPK SG	12.3	27.3	113.3	18.3	28.3

Table 4. Effects of USG and multi-nutrient super granules on grain and straw yields of rice at Madhupur farmers' field

Treatment	Grain yield		Straw yield	
	(t ha^{-1})	over control	(t ha^{-1})	over control
Control	3.22 d	—	4.36 c	—
Urea	4.21 c	30.75	5.45 b	25.00
USG	5.14 b	59.63	5.69 b	30.50
U-DAP SG	5.48 a	70.19	5.95 b	36.47
NPK SG	5.73 a	77.95	6.74 a	54.59

Figures in a column having common letters do not differ significantly at 5% level of significance.

super granule treatment (6.74 t ha^{-1}). The second highest straw yield of rice was obtained from Urea-DAP super granule treatment (5.95 t ha^{-1}), which, however, did not significantly differ from that of USG (5.69 t ha^{-1}) or urea (5.45 t ha^{-1}) treatments. The minimum straw yield (4.36 t ha^{-1}) was recorded in the control treatment (Table 4).

Conclusion

The point placement of USG, Urea-DAP and NPK super granules greatly increased yield contributing attributes and yields of both rice grain and straw over that of standard broadcast application of urea with recommended rates of other fertilizer nutrients added. This is true for both the experiments at the BAU farm and the Madhupur farmers' field. Point placement of multiple fertilizer nutrients in the form of Urea-DAP and NPK super granules appear more promising in economizing fertilizer nutrient uses and increasing the yield of rice, which is the staple crop of Bangladesh.

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