

EFFECT OF UREA SUPER GRANULE ON THE PERFORMANCE OF CABBAGE IN YOUNG JAMUNA AND BRAHMAPUTRA FLOODPLAIN SOILS OF TANGAIL

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Abstract

A number of experiments were conducted at the Farming Systems Research and Development (FSRD) site, Palima, Tangail for three consecutive years to evaluate the efficiency of USG application in comparison with prilled urea on the yield and yield attributes of cabbage (cv. Atlas-70). There were five treatments, T₁= N₁₉₅ (recommended N dose for HYG, used as prilled urea), T₂= N₁₉₅ (recommended N dose for HYG, used as USG), T₃=N₁₇₅ (N 10% reduction of recommended N dose as USG), T₄= N₁₅₅ (N 20% reduction of recommended N dose as USG), and T₅= N₁₀₅ (Farmers' N dose used as prilled urea). Treatments T₁-T₄ received recommended dose of other nutrients (P₅₆K₁₆₂S₁₃Mo_{0.6}CD_{3t}) and T₅ received P₂₅K₉₀S₀Mo₀CD₅₁. Yield and yield-contributing characters of cabbage significantly responded to the application of USG. The highest head yield (78.1 t/ha) was obtained with the recommended dose of N as USG, and 10% (77.1 t/ha), and 20% (72.0 t/ha) less than the recommended dose of N as USG also produced higher yield than recommended prilled urea-N. Application of USG was found more efficient than prilled urea and the treatment N₁₉₅P₅₆K₁₆₂S₁₃Mo_{0.6}CD_{3t} (recommended N as USG for HYG) was found profitable for cabbage cultivation in terms of yield and the treatment N₁₇₅P₅₆K₁₆₂S₁₃Mo_{0.6}CD_{3t} (10% N reduction of recommended N dose as USG) was found profitable in terms of economic returns.

Keywords: USG, prilled urea, cabbage.

Introduction

Cabbage (*Brassica oleracea* var. *capitata* Lin.) is one of the popular and nutritious vegetable crops in Bangladesh for being a good source of vitamin A, B, and C, Ca and Fe (Atwal, 1976). It is cultivated all over the country with an annual production of 183 thousand metric tons (BBS, 2007). However, average yield (10.25 t/ha) of the crop in Bangladesh is low compared to that in some advanced countries of the world. The low yield of cauliflower in Bangladesh is primarily due to lack of high yielding varieties, inadequate manuring, and fertilization, especially nitrogen and improper agronomic practices.

Nutrient supply is a key factor in crop production, but global crisis of energy and high costs of fertilizer nutrients necessitate economizing their use. Nitrogen

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is the most deficient nutrient element in Bangladesh soil and cabbage needs a large amount of N fertilizer. Urea Super Granule (USG) is one of the popular N fertilizers and farmers have adopted it in *boro* rice cultivation. It was assumed that application of USG could also be profitable in different upland vegetables and fruit crops, such as cabbage, cauliflower, brinjal, banana, etc. According to Creswell and De Datta (1980), broadcast application of urea on the surface soil causes loss upto 50% but point placement of USG in 10 cm depth can save 30% nitrogen as prilled urea, increase absorption rate, improve soil health and ultimately increase rice yield (Savant *et al.*, 1991). It was reported that the grain yield of millet was the highest with BCUSG and the lowest with urea and in case of wheat, among N sources residual effects were in the order BCUSG>USG>BCU> urea (Sarker and Faroda, 1993). The N uptake and recovery of applied N were the highest in the USG + urea treatment and N use efficiency was highest with urea alone (Saha, 1984). In a field experiment, wheat grain yield increased with increasing residual N rate and was highest after deep placement of 120 kg N as USG (Das *et al.*, 1994). Modified urea materials under different moisture regimes influence NH₃ volatilization loss and significantly less NH₃-N loss was observed for USG treatments than from surface applied urea (Muneshwar *et al.*, 1992). However, research on USG management in cabbage is inadequate in Bangladesh. Therefore, the present study was undertaken to evaluate the efficiency of USG in comparison with prilled urea and also to determine the optimum dose of USG with respect to yield and yield attributes of cabbage.

Materials and Method

The experiment was carried out in the medium highland of AEZ-8 (Young Jamuna and Brahmaputra Floodplain) at the Farming Systems Research and Development site, Palima, Tangail of Bangladesh Agricultural Research Institute (BARI) during *rabi* seasons of 2000-2001, 2001- 2002 and 2002-2003. Prior to experimentation of 2000-01, the soil was analyzed for different properties. Soil is slightly acidic (pH 5.8) with medium contents of organic matter (1.72%), very low content of total N (0.072%), and P (5.20 µg/g), low k (0.1crnol/kg, S 13 (µg/g), B (0.91 µg/g), and high Zn (7.53 µg/g). The experiment was laid out in a randomized compete block design (RCBD) having 6 dispersed replications. Five treatments were T₁= N₁₉₅ (recommended dose for HYG, N as prilled urea), T₂= N₁₉₅ (recommended dose for HYG, N as USG), T₃= N₁₇₅ (N 10% reduction of recommended N dose as USG), T₄= N₁₅₅ (N 20% reduction of recommended N dose as USG), and T₅ = N₁₀₅ (Farmers' N dose, N as prilled urea). Farmers' dose was identified by the average dose of 30 farmers' practice in that area.

Treatments T₁=T₄ received 56 kg P, 162 kg K, 13 kg S, 0.6 kg Mo, and 3 tons of CD per ha (all recommended dose). The doses for farmer's practice (T₅)

were 25 kg P, 90 kg K, 0 kg S, 0 kg Mo, and 5 tons CD per ha. Moreover, a common dose of boron fertilizer was applied @ 1 kg B/ha for all the treatments. The unit plot size was 8 m × 5 m. and variety was Atlas-70. Seedlings were transplanted at a spacing of 45 cm × 60 cm for plant-plant and line-line, respectively. Transplantation was done with 30-day-old seedlings in the first week of November every year. Fertilizers were calculated on the basis of soil test values (FRG, 1997). Except prilled urea and USG, all other fertilizers and 50% MoP were applied during final land preparation. For each year, USG was applied at 10 days after transplanting (DAT), in ring method as 9-10 cm apart from the seedling base and at 7-8 cm depth in soil. Prilled urea was applied as 3 equal splits at 10 DAT, 25 DAT, and 35 DAT (head initiation stage) and covered with soil properly. Rest 50% MoP was applied with USG and prilled urea at 10 days after transplanting.

Three irrigations were applied at 15, 25, and 40 DAT. Two weeding and mulching were done at 20 and 30 DAT. The crop was also free from pest attack. Harvesting was started in January and continued upto the end of February. Data on yield and yield contributing characters were recorded from 10 plants selected randomly for each plot and total yield was calculated by multiplying average plant yield with plant population. Data were collected and analyzed statistically using MSTAT-C package and means were separated by DMRT at 5% level of significance.

Results and Discussion

Yield attributes of cabbage

Yield and yield contributing characters were studied and three years' pooled data are presented in Table 1 and economic analyses are presented in Table 2. Results revealed that among the characters except number of outer leaves, plant height, head diameter, head pericycle, head length, head weight with outer leaves, head weight without outer leaves and head yield showed significant differences among the treatments. Highest plant height (22.07cm) was found with the recommended USG dose, which was statistically similar to USG 10% < recommended dose and the lowest plant height (19.98cm) was resulted from farmers' practice. Highest head diameter (22.91cm), head pericycle (70.67cm) and head length (14.89 cm) were produced by the recommended USG, which was statistically similar to recommended prilled urea, 10% and 20% < recommended USG dose but different from farmers' practice. No significant difference was observed in number of outer leaves among the treatments.

Table 1. Effect of USG and PU on the yield contributing characters of cabbage (3 years average data).

Treatments	Plant height (cm)	Head diameter (cm)	Head pericycle (cm)	Head length (cm)	Head wt with outer leaves (kg)	Head wt without outer leaves (kg)	Head yield (t/ha)
Prilled urea (Rec. N)	21.00b	21.97a	67.86a	14.28a	2.73bc	2.08bc	70.03b
USG (Rec.N)	22.07a	22.91a	70.67a	14.89a	3.00a	2.35a	78.07a
USG (10%<Rec.. N)	21.82a	22.78a	69.81a	14.77a	2.97ab	2.28ab	77.10a
USG (20%<Rec. N)	21.17b	22.20a	67.96a	14.49a	2.79ab	2.13b	72.03b
Farmers' dose	19.98c	20.61b	64.85b	13.49b	2.52c	1.89c	61.07c
LSD (5%)	0.60	1.35	2.91	0.89	0.24	0.20	3.97
CV (%)	1.49	3.25	2.26	3.33	4.55	4.82	2.94

Means followed by common letters are not significantly different at 5% level of probability.

Head weight with outer leaves and head weight without outer leaves also differed significantly among the treatments. The highest head weight with outer leaves (3.00 kg) was obtained from the recommended USG, which was statistically identical with 10% and 20% reduction of the N dose (USG), but it was significantly higher than recommended prilled urea and farmers' practice. The highest head weight without outer leaves (2.35 kg) was also obtained from recommended USG followed by 10%< than recommended USG dose (2.28 kg), but different from all other treatments. Farmers' dose produced the lowest head weight without outer leaves (1.89 kg). It was due to minimized ammonia volatilization loss and less NH₃-N loss for USG treatments as reported by Muneshwar *et al.* (1992).

Head yield of cabbage

Head yield of cabbage was significantly influenced by the application of different doses of prilled urea and USG (Table 1). It appeared that in general yield of cabbage was increased by the application of USG in comparison with prilled urea and the highest yield (78.07 t/ha) was obtained from recommended N dose as USG, which was statistically identical with the treatment 10%< recommended USG (77.10 t/ha), but it was different from recommended prilled urea and 20%< recommended USG. This might be due to the higher use efficiency of nitrogen by the slow releasing property of USG and its deep placement. This result was

supported by the findings of Setty *et al.* (1987) where USG produced the highest grain yield in rice. Das *et al.* (1994) reported that wheat grain yield increased with increasing residual nitrogen rate and was highest after deep placement of 120 kg N as USG. The soil test value showed that the experimental field was deficit in N, P, K, and S. So, the application of these fertilizers including P probably helped maintaining the soil fertility and showed favourable response to the required nutrients. Muneshwar *et al.* (1992) reported that modified urea materials under different moisture regimes influence ammonia volatilization loss and significantly less $\text{NH}_3\text{-N}$ loss was observed for USG treatments than from surface applied urea. So, the application of 10% less N fertilizer as USG also performed better than the recommended prilled urea due to higher uptake and recovery rate of N, and minimum volatilization loss of N fertilizer. Similar result was observed by Saha (1984) where N uptake and recovery of applied N were the highest in the USG + urea treatment and N use efficiency was highest with urea alone. Farmers' practice resulted in the lowest yield (61.0 t/ha) due to unbalanced fertilizer use.

Cost and return analysis

Economic evaluation of different treatments has been shown in Table 2. Though higher cost was involved in USG practice and 10% less USG than recommended dose in comparison with prilled urea, the highest gross margin (Tk.117588) was obtained from the N recommended dose of N as USG among the treatments. Even 10% and 20% <rec. USG showed higher gross return (Tk.190342 and Tk. 189286) and gross margin (Tk. 116847 and Tk. 105904) than prilled urea and farmers' dose. The highest and similar benefit cost ratio (BCR) of 2.61 was achieved from USG use as a source of N and USG 10% < recommended dose. But the lowest BCR was resulted from prilled urea treatment due to higher fertilizer cost and lower yield performance. MBCR was also higher in USG treated plot and the highest MBCR (12.83) was obtained from USG 10% <rec. dose followed by recommended USG dose. The present study indicates that USG, as a source of N is more efficient than that of prilled urea. Therefore, 175 to 195 kg N as USG i.e., 10-12 balls of USG (0.90 g/ball) per plant, placing 9-10 cm apart from plant base and 7-8 cm depth in soil as ring method at 10 DAT along with other fertilizers as $\text{N}_{175} \text{P}_{56} \text{K}_{162} \text{S}_{13} \text{Mo}_{0.6} \text{CD}_{3t}$ (N 10% <Recommended dose as USG) to $\text{N}_{195} \text{P}_{56} \text{K}_{162} \text{S}_{13} \text{Mo}_{0.6} \text{CD}_{3t}$ (Recommended dose for HYG, N as USG) was found the most suitable dose for obtaining the maximum yield and economic benefit in cabbage cultivation in the Young Jamuna and Brahmaputra Floodplane soils of Tangail in Bangladesh.

Table 2. Cost and return analysis of the treatments effect on cabbage production (Average of 3 years).

Treatments	Gross return (Tk./ha)	TVC (Tk./ha)	Gross margin (Tk./ha)	BCR	MBCR over control
Prilled urea (Rec. N)	171693	72754	98939	1.74	5.7
USG(Rec.N)	190342	72754	117588	2.61	11.8
USG(10%<Rec.N)	189286	72439	116847	2.61	12.8
USG(20%<Rec.N)	178085	72181	105904	2.47	9.6
Farmers' dose	153889	69679	84210	2.20	-
<u>Price of inputs: Tk./kg</u>		<u>Price of output: Tk./kg</u>			
Urea	: 5.70	Cabbage	: 2.50		
USG	: 6.00				
TSP	: 14.00				
MoP	: 9.00				
Gypsum	: 4.00				
Zinc sulphate	: 35.00				

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