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Profitability of urea super granule as a source of nitrogen on the yield and yield attributes of mustard

Rojina Akter[1], Md. Mahmudul Hasan Khan[2*] Muhammad Ziaur Rahman[3]

[1]*Scientific officer, Agronomy Division, Regional Agricultural Research Station, Bangladesh Agricultural Research Institute, Rahmatpur, Barisal, Bangladesh*

[2]*Scientific officer ,Plant Breeding Division, Regional Agricultural Research Station, Bangladesh Agricultural Research Institute, Rahmatpur, Barisal, Bangladesh*

[3]*Scientific officer ,Plant Pathology Division, Regional Agricultural Research Station, Bangladesh Agricultural Research Institute, Rahmatpur, Barisal, Bangladesh*

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Abstract

A field experiment was carried out at the field laboratory of Department of Agronomy, Sher-e-Bangla Agricultural University, Dhaka during the period from 6thNovember / 2009 to 10th February / 2010 to assess the feasibility of using Urea Super Granule (USG) over normal urea in up land crop, like mustard. The experiment was laid out in a Split plot Design with 3 replications. There were a total of 36 unit plots. The size of the unit plot was 4.25 × 2.5m. There were two factors, *viz.* Factor 1.USG point placement and factor 2.Variety (BARI Sarisha 11, BARI sarisha-13 and BARI sarisha-14). The treatments were, T_1= Normal urea, T_2 = USG as basal, T_3 = USG at 15 DAE (Days after emergence) and T_4 = USG at 25 DAE (Days after emergence). The effect of different management of nitrogenous fertilizer was studied on growth, yield and yield attributing characters of mustard. The analysis revealed that the growth, yield and yield attributes of the cultivars were significantly influenced by USG with a few exceptions. Plant height, number of branches plant^{-1}, number of leaves plant^{-1}, leaf area plant^{-1}, total dry matter, number of siliqua plant^{-1}, siliqua length, number of seed siliqua-1, 1000-seed weight, and seed yield were found highest when USG was applied as basal dose and all the characters showed lowest value when USG was applied at 25 DAE.

* **Corresponding Author:** Md. Mahmudul Hasan Khan ✉ mhasan.bari12@gmail.com

Introduction

Mustard is the most important edible oil crop in Bangladesh. It belongs to family Cruciferae and genus *Brassica*. Bangladesh is facing acute shortage in edible oil. Mustard covers an area of 325053 hectares of land in Bangladesh and produces 359452 metric tons of oil seeds which are about 83.33 % of total acreage and 39.87 % of total oil seed production and which meets only 11.2% of total demands of the country (BBS, 2015).

The value of imported oil seeds and edible oils was TK 27612 million and TK 122772 million which were 0 .87 % and 3.88 % of the total value of imports (TK 3165162 million) respectively (Bangladesh bank, 2016). Oil seed crops are pushed down to marginal land because of their low yield and increasing rice producing area to meet food demand. Their yield is low due to improper use of fertilizers and inputs, lack of high yielding variety and lower management practices. High yielding varieties of mustard are very responsive to fertilizers, particularly nitrogen. But nitrogen is the most limiting nutrient element because of its high mobility and different types of losses like leaching, volatilization and mobilization (Crasse Well and De Dutta 1980; Bhuiyan *et al.*, 1990; Zaman *et al.*, 1993). To improve nitrogen use efficiency different types of fertilizer materials are available in the market. Urea super granule is a slow releasing nitrogenous fertilizer and farmers have adopted it in boro rice cultivation.

It is assumed that application of USG can also be profitable in different upland crops like vegetables, fruits and oil seed crops. Several research reports showed that USG is more efficient than that of prilled urea. Prilled urea application by broadcast method causes loss upto 50% while point placement of USG in 8-10 cm depth save 30% nitrogen than prilled urea (Crass Well and De Dutta; 1980).

Deep placement of modified urea materials in the form of USG under different moisture regimes reduce NH_3 volatilization loss, increase absorption rate, improve soil health and ultimately increase yield (Savant *et al.*, 1991; Muneshwar *et al.,* 1992).

Therefore the present study was undertaken to evaluate the efficiency of USG in comparison with prilled urea and to reduce economic loss.

Materials and method

The experiment was conducted in the medium high laid, the soil was silty loam belonging to the Madhupur tract under AEZ 28. Prior to experimentation the soil was analyzed for different properties.

The experiment was laid out in a split plot design having 3 replications and 2 factors, such as USG application and variety.

The treatments were T_1= Normal urea application, T_2= Application of USG as basal dose, T_3= Application of USG at 15 DAE (Days after emergence), T_4=Application of USG at 25 DAE. All the treatment received TSP 120 kg/ha, MoP120 kg/ha, gypsum 180 kg/ha, and borax 10 kg/ha (BARI recommended dose). Total amount of TSP, MoP, gypsum and borax were applied as basal during final land preparation.

In T_1 treatment half of prilled urea was applied during final land preparation and rest half was applied before flowering (52 DAS). In USG treatments USG was placed in rows maintaining distance of 10 cm and depth 5 cm.

Three irrigations were applied at 15, 30 and 50 DAS. Data on yield and yield contributing characters were recorded from 10 plants selected randomly from each plot. Data were collected and analyzed statistically using MSTAT-C package and means were separated by DMRT at 5% level of significance.

Result and discussion

Yield and yield attributes

There were significant variation among the treatments in respect of all the characters studied except plant height, no. seeds siliqua^{-1} and 1000 seeds weight.

Table 1. Soil analysis values of different samples collected from experimental plot.

Elements	OM	Total nitrogen	P(µg/g)	K(meq/100g)	S(µg/g)	B(µg/g)	Zn(µg/g)
Soil test value	1.21	0.083%	4.93	0.1	13	0.89	5.53
Interpretation	Low	Very low	Low	Low	Medium	Very low	Optimum

The highest plant height (117.2 cm) was recorded from T_2 (USG application as basal dose) treatment and lowest (104 cm) was observed in T_4 (USG application at 25 DAE) treatment which was statistically similar to that in T_3 (USG application at 15 DAE) (107.8 cm) treatment. The rate of branching (primary branch 6.36, secondary branch 12.27) was highest in T_2 treatment followed by T_1 treatment (5.86 and 10.80 respectively) (table 2). The branching (5.08 and 6.62 respectively) was observed inT_3 and T_4treatment respectively.

Table 2. Effect of USG on plant growth and development of plant.

Treatments	Plant Height (cm)	No. of Leaf plant^{-1}	No. of Primary Branches plant^{-1}	No. of Secondary Branches plant^{-1}	Leaf Area (cm^2)
Normal Urea (T_1)	111.9 b	12.53 b	5.86 b	10.80 ab	156.4 b
USG Basal (T_2)	117.2 a	14.32 a	6.36 a	12.27 a	191.8 a
USG 15 DAE(T_3)	107.8 c	11.50 c	5.37 c	9.32 b	116.2 c
USG 25 DAE(T_4)	104.0 c	10.99 c	5.08 c	6.62 c	105.1 c
S-$_x$	1.36	0.28	0.11	0.59	4.94
CV %	3.70	6.77	5.85	18.18	10.40

These might be due to the fact that USG (basal dose) receiving plant got continuous supply of nitrogen and plant could better utilize them.A Seed yield is a combined result of various yield contributing characters such as siliqua plant^{-1}, length of siliqua, no. seeds siliqua^{-1} and 1000-seed weight. The maximum number of siliqua (330) was found in T_2 treatment which was statistically similar to that of T_1 (305.1) treatment and the lowest (182) number was observed in T_4 treatment. Result revealed that USG (basal) applied plot gave 3% more siliqua plant^{-1} than conventional (broadcasting) use of prilled urea. Nitrogen treatments significantly influenced the number of seeds per siliqua.

Table 3. Effect of USG on yield and yield contributing characters of mustard.

Treatments	no. of Siliqua plant^{-1}	Length of Siliqua (cm)	Total Dry Matter (g)	no. of Seed Siliqua^{-1}	1000 Seed Weight (g)	Yield (t ha^{-1})
Normal Urea (T_1)	305.1 a	5.248	45.69 a	24.72 b	3.771 b	1.475 b
USG Basal (T_2)	333.0 a	5.198	48.55 a	26.47 a	3.917 a	1.649 a
USG 15 DAS(T_3)	232.0 b	4.943	37.82 b	23.61 c	3.728 b	1.281 c
USG 25 DAS(T_4)	182.8 c	4.707	28.56 c	21.47 d	3.579 c	1.170 c
S-$_x$	14.58	NS	2.48	0.31	0.05	0.04
CV %	16.62	15.09	18.54	3.92	3.71	8.99

Highest seeds siliqua^{-1} (26.47) was observed in T_2 treatment. USG basal dose treated plot gave 1.07% more seeds siliqua^{-1} over prilled urea. Similar result was observed by Masum (2008) that was higher number of filled grains panicle^{-1} was obtained with USG (105.91) than prilled urea in aman rice cultivation. Maximum 1000-seed weight was observed in T_2 treatment and lowest in T_4 treatment which was similar to the observation of Ahmed *et al.* (2000). Maximum seed yield (2.06 t ha^{-1}) at T_2 treatment showed its superiority over prilled urea and gave 1.09 % more yield over prilled urea though they

are statistically similar. Lowest yield was obtained from T_4 treatment where USG was applied at 25 days after emergence. BRRI (2000) reported that USG gave 18% more yield over prilled urea in aman rice. Similar results were reported by Mishra *et al.* (2000). Highest stover yield (3.86 t ha^{-1}) was gained from T_2 treatment and lowest (2.67 t ha^{-1}) from T_4 treatment.

USG treated plant performed better than prilled urea. This may be due to the facts that loss of nitrogen was lower, solubility was synchronized and there was availability of nitrogen over the whole growing period for its proper growth and development. As a result dry matter partitioning from source to sync was higher and ultimately higher was obtained.

Table 4. Cost and return analysis of the effect of USG on mustard.

Treatment	Input cost/ha (Traded)	Input cost tk/ha (non traded)	Labour cost tk/ha	Total cost tk/ha	Gross return tk/ha	Gross margin tk/ha	BCR
Prilled urea	8000	17000	7200	32200	51625	19425	1.60
USG basal	6700	15000	8000	29700	57715	28015	1.94
USG15 DAE	6700	15000	8000	29700	44800	15100	1.50
USG25 DAE	6700	15000	8000	29700	40950	11250	1.37

Market price (Tk./kg) : mustard-35,USG-12,TSP-8,MoP-12,Gypsum-5,boric acid-110.

Economic analysis

Economic evaluation of different treatment has been shown in table 4. Comparatively low amount (60%) of urea was needed in mustard cultivation in case of using USG instead of PU though comparatively higher labours was involved in USG application. Weeding cost was lower in USG using plots.

The highest gross margin (Tk.28015) and gross return (Tk. 57715) was obtained from T_2 treatment where USG was applied as basal dose. T_2 treatment showed highest benefit cost ratio (1.94) the lowest benefit cost ratio (1.37) was obtained from T4 treatment where USG was applied at 25 days after emergence.

Conclusion

Point placement of USG is a new approach in increasing yield of crops with use of lesser amount of fertilizer. It saves fertilizers to a great extent through reduction of its uses because of increased agronomic efficiency and at the same time the approach is environmentally friendly since, the effect on environmental pollution is greatly minimized.

The current investigation the application of USG in mustard production was first trial. To find out its superiority it can be done in different agro-ecological zones of Bangladesh.

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