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Effects of Urea Super Granule as a Source of Nitrogen on the Growth and Yield of Tomato

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Abstract: An experiment was conducted with a view to observe the efficiency of Urea Super Granule (USG) on tomato. The variety, Ratan was tested in the farmer's field at FSRD site, Syedpur, Rangpur under Tista Meander Floodplain highland soils (AEZ No. 3) for two consecutive years during Rabi, 2001-02 and 2002-03. The experiment was laid out in RCB design with six dispersed replications. Two forms of urea i.e. prilled urea (PU) and USG with different rates were used. The two years' results revealed that urea super granule had significant positive effect on the yield of tomato as compare to normal urea. The recommended dose of N (150 kg ha^{-1}) from USG gave the significantly highest marketable fruit yield of 79.13 t ha^{-1} in 1st and 73.60 t ha^{-1} in 2nd year. It was also possible to harvest marketable fruit of 73.69 t ha^{-1} in 1st and 68.29 t ha^{-1} in 2nd year and 68.13 t ha^{-1} in 1st and 62.45 t ha^{-1} in 2nd year using 90% (135 kg ha^{-1}) and 80% (120 kg ha^{-1}) recommended dose of N from USG and these yields were statistically identical to the yield (67.22 t ha^{-1} in 1st and 60.23 t ha^{-1} in 2nd year) obtained from 150 kg ha^{-1} N from prilled urea. The 150 and 135 kg ha^{-1} of N from USG gave 11 and 2% higher yield of tomato than that of using 150 kg ha^{-1} N from prilled urea, respectively. These results implied that efficiency of USG was found to be positive on the yield of tomato and 20% N might be saved using USG compare to PU. The economic analysis also showed that the use of urea super granule was economically viable to cultivate the tomato. Farmers show their willingness to use USG.

Key words: Urea super granule, source of nitrogen, tomato

INTRODUCTION

Nitrogen is a major essential element for the plants and it is most limiting nutrient because of its high mobility and different kind of losses[1]. To improve the N use efficiency different types of fertilizer materials are becoming available in the market in our country. Urea Super Granule (USG) is one of the popular nitrogenous fertilizer, which is now available in the market and the farmers are already using it in boro rice. More recently, some researchers have tried USG as an alternative N source for wetland and it has been found to be quite superior to PU in terms of efficiency in wetland rice culture[2-7]. Prasad and De Datta[8] and BRRI[9] reported that USG is a superior source of N over PU. Farmers are now also using it in different upland vegetables and fruit crops such as, brinjal, cabbage, cauliflower, tomato, banana etc. These crops are growing in Rangpur region in a considerable area and the area under these crops are increasing day by day. But the efficiency of USG to these upland crops are not yet to be established, however, a few farmers are already using it in their crops. Therefore, it is very important to evaluate the efficiency of USG on different upland crops. Keeping this view in mind the present experiment was undertaken to:

- examine the effect of USG application on the yield of tomato;
- to compare the superiority of USG application over PU and
- observe farmer's reaction on its acceptability.

MATERIALS AND METHODS

The experiment was carried out in the farmer's fields at Syedpur FSRD site, OFRD, Rangpur, Bangladesh for two consecutive years during Rabi 2001-02 and 2002-03. The field was high land with loamy soils under AEZ No. 3. The design of the experiment was RCB with six dispersed replications. Tomato (variety Ratan) was tested using two forms of urea (prilled or normal and urea super granule) considering the following treatments:

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T_1 = Recommended dose (150 kg ha^{-1}) of N from prilledurea+40-140-30-4-1-5000kg P-K-S-Zn-B-cow dung ha^{-1}

T_2 = Recommended dose (150 kg ha^{-1}) of N from USG+40-140-30-4-1-5000 kg P-K-S-Zn-B-cow dung ha^{-1}

T_3 = 90% of recommended dose (135 kg ha^{-1}) of N from USG+40-140-30-4-1-5000 kg P-K-S-Zn-B-cow dung ha^{-1}

T_4 = 80% of recommended dose (120 kg ha^{-1}) of N from USG+40-140-30-4-1-5000 kg P-K-S-Zn-B-cow dung ha^{-1}

T_5 = Framers dose: 101 kg ha^{-1} N from prilled urea+34-62-9-2000 kg P-K-S-cowdung ha^{-1}

The land was properly prepared by country plough and power tiller. Well-decomposed cow dung was applied as per treatment during land preparation. All amount of TSP, gypsum, zinc sulphate and borax were applied during final land preparation as per treatment. The unit plot size of the experiment was 3.6×3 m. Forty to 42 and 34-35 day-old seedlings were transplanted during Dec. 1-4, 2001 and Nov. 26-27, 2002, respectively with a spacing of 60×45 cm. The requirement of urea (prilled and USG) and MP for one plant were calculated as per treatment and accordingly applied as a ring placement method in two equal splits. According to calculation 9, 8 and 7 number of USG balls per plant were applied in two splits (5, 4 and 4 number of USG balls at 15 days and 4, 4 and 3 number of USG balls at 35 days after transplanting in T_2, T_3 and T_4, respectively). A ring with a depth of 5-6 cm from the soil surface was made 10 and 20 cm apart from the plant during 1st and 2nd time of urea and MP application, respectively. The ring was covered with soil just after application of fertilizer.

Pruning of side suckers (two times), weeding, mulching, irrigation, pest management measures were taken as and when necessary. Harvesting of fruits started from 1st week of March and continued till 1st week of April both the year having 7-11 harvests. Data on the yield and yield contributing characters were recorded and analyzed statistically. Cost and return of all inputs and outputs were noted down and accordingly economic analysis was done.

RESULTS AND DISCUSSION

There was significant difference among the treatments in respect of all the characters studied except plant population at harvest both the years (Table 1 and 2). The highest plant height (95.4 cm) was recorded from T_2 (150 kg ha^{-1} N from USG), which was statistically identical with T_1 (150 kg ha^{-1} N from PU), T_3 (135 kg ha^{-1} N from USG) and T_4 (120 kg ha^{-1} N from USG) and the lowest recorded from T_5 (farmers' dose: 101 kg ha^{-1} N from PU). Maximum number of marketable fruits $plant^{-1}$ (33.5) was also observed in T_2 and minimum in T_5 (26.7). The highest fruit weight (2.42 kg $plant^{-1}$) was recorded from T_2 and the lowest (1.72 kg $plant^{-1}$) from T_5 (Table 1). Significantly the highest yield (79.13 t ha^{-1} in 1st and 73.60 t ha^{-1} in 2nd year) of tomato was recorded from the treatment T_2 where recommended doses (150 kg ha^{-1}) of N from USG were applied and it was statistically identical to the yield (73.69 t ha^{-1} in 1st and 68.29 t ha^{-1} in 2nd year) obtained from T_3 where 90% of recommended dose (135 kg ha^{-1}) from USG was used. The yield (68.13 t ha^{-1} in 1st and 62.45 t ha^{-1} in 2nd year) obtained from the treatment T_4 (80% of recommended N from USG) was also statistically identical to the yield (67.22 t ha^{-1} in 1st and 60.23 t ha^{-1} in 2nd year) of treatment T_1 (recommended dose of N from prilled urea). The lowest yield (58.53 t ha^{-1} in 1st and 54.34 t ha^{-1} in 2nd year) was calculated from the farmers' dose. The higher yield of T_2 might be due to higher number of fruits

Table 1: Effect of Urea Super Granule (USG) as a source of N on the yield attributes of tomato during Rabi 2001-2002 and 2002-03 at Syedpur FSRD site, OFRD, Rangpur

Treatments	Plant height at harvest (cm)	Plants m^{-2} at harvest (No.)	Marketable fruits $plant^{-1}$ (No.)	Marketable fruit weight $plant^{-1}$ (kg)
Year 1st: Rabi 2001-02				
T_1	92.4a	3.68a	29.7b	1.98b
T_2	95.4a	3.65a	33.5a	2.42a
T_3	92.2a	3.68a	29.5b	2.15b
T_4	91.4a	3.65a	27.6b	2.07b
T_5	87.0b	3.70a	26.7c	1.72c
CV (%)	3.4	1.90	9.1	10.10
Year 2nd: Rabi 2002-03				
T_1	90.6ab	3.65a	26.5b	1.70c
T_2	94.1a	3.60a	30.3a	2.20a
T_3	92.0a	3.67a	25.8bc	1.95b
T_4	90.3ab	3.63a	23.2cd	1.73c
T_5	86.1b	3.63a	22.7d	1.56c
CV (%)	4.5	2.30	8.7	8.50

Table 2: Effect of Urea Super Granule (USG) as a source of N on the yield of tomato during Rabi 2001-02 and 2002-03 at Syedpur FSRD site, OFRD, Rangpur

	Marketable fruit yield (t ha^{-1})				
Treatments	Year: 1st (2001-02)	Year: 2nd (2002-03)	Mean of 2 years	%Increased over T_1	%Increased over T_5
T_1	67.22b	60.23cd	63.73	-	13
T_2	79.13a	73.60a	76.37	20%	35
T_3	73.69ab	68.29ab	70.29	11%	26
T_4	68.13b	62.45bc	65.29	2%	16
T_5	58.53c	54.34d	56.44	NI	-
CV (%)	9.20	8.30	-	-	-

In a column, means followed by a common letter(s) are not significantly different at the 5% level by DMRT NI: Not increased

Table 3: Cost and return of tomato (Var. Ratan) production using USG and prilled urea at FSRD site, Syedpur, Rangpur during Rabi, 2001-02 and 2002-03

Treatments	Gross return (Tk ha^{-1})	Total variable cost (Tk ha^{-1})	Gross margin (Tk ha^{-1})	BCR	MBCR over farmer's dose	MBCR over PU (100%)	MRR (%)
Year 1st: Rabi 2001-02							
T_1	134400	44658	89742	3.01	2.62	-	-1485
T_2	158200	44985	113215	3.52	6.04	72.78	4616
T_3	147400	44756	102644	3.29	4.59	132.65	13265
T_4	136200	44528	91672	3.06	2.96	-	207
T_5	117700	38280	78720	3.06	-	-	-
Year 2nd: Rabi 2002-03							
T_1	195748	45988	149750	4.25	2.91	-	-5484
T_2	239200	46335	192865	5.16	9.06	128.94	7212
T_3	221943	46099	175844	4.81	6.80	259.36	25836
T_4	202963	45864	157098	4.43	4.10	-	310
T_5	176605	39428	137177	4.48	-	-	-
Mean of 2 years							
T_1	165074	45328	119746	3.64	2.77	-	-3515
T_2	198700	45660	153040	4.35	7.57	101.28	5947
T_3	184672	45428	139244	4.07	5.71	195.98	19498
T_4	169582	45196	124386	3.75	3.54	-	254
T_5	147153	38854	108299	3.79	-	-	-

Market price (Tk. kg^{-1}):

Item	Year 2001-02	2002-03
Prilled urea	6.00	6.00
USG	7.00	7.00
TSP	13.00	13.20
MP	8.70	8.70
Gypsum	3.00	3.00
Zinc sulphate	35.00	35.00
Borax	40.00	40.00
Cowdung	0.25	0.25
Tomato	2.00	3.25
100 tomato seedlings	10.00	10.00

per plant as well as yield per plant (Table 2). It can be assumed from the better performance of USG that N loss from this fertilizer was markedly less than that from PU. Similar results have been reported by many workers[7,10-12] for wetland rice. The 150 and 135 kg ha^{-1} of N from USG gave 11 and 2% higher yield of tomato than that of using 150 kg ha^{-1} N from prilled urea, respectively. Eusuf *et al.*[5] reported that application of USG gave 14% higher yield over PU using same dose of fertilizer in irrigated boro rice. Nitrogen with the rate of 150 and 135 kg ha^{-1} from USG gave 35 and 26% higher yield than farmers dose of N from PU. These results implied that efficiency of USG was found to be positive on the yield of tomato and 20% N might be saved using USG compare to PU. By using USG farmers can overcome the difficulty of applying fertilizer repeatedly. At the same time, by using USG, they can also save the amount of fertilizer. Similar results also reported by Eusuf *et al.*[4]. The plot using USG gave significantly higher yield than that of PU using similar doses of fertilizer[13]. Since 58 kg USG and 87 kg PU produced almost similar grain yield of rice. As a result using USG at the same level of crop yield can save one-third of nitrogen required for conventional split application of urea. The use of N as USG has more efficiency than that of PU[14]. From this study, it reveals that deep placement of USG is an effective means of increasing nitrogen use efficiency of rice as compared to the traditional split application of PU. The USG with deep placement provided a zone of concentrated urea solution where the denitrifying bacteria cannot enter and therefore nitrogen is left at the root zone for uptake by the plants[15]. Deep placement of Urea Super Granule (USG) was best suited to conditions where the predominant N loss mechanism is ammonia volatilization rather than leaching or denitrification. Deep placement of USG thus has greater benefit over surface split application on moderate to heavy textured soils[16].

The two year's mean results showed that the highest gross return (Tk. 198700 ha^{-1}), gross margin (Tk. 153040 ha^{-1}), benefit cost ratio (4.35) and MBCR over farmers' dose (7.57) calculated from the treatment T_2 where 100% recommended dose of N applied as USG. On the other hand the highest MRR (19498%) was recorded from the treatment T_3 where 90% of the recommended N applied as USG followed by the treatment T_2 (100% recommended N as USG). These results implied

that use of all the rate of urea super granule found to be economically viable (Table 3).

The co-operator farmers were found to be quite happy with the higher yield of tomato for the application of USG. They expressed their willingness to use USG on tomato cultivation next year on the availability of USG in the market.

On the basis of the two year's results, it was observed that urea super granule had positive impact on tomato cultivation. On an average 20% N could be saved as compare to the existing recommended dose of N from prilled urea. Hence, N at the rate of 120-150 kg ha^{-1} from USG may be recommended as an extension message to cultivate tomato (variety Ratan) in the irrigated highland of AEZ No. 3.

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