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Effect of Prilled Urea, Urea and NPK Briquettes on the Yield of Bitter Gourd in Two Upazillas of Jessore District

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Abstract

An experiment was conducted to evaluate the performance of deep placement of urea and NPK briquettes compared to broadcast application of prilled urea for bitter gourd production during the *Kharif-1* season of 2013. The experiments were conducted in two locations in Jessore district, Chowgacha and Jessore sadar. Seven treatments were designed to evaluate crops response: T_1: Control, T_2: Farmer's practice, T_3: Recommended doses of all fertilizers except N, T_4: Recommended doses of all fertilizers, T_5: Urea briquette + other fertilizers, T_6: NPK briquette + other fertilizers and T_7: NPK briquette + other fertilizers except cowdung. The rate of urea and NPK briquette was 10 percent less than the rate of recommended prilled urea. The experiment was laid out in a Randomized Complete Block Design (RCBD) with three replications. The sizes of NPK and urea briquette were 3.4 g and 2.7 g, respectively. The recommended fertilizer doses were used to supply N, P, K, S, Zn and B from Urea, TSP, MoP, gypsum, zinc sulphate (hepta) and boric acid, respectively. The results showed that deep placement of NPK briquette gave significantly the highest yield of bitter gourd (32.16 tha^{-1}) followed by urea briquette (30.45 tha^{-1}) which were 12.34 and 7.41 percent higher over recommended doses of all fertilizers. The highest N recovery (77.4 %) was found when 72 kg N ha^{-1} was applied as NPK briquette.

Key words: Bitter gourd, NPK, UDP, Yield

Introduction

Urea deep placement (UDP) or fertilizer deep placement (FDP) is an effective management practices for wetland transplanted rice by increasing its productivity (Savant and Stangel, 1990; Misra *et al*., 1995; Bowen *et al*., 2005). Rice yields with FDP compared with broadcasting are almost 30 percent more (1.2 metric tons per hectare) (IFDC, 2015). In Bangladesh, demand for vegetable production in terms of domestic and export market is increasing day by day, but soil fertility is the major constraint for agriculture especially vegetable production. Vegetable crops are very responsive to soil fertility status. Most of the farmers of Bangladesh do not follow the judicious nutrient management strategies on vegetable productions. As a result, farmers cannot get maximum benefits of fertilizer application on crop yields. When urea is broadcast in crop fields, a large portion of the N is wasted – lost through leaching, runoff, volatilization (atmospheric evaporation) and denitrification. Additional amounts of N are converted to nitrates, which are mobile in the soil and can contaminate groundwater. With FDP, urea is deep-placed into the soil, where the majority remains in the form of ammonium, which is much less mobile than nitrates. As a consequence, more N is available to the crop throughout its growth cycle. Therefore, losses to the atmosphere, groundwater and waterways are drastically reduced. Only about 4 percent of the N is lost to the environment, compared with about 35 percent when N is applied via broadcasting. It has been found to be quite superior to prilled urea (PU) in terms of N use efficiency (Bhuiyan and Shah, 1990; Mishra *et. al*., 1999). Application of urea and NPK briquette proved to be profitable in different upland crops such as tomato, cabbage, cauliflower and potato. By using of UDP technology, yield increased significantly with less use of urea about 10-20 percent as compared to prilled urea (OFRD, 2009). Khalil *et al*. (2009) reported that the volatilization loss of PU is very high and farmers lose a huge amount of money for N fertilizer and proposed that to control this loss, deep placement of fertilizer may be a good option to minimize production cost as well as to increase yield.

Balance fertilization is indispensable to avoid crop yield decline on cultivated land and to supplement nutrient loss from the soil ecosystem. Balance fertilization ensures high productivity in accordance with nutrient demand by individual crops without causing harm to the environment. Therefore, the present study was undertaken to evaluate the effect of prilled urea, urea and NPK briquette on the yield of bitter gourd and to find out a suitable technology for better production of bitter gourd.

Materials and Methods

Experimental location

Field experiments were carried out on Jessore sadar and Chowgacha upazilas to evaluate the effectiveness of fertilizer deep placement as UDP or NPK briquette on bitter gourd during the *Kharif-1* season of 2013. The experimental details are presented in Table 1.

Experimental design and management

Soil of this region is generally calcareous in nature, soil pH of the experimental site is 7.5, soil fertility level is low (% organic matter 1.5 and % N was

0.088) although CEC (cation-exchange capacity) is medium and K bearing minerals are medium to high but Zn and B status are low. Considering these, seven treatments were designed to evaluate crops response to the broadcast incorporation of N, P and K deep placement of urea briquette and NPK briquette and the farmers' practice.

The treatments were selected on the basis of soil test based fertilizer recommended following FRG 2005. Treatment descriptions are described in Table 2.

Table 1. Experimental sites with plant materials

Location	Crop	Variety	Plot size (m^2)	Spacing (cm x cm)	Planting date	Date of harvest	
						Start	End
Jessore sadar	Bitter gourd	Hybrid (Tia F1)	6 x 6	100 x 100	20-03-13	15-05-13	01-07-13
Chowgacha	Bitter gourd	Hybrid (Tia F1)	6 x 6	100 x 100	21-03-13	16-05-13	02-07-13

Table 2. Treatment details

Treatments	Description
T_1	Control ($N_0P_0K_0S_7Zn_4B_3$ kg/ha and cowdung 4 tha^{-1})
T_2	Farers practice ($N_{60}P_{25}K_{20}S_7Zn_4$B3 kg/ha and cowdung 4 tha^{-1})
T_3	Recommended doses of all fertilizers except N ($N_0P_{30}K_{35}S_7Zn_4B_3$ kg/ha and cowdung 4 tha^{-1})
T_4	Recommended doses of all fertilizers ($N_{80}P_{30}K_{35}S_7Zn_4B_3$ kg/ha and cowdung 4 tha^{-1})
T_5	Urea briquette + other fertilizers ($N_{72}P_{30}K_{35}S_7Zn_4B_3$ kg/ha and cowdung 4 tha^{-1})
T_6	NPK briquette + other fertilizers ($N_{72}P_{27}K_{31.5}S_7Zn_4B_3$ kg/ha and cowdung 4 tha^{-1})
T_7	NPK briquette + other fertilizers ($N_{72}P_{27}K_{31.5}S_7Zn_4B_3$ kg/ha)

NPK briquette (3.4g) was prepared using PU, DAP and MoP fertilizers with mixing nutrient combinations of 18:22:10

Fertilizer application

Different chemical fertilizers (prilled urea, TSP and MOP), commercially produced urea and NPK briquette were used to provide different nutrient combinations. Treatment wise other fertilizers (S, Zn and B containing fertilizers) and full amount of well decomposed cow dung were applied and mixed with soil thoroughly at the time of final ploughing. Phosphorus and potash containing fertilizers were used as basal except in the T_6 and T_7 treatments. After 10 days of transplanting, NPK briquettes (for T_6 and T_7) and urea briquettes (for T_5) for each plant were applied in ring method. Urea and NPK briquette were applied 9-10 cm apart from the base of the plant and 7-8 cm deep. Subsequently fertilizers were covered by soils perfectly. In treatment T_2 and T_4, N was applied in two equal installments at 10 and 30 days after germination.

Statistical analysis

The collected data were analyzed statistically by F- test to examine the treatment effects and the mean differences were adjusted by Duncan's New Multiple Range Test (DMRT) (Gomez and Gomez, 1984).

Results and Discussion

From the experimental result it was observed that significantly higher yield of fresh bitter gourd was recorded with the use of NPK briquette (T_6) as compared to prilled urea (PU) and urea briquette (T_5). Deep placement of NPK briquette (T_6) gave significantly the highest yield of bitter gourd (32.16 tha^{-1}) followed by urea briquette (30.45 tha^{-1}) which was 12.34 and 7.41 percent higher yield over PU (T_4), respectively (Table 3).

Table 3. Yield response to fertilizer application by deep placement vs. conventional broadcast application in experimental fields

Treatments		Yield (tha^{-1}) Chowgacha	Yield (tha^{-1}) Jessore Sadar	Average (tha^{-1})	% Yield increase over recommended dose
T_1	Control	20.51b	19.83d	20.17e	-39.75
T_2	Farmers' Practice	21.60b	23.54c	22.57d	-24.91
T_3	Recommended Doses except N	21.93b	20.51cd	21.22de	-32.84
T_4	Recommended Doses (PU)	28.50a	27.87b	28.19c	-
T_5	Urea Briquette	29.69a	31.20ab	30.45ab	7.41
T_6	NPK Briquette	31.38a	32.94a	32.16a	12.34
T_7	NPK Briquette without cowdung	28.86a	29.49ab	29.18b c	2.82
CV (%)		6.91	7.42	4.37	

Figures in a column having common letters do not differ significantly at 5% level of significance
CV = Co-efficient of variation

Higher N uptake from urea and NPK briquette were observed in T_6 and T_5 treatments, respectively over prilled urea (Table 4). The highest P uptake was found in NPK briquette treated plot and the lowest was in control. Control treatment was statistically similar with farmers practice and recommended doses except N. Urea and NPK briquette were statistically similar in terms of P uptake. In case of K uptake, T5 treatment was the highest which was similar to T_4, T_5 and T_6 treatments. The lowest was found in control which was similar to recommended dose except nitrogen.

Table 4. N, P and K uptake by bitter gourd as affected by fertilizer application with deep placement vs. conventional broadcast application

Treatments		Nutrient uptake (kg/ha)		
		N	P	K
T_1	Control	95.17e	18.87c	97.33c
T_2	Farmers' Practice	130.7bc	21.87c	113.1b
T_3	Recommended Doses except N	113.8d	22.83bc	102.8dc
T_4	Recommended Doses (PU)	132.5bc	27.65ab	126.2a
T_5	Urea Briquette	139.9b	29.07a	130.1a
T_6	NPK Briquette	150.9a	29.50a	126.8a
T_7	NPK Briquette without cowdung	126.4c	22.27bc	120.6ab
CV (%)		4.71	13.15	4.92

Figures in a column having common letters do not differ significantly at 5% level of significance
CV = Co-efficient of variation

Deep placement of urea briquette and NPK briquette showed higher N and P recovery percentage compared to surface application of PU (Table 5) but K recovery percentage higher on urea briquette treatment over all other treatments. Nitrogen recovery from PU decreased with increase in N rates over urea and NPK briquettes. The highest N recovery (77.4 %) was found when 72 kg N ha^{-1} was applied as NPK briquette. The N recovery from urea briquette was 62.1 %.

Table 5. Apparent N, P and K recovery by cucumber, taro and bitter gourd as affected by fertilizer application with deep placement vs. conventional broadcast application

Treatments		**Apparent Nutrient Recovery (%)**		
		N	P	K
T_1	Control	-	-	-
T_2	Farmers' Practice	59.3	9.6	79.0
T_3	Recommended Doses except N	-	13.2	15.7
T_4	Recommended Doses (PU)	46.7	29.3	82.4
T_5	Urea Briquette	62.1	34.0	93.7
T_6	NPK Briquette	77.4	39.4	93.6
T_7	NPK Briquette without cowdung	43.4	12.6	74.0

Based on the treatments comparisons of the urea briquette and NPK briquettes with PU, the benefits for bitter gourd production can largely be attributed to the deep placement of NPK and urea briquette. The combined NPK briquette deep placement in a single operation provides all the N, P, and K needs for the crop compared with the conventional practice. In addition, environmental losses from fertilizers were practically reduced. In this study, deep placement of fertilizer briquette resulted in greater vegetable yield compared to conventional fertilizer practice. These results are consistent with the yield increases reported by Kadam and Sahane (2001) on tomato by 26 percent, Bhattarai *et al*. (2011) on cucumber by 22 percent and yard long bean by 9 percent with fertilizer briquette deep placement compared to conventional fertilizer practice. The N, P, and K uptake were significantly higher due to NPK deep placement of briquette, although 10 percent less NPK fertilizers were applied compared to PU treatment. The N and K uptake with the deep placement of NPK briquettes was significantly higher than broadcast application. Based on the treatment comparisons, the benefits to the vegetables crops can largely be attributed to the deep placement of NPK briquettes. Kapoor *et al*. (2008) and Islam *et al*. (2011) observed significantly higher N, P, and K uptake with deep placement of NPK briquette compared to broadcast application. The positive impact of cowdung is evident for higher yield, nutrient uptake, and nutrient recovery when compare the NPK briquette with cowdung (T_6) and NPK briquette without cowdung (T_7). This indicates that integrated management of manure with deep placement in upland crops can play an important role in increasing productivity and improving nutrient use efficiency.

Conclusions

The deep placement of urea briquette and NPK briquette resulted in higher vegetable yields compared to PU. Greater benefits were accrued with the integrated use of manures and deep placement of briquettes. Therefore, the use of NPK briquette with cowdung could be recommended for bitter gourd production during *Kharif-1* season in Bangladesh with some further field trials.

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