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Research Article

Effects of Prilled Urea and Urea Super Granule with Poultry Manure on Rice Field Water Property, Growth and Yield of BRRI Dhan 49

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Abstract

A field experiment was conducted at the Soil Science farm of Bangladesh Agricultural University, Mymensingh during the *Aman* season of 2011 for investigating the integrated effect of prilled urea (PU) and urea super granules (USG) with poultry manure (PM) on field water property, growth and yield of BRRI Dhan 49. There were seven treatments such asT_1: Control, T_2: 56 kg N ha^{-1} as USG; T_3: 83.5 kg N ha^{-1} as PU; T_4: 56 kg N ha^{-1} as USG+PM (3.0 t ha^{-1}); T_5: 83.5 kg N ha^{-1} as PU+PM (3.0 t ha^{-1}); T_6: 112.5 kg N ha^{-1} as USG; T_7: 165.0 kg N ha^{-1} as PU. Application of USG in combination with poultry manure produced NH_4^+-N slowly and steadily due to deep placement by keeping most of the urea nitrogen in the soil and out of the irrigation water. This resulted in continuous supply of available N throughout the growth period of rice plant, which ultimately gave the higher yield. Significant variations were found in all the yield contributing characters except thousand grain weight by different treatments over control. The highest grain yield (5389 kg ha^{-1}) and straw yield (6921 kg ha^{-1}) was produced from T_4 which is statistically similar to T_5 and T_6. The maximum N uptake by grain (64.28 kg ha^{-1}) and straw (40.91 kg ha^{-1}) were obtained from USG in combination with poultry manure. It also showed the maximum values of apparent N recovery and N use efficiency possibly due to deep placement of USG and application of poultry manure in rice field. The overall results clearly indicate that application of USG in combination with poultry manure in rice field increases absorption efficiency and decreases N loss leading to water pollution reduction, efficient uptake and utilization of the applied N, and rice yield augmentation.

ABBREVIATIONS

BRRI: Bangladesh Rice Research Institute; TSP: Triple Super Phosphate; MoP: Muriate of Potash; PPM: Parts Per Million; EC: Electrical Conductivity

INTRODUCTION

Rice is the foremost staple food for the people of Bangladesh. The total area and production of rice in Bangladesh are about 11.7 million hectares and 31.8 million metric tons, respectively [1]. In Bangladesh, rice is being grown in all three cropping seasons which are named as *Aus, Aman* and *Boro*. Among these three seasons *Aman* rice covers the largest area of 5.58 million hectares with a production of 12.798 million metric tons [1]. Increase in production per unit area through the judicious application of fertilizer is the only way to increase food production. BRRI Dhan 49 is a modern variety suitable for cultivation in *Aman* season which produces higher yield than many other varieties.

N is the most important key input among the essential nutrients for rice production for its large requirement and instability in soil. In most cases, surface broadcasting of prilled urea (PU) is practised by farmers to meet up the N demand for rice crop. But by this method of application a large amount of applied N is being lost through NH_3 volatilization, leaching, denitrification and surface runoff [2]. In the wetland rice soils, rice plants take N mainly as ammonium (NH_4^+), requiring less energy to assimilate into amino acids than nitrate [3]. Ammonia volatilization losses occur in flooded rice soils in moderately to slightly acid soils, although losses are higher in alkaline soils [4]. The ammonium ion retained in the soil-water system is readily converted to nitrite, then to nitrate through the nitrification process. The nitrate ion is subject to lost through denitrification and leaching. So if the nitrification of ammonium into nitrate is delayed or reduced, denitrification and leaching loss will be reduced. Deep placement of N fertilizers into the anaerobic soil zone is an effective method to reduce volatilization loss [5]. Denitrification losses can be decreased by deep placement of urea fertilizer [6,7]. In the zone of USG placement, a high-localized urea/NH_4^+ concentration develop followed by an increase in soil pH through enzyme-catalysed hydrolysis [8]. The placement of USG at 8-10 cm depth of soil can save 30% nitrogen than PU, increases nutrient absorption, improves soil health and ultimately increases the crop yields [9].

Organic matter acts as a reservoir for plant nutrients (mainly N, P and S) and prevents leaching loss of the elements which are vital for the plant growth. Poultry manure (PM) contains high amount of secondary and micronutrients in addition to N, P and K. Integrated use of PM and chemical fertilizers may facilitate the utilization of nutrients for crop growth and productivity and replenish the organic matter status in soil. PM is a cheap source of plant nutrients as there are many poultry farms of different sizes established all over Bangladesh. Application of PM in rice cultivation may reduce the environmental pollution considerably by reducing chemical fertilizer use and increasing the use of PM. It is true that sustainable production of crops can be maintained by using only chemical fertilizers and similarly it is not possible to obtain higher crop yield by using organic manure alone [10]. Therefore many researches are necessary to formulate PM, chemical fertilizers and their combination that will be economically viable, technically effective and feasible and environmentally sound. Hence, the field experiment was undertaken to investigate the effects of prilled urea and USG with poultry manure on rice field water property, growth and yield of BRRI Dhan 49.

MATERIALS AND METHODS

The field experiment was conducted at the Soil Science farm of Bangladesh Agricultural University, Mymensingh during the *Aman* season of 2011 to investigate the integrated effect of PU and USG with PM on field water property, growth and yield of BRRI Dhan 49. The general soil type of the experimental field was Non-calcareous dark grey floodplain under *Sonatala* soil series and Old Brahmaputra Floodplain Agro-ecological zone [11].

Initial soil samples were collected at a depth of 0-15cm from the surface. The soil samples were analyzed for determining physical and chemical properties following standard methods. Particle size of soil was determined by hydrometer method [12] and the textural class according to the USDA system. Soil pH was measured by glass electrode method [13] and EC by conductivity meter. Organic matter was determined by Walkley and Black method [14], total N by Semi-micro Kjeldahl method [15], available P by Olsen method [16], available S by spectrophotometer method [17] and exchangeable K by flame photometer [18]. The experiment was laid out in randomized complete block design with three replications. There were seven treatments such as T_1: Control, T_2: 56 kg N ha^{-1} as USG; T_3: 83.5 kg N ha^{-1} as PU; T_4: 56 kg N ha^{-1} as USG+PM (3.0 t ha^{-1}); T_5: 83.5 kg N ha^{-1} as PU+PM (3.0 t ha^{-1}); T_6: 112.5 kg N ha^{-1} as USG; T_7: 165.0 kg N ha^{-1} as PU. The rice variety BRRI Dhan 49 was used in the experiment. Seedlings of 35 days age were transplanted on 15 August, 2011 at 20cm×20cm spacing. Well decomposed poultry manure having 0.7% N content was incorporated properly in the soils before 6 days of transplanting. Full dose of TSP, MOP, gypsum and $ZnSO_4$ were applied to the soil during final land preparation @ 15 kg P, 50 kg K, 15 kg S and 2.5 kg ha^{-1} respectively. Prilled urea was applied in three splits such as at 7, 30 and 45 days after transplanting (DAT) and urea super granule was applied at 7 DAT. One granule of 0.9 g size was placed for every four hills at 6-8 cm depth in puddled soil by hand and leveled immediately after placement.

Other cultural operations such as weeding and pesticide application were done as and when necessary. The rice field was irrigated to maintain 6 cm of water above the soil surface for water sample collection and as per necessity of the crop. The water sample was collected during each top dressing of PU and deep placement of USG to determine the field water properties like pH, electrical conductivity (EC) and NH_4-N. Sampling was done before irrigation and two hours after irrigation followed by next seven days maintaining a specific sapling time of the day. NH_4-N of water samples was determined by titrimetric method as outlined by [19].

The crop was harvested at proper maturity on 28 November, 2011. Data on yield contributing characters of rice such as plant height, number of effective tillers hill^{-1}, panicle length, number of filled grains panicle^{-1} and thousand grain weights were taken. Grain yield was recorded at 14% moisture basis and straw yield at sun dry basis. The grain and straw samples were analyzed for determining total N of plant following H_2SO_4-H_2O_2 digestion method as described by [20]. N uptake was calculated multiplying the N content (%) by the corresponding dry weight divided by 100. Apparent N Recovery (ANR) and N Use Efficiency (NUE) were calculated by the following two equations:

(a) Apparent N Recovery (kg ha^{-1}) = $(UN_N - UN_{N0})/FN$

Where, UN_N is total N uptake (grain and straw) with N application (kg ha^{-1})

UN_{N0} is the total N uptake without N application (kg ha^{-1})

FN is amount of fertilizer N applied (kg ha^{-1}).

(b) N Use Efficiency (kg kg^{-1}) = $GY(GY_N - GY_{N0})/FN$

Where, GY_N is grain yield with N application

GY_{N0} is grain yield without N application

FN is amount of fertilizer N applied (kg ha^{-1}).

All the collected data were analyzed following standard statistical procedure and differences among treatment means were adjudged by Duncan's Multiple Range Test [21].

RESULTS AND DISCUSSION

Field water property

From Figure 1 it is shown that the concentration of available NH_4^+-N in rice field water started to increase after 2 hours of prilled urea application and deep placement of urea super granules, continued up to 2 days and afterwards gradually decreased. Prilled urea alone or in combination with poultry manure released higher amount of available NH_4^+-N than USG and the concentration sharply changed with the progress of time. The higher dose of prilled urea produced the higher amount of NH_4^+-N subjected to ammonia volatilization. Application of 165.0 kg N as prilled urea produced the maximum amount of NH_4^+-N (4.33, 3.87 and 3.95 ppm during 1st, 2nd and 3rd sampling, respectively) at 2nd day and the minimum amount of NH_4^+-N at 7th day.

On the other hand, USG produced NH_4^+-N slowly and steadily due to deep placement by keeping most of the urea nitrogen in the soil, close to plant roots and out of the irrigation water. This resulted in continuous supply of available nitrogen throughout the growth period of rice plant, which ultimately gave the higher yield. Application of USG along with poultry manure produced

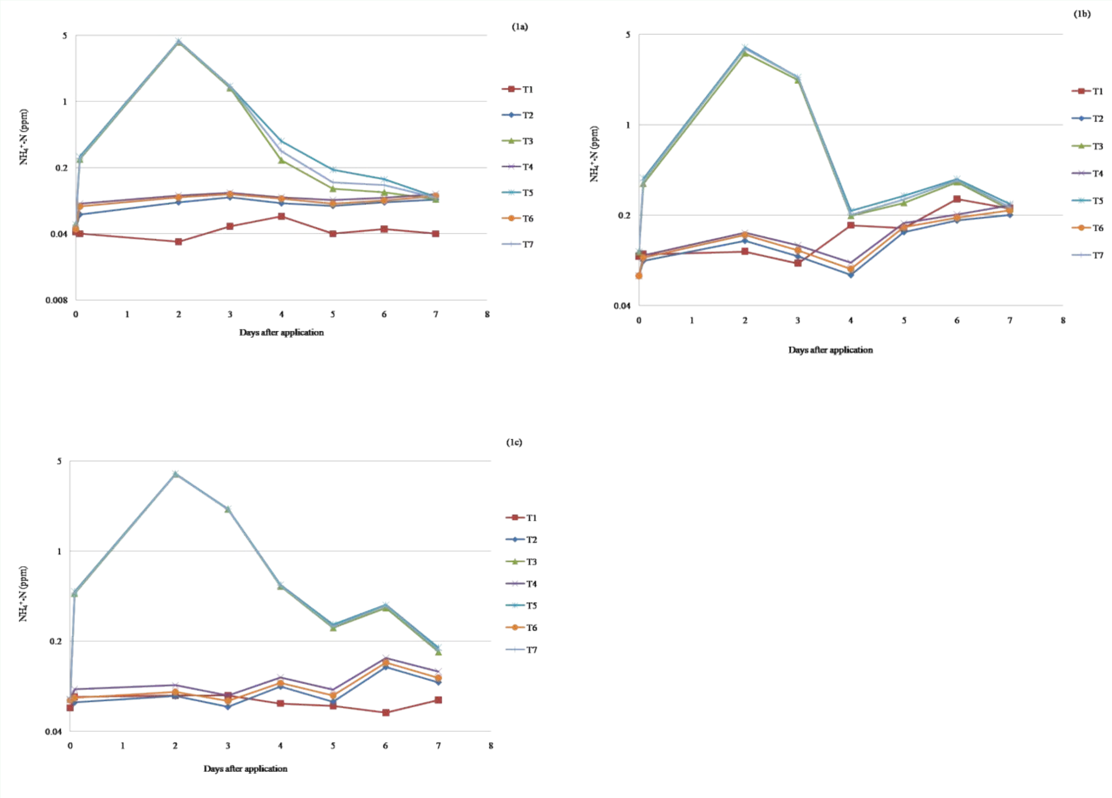

Figure 1 Effect of prilled urea and USG with poultry manure on field water NH_4^+-N concentration during (1a) 1st sampling, (1b) 2nd sampling and (1c) 3rd sampling period.

NH_4^+-N of 0.097, 0.050 and 0.141 ppm at 2nd day and 0.096, 0.047 and 0.231 ppm at 7th day during 1st, 2nd and 3rd sampling, respectively. The above results are well correlated with the findings of [22] that showed deep placement of N fertilizers as effective method due to reduced volatilization. [23] observed that ammoniacal-N concentrations in the urea treatment reached maxima at 3 to 5 days after urea application and then declined steadily to negligible concentrations in 7 days.

From Figure 2 we see that the water pH sharply increased after two hours of prilled urea application and decreased with the passes of time. The pH was more or less constant where USG was applied. EC of water samples was higher in the first sampling than that of second and third sampling in all the treatments (Figure 3, Table 1).

Yield contributing characters

All the yield contributing characters except thousand grain weight were influenced significantly by different treatments over control (Table 2).

Plant height

The combined application of 56 kg N ha^{-1} as USG and poultry manure produced the tallest plants (90.8 cm) which was statistically identical to those produced by the application of 112.5 kg N ha^{-1} as USG. This result is similar with the findings of [24]. [25] also reported that deep placement of USG resulted in the taller plant than prilled urea.

Number of effective tillers hill^{-1}

The treatment T_4 produced the maximum number of effective tillers hill^{-1} (22.0) which was statistically similar to T_6 (21.0) but superior to other treatments. These results are well corroborated with the findings of [26] who found increased number of effective tillers hill^{-1} with the integrated use of vermi-compost, poultry manure and nitrogenous fertilizers.

Panicle length

The panicle length ranged from 17.9 cm in T_1 to 21.2 cm in T_4. All the fertilized treatments produced panicles of statistically similar length but different from control. These results are in agreement with [27] who found increased panicle length with the application of urea, cow dung and *Azospirillum*, individually or in combinations.

Number of filled grains panicle^{-1}

All the treatments except T_3 and T_1 produced statistically similar number of filled grains panicle^{-1}. [28] also found increased percentage of filled grains with increasing NPK rates and FYM application.

Thousand grain weight

The thousand grain weight was not influenced significantly by different treatments. This is well corroborated with the findings of [29] who found an insignificant response of urea-N and manures on 1000- grain weight of BRRI Dhan 29.

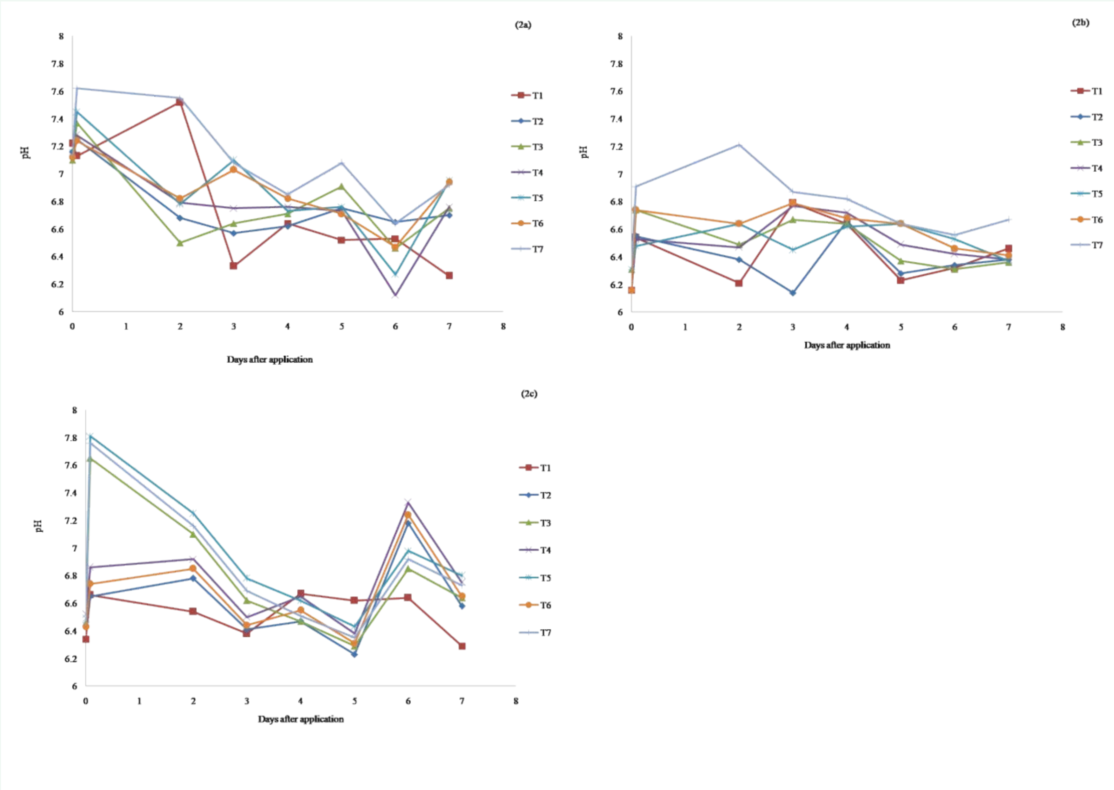

Figure 2 Effect of prilled urea and USG with poultry manure on field water pH during (2a) 1st sampling, (2b) 2nd sampling and (2c) 3rd sampling period.

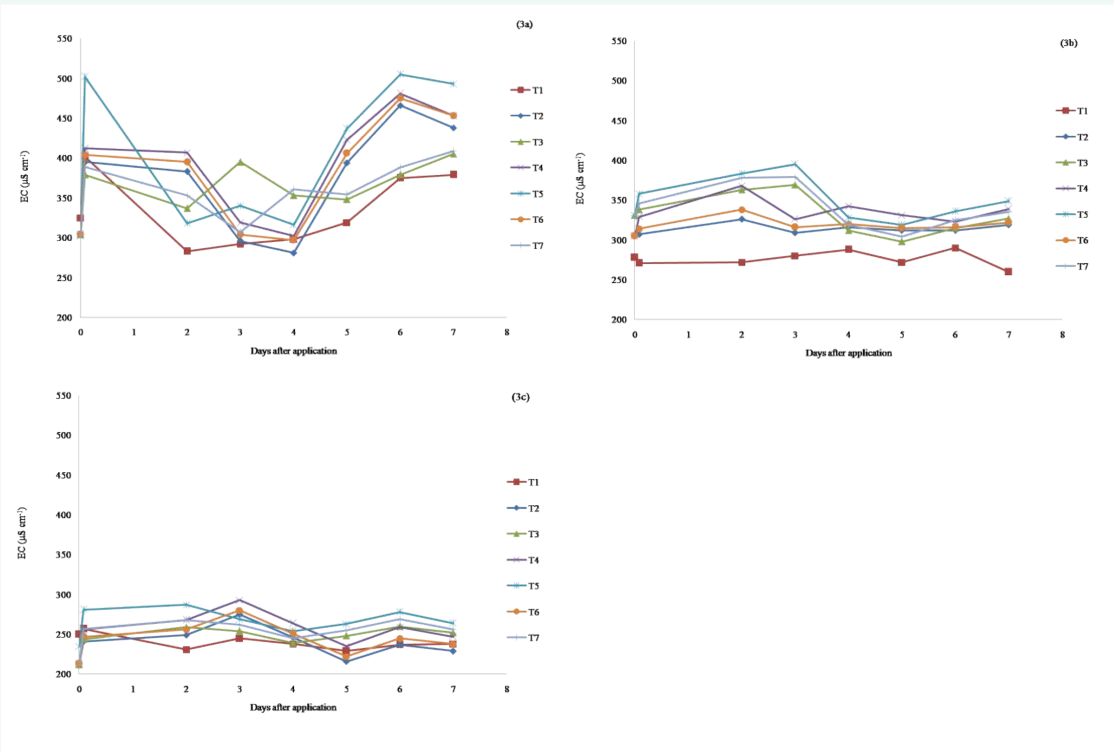

Figure 3 Effect of prilled urea and USG with poultry manure on field water EC during (3a) 1st sampling, (3b) 2nd sampling and (3c) 3rd sampling period.

Table 1: Soil properties of the experimental field.	
Constituents	**Analytical value**
Physical characteristics	
% Sand (2-0.05 mm)	20.2
% Silt (0.05-0.002 mm)	65.6
% Clay (<0.002 mm)	14.3
Textural class	Silt loam
Chemical characteristics	
pH (soil:water = 1:2.5)	6.8
EC (ds m^{-1})	0.2
Organic matter (%)	1.8
Total N (%)	0.1
Available P (mg kg^{-1})	9.2
Available S (mg kg^{-1})	13.0
Exchangeable K (me100^{-1}g soil)	0.1

Grain and straw yield

Application of prilled urea and USG alone or in combination with poultry manure showed a positive effect on the grain yield of BRRI Dhan 49 (Table 2). It was found that the grain yield ranged from 3849 kg ha^{-1} to 5389 kg ha^{-1}. The application of 56 kg N ha^{-1} as USG along with poultry manure gave the highest grain and straw yield (5389 and 6921 kg ha^{-1}, respectively) which is statistically similar to T_5 and T_6. USG in association with poultry manure gave better yield than other treatments. This might be due to optimum release of N from deep placed USG for prolonged period and adequate release of N and other nutrients from poultry manure. These results support the findings of [30] who reported that organic manure application combined with chemical fertilizers treatments were 65.4%-71.5% higher than control, and 3.9%-7.8% higher than NPK treatment in yield. [31] also reported that the application of organic matter and chemical fertilizer increased grain and straw yields of rice.

N CONTENT, N UPTAKE, APPARENT N RECOVERY AND N USE EFFICIENCY

Table 3 shows the effects of prilled urea and USG with poultry manure on nitrogen content, nitrogen uptake, apparent N recovery and N use efficiency of BRRI Dhan 49. The grain and straw N content varied significantly due to different treatments. The highest N content (1.42 and 0.67% in grain and straw, respectively) was obtained from the application of 56 kg N ha^{-1} as USG along with poultry manure which is statistically similar with that obtained from 112.5 kg N ha^{-1} as USG. Poultry manure combined with USG showed more pronounced response in increasing the N content both in grain and straw of BRRI Dhan 49 compared to other treatments. The N content in rice grain was higher than that of straw. [32] Also reported a significant increase in N content in rice grain and straw due to manures and fertilizers application.

Application of prilled urea and USG alone or in combination with poultry manure showed significant variation in N uptake both by grain and straw of BRRI Dhan 49. Combined application of poultry manure with prilled urea or USG helped in better N uptake by both grain and straw than their sole application. Furthermore, integration of USG with poultry manure produced more pronounced responses in N uptake than that of prilled urea and poultry manure. The maximum N uptake by grain (64.28 kg ha^{-1}) and straw (40.91 kg ha^{-1}) was obtained from USG in combination with poultry manure. The total N uptake of BRRI Dhan 49 varied from 43.72 ka ha^{-1} (T_1) to 105.2 kg ha^{-1} (T_4). Although T_4, T_5 and T_6 are statistically similar in case of total N uptake, application of 56 kg N ha^{-1} as USG along with poultry manure (T_4) was more economical and environment friendly due to replacement of some chemical N by poultry manure. These results are in agreement with the findings of [33] who found significant increase in N uptake by rice grain and straw with the application of organic manures and fertilizers.

Apparent N Recovery (ANR) and N Use Efficiency (NUE) of BRRI Dhan 49 ranged from 16.78% to 79.84% and 4.6 kg ha^{-1} to 20.0 kg ha^{-1}, respectively (Table 3). From the data it is evident that the maximum values of ANR and NUE were obtained with the application of USG along with poultry manure. The maximum ANR and NUE of the applied fertilizer could be due to the deep placement of USG and application of poultry manure in rice field that resulted in continuous and steady supply of available N throughout the growth period. The results indicate that application of USG in combination with poultry manure in rice field increases absorption efficiency and decreases N loss leading to efficient uptake and utilization by plants and reduced rate

Table 2: Effect of prilled urea and USG with poultry manure on yield contributing characters of BRRI Dhan 49.

Treatment	Plant height (cm)	Effective tillers $hill^{-1}$	Panicle length (cm)	Filled grains $panicle^{-1}$	1000- grain weight (g)	Grain yield (kg ha^{-1})	Straw yield (kg ha^{-1})
T_1	73.9d	19.2c	10.3b	81.0c	19.3ab	3849c	4085c
T_2	83.8c	19.8c	12.2ab	103.2ab	19.7ab	4596b	5215b
T_3	82.3c	19.4c	12.1ab	98.6b	19.4ab	4524b	5280b
T_4	90.8a	21.6a	13.9a	118.2a	21.2a	5389a	6921a
T_5	86.0bc	20.6b	12.9ab	112.7ab	20.4a	5100a	5875ab
T_6	89.6ab	21.4a	13.2ab	115.8ab	20.8a	5241a	6502a
T_7	84.3c	19.6c	12.7ab	102.0ab	19.8ab	4608b	5322b
SE (±)	1.15	0.20	0.36	2.96	0.08	116.89	211.12

T_1: Control, T_2: 56 kg N ha^{-1} as USG, T_3: 83.5 kg N ha^{-1} as PU, T_4: 56 kg N ha^{-1} as USG + PM @ 3.0 tha^{-1}, T_5: 83.5 kg N ha^{-1} as PU + PM @ 3.0 tha^{-1}, T_6: 112.5 kg N ha^{-1} as USG and T_7: 165.0 kg N ha^{-1} as PU. Values in column having same letter are not significantly different at 0.05 level of probability by DMRT.

Table 3: Effect of prilled urea and USG with poultry manure on N content, N uptake, ANR and NUE of BRRI Dhan 49.

Treatment	N applied (kg ha^{-1})	N content (%)		N uptake (kg ha^{-1})			Apparent N recovery (%)	NUE (kg kg^{-1})
		Grain	Straw	Grain	Straw	Total		
T_1	0	0.90e	0.37e	30.33d	13.38d	43.72d	-	-
T_2	56	1.23c	0.50cd	49.00bc	23.59c	72.59bc	51.56	13.34
T_3	83.5	1.12d	0.45de	45.26c	20.92cd	66.19c	26.91	8.08
T_4	77	1.42a	0.67a	64.28a	40.91a	105.20a	79.84	20
T_5	104.5	1.33b	0.56bc	58.22ab	29.01bc	87.23ab	41.64	11.97
T_6	112.5	1.38ab	0.64ab	62.323a	36.30ab	98.63a	48.81	12.37
T_7	165	1.16cd	0.49cd	48.978bc	22.42cd	71.41bc	16.78	4.6
SE (±)	-	0.039	0.0403	4.85	4.26	8.55	-	-

T_1: Control, T_2: 56 kg N ha^{-1} as USG, T_3: 83.5 kg N ha^{-1} as PU, T_4: 56 kg N ha^{-1} as USG + PM @ 3.0 tha^{-1}, T_5: 83.5 kg N ha^{-1} as PU + PM @ 3.0 tha^{-1}, T_6: 112.5 kg N ha^{-1} as USG and T_7: 165.0 kg N ha^{-1} as PU. Values in column having same letter are not significantly different at 0.05 level of probability by DMRT.

of N application. Prilled urea showed lower ANR and NUE due to possibly more release and more loss of the applied N. [34] also found higher NUE from USG in compared to prilled urea. [35] concluded that mixed application of mineral and organic N showed better effects on N use efficiency compared with the single application of mineral N.

CONCLUSION

Application of USG in combination with poultry manure produced NH_4^+-N slowly and steadily. Prilled urea alone or in combination with poultry manure released higher amount of available NH_4^+-N and the water properties (NH_4^+-N, pH, EC) sharply changed with the progress of time. The higher dose of prilled urea produced the higher amount of NH_4^+-N subjected to ammonia volatilization. The application of USG in combination with poultry manure showed maximum values of grain and straw yield, total N uptake, apparent N recovery and N use efficiency. The maximum recovery and utilization efficiency of the applied N could be due to the deep placement of USG and application of poultry manure in rice field resulting continuous and steady supply of available N throughout the growth period. The overall results indicate that application of USG in combination with poultry manure in rice field increases absorption efficiency and decreases N loss leading to water pollution reduction, efficient uptake and utilization of the applied N, and rice yield augmentation.

REFERENCES

1. BBS (Bangladesh Bureau of Statistics). Monthly Statistical Bulletin of Bangladesh. May 2011. Bangladesh Bureau of Statistics, Stat Div, Ministry of Planning, Gov. People's Repub. Bangladesh, Dhaka. 2011; 52-56.
2. Dhane SS, Khadse RR, Patil VH, Sauant NK. Effect of deep placed USG with limited green manure on transplanted rice yield. Inter. Rice Res Newsl. 1989; 14: 31.
3. Kennedy IR. Acid Soil and Acid Rain, 2nd edn. Research Studies Press Ltd. Taunton, United Kingdom. 1982.
4. De Datta SK. Fertilizer management for efficient use in wetland rice soils. In Soils and Rice; Ponnamperuma, FN, edn. International Rice Research Institute: Los Banos, Philippines. 1978; 671-701.
5. Mikkelsen DS, De Datta SK, Obcemea WN. Ammonia volatilization losses from flooded rice soils. Soil Sci Soc Am J. 1978; 42: 725-730.
6. Ding H, Guxin C, Yuesi W, Deli C. Nitrification-denitrification loss and N_2O emission from urea applied to crop-soil systems in North China Plain. Proceedings of the 17th World Congress of Soil Science. 2002; 1-13.
7. Fillery IRP, Roger PA, De Datta SK. Ammonia volatilization from nitrogen sources applied to rice fields: II. Floodwater properties and submerged photosynthetic biomass. Soil Sci Soc Am J. 1986; 5091-5096.
8. Singh Y, Malhi SS, Nyborg M, Beauchamp EG. Large granules, nests or bands: Methods of increasing efficiency of fall-applied urea for small cereal grains in North America. Fert Res. 1994; 38: 61-87.
9. Savant NK, Crasewer ET, Diamond RB. Use of urea super granules for wetland rice: a review. Fertilizer News. 1983; 18: 27-35.
10. Bair W. Characterization of environment of sustainable agriculture in semi Arid Tropics. In: Proc. Sustainable Agriculture. Issues, Perspectives and Prospects Semi Arid Tropics (Ed. Singh RP) Hyderabad, India. Indian Soc Agron. 1990; 1: 90-124.
11. FAO-UNDP. Production Yearbook, Food and Agricultural Organization of the United Nations, Rome, Italy. 1988; 57: 76-77.
12. Black CA. Methods of Soil Analysis part-I and part-II. Amer Soc Agron Inc. Madison, Wisconsin, USA. 1965; 770.
13. Michael P. Hydrogen-ion activity. In methods of soil analysis part 2 edited by CA Black. Amer Soc Agron Inc. Publisher, USA. 1965; 914-926.
14. Walkley A, Black IA. An examination of the Degtjareff method for determining soil organic matter and a proposed modification for the chromic acid titration method. Soil Sci. 1934; 37: 29-38.
15. Bremner JM, Mulvaney CS. Nitrogen-Total. In methods of soil Analysis Part 2. Edited by AL Page, RH Miller, and DR Keeney. Amer Soc Agron Inc and Soil Sci Soc Amer Inc., Madison, Wisconsin. 1982; 595-624.
16. Olsen SR, Cole CU, Watanable FS, Deun LA. Estiamtion of available P in soil extraction with sodium bicarbonate. US. Agril Cir. 1954; 929.
17. Williams CH, Stenbergs A. Soil sulphur fractions as chemical indices of available sulphur in some Australian soils: Aust J Agric Res. 1959; 10: 340-352.
18. Knudsen D, Peterson GA, Pratt PF. Lithium, Sodium and Potassium. In methods of Soil Analysis Part 2 edited by Page, Miller and Keeney. Amer Soc Agron Inc. 1982; 225-245.
19. APHA. Standard Methods for the Examination of Water and Wastewaters. 20th Edn. American Public Health Assoc, Washington, DC, USA. 1998.
20. Lu RK. Analytical Methods of Soil Agrochemistry. Chinese Agricultural Science and Technology Press, Beijing. 1999; 308-315.
21. Gomez KA, Gomez AA. Statistical Procedures for Agricultural Research. John Wiley and Sons. New York. 1984.
22. Mikkelsen DS, De Datta SK, Obcemea WN. Ammonia volatilization

losses from flooded rice soils. Soil Sci Soc Am J. 1978; 42: 725-730.

23. Fillery IRP, Vlek PLG. The significance of denitrification of applied nitrogen in fallow and cropped rice soils under different flooding regimes. Greenhouse experiments. Plant Soil. 1982; 65: 153-169.

24. Rajni R, Srivastava OP, Rani R. Effect of integration of organics with fertilizer N on rice and N uptake. Fertilizer Newsl. 2001; 46: 63-65.

25. Singh BK, Singh RP. Effect of modified urea materials on rain fed lowland transplanted rice and their residual effect on succeeding wheat crop. Indian J Agron. 1986; 31: 198-200.

26. Rajni R, Srivastava OP, Rani R. Effect of integration of organics with fertilizer N on rice and N uptake. Fertilizer Newsl. 2001; 46: 63-65.

27. Singh S, Singh RN, Prasad J, Singh BP. Effect of integrated nutrient management on yield and uptake of nutrients by rice and soil fertility in rain fed uplands. J Indian Soc Soil Sci. 2006; 54: 327-330.

28. Mondal SS, Joyaram D, Pradhan BK. Effect of fertilizer and farmyard manure on the yield and yield components of rice (*Oryza sativa* L.) Environ Ecol. 1990; 8: 223-226.

29. Rahman MS, Islam MR, Rahman MM, Hossain MI. Effect of cow dung, poultry manure and urea on the yield and nutrient uptake of BRRI Dhan 29. Bangladesh Res Pub J. 2009; 2: 552-558.

30. Qian H, Xiu ML, Rong GL, Zhang L, Ren YL, Lan YH, et al. Effect of long-term located organic-inorganic fertilizer application on rice yield and soil fertility in red soil area of China. Scientia Agricultura Sinica. 2011; 44: 516-523.

31. Ahmed M, Rahman S. Influence of organic matter on the yield and mineral nutrition of modem rice and soil properties. Bangladesh Rice J. 1991; 2: 107-112.

32. Bhaskaram U, Krisna D. Effect of organic farming on soil fertility, yield and quality of crops in the tropics. XVIth Int Plant Nutri Col. 2009; 89-90.

33. Verma TS, Dixit SP. Paddy straw management in wheat-paddy cropping in north-west Himalayan soils. Asso Rice Res Workers Oryza. 1989; 26: 48-60.

34. Siddika N. Effect of nitrogen management with prilled urea, urea super granule and leaf color chart on the performance of transplant aman rice (cv. BR 14) [dissertation]. Dept Agron Bangladesh Agril Univ Mymensingh. 2007; 35: 42-44.

35. Lin M, Zhang XL, Jiang XF, Wang QJ, Huang QW, Xu YC, et al. Effects of partial mineral nitrogen substitution by organic fertilizer nitrogen on the yields of rice grains and their proper substitution rate. Sci Agric. 2009; 42: 532-542.

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