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Effect of Fertilizer and Manure on the Change of Nutrient Availability of T. Aman Rice in Different Soil

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Abstract: *The experiment was conducted in the experimental area of Sher-e-Bangla Agricultural University, Sher-e-Bangla Nagar, Dhaka during the period from June to November 2013 in aman season to find out effect of fertilizer and manure on the nutrient availability of T. Aman rice in different soil. BRRI dhan33 was used as the test crop in this experiment. The experiment comprised of two factors- Factors A: Soils from different location (soil from 2 locations), S_1: SAU soil, S_2: Shingair soil (collected from Shingair Manikgonj) an Factor B: Levels of fertilizers and manures (5 levels)- T_0: Control condition i.e. no fertilizers and manures; T_1: Recommended dose of fertilizer ($N_{120}P_{25}K_{60}S_{20}$), T_2: 50% NPKS + 5 ton cow dung ha^{-1}, T_3: 50% NPKS + 5 ton compost ha^{-1} and T_4: 50% NPKS + 3.5 ton poultry manure ha^{-1}. The experiment was laid out in a randomized complete block design (RCBD) with three replications. Data were recorded on different nutrient concentration in grain and nutrient status of post harvest soil and significant variation was observed for different treatment and their interaction effect. The highest N, P, K and S concentration in grain (1.378%, 0.249%, 0.225% and 0.071%, respectively) was recorded from S_2, whereas the lowest was found from S_1. The highest N, P, K and S concentration in grain (1.536%, 0.279%, 0.252% and 0.077%, respectively) was recorded from T_4, while the lowest was observed from T_0. The highest N, P, K and S concentration in grain (1.651%, 0.286%, 0.262% and 0.081%, respectively) was recorded from S_2T_4 and the lowest was found from S_1T_0. The level of total N, available P and S of the post experiment soil increased more in the SAU soil with 50% inorganic fertilizer plus 3.5 t poultry manure ha^{-1}.*

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I Introduction

Rice (*Oryza sativa* L.) the most important and staple food not only for Bangladesh but also for the South Asia and widely grown in tropical and subtropical regions[1]. At present the national average rice yield in Bangladesh (4.2 t ha^{-1}) is very low compared to other rice growing countries, like China (6.30 t ha^{-1}), Japan (6.60 t ha^{-1}) and Korea (6.30 t ha^{-1})[2]. Rice yields are either decelerating/stagnating/declining in post green revolution era mainly due to imbalance in fertilizer use, soil degradation, type of cropping system practiced, lack of suitable rice genotypes/variety for low moisture adaptability and disease resistance[3]. Among the production factors affecting crop yield, essential nutrient is the single most important factor that plays a dominant role in yield increase if other production factors are not limiting. It is reported that chemical fertilizers today hold the key to success of production systems of Bangladesh agriculture being responsible for about 50% of the total crop production[4]. Nutrient imbalance can be minimized by judicious application of different fertilizers. Depleted soil fertility is a major constrain to higher crop production in Bangladesh. The increasing land use intensity has resulted in a great exhaustion of nutrient in soils. The farmers of our country use on an average 102 kg nutrients ha^{-1} annually (70 kg N + 24 kg P + 6 kg K + 2 kg S and Zn) while the crop removal is about 200 kg ha^{-1} [5]. The application of different fertilizers and manures also positively correlated with soil porosity and enzymatic activity. Organic fertilizer enhances soil porosity by increasing regular and irregular pores and causes a priming effect of native soil organic matter. Application of both chemical and organic fertilizers needs to be applied for the improvement of soil physical properties and supply of essential plant nutrients for higher yield. A suitable combination of organic and inorganic sources of nutrients is necessary for sustainable agriculture that can ensure quality food production. Keeping in the view of the importance of rice and role of organic and inorganic nutrient in crop physiology, therefore, the present research work has been undertaken with the following objectives:

- Effects of fertilizer and manure with different soils on the nutrient availability in soil with rice culture, and
- To know the effects of fertilizer and manure on the fertility improvement in soil.

II Materials And Methods

The experiment was conducted during the period from June to November 2013 in aman season.The present piece of research work was conducted in the experimental area of Sher-e-Bangla Agricultural University, Sher-e-Bangla Nagar, Dhaka. Two different soils from different places and AEZ were collected. There were used 30 earthen pots altogether and 14 kg soil was taken in each earthen pot. Some physicochemical properties of initial soils (0-15 cm) of SAU and Shingair soils are shown in Table 1. BRRI dhan33 was used as the test crop in this experiment.

Table 1. Physicochemical properties of initial soils (0-15 cm) of SAU and Shingair soils

Characteristics	SAU Soil	Shingair Soil
Textural class	Silt Loam	Clay loam
pH	6.4	6.5
Organic matter (%)	1.12%	2.12%
Total N (%)	0.07%	0.08%
Available P(ppm)	7.6	5.72
Exchangeable K (ppm)	18.6	28.6
Available S (ppm)	7.20	8.0

Treatment of the experiment

The experiment comprised of two factors

Factors A: Soils from different location (soil from 2 locations)

i) S_1: SAU soil

ii) S_2: Shingair soil (collected from Shingair Manikgonj)

Factor B: Levels of fertilizers and manures (5 levels)

i) T_0: Control condition i.e. no fertilizers and manures

ii) T_1: Recommended dose of fertilizer ($N_{120}P_{25}K_{60}S_{20}Zn_2$)

iii) T_2: 50% NPKSZn + 5 ton cow dung ha^{-1}

iv) T_3: 50% NPKSZn + 5 ton compost ha^{-1}

iv) T_4: 50% NPKSZn + 3.5 ton poultry manure ha^{-1}

There were in total 10 (2×5) treatment combinations such as S_1T_0, S_1T_1, S_1T_2, S_1T_3, S_1T_4, S_2T_0, S_2T_1, S_2T_2, S_2T_3 and S_2T_4. The experiment was laid out in a randomized complete block design (RCBD) with three replications. Each block was divided into 10 unit pots as treatments. Thus the total numbers of pots were 30. The fertilizers N, P, K, S and Zn in the form of urea, TSP, MoP, Gypsum and zinc sulphate, respectively were applied as per treatment. As a manure cowdung, compost and poultry manure also applied as per treatment. The one third amount of urea and entire amount of TSP, MOP, gypsum and zinc sulphate were applied during the final preparation of pot. Rest urea was applied in two equal installments at tillering and panicle initiation stages.

Statistical analysis

The mean values of all the characters were calculated and analysis of variance was performed by MSTAT-C. The significance of the differences among the treatment means were estimated by the Duncan's Multiple Range Test (DMRT) at 5% level of probability[6].

III Results And Discussion

N, P, K and S concentration in grain

Statistically significant variation was found for N, P, K and S concentration in grain of BRRI dhan33 due to soil from different location (Table 1). The highest N, P, K and S concentration in grain (1.378%, 0.249%, 0.225% and 0.071%, respectively) was recorded from S_2, whereas the lowest N, P, K and S concentration in grain (1.280%, 0.238%, 0.213%, and 0.066%) from S_1. N, P, K and S concentration in grain of BRRI dhan33 varied significantly for different levels of fertilizers & manures (Table 1). The highest N, P, K and S concentration in grain (1.536%, 0.279%, 0.252% and 0.077%) was recorded from T_4, while the lowest N, P, K and S concentration in grain (1.023%, 0.167%, 0.131% and 0.050%) was observed from T_0. Sharma and Mitra (1991)[7] reported a significant increase in N, P and K content and also the nutritional status of soil with 5 t ha^{-1} of FYM of rice based cropping system. Interaction effect of soil from different location and levels of fertilizers & manures showed significant variation on N, P, K and S concentration in grain (Table 2). The highest N, P, K and S concentration in grain (1.651%, 0.286%, 0.262% and 0.081%) was recorded from S_2T_4 and the lowest N, P, K and S concentration in grain (1.007%, 0.164%, 0.126% and 0.048%) was found from S_1T_0.

Table 1: N, P, K and S concentrations in grain of BRRI dhan33 influenced by fertilizer & manure from different locations of soil

Treatment	Concentration (%) in grain			
	N	P	K	S
Soil from different locations				
S_1	1.280 b	0.238 b	0.213 b	0.066 a
S_2	1.378 a	0.249 a	0.225 a	0.071 a
SE(±)	0.064	0.008	0.008	0.008
Fertilizer & manure				
T_0	1.023 d	0.167 b	0.131 d	0.050 b
T_1	1.405 b	0.256 b	0.239 bc	0.073 a
T_2	1.248 c	0.249 a	0.227 c	0.065 a
T_3	1.434 b	0.268 a	0.247 ab	0.076 a
T_4	1.536 a	0.279 a	0.252 a	0.077 a
SE(±)	0.102	0.012	0.012	0.012

In a column means having similar letter(s) are statistically similar and those having dissimilar letter(s) differ significantly at 0.05 level of probability

S_1: SAU soil	T_0: Control condition
S_2: Shingair soil	T_1: Recommended dose of fertilizer ($N_{120}P_{25}K_{60}S_{20}$)
	T_2: 50% NPKS + 5 ton cow dung ha^{-1}
	T_3: 50% NPKS + 5 ton compost ha^{-1}
	T_4: 50% NPKS + 3.5 ton poultry manure ha^{-1}

Table 2. Interaction effect of soil from different locations and fertilizer & manure on N, P, K and S concentrations in grain of BRRI dhan33

Treatment	Concentration (%) in grain			
	N	P	K	S
S_1T_0	1.007 e	0.164 d	0.126 d	0.048 c
S_1T_1	1.410 bc	0.254 bc	0.246 ab	0.076 a
S_1T_2	1.301 bcd	0.244 c	0.207 c	0.054 bc
S_1T_3	1.261 cd	0.258 bc	0.247 ab	0.076 a
S_1T_4	1.422 b	0.271 ab	0.242 b	0.074 a
S_2T_0	1.039 e	0.169 d	0.136 d	0.052 c
S_2T_1	1.401 bc	0.259 bc	0.232 b	0.070 ab
S_2T_2	1.195 d	0.254 bc	0.248 ab	0.076 a
S_2T_3	1.606 a	0.278 a	0.248 ab	0.076 a
S_2T_4	1.651 a	0.286 a	0.262 a	0.081 a
SE(±)	0.144	0.017	0.017	0.017

In a column means having similar letter(s) are statistically similar and those having dissimilar letter(s) differ significantly at 0.05 level of probability

S_1: SAU soil	T_0: Control condition
S_2: Shingair soil	T_1: Recommended dose of fertilizer ($N_{120}P_{25}K_{60}S_{20}$)
	T_2: 50% NPKS + 5 ton cow dung ha^{-1}
	T_3: 50% NPKS + 5 ton compost ha^{-1}
	T_4: 50% NPKS + 3.5 ton poultry manure ha^{-1}

Nutrient status of post harvest soil

Total nitrogen

Statistically significant variation was found for total nitrogen in post harvest soil of BRRI dhan33 due to soil from different location (Table 3). The highest total nitrogen (0.087%) was attained from S_2, while the lowest (0.072%) was recorded from S_1. Total nitrogen in post harvest soil of BRRI dhan33 varied significantly for different levels of fertilizers & manures (Table 3). The highest total nitrogen (0.101%) was observed from T_4, which was statistically identical (0.090%) with T_3 and closely followed (0.079%) by T_1, whereas the lowest total nitrogen (0.060%) was observed from T_0 which was statistically similar (0.066%) with T_2. Interaction effect of soil from different location and levels of fertilizers & manures showed significant variation on total nitrogen (Table 4). The highest total nitrogen (0.115%) was found from S_2T_4 and the lowest total nitrogen (0.051%) was recorded from S_1T_0.

Available P

Statistically significant variation was found for available P in post experiment soil collected from different location (Table 3). The highest available P (8.91 ppm) was found from S_1 and the lowest (6.46 ppm) from S_2. Available P in post harvest soil of BRRI dhan33 varied significantly for different levels of fertilizers &

manures (Table 3). The highest available P (11.67 ppm) was observed from T_4, while the lowest available P (6.32 ppm) was found from T_1 which was which was statistically similar (6.66 ppm, 6.86 ppm and 6.93 ppm) with T_1, T_2 and T_3. Interaction effect of soil from different location and levels of fertilizers & manures showed non-significant variation on available P (Table 4). The highest available P (12.96 ppm) was observed from S_1T_4, while the lowest available P (5.51 ppm) was recorded from S_2T_0.

Available K

Statistically significant variation was found for available K in post harvest soil of BRRI dhan33 due to soil from different location (Table 3). The highest available K (0.041 me/100 g soil) was recorded from S_2, while the lowest (0.034 me/100 g soil) was observed from S_1. Available K in post harvest soil of BRRI dhan33 varied significantly for different levels of fertilizers & manures (Table 3). The highest available K (0.045 me/100 g soil) was found from T_1, which was closely followed (0.035 me/100 g soil) by T_2, whereas the lowest available K (0.029 me/100 g soil) was recorded from T_4 which was followed (0.030 me/100 g soil) by T_4. Interaction effect of soil from different location and levels of fertilizers & manures showed non-significant variation on available K (Table 4). The highest available K (0.047 me/100 g soil) was found from S_2T_1 and the lowest available K (0.026 me/100 g soil) was recorded from S_1T_0.

Available sulphur

Statistically significant variation was found for available S in post harvest soil of BRRI dhan33 due to soil from different location (Table 3). The highest available S (9.67 ppm) was found from S_2, whereas the lowest (8.11 ppm) from S_1. Available S in post harvest soil of BRRI dhan33 varied significantly for different levels of fertilizers & manures (Table 3). The highest available S (10.58 ppm) was recorded from T_4, which was statistically similar (9.68 ppm and 9.57 ppm) with T_3 and T_1, while the lowest available S (6.09 ppm) was found from T_0 which was followed (8.51 ppm) by T_2. Interaction effect of soil from different location and levels of fertilizers & manures showed significant variation on available S (Table 4). The highest available S (11.62 ppm) was recorded from S_2T_4 and the lowest available S (5.22 ppm) was recorded from S_1T_0.

Table 3. Effect of soil from different locations and fertilizer & manure on total N, available P, available K and available S BRRI dhan33

Treatment	Total N (%)	Available P (ppm)	Available K (me %)	Available S (ppm)
Soil from different locations				
S_1	0.072 b	8.91 a	0.034	8.11 b
S_2	0.087 a	6.46 b	0.041	9.67 a
SE(±)	0.008	0.23	0.001	0.775
Fertilizer & manure				
T_0	0.060 c	6.66 b	0.029 d	6.09 c
T_1	0.079 b	6.32 b	0.045 a	9.57 ab
T_2	0.070 b	6.86 b	0.035 b	8.51 b
T_3	0.090 ab	6.93 b	0.032 c	9.68 ab
T_4	0.101 a	11.67 a	0.030d	10.58 a
SE(±)	0.012	0.37	0.002	1.226

In a column means having similar letter(s) are statistically similar and those having dissimilar letter(s) differ significantly at 0.05 level of probability

S_1: SAU soil	T_0: Control condition
S_2: Shingair soil	T_1: Recommended dose of fertilizer ($N_{120}P_{25}K_{60}S_{20}$)
	T_2: 50% NPKS + 5 ton cow dung ha^{-1}
	T_3: 50% NPKS + 5 ton compost ha^{-1}
	T_4: 50% NPKS + 3.5 ton poultry manure ha^{-1}

Table 4. Interaction effect of soil from different locations and fertilizer & manure on total N, available P, available K and available S of BRRI dhan33

Treatment	Total N (%)	Available P (ppm)	Available K (me %)	Available S (ppm)
S_1T_0	0.051 d	7.81	0.026	5.22 c
S_1T_1	0.078 bc	7.06	0.043	10.17 ab
S_1T_2	0.076 c	8.83	0.030	6.60 c
S_1T_3	0.085 bc	7.89	0.030	9.01 b
S_1T_4	0.088 bc	12.96	0.027	9.54 b
S_2T_0	0.069 cd	5.51	0.032	6.96 c
S_2T_1	0.079 bc	5.58	0.047	8.98 b
S_2T_2	0.085 bc	5.89	0.040	10.43 ab
S_2T_3	0.096 b	5.96	0.033	10.35 ab
S_2T_4	0.115 a	10.38	0.033	11.62 a
SE(±)	0.017	NS	NS	1.733

In a column means having similar letter(s) are statistically similar and those having dissimilar letter(s) differ significantly at 0.05 level of probability

S_1: SAU soil	T_0: Control condition
S_2: Shingair soil	T_1: Recommended dose of fertilizer ($N_{120}P_{25}K_{60}S_{20}$)
	T_2: 50% NPKS + 5 ton cow dung ha^{-1}
	T_3: 50% NPKS + 5 ton compost ha^{-1}
	T_4: 50% NPKS + 3.5 ton poultry manure ha^{-1}

IV Conclusion

It may be concluded that Shingair soil and 50% NPKS + 3.5 ton poultry manure ha^{-1} performed better in relation to nutrient availability of BRRI dhan33. The application of inorganic fertilizer plus manure improved the chemical properties and nutrient level of post experiment soil. The level of organic matter was more increased in the lower organic matter containing post experiment soil of SAU by applying organic plus inorganic fertilizer treatments.

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