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Interaction Effect of Fertilizer and Manure on the Growth and Yield 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 yield 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 ($N_{120}P_{25}K_{60}S_{20}Zn_2$), T_2: 50% NPKSZn + 5 ton cow dung ha^{-1}, T_3: 50% NPKSZn + 5 ton compost ha^{-1} and T_4: 50% NPKSZn + 3.5 ton poultry manure ha^{-1}. The experiment was laid out in a randomized complete block design (RCBD) with three replications. Due to the interaction of soil from different location and fertilizers and manure, the highest grain yield (134.97 g pot^{-1}) was found from S_2T_4, whereas the lowest grain yield (32.03 g pot^{-1}) was recorded from S_1T_0. Shingair soil and 50% NPKSZn + 3.5 ton poultry manure ha^{-1} performed better in relation to yield contributing characters and yield of BRRI dhan33.

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 (Singh *et al*., 2012). It provides 21% and 15% per capita of dietary energy and protein, respectively (Maclean *et al*., 2002). The slogan 'Rice is life' is most appropriate for Bangladesh and this crop plays a vital role in food security and livelihood for millions of rural peoples. However, 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}) (FAO, 2009). 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 (Prakash, 2010).

Among the fertilizers, nitrogen (N) is essential for vegetative growth but excess N may cause excessive vegetative growth, prolong the growth duration and delay crop maturity with reduction in grain yield. Many research works revealed a significant response of rice to N fertilizer in different soils (Hussain *et al*., 1989). Inadequate and improper applications of N are now considered one of the major reasons for low yield of rice in Bangladesh. Phosphorus is also one of the important essential macro elements for the normal growth and development of plant. It is a major component in ATP, the molecule that provides 'energy' to that plant for such processes as photosynthesis, protein synthesis, nutrient translocation, nutrient uptake and respiration (Li *et al.*, 2007). Potassium plays a vital role in proper growth and development and also increased growth parameters and also yield of rice (Krishnappa *et al.*, 2006). Sulphur requirement of rice varies according to the nitrogen supply and it is required early in the growth of rice plants. If it is limiting during early growth, then tiller number and therefore final yield will be reduced (Blair and Lefroy, 1987). Zinc deficiency is the most widespread micronutrient disorder in lowland rice and application of Zinc increases the grain yield dramatically in most cases (Chaudhary *et al*., 2007; Muthukumararaja and Sriramachandrasekharan, 2012). Soil organic matter improves the physicochemical properties of the soil and ultimately promotes crop production. Evidences from different AEZ of the country have shown a decrease in the content of organic matter by the range of 15 to 30% over the last 20 years (Miah, 1994). Therefore, it would not be wise to depend only on inherent potentials of soils for higher crop production. More recently, attention is focused on the global environmental problems; utilization of organic wastes, vermicompost and poultry manures as the most effective measure for the purpose. 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. The long-term research of BARI revealed that the application of cow dung @ 5 t ha^{-1} $year^{-1}$ improved rice productivity as well as prevented the soil resources from degradation (Bhuiyan, 1994). A marked higher incidence of micro and macro nutrient deficiency is found in crop due to intensive cropping, loss of fertile top soil and losses of nutrient through leaching (Rahman *et al*., 2008; Somani, 2008 and Singh *et al*., 2011). 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,
- Effects of fertilizer, manure and soil on the yield and quality of T. Aman rice, and

II. MATERIALS AND METHODS

The experiment was conducted to find out effect of fertilizer and manure on the yield of T. Aman rice in different soil. The experiment was conducted during the period from June to November 2013 in aman season.The location of the site is $23^0 74^/$N latitude and $90^0 35^/$E longitude with an elevation of 8.2 meter from sea level.

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. BRRI dhan33 was used as the test crop in this experiment. This variety was developed at the Bangladesh Rice Research Institute. It is recommended for Aman season and average plant height of the variety is 100 cm. It requires about 118 days completing its life cycle with an average yield is 4.5 t ha^{-1} (BRRI, 2012). 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)

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 ($N_{120}P_{25}K_{60}S_{20}Zn_2$), **$T_2$**: 50% NPKSZn + 5 ton cow dung ha^{-1}, **T_3**: 50% NPKSZn + 5 ton compost ha^{-1}, **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. Seeds were collected from BRRI (Bangladesh Rice Research Institute), Gazipur just 25 days ahead of the sowing of seeds in seed bed. Seeds were immersed in water in a bucket for 24 hours. These were then taken out of water and kept in gunny bags. The seeds started sprouting after 48 hours which were suitable for sowing in 72 hours. The nursery bed was prepared by puddling with repeated ploughing followed by laddering. The sprouted seeds were sown as uniformly as possible. The pot selected for conducting the experiment was filled up with 14 kg soil in the second week of July 2013. Weeds and stubbles were removed. The experimental pot was partitioned in accordance with the experimental design. Organic and inorganic manures as indicated below were mixed with the soil of each pot. 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. Twenty five days old seedlings of BRRI dhan33 were carefully uprooted from the seedling nursery and transplanted on 22 July, 2013 in well prepared pots. Two seedlings pot^{-1} were used. After one week of transplanting all pots were checked for any missing hill, which was filled up with extra seedlings whenever required. The data obtained for different parameters were statistically analyzed to find out the significant difference of fertilizer and manure on the yield of T. Aman rice in different soil. 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 (Gomez and Gomez, 1984).

III. RESULTS AND DISCUSSION

The experiment was conducted to find out effect of fertilizer and manure on the yield of T. Aman rice in different soil. The results have been presented and discusses with the help of table and possible interpretations given under the following headings:

Plant height

Statistically non-significant variation was recorded due to the interaction effect of soil from different location and levels of fertilizers & manures (Table 1). The tallest plant (106.7 cm) was observed from S_2T_2 (Shingair soil with 50% NPKSZn + 5 ton cowdung ha^{-1}) which was similar to S_1T_1, S_1T_3, S_1T_4, S_2T_1, S_2T_2 and S_2T_3 treatment combination. The shortest plant (89.8 cm) was recorded from S_1T_0 (SAU soil in control condition) treatment combination which was statistically comparable to S_2T_0 treatment combination.

Plant height was significantly influenced by the integrated effect of organic and inorganic fertilizers. Gurung and Sherchan (1993) reported that the application of cowdung with chemical fertilizers produced significantly plant than that of chemical fertilizers alone. Rini and Srivastava (1997) reported that one-third or one-quarter of N as vermicompost increased plant height yield components of rice.

Number of effective tillers $hill^{-1}$

Interaction effect of soil from different location and levels of fertilizers & manures showed non-significant variation on number of effective tillers $hill^{-1}$ (Table 1). The maximum number of effective tillers $hill^{-1}$ (35.33) was recorded from S_2T_4 and the minimum number (12.67) was found from S_1T_0. Kant and Kumar (1994) reported that the increasing rates of amendments of chemical fertilizers with FYM increased the number of effective tillers $hill^{-1}$ significantly and at the maximum level of FYM (30 t ha^{-1}) the increase of 48% tillers $hill^{-1}$ over the control were recorded.

Length of panicle

Number of filled grains $panicle^{-1}$ showed non-significant variation due to the interaction effect of soil from different location and levels of fertilizers & manures (Table 1). The maximum number of filled grains $panicle^{-1}$ (174.1) was observed from S_2T_2 and the minimum number (99.5) was recorded from S_1T_0. Rini and Srivastava (1997) reported that one-third or one-quarter of N as vermicompost increased yield components of rice.

Number of filled grains panicle^{-1}

Interaction effect of soil from different location and levels of fertilizers & manures showed non-significant variation on length of panicle (Table 1). The longest panicle (25.91 cm) was found from S_1T_3, while the shortest panicle (21.66 cm) was observed from S_1T_0. Kant and Kumar (1994) reported that the increasing rates of amendments of chemical fertilizers with FYM increased the number of grain panicle^{-1} increased over the control and at the maximum level of FYM (30 t ha^{-1}) the increase of 14% number of grain panicle^{-1} over the control were recorded.

Table 1. Interaction effect of soil from different locations and fertilizer & manure on plant height, effective tiller hill^{-1}, panicle length and grains panicle^{-1} of BRRI dhan33

Treatment	Plant height (cm)	Number of effective tiller hill^{-1}	Panicle length (cm)	Number of filled grain panicle^{-1}
S_1T_0	89.8	12.667	21.66	99.5
S_1T_1	106.4	26.333	25.51	163.0
S_1T_2	98.3	23.667	23.98	130.3
S_1T_3	105.8	27.667	25.91	158.6
S_1T_4	101.3	30.337	24.33	143.2
S_2T_0	94.1	13.333	22.28	123.4
S_2T_1	101.7	31.667	25.02	153.4
S_2T_2	106.7	32.333	25.04	174.1
S_2T_3	105.9	31.667	25.66	171.5
S_2T_4	104.9	35.333	24.94	154.0
SE(±)	NS	1.643	NS	NS

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 ($N_{120}P_{25}K_{60}S_{20}Zn_2$)
T_2: 50% NPKSZn + 5 ton cow dung ha^{-1}
T_3: 50% NPKSZn + 5 ton compost ha^{-1}
T_4: 50% NPKSZn + 3.5 ton poultry manure ha^{-1}

Weight of 1000-grain

Interaction effect of soil from different location and levels of fertilizers & manures showed non-significant variation on weight of 1000-grains (Table 2). The highest weight of 1000-grains (21.33 g) was obtained from S_2T_4 and the lowest weight (19.67 g) was found from S_2T_0. Kant and Kumar (1994) reported that the increasing rates of amendments of chemical fertilizers with FYM increased weight of 1000-grain also increased over the control and 4.5% weight of 1000-grain over the control were recorded.

Grain yield pot^{-1}

Statistically significant variation was recorded due to the interaction effect of soil from different location and levels of fertilizers & manures in terms of grain yield pot^{-1} (Table 2). The highest grain yield pot^{-1} (134.97 g) was found from S_2T_4, whereas the lowest grain yield pot^{-1} (32.03 g) was recorded from S_1T_0. Gurung and Sherchan (1993) reported that the application of cowdung with chemical fertilizers produced significantly higher grain yield than that of chemical fertilizers alone. Rahman (2001) reported that in rice-rice cropping pattern, the highest grain yield of Boro rice was recorded in the soil test basis (STB) N P K S Zn fertilizers treatment while in T. Aman rice the 75% or 100% of N P K S Zn (STB) fertilizers plus green manure (GM) with or without cowdung gave the highest or a comparable yield.

Straw yield pot^{-1}

Interaction effect of soil from different location and levels of fertilizers & manures showed significant variation on straw yield pot^{-1} (Table 2). The highest straw yield pot^{-1} (110.07 g) was observed from S_2T_4 and the lowest straw yield pot^{-1} (32.93 g) was recorded from S_1T_0. Chittra and Janaki (1999) reported that application of 50 kg N with green leaf manure gave the highest straw yield.

Table 2. Interaction effect of soil from different locations and fertilizer & manure on weight of 1000 grains and grain and straw yield plant^{-1} of BRRI dhan33

Treatment	Weight of 1000 grains (g)	Grain yield (g pot^{-1})	Straw yield (g pot^{-1})
S_1T_0	19.83	32.03d	32.93
S_1T_1	20.33	84.33c	80.87
S_1T_2	21.00	74.10c	77.07
S_1T_3	20.33	78.23c	70.67
S_1T_4	21.17	112.33b	92.63
S_2T_0	19.67	35.37d	36.30
S_2T_1	20.83	108.10b	89.77
S_2T_2	21.00	111.33b	91.27
S_2T_3	21.00	115.87ab	90.27
S_2T_4	21.33	134.97a	110.07
SE(±)	NS	5.37	NS

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 ($N_{120}P_{25}K_{60}S_{20}Zn_2$)
T_2: 50% NPKSZn + 5 ton cow dung ha^{-1}
T_3: 50% NPKSZn + 5 ton compost ha^{-1}
T_4: 50% NPKSZn + 3.5 ton poultry manure ha^{-1}

IV. CONCLUSION

It may be concluded that Shingair soil and 50% NPKSZn + 3.5 ton poultry manure ha^{-1} performed better in relation to yield contributing characters and yield of BRRI dhan33.

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