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Response of T. Aman Rice (*Oryza sativa L.*) to S, Mg, Zn, B, Mo and Organic Amendments in Tista Meander Floodplain Soil

G. K. M. Mustafizur Rahman[1*], R. Ashrafi[2], M. B. Hossain[3] and M. L. Rahman[4]

[1]*Department of Soil Science, Bangabandhu Sheikh Mujibur Rahman University, Gazipur-1706, Bangladesh*
[2] *Department of Soil Science, Bangladesh Agricultural University, Mymensingh, Bangladesh*
[3]*Bangladseh Institute of Nuclear Agriculture, Mymensingh, Bangladesh*
[4]*Department of Soil Science, Dhaka University, Bangladesh*
** Corresponding author*

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Abstract

A field experiment was conducted at the BINA sub-station of Tajhat, Rangpur in the Tista Meander Floodplain soil during aman season 2003 to study the response of T. aman rice to S, Mg, Zn, B, Mo and organic amendments. The experiment was laid-out in a randomized complete block design with nine treatments is with three replications as T_1: complete (S + Mg + Zn + B + Mo), T_2: complete–S, T_3: complete–Mg, T_4: complete–Zn, T_5: complete–B, T_6: complete–Mo, T_7: cowdung @ 5 t/ha, T_8: poultry manure @ 5 t/ha and T_9: control. Nitrogen, phosphorus and potassium were applied in recommended doses as basal. The highest grain (3927 kg/ha) and straw (4472 kg/ha) yields were recorded with the application of poultry manure, followed by cowdung and complete (S+Mg+Zn+B+Mo) treatment. The lowest yield was recorded in the control plot. The overall results indicate that application of organic amendments with NPK gave satisfactory yield of T. aman rice in the Tista Meander Floodplain Soil.

Keywords: Yield, organic amendments, rice.

1. Introduction

Bangladesh soils are depleted in many respects of essential nutrients mainly because of intensive cultivation without organic matter recycling. Fertilizers are indispensable for modern agriculture and are being responsible for about 50 % of the total agricultural production (FRG, 1997). Howevwer, it is difficult to sustain crop production by using either chemical fertilizers or organic manures alone (Bair, 1990). The combined use of organic and inorganic fertilizers might be helpful for sustainable crop production and maintenance of soil fertility. Nambiar (1991) reported that integrated use of organic manure and chemical fertilizers would be quite promising not only for stability in production, but also for maintaining soil fertility status.

Before 1980's, deficiency of NPK was a major problem of Bangladesh soils, but thereafter deficiencies of S, Zn and B were also frequently reported to be deficient(Islam and Hossain, 1993; Hoque and Jahiruddin, 1994; Jahiruddin *et al.*, 1995). Thus, soil fertility has been gradually declining resulting stagnation yields of major crops of the country (Bhuiyan, 1995). Hence, an experiment was conducted to study the response of T. aman rice to applied S, Mg, Zn, B, Mo and organic amendments in Tista Meander Floodplain Soil.

2. Materials and Methods

The experiment was carried out at the BINA Sub-station, Tajhat and Rangpur during aman season of 2003. The soils belong to the agroecological zone "Tista Meander Floodplain Soil" having texture of

sandy loam, pH 6.30, organic matter 1.24%, total N 0.11%, available P 2.44 ppm, exchangeable K 0.05 meq%, available S 6.62 ppm, available B 0.17 ppm, available Zn 0.45 ppm, exchangeable Mg 1.37 meq%, available Fe 31.92 ppm, available Mn 5.13 ppm and available Mo 0.25 ppm.

T. aman rice cv. Binadhan-4 was used as test crop. The experiment was laid out in a randomized complete block design with three replications. There were nine treatment combinations as T_1 = complete (S+Mg+Zn+B+Mo); T_2 = complete – S; T_3 = complete – Mg; T_4 = complete – Zn; T_5 = complete – B; T_6 = complete – Mo; T_7 = Cowdung (CD) @ 5 t/ha; T_8 = Poultry Manure (PM) @ 5 t/ha and T_9 = control. The unit plot size was 4 x 3m. The distance between two unit plots and blocks were 0.3m and 0.7m, respectively. N, P, K, S, Mg, Zn, B, and Mo were used at the rate of 75, 20, 25, 30, 15, 5, 2 and 1.5 kg/ha, respectively in the experiment and all the plots including control received NPK as basal dose. The sources of N, P, K, S, Mg, Zn, B, and Mo were urea, DAP, MP, gypsum, the magnesium oxide, zinc oxide, borax and ammonium molybdate, respectively. The amount of N contained in the DAP was adjusted with urea at the time of calculating the fertilizer. All the other fertilizers and 1/3 urea were applied at the time of final land preparation and rest of the urea was applied in two equal installments at maximum tillering stage and at panicle initiation stage of the crop. Cowdung and poultry manure were applied 15 days before planting. Twenty five days old seedlings were transplanted at 3 seedlings per hill a distance of 20 x 20 cm.

Standing water of approximately 5-6 cm was maintained in each pot throughout the growing period. All other intercultural operations were done whenever necessary and data on yield and yield contributing parameters were recorded at maturity of the crop. All the data were taken when the crop attained maturity. The yield contributing parameters such as plant height, panicle length, number of panicles per hill, and 1000-grain weight (g) were collected from 10 (ten) randomly selected plants taken from each plot. Grain and straw yields were recorded plot-wise. The grain and straw yields were recorded on sundry basis. Grain yield was adjusted to 14 % moisture content. All chemical analysis for soil was done using the following methods:

The particle size analysis was done by hydrometer method as described by Piper (1966) and the textural class was determined by using the Marshall's triangular co-ordinate following USDA system and soil pH was determined by using Glass Electrode pH meter. The soil-water ratio was 1: 2.5 as described by Jackson (1973).

The organic carbon of the soil sample was determined by Walkley and Black (1965) wet oxidation method as outlined by Jackson (1973). The amount of soil organic matter was calculated by multiplying the percent value of organic carbon with Van Bemmelen factor, 1.73.

Total nitrogen content was determined following Micro Kjeldahl method as described by Jackson (1973). Total N in the soil was determined by Micro Kjeldahl method by digesting soil sample with H_2O_2 concentrated H_2SO_4 and catalyst mixture (K_2SO_4 **:** $CuSO_4.5H_2O$ **:** Se =10 **:**1 **:** 0.1). Nitrogen in the digest was estimated by distillation with 40 % NaOH followed by titration of the distillate trapped in H_3BO_3 with 0.01 N H_2SO_4 (Page *et al.*, 1982).

Available P in the soil was extracted by shaking with 0.5 M $NaHCO_3$ solution having pH 8.5 following the method described by Olsen *et al.* (1954). The extracted P was then determined colorimetrically by $SnCl_2$ reduction method at 660 nm wave length.

Exchangeable K and Mg were determined by extraction with 1 N NH_4OAc, pH 7.0 solution followed by measurement of extractable elements by atomic absorption spectrophotometer (Page *et al.*, 1982).

Available S content in soil was determined by extracting soil sample with calcium phosphate {$CaH_4(PO_4)$} as described by ASI (Agro Services International). The S content in the digest (extract) was determined by the acid seed and turbidimetric procedure improved by Hunter (1984). Available Zn, Fe and Mn in soil were determined by DTPA extraction method. While

B was determined by 0.01 M $CaCl_2$. $2H_2O$ extracting method. Besides, grain and straw samples were analyzed for N, P, K, S, Mg, Zn, B, Fe and Mn using standard methods (Jackson, 1973; Page *et al*. 1982 and Hunter 1984).

The analyses of variance for different parameters were done following the principle of F-statistics and the mean results were compared using Duncan's Multiple Range Test (DMRT).

3. Results and Discussion

Plant height, panicle length and 1000-grain weight of T. aman rice were not influenced by different treatment combinations except tillering (Table 1). However, the highest number of panicles/hill (7.40) was observed when poultry manure was applied (T_8). This was statistically identical with that of the treatments T_7 (cowdung), T_2 (complete-S) and T_1 (complete). The lowest number of tillers/hill (5.87) was observed in control (T_9) treatment. Similar results were also found by Kant and Kumar (1994).

Grain yield responded significantly to the application of S, Mg, Zn, B, Mo and organic amendments (Table 1). All the treatments gave significantly higher grain yield over control. The grain yield varied from 3408 to 3927 kg/ha. The highest grain yield of 3927 kg/ha was given by the treatment T_8 (Poultry Manure) which was 15.2 % higher than that of control. The second highest grain yield of 3597 kg/ha was observed in the treatment T_1 (comprising all the 5 added nutrients) and it was statistically identical with that of T_7 (cowdung) and T_5 (complete−B) treatments. In producing grain yield, the treatments could be ranked in order of $T_8 > T_1 > T_7 > T_5 > T_3 > T_2 > T_6 > T_4 > T_9$. This result is in agreement well with those reported by Karim (2001).

Straw yield was also significantly influenced by treatments (Table 1). The straw yields varied from 3916 to 4472 kg/ha. As in case of grain yield, the highest straw yield (4472 kg/ha) was recorded in poultry manure treatment (T_8) which was significantly different from that of all other treatments. The second highest straw yield was obtained in T_5 (complete −B) treatment which was statistically similar to T_7 (CD) but significantly higher than that of other treatments. In producing straw yield, the treatments could be ranked in order of $T_8 > T_5 > T_7 > T_1 > T_6 > T_2 > T_3 > T_4 > T_9$. Other workers (Rajput and Warsi, 1991) also reported that the application of organic manure and chemical fertilizers increased straw yield of rice.

Table 1. Effect of S, Mg, Zn, B, Mo and organic manures on yield and yield components of T. aman rice (Binadhan-4).

Treatments	Plant height (cm)	No. of panicles/ hill	Panicle Length (cm)	1000 grain weight (g)	Grain yield (kg/ha)	Straw yield (kg/ha)
T_1= S+Mg+Zn+B+Mo(Complete)	100.4	6.90 abc	25.73	22.82	3597 b	4085c
T_2 = Complete –S	99.67	6.80 abc	25.00	21.41	3441 d	4044 cd
T_3 = Complete –Mg	99.67	6.00 de	25.13	22.67	3519 c	3999 cde
T_4 = Complete –Zn	101.1	6.33 cde	25.63	21.28	3411 d	3971 de
T_5 = Complete –B	100.2	6.73 bc	25.13	22.00	3555 bc	4238 b
T_6 = Complete –Mo	98.93	6.60 bcd	26.00	21.00	3430 d	4077 c
T_7 = Cowdung @ 5t/ha	101.3	7.00 ab	26.33	23.55	3597 b	4180 b
T_8 = Poultry Manure @5t/ha	100.1	7.40 a	25.00	24.00	3927 a	4472 a
T_9 = Control	98.07	5.87 e	24.97	20.33	3408 d	3916 e
CV (%)	4.89	5.03	4.54	7.83	4.87	3.19
LSD (0.05)	4.997	0.5767	1.998	3.238	40.39	84.94

The figures having common letter in a column are not significantly different by DMRT at 5% level.
LSD = Least Significant Difference, CV = Co-efficient of Variation

Table 2. Effect of added nutrients on N, P, K, S, Mg, Zn and B uptake (Kg/ha) by grain and straw of T. aman rice (Binadhan-4).

Treatments	Grain							Straw						
	N	P	K	S	Mg	Zn	B	N	P	K	S	Mg	Zn	B
T1	28.32 bc	10.57	24.51 a	3.140 bc	6.004 a	0.085 a	0.057 a	17.14 c	6.602	76.17 c	5.140 a	8.495	0.290 ab	0.205 ab
T2	26.37 c	10.59	18.89 cd	2.595 d	5.458 b	0.069 cde	0.048 b	15.16 d	7.388	47.49 cd	3.702 bc	8.436	0.275 bc	0.192 bc
T3	26.50 c	11.27	22.18 ab	3.051 c	5.369 b	0.072 bc	0.045 b	16.84 c	6.914	70.45 e	5.130 a	7.300	0.283 ab	0.152 e
T4	26.12 c	10.43	19.35 cd	2.934 c	5.469 b	0.066 de	0.049 b	17.76 c	6.646	73.01 de	4.666 ab	8.498	0.190 e	0.182 cd
T5	26.18 c	11.19	19.69 c	2.820 cd	5.573 b	0.072 bcd	0.038 c	23.59 ab	8.237	70.31 e	5.139 a	8.609	0.296 a	0.134 f
T6	27.76 c	11.00	17.30 d	2.927 c	6.004 a	0.070 bcde	0.045 b	22.03 b	7.396	72.93 de	4.823a	8.497	0.278 ab	0.171 d
T7	30.96 ab	11.58	22.66 ab	3.716 a	5.662 b	0.076 b	0.058 a	22.16 b	7.986	79.03 b	5.013 a	7.906	0.240 d	0.215 a
T8	31.83 a	12.41	23.97 a	3.416 ab	6.161 a	0.082 a	0.056 a	24.38 a	9.080	82.26 a	5.013 a	8.695	0.259 c	0.143 ef
T9	25.47 c	11.36	20.79 bc	2.498 d	4.925 c	0.065 e	0.037 c	14.02 d	7.203	74.70 cd	3.325 c	7.212	0.184 e	0.101 g
CV (%)	4.20	7.83	5.87	5.92	5.64	3.41	5.26	4.67	15.85	4.52	12.72	9.60	7.18	6.56
LSD (0.05)	2.863	1.513	2.158	0.310	0.295	0.006	0.006	1. 569	2.056	2.670	1.025	1.360	0.017	0.013

N. B.: The figures having common letter in a column are not significantly different by DMRT at 5% level.
LSD = Least Significant Difference
CV = Co-efficient of Variation

Nutrient uptake by rice grain and straw were significantly influenced by the treatments (Table 2). The highest uptake of all the nutrients by rice was observed in T_8 (Poultry Manure) treatment except for S in T_7 treatment (cowdung). The lowest (2.498 kg/ha) S uptake by rice grain was found in T_9 (control) which was statistically identical to T_2 (complete–S) treatment. The results indicate that S uptake in rice grain increased with the application of cowdung plus NPK fertilizer. The findings of Wankhade *et al*, (1996) are in good agreement with this study. Those workers found that application of macro nutrients markedly increased their respective concentration and uptake by the crops.

Zinc uptake by grains and straw of T. aman rice was significantly influenced by addition of other nutrients (Table 2). The highest Zn uptake was observed in T_1 treatment which was statistically similar to that found in T_8 (PM) treatment. The lowest Zn uptake was observed in T_9 treatment which was statistically different from all other treatments. The highest B uptake by rice grain and straw was observed in T_7 treatment which was statistically similar to that found in T_1 (complete) and T_8 (PM) treatments. It might be due to B fertilization as well as contribution of B from CD and PM. The lowest B uptake by rice plant was observed in T_9 (control) treatment which was statistically similar to that found in T_5 (complete–B). The observation of Wankhade *et al.* (1996) was very similar to the present findings. They observed higher uptake of Zn and B with the application of single nutrient or with other micronutrients.

4. Conclusions

It may be concluded that for efficient T. aman rice production in this soil, an application of secondary nutrients and micronutrients with N, P, K is essential but among the treatments the highest yield (straw 4472 and grain 3927 kg/ha) was observed in the treatment (T_8) where poultry manure (@ 5 t/ha) with NPK was applied.

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