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PERFORMANCE OF AN ORGANIC FERTILIZER ON THE GROWTH AND YIELD OF RICE

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Abstract

A total of 9 treatments of Northern Jaibo-Sar (NJS) and Northern Bio Fertilizer (NBF) in combination with different proportions of soil test based fertilizer (SBF) together with a control was applied, Northern Shakti was used instead of NBF in Boro season. Maximum net benefit and marginal rate of return was obtained in case of T. Aman and Boro season from treatment T_3. On the basis of results, it may be suggested that 50% reduction of chemical fertilizer on STB along with Northern Jaibo-Sar @ 500kg/ha may be a good combination of organic and inorganic fertilizer for sustaining soil fertility and increasing T. Aman and Boro rice.

Introduction

Continuous use of inorganic fertilizers alone to soils had a deleterious effect on soil productivity and in rice productivity(1). Organic matter content of the soils is constantly lessening by repeated farming which leads to hard soil. Nutrient rich organic fertilizer improves soil condition; reduce soil compactness, clotting and erosion. Suitable organic sources of nutrients are necessary for sustainable agriculture that will provide maximum rice production with good quality and maintain a sound environment. Organic matter is the vital component of soil health as well as crop production. Most of the cultivated soil in Bangladesh, organic matter is very low ranging from 0.5 - 2% where majority of the cultivated soils is less than 1%(2). Northern Jaibo-Sar is a nutrient enriched organic fertilizer containing total N (4%), P (1.15%), K (1.5%), S (1%) and some trace element(3). Hence, the performance of this fertilizer was evaluated in the farmer's field in T. Aman, 2011 and Boro rice, 2012 seasons.

Materials and Methods

Two experiments were conducted at farmer's field, Tukerbazar, Sylhet during T. Aman season, 2011 and Boro season, 2012. The initial soil properties of the experimental site is presented in Table 1. Soil texture, pH, organic matter, available P, S, Zn and

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exchangeable K were determined following standard methods[4-8]. The elemental composition of Northern Bio Fertilizer (NBF) was N = 6.48%, P = 4.56%, K = 1.2%, S = 3.36%, Zn = 0.40%, and B = 0.10% where as in Northern Shakti, N = 6.0%, P = 3.5%, K = 8.5%, S = 2%, Ca = 2%, Mg = 1% and B = 0.10%. The following nine treatment combinations were tested in T. Aman season : T_1 = Control, T_2 = Northern Jaibo-Sar (NJS) @ 500 kg/ha, T_3 = STB (Soil Test Based), T_4 = T_2 + NBF @ 250 kg/ha + Recom. N, T_5 = T_2 + 50% STB, T_6 = T_2 + 60% STB, T_7 = T_2 + 70% STB, T_8 = T_2 + 80% STB and T_9 = T_2 + T_3. The experiment was laid out in a RCBD with three replications having unit plot size of 6 m × 5 m. Fertilizer doses on STB were 77 kg N, 18 kg P, 36 kg K and 13 kg S/ha and was applied as urea, TSP, MP and gypsum, respectively. BRRIdhan 31 was used as test crop. Thirty-day-old 2 - 3 seedling/hill were transplanted with 20 cm × 20 cm spacing. During Boro season, the same nine treatment combinations were tested except treatment T_4. The treatment T_4 was as NJS @ 500 kg/ha + Northern Shakti @ 500 kg/ha + Recom. N. Fertilizer doses on STB were 115 kg N, 30 kg P, 56 kg K and 23 kg S/ha and was applied as urea, TSP, MP and gypsum, respectively. BRRIdhan 29 was used as test crop. Fifty day old 2-3 seedling/hill were transplanted with 20 cm × 20 cm spacing. TSP, MP, Gypsum and Northern Jaibo-Sar were applied at final land preparation. Urea was applied into three equal splits, 1/3 basal, 1/3rd maximum tillering stage and the remaining 1/3rd at panicle initiation stage. Necessary intercultural operations were done as and when required. At maturity, the crop was harvested from 5 m^2 area for grain and straw yield and grain yield was adjusted to 14% moisture content. The plant height, tiller, panicle production, grain and straw yield were recorded. Finally economic analyses were done for net benefit and marginal rate of return.

Table 1. Initial soil properties of the experimental site of farmer's field of Tukerbazar, Sylhet.

Soil properties	Results
Texture	Clay loam
pH (1:2.5)	5.42
Total N (%)	0.13
P (ppm)	6.04
K (meq/100g soil)	0.15
S (ppm)	6.78
Zn (ppm)	2.1

Results and Discussion

Application of chemical fertilizer on Soil Test Based (STB) alone or in combination with Northern Jaibo-Sar (NJS) in T. Aman increased the plant height, tiller and panicle number of rice significantly over the control. Highest plant height and maximum number of tiller and panicle was recorded in treatment T_9 followed by T_3. Maximum 1000-grain

weight was found in the T_8 followed by T_2 (Table 2). Chemical fertilization alone or in combination with NJS produced identical and substantially higher grain and straw yield of rice than those of control and lone application of NJS.

Table 2. Effect of Northern Jaibo-Sar alone and in combination with chemical fertilizer on the growth and yield of T. Aman rice.

Treatment*	Plant height (cm)	Tiller No./m²	Panicle No./m²	1000-grain wt. (g)	Grain yield (t/ha)**	Straw yield (t/ha)
T_1	104	160	139	26.4	2.84	3.61
T_2	107	174	160	26.7	3.07	3.76
T_3	117	223	203	26.4	3.59	5.09
T_4	113	219	197	25.9	3.35	4.94
T_5	114	211	195	25.9	3.57	5.03
T_6	114	205	179	26.5	3.42	4.80
T_7	114	221	196	25.5	3.62	4.92
T_8	116	220	202	27.0	3.46	5.55
T_9	120	229	205	26.4	3.46	4.78
LSD (5%)	8	41	37	1.2	0.38	0.94

*T_1 = Control, T_2 = Northern Jaibo-Sar (NJS) @ 500 kg/ha, T_3 = STB (Soil Test Based), T_4 = T_2 + Northern BF @ 250 kg/ha + Recommended N, T_5 = T_2+50% STB, T_6 = T_2 + 60% STB, T_7 = T_2 + 70% STB, T_8 = T_2 + 80% STB and T_9 = T_2 + T_3. **Yield reduced due to attack of tungro disease.

The treatment T_7 produced maximum grain yield followed by T_3 and T_5. From the results it appeared that the integrated use of NJS @ 500 kg/ha along with 30 - 50% reduced rate of chemical fertilizer may be sufficient to produce substantially higher yield of rice.

Application of chemical fertilizer on STB alone or in combination with NJS in Boro season increased the plant height, tiller and panicle number of rice over the control. Highest plant height and maximum number of tiller and panicle was recorded in T_4 followed by T_9. Highest 1000-grain weight was obtained in the T_3 and T_6 followed by T_9 (Table 3). Chemical fertilization alone or in combination with NJS produced identical and substantially higher grain and straw yield of rice than those of control and lone application of NJS. The T_9 produced maximum grain yield followed by T_4. From the results it appeared that the integrated use of NJS @ 500 kg/ha along with 30 - 50% reduced rate of chemical fertilizer may be sufficient to produce substantially higher yield of rice. Similar observation was shown when Moni Mukta organic fertilizer in combination with 50% of recommended dose of chemical fertilizer produced substantially higher yield than those of other tested treatments[9].

Economic analysis on partial budget of the experiment is presented in Tables 4 and 5. The net benefit of each treatment is calculated by subtracting the total costs that vary from the gross field benefit. The total costs that vary are the sum of all the costs that vary

Table 3. Effect of Northern Jaibo-Sar alone and in combination with chemical fertilizer on the growth and yield of boro rice.

Treatment*	Plant ht. (cm)	Tiller No./m²	Panicle No./m²	Sterility (%)	1000-grain wt. (g)	Grain yield (t/ha)	Straw yield (t/ha)
T_1	80	174	168	11	22.5	2.96	3.54
T_2	83	170	161	10	23.5	3.24	3.72
T_3	97	239	229	11	24.4	5.99	6.2
T_4	100	281	272	20	23.4	6.15	6.54
T_5	91	230	222	10	23.6	5.13	5.49
T_6	96	234	221	12	24.4	5.16	5.29
T_7	95	210	199	9	23.6	5.52	5.62
T_8	97	264	246	14	23.4	5.79	6.05
T_9	99	270	260	9	23.7	6.19	6.32
LSD (5%)	4	46	48	4	1.17	2.96	3.54

*T_1 = Control, T_2 = Northern Jaibo-Sar (NJS) @ 500 kg/ha, T_3 = STB (Soil Test Based), T_4 = T_2 + Northern Shakti @ 500 kg/ha + rrecommended N, T_5 = T_2 + 50% STB, T_6 = T_2 + 60% STB, T_7 = T_2 + 70% STB, T_8 = T_2 + 80% STB and T_9 = T_2 + T_3.

Table 4. Partial budget for the experiment of Northern Jaibo-Sar for T. Aman rice production.

Particulars	Treatments								
	T_1	T_2	T_3	T_4	T_5	T_6	T_7	T_8	T_9
Grain yield (t/ha)	2.84	3.07	3.59	3.35	3.57	3.42	3.62	3.46	3.46
Straw yield (t/ha)	3.61	3.76	5.09	4.94	5.03	4.8	4.92	5.55	4.78
Adjusted grain yield (t/ha)	2.56	2.76	3.23	3.02	3.21	3.08	3.26	3.11	3.11
Adjusted straw yield (t/ha)	3.25	3.38	4.58	4.45	4.53	4.32	4.43	5.00	4.30
Gross field benefit, grain (Tk/ha)	25560	27630	32310	30150	32130	30780	32580	31140	31140
Gross field benefit, straw (Tk/ha)	6498	6768	9162	8892	9054	8640	8856	9990	8604
Total gross field benefit (Tk/ha)	32058	34398	41472	39042	41184	39420	41436	41130	39744
Total gross field cost (Tk/ha)	0	3500	3286	7016	5143	5471	5800	6128	6786
Net benefit (Tk/ha)	32058	30898	38186	32026	36041	33949	35636	35002	32958

Urea = Tk. 20 /kg, TSP = Tk. 26/kg, MP = Tk. 2./kg , gypsum = Tk. 10/kg, Northern Jaibo-Sar = Tk. 10/kg, Northern BF = Tk. 12/kg, paddy = Tk.15/kg and straw = Tk. 3 /kg, as the requirement of the model the grain and straw yield was adjustment @ 10% reduced level and minimum rate of return = 100%.

for a particular treatment. The maximum net benefit was achieved in T_3 followed by T_5 (T. Aman season). On the other hand, the highest net benefit was found in T_3 followed by T_4 (Boro season).

Table 5. Partial budget for the experiment of Northern Jaibo-Sar for Boro rice production.

Particulars	Treatments								
	T_1	T_2	T_3	T_4	T_5	T_6	T_7	T_8	T_9
Grain yield (t/ha)	2.96	3.24	5.99	6.15	5.13	5.16	5.52	5.79	6.19
Straw yield (t/ha)	3.54	3.72	6.2	6.54	5.49	5.29	5.62	6.05	6.32
Adjusted grain yield (t/ha)	2.66	2.92	5.39	5.54	4.62	4.64	4.97	5.21	5.57
Adjusted straw yield (t/ha)	3.19	3.35	5.58	5.89	4.94	4.76	5.06	5.45	5.69
Gross field benefit, grain (Tk./ha)	26640	29160	53910	55350	46170	46440	49680	52110	55710
Gross field benefit, straw (Tk./ha)	6372	6696	11160	11772	9882	9522	10116	10890	11376
Total gross field benefit (Tk./ha)	33012	35856	65070	67122	56052	55962	59796	63000	67086
Total gross field cost (Tk./ha)	0	3500	6426	9518	6713	7356	7998	8641	9926
Net benefit (Tk./ha)	33012	32356	58644	57604	49339	48606	51798	54359	57160

Table 6. Dominance and marginal analysis of Northern Jaibo-Sar for rice production.

Treatments*	Variation of total costs (Tk./ha)		Net benefit (Tk./ha)		Marginal rate of return (%)	
	T. Aman	Boro	T. Aman	Boro	T. Aman	Boro
T_1	0	0	32058	33012	186	898
T_2	3500	3500	30898D	32356		
T_3	3286	6426	38186	58644		
T_4	7016	9518	32026D	57604 D		
T_5	5143	6713	36041D	49339D		
T_6	5471	7356	33949D	48606D		
T_7	5800	7998	35636D	51798D		
T_8	6128	8641	35002D	54359 D		
T_9	6786	9926	32958D	57160 D		

D = Dominated; *T_1 = Control, T_2 = Northern Jaibo-Sar (NJS) @ 500 kg/ha, T_3 = STB (Soil Test Based), T_4 = T_2 + Northern BF @ 250 kg/ha + recommended N, T_5 = T_2+50% STB, T_6 = T_2 + 60% STB, T_7 = T_2 + 70% STB, T_8 = T_2 + 80% STB and T_9 = T_2 + T_3.

In the experiment, the marginal rate of return between T_1 and T_3 was 186% (T. Aman season) and in T_2 and T_3 was 898% (Boro season) well above the 100% minimum. Farmers

will continue to invest as long as the returns to each extra unit invested (measured by MRR) which were higher than the cost of the extra invested (Table 6). Thus, T_3 (T. Aman season) and T_2 (Boro season) were the most economically viable treatments of the experiment.

In terms of economic point of view, the treatment T_3 (STB) was found superior though the treatments T_5 and T_7 produced higher yield than that of the treatment T_3 (STB) (T. Aman season) and T_2 (NJS @ 500 kg/ha) was found superior though the treatments T_9 and T_4 produced higher yield than that of the treatment T_2. Integrated use of organic and inorganic fertilizer is the need of time for sustainable increased crop production and improved soil fertility. In addition, reduced use of chemical fertilizer positively influences the environment through reducing contamination of air, soil and water. Considering these points it may be suggested that 50% reduction of chemical fertilizer on STB along with Northern Jaibo-Sar @ 500kg/ha may be a good combination of organic and inorganic fertilizer for sustaining soil fertility and increasing T. Aman and Boro rice.

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