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PERFORMANCE OF SHUSAMA ORGANIC FERTILIZER ON THE GROWTH AND YIELD OF WETLAND RICE

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Abstract

Studies on the performance of Shusama organic fertilizer on the growth and yield of wetland rice was carried out during the T. aman season. The modern rice variety BRRIdhan 31 was used as test crop. The following eight treatment combinations were tested: T_1 = Native nutrient; T_2 = Soil Test Base (STB); T_3 = 1/3rd of STB + Shusama @ 124Kg/ha; T_4 = 1/3rd of STB + Shusama @ 124 Kg/ha as basal and 250 g/decimal at 40 - 45 DAT; T_5 = 25% STB + Shusama @ 124 Kg/ha; T_6 = 50% STB + Shusama @ 124 Kg/ha; T_7 = 75% STB + Shusama @ 124 Kg/ha; T_8 = 100% STB + Shusama @ 124 Kg/ha. The experiment was laid out in Randomized Complete Block Design with 3 replications of each treatment. It appeared from the results that 50% reduction of chemical fertilizer on STB along with Shusama @ 124 Kg/ha may be a good combination of organic and inorganic fertilizer for sustaining soil fertility and increasing T. aman rice.

Introduction

Benefit from fertilizer to crops has been realized by farmers in decades in terms of accelerating plant growth, increasing agricultural production resulting in better food quality and crop yield. Over the past 50 years, agricultural production increased dramatically, in part through the use of chemical fertilizers and pesticides. These technologies and the intensive production systems provided increased human and environmental health risks.(1) Continuous use of inorganic fertilizers alone to soils had a deleterious effect on soil productivity and a steadily trend in rice productivity associated mainly with loss of inherent soil fertility.(2) Organic matter content of the soils are constantly lessening by repeated farming which leads to harden soil. Nutrient rich organic fertilizer improves soil condition by reducing 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. Shusama is a nutrient enriched organic fertilizer containing total N (7%), P (6.6%), K (4%) and some trace element and such organic fertilizer was supplied to soil science division, BRRI to evaluate its performance in rice production and was tested in T. aman season, 2007.

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Materials and Methods

The experiment was conducted at BRRI farm, Gazipur during T. aman season of 2007. Soil texture, pH, organic matter, available P and S, exchangeable K, Na, Ca and Mg were determined following standard methods.[3-7] The experiment was laid out in a randomized complete block design with three replications having unit plot size of 5m x 4m. The eight treatment combinations were tested in the experiment *viz.* T_1 = Native nutrient; T_2 = Soil Test Base (STB); T_3 = 1/3rd of STB + Shusama @ 124 Kg/ha; T_4 = 1/3rd of STB + Shusama @ 124 Kg/ha as basal and 250 g/decimal at 40 - 45 DAT; T_5 = 25% STB + Shusama @ 124 Kg/ha; T_6 = 50% STB + Shusama @ 124 Kg/ha; T_7 = 75% STB + Shusama @ 124 Kg/ha; T_8 = 100% STB + Shusama @ 124 Kg/ha.

Amounts of N. P, K added (Kg/ha) in different treatments were outlined as T_1 = 0 Kg N, 0 Kg P and 0 Kg K; T_2 = 90 Kg N, 20 Kg P and 40 Kg K; T_3 = 38.68 Kg N, 14.84 Kg P and 18.29 Kg K; T_4 = 42.02 Kg N, 18.93 Kg P and 20.77 Kg K; T_5 = 31.18 Kg N, 13.18 Kg P and 14.96 Kg K; T_6 = 53.68 Kg N, 18.18 Kg P and 24.96 Kg K; T_7 = 76.18 Kg N, 23.18 Kg P and 34.96 Kg K; T_8 = 98.68 Kg N, 28.18 Kg P and 44.96 Kg K.

TSP, MP, gypsum, zinc sulphate and Shusama were applied at final land preparation. Urea was applied into three equal splits, 1/3rd basal, 1/3rd at maximum tillering stage and the remaining 1/3rd at panicle initiation stage. BRRIdhan 31 was used as test crop. Thirty-day-old 2-3 seedling/hill were transplanted on 11 August, 2003 with 20 cm × 20 cm spacing. Necessary intercultural operations were done as and when required. The crop was harvested plot wise on 24 November, 2003. The tiller, panicle, filled grain and unfilled grain production and grain and straw yield were recorded. Nutrient content of straw and grain were determined using standard analytical procedure. Total nutrient uptake was estimated. Finally economic analyses were done for net benefit and marginal rate of return.

Results and Discussion

Initial soil properties of the experimental sites were presented in Table 1, which indicates that the soils were low in nutrients contents. Application of Shusama alone or in combination with chemical fertilizer increased the tiller and panicle number of rice over control. Highest number of tiller was recorded in treatment T_2 (where chemical fertilizer was applied on STB) followed by treatment T_8 (100% STB + Shusama @ 124 Kg/ha). On the other hand, treatment T_8 produced the highest number of panicle followed by T_7 (75% STB + Shusama @ 124 Kg/ha (Table 2). Maximum number of filled grain was observed in treatment T_7 followed by T_6 (50% STB + Shusama @ 124 kg/ha) (Table 2). Application of chemical fertilizer on STB alone or in combination with Shusama significantly increased the grain yield of rice over control. The treatments T_2 (STB), T_6 (50% STB + Shusama @ 124 Kg/ha), T_7 (75% STB + 124 Kg/ha) and T_8 (100% STB + Shusama @ 124 Kg/ha) produced stastistically identical grain yield. It can be mentioned

that application of Moni Mukta organic fertilizer in combination with 50% of recommended dose of chemical fertilizer produced substantially higher yield than those of other tested treatments.[8] It is also found that application of Sunray organic fertilizer in combination with chemical fertilizer on STB produced substantially higher yield than those of other tested treatments.[9] Above mentioned reference supported present findings. It appears from the results that 50% reduction of chemical fertilizer along with Shusama @ 124 Kg/ha may be a good combination of organic and inorganic fertilizer for producing reasonable higher yield.

Table 1. Initial soil characteristics of the experimental site of Shusama organic fertilizer, BRRI.

Parameters	Value
Texture	Clay loam
pH	6.44
Total N (%)	0.16 (low)
Available P (ppm)	6.65 (low)
Exchangeable K (meq/100g soil)	0.17 (medium)
Available S (ppm)	9.02 (low)
Available Zn (ppm)	5.50 (very high)

Table 2. Effect of Shusama organic fertilizer alone and in combination with chemical fertilizer on the growth and yield of wetland rice.

Treatment[1]	Till./m^2	Pan./m^2	% sterility	1000 g wt.	GY(t/ha)	SY(t/ha)
T_1	167	143	35.9	26.7	2.95	3.40
T_2	209	181	29.7	28.8	3.89	5.19
T_3	189	172	33.4	26.8	3.32	3.98
T_4	181	161	34.8	28.5	3.38	3.91
T_5	183	163	37.3	26.6	3.42	3.90
T_6	185	165	28.4	28.6	3.54	4.39
T_7	197	183	26.2	28.7	3.61	4.21
T_8	204	184	29.5	27.3	3.64	4.98
LSD (5%)	2.60	19.37	7.28	2.60	0.36	0.76

[1]Treatment descriptions are presented in materials and methods.

Application of chemical fertilizer alone or in combination with Shusama increased the N concentration in grain and straw over control (Table 3). In grain, maximum N concentration was found in treatment T_2 and in straw highest N concentration was recorded in treatment T_8. In case of P and K concentration in grain and straw remained almost same. Application of chemical fertilizer alone or in combination with Shusama increased the total uptake of N, P and K (Table 4). Maximum total N uptake was

recorded in treatment T_2 followed by treatment T_8. Highest total P uptake was recorded in treatment T_2 followed by treatment T_8. Similar trend was also found in total K uptake.

Table 3. Effect of Shusama organic fertilizer alone and in combination with chemical fertilizer on the nutrient content of BRRIdhan 31

Treatments[1]	N (%)		P (%)		K (%)	
	Grain	Straw	Grain	Straw	Grain	Straw
T_1	1.24	0.57	0.18	0.046	0.18	1.28
T_2	1.43	0.67	0.19	0.049	0.19	1.32
T_3	1.33	0.64	0.17	0.047	0.17	1.36
T_4	1.35	0.65	0.18	0.047	0.18	1.31
T_5	1.40	0.63	0.18	0.048	0.17	1.27
T_6	1.41	0.65	0.18	0.049	0.20	1.28
T_7	1.39	0.71	0.18	0.048	0.19	1.31
T_8	1.40	0.72	0.18	0.049	0.19	1.36
LSD (5%)	0.52	0.33	0.96	0.277	0.28	0.18

[1] Treatment descriptions are presented in materials and methods.

Table 4. Effect of Shusama on nutrient uptake by BRRIdhan 31.

Treatments[1]	Total uptake (kg/ha)		
	N	P	K
T_1	56.48	6.98	50.75
T_2	90.37	9.83	76.69
T_3	67.60	7.37	59.81
T_4	69.20	7.69	57.27
T_5	70.28	7.71	55.74
T_6	78.10	8.51	63.37
T_7	76.28	8.02	61.92
T_8	88.81	9.22	75.74
LSD(5%)	6.30	0.83	15.76

[1] Treatment descriptions are presented in materials and methods.

As Shusama is a nutrient enriched organic fertilizer where the growth and yield of rice was related to the added amounts of N, P, K. Even, the content of N, P, K in rice was correlated to the added amount of N, P, K and also it can be noted that only the composition of Shusama itself was responsible for such growth and yield of rice.

Economic analysis on partial budget of the experiment is presented in Table 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 for a

particular treatment. The maximum net benefit was achieved in treatment T_2 followed by T_1.

Table 5. Partial budget for the experiment Shusama organic fertilizer for rice production.

Particulars	Treatments							
	T_1	T_2	T_3	T_4	T_5	T_6	T_7	T_8
Grain yield (t/ha)	2.95	3.89	3.32	3.38	3.42	3.54	3.61	3.65
Straw yield (t/ha)	3.40	5.19	3.98	3.91	3.90	4.39	4.21	4.98
Adjusted grain yield (t/ha)	2.65	3.50	2.98	3.04	3.07	3.18	3.24	3.28
Adjusted straw yield (t/ha)	3.06	4.67	3.58	3.52	3.51	3.95	3.78	4.48
Gross field benefit, grain (Tk/ha)	21240	28008	23840	24320	24560	25440	25920	26240
Gross field benefit, straw (Tk/ha)	3060	4671	3582	3519	3510	3951	3789	4482
Total gross field benefit (Tk/ha)	24300	32679	27422	27839	28070	29391	29709	30722
Total gross field cost (Tk/ha)	0	3923	5028	6888	4701	5682	6662	7643
Net benefit (Tk/ha)	24300	28756	22394	20951	23369	23709	23047	23079

Urea = Tk. 6.00/Kg, TSP = Tk 14.00/Kg, MP = Tk. 10.00/Kg , gypsum = Tk. 4.00/Kg, zinc sulphate = Tk. 65.00/Kg, shusama = Tk 30.00/Kg, paddy = Tk. 8.00/Kg and straw = Tk. 1.00/Kg, yield adjustment of paddy and straw = 10% and minimum rate of return = 100%.

The analysis has been done in stepwise manner, passing from the treatment with the lowest costs that vary to the next one. With the increase in cost, the net benefit was increased. But the net benefits were lower in T_3, T_4, T_5, T_6, T_7 and T_8 as the cost increase. Thus T_3, T_4, T_5, T_6, T_7 and T_8 were cost dominated treatment and was eliminated for further consideration (Table 6).

It is well-known that the minimum marginal rate of return for the crop is 100%. If the marginal rate of return of the change from the first to the second treatment is equal or above the minimum marginal rate of return then the next comparison has been made between second and third treatment (not between first and third). This comparison was been continued (i.e. increasing level of investment) until the marginal rate of return fell below the minimum rate of return.

In the experiment the marginal rate of return between T_1 and T_2 was 114% well above the 100% minimum. Farmers continue to invest as long as the returns to each extra unit invested (measured by MRR) which are higher than the cost of the extra invested

(measured by the minimum acceptable rate of return) (Table 6). Thus it is concluded that T_2 was the most economically viable treatment of the experiment.

Table 6. Dominance and marginal analysis of Shusama organic fertilizer for rice production.

Treatments[1]	Total variable costs (Tk./ha)	Net benefit (Tk./ha)	Marginal rate of return (%)
T1	0	24300	
T2	3923	28756	
T3	5028	22394D	
T4	6888	20951 D	114
T5	4701	23369 D	
T6	5682	23709 D	
T7	6662	23047 D	
T8	7643	23079 D	

[1] Treatment descriptions are presented in materials and methods, D = Dominated.

The treatment T_6 where organic fertilizer Shusama was applied in combination with 50% reduced rate of chemical fertilizer on STB produced substantially higher yield. 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 Shusama @ 124 kg/ha may be a good combination of organic and inorganic fertilizer for sustaining soil fertility and increasing T. aman rice.

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